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Employment Service Bureau

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

CALLING ALL ENGINEERS !

Any engineers who are so situated that they can get leave of absence in order to participate in some phase of war industry are requested to communicate with Headquarters.

SITUATIONS VACANT

GRADUATES in mechanical, electrical, metallurgical and ELECTRICAL DRAUGHTSMEN required. Applications should be accompanied with photo, list of references and synopsis of experience, and addressed to Personnel Dept., Aluminum Co., of Canada Ltd., 1010 St. Catherine Street, Montreal, Que.

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ENGINEERS FOR THE AIR SERVICE

The following communication is printed at the request of Air Marshal L. S. Breadner, Chief of Air Staff. Members of the Institute and other engineers are requested to give it careful consideration. Any persons remote from recruiting centres are welcome to write to Headquarters for additional information.

DEPARTMENT OF NATIONAL DEFENCE
"AIR FORCE"

Ottawa, Canada, November 29th, 1940.

MR. L. A. WRIGHT, *Secretary,*
ENGINEERING INSTITUTE OF CANADA, MONTREAL, QUE.

Dear Sir:

The development of the British Commonwealth Air Training Plan and the absorption of Technical personnel in war industry, has resulted in a shortage of available men with engineering qualifications.

At the present time the Royal Canadian Air Force is in urgent need of personnel for training as Aeronautical Engineer Officers. There is also an immediate requirement of Technical Engineers with practical experience in aircraft production or maintenance. Qualifications required of candidates for appointment under these two classifications are as follows:

(a) **Technical Engineer Officers**

Candidates must be suitable in personal respects to hold commissioned rank and must have the following qualifications:

Thorough knowledge in engineering, applicable to aeronautical requirements.

Adequate experience in aircraft repair work or extensive aircraft factory experience.

Age limit—up to 50 years (highly qualified candidates will be considered up to age 55).

While graduate engineers are preferred, it may be necessary to accept candidates with lesser academic standing provided they have extensive practical experience.

(b) **Potential Aeronautical Engineer Officers**

These officers will be required to undergo a very thorough course in aeronautical engineering before they are assigned to duties.

Candidates must be of good character, suitable in all personal respects for appointment to commissioned rank and above average in mental alertness.

An applied science degree in aeronautical, mining, mechanical, civil, chemical, or electrical engineering is desirable.

A candidate having extensive practical experience but with a lower standard of education may be accepted. He must, however, have attained a standard not lower than senior matriculation. University graduates should have at least one year's practical experience along any of the several mechanical lines. Candidates with less than university graduation standing will be required to have a correspondingly greater practical experience.

The preferred age for appointment in this category is 25 to 40 years.

It would be greatly appreciated if you would make our needs known to the several branches of your organization throughout Canada and through this medium, to the individual members of the Institute. It is felt that an appeal of this nature may be instrumental in directing to the Royal Canadian Air Force, men who possess engineering qualifications which may be of value to this service.

Prospective candidates should make application at the nearest R.C.A.F. Recruiting Centre, so that it may be ascertained whether they are physically fit and suitable in all respects. This action will not necessitate a severance of their civilian employment before they are appointed and will entail no obligation on their part until actually called for duty.

Your co-operation in this matter is earnestly requested and it is hoped that if you have knowledge of any suitable prospective applicants you will find it possible to acquaint them with our urgent need and the procedure for submitting their application. Might I also ask that you forward their names and addresses, together with your recommendation in each case, to the nearest R.C.A.F.. Recruiting Centres or, if more convenient, to these Headquarters.

Assuring you that your assistance in this matter will be most sincerely appreciated.

I am, yours very truly,

(*Signed*) L. S. BREADNER, AIR VICE MARSHAL,
Chief of the Air Staff.

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THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 23 | JANUARY 1940 | NUMBER 1

PUBLISHED MONTHLY BY
THE ENGINEERING INSTITUTE OF CANADA
2050 MANSFIELD STREET - MONTREAL

Price 50 cents a copy, $3.00 a year, in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

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THE ENGINEERING JOURNAL

VOLUME 23 JANUARY 1940 NUMBER 1

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

LOOKING AHEAD

ONCE AGAIN the Institute finds itself at the beginning of a New Year, a year which is certain to be one of the most momentous of all time. Canada and the Empire are again at war, engaged in a struggle, upon the result of which depends the continuance of that type of liberty which is peculiar to democracy. For many years now the Empire has done everything in its power to avoid open conflict, yielding time and again to the pressure of the dictators, rather than risk the chance of war. However, during the latter part of the year just past, conditions became such that no choice, but the use of force, remained. We are fighting to retain on the earth's face those ideals of civic and religious liberty to which Anglo-Saxons have been accustomed for many generations. Even more we were faced with the possible destruction of the very foundation of our liberty and the basis of our civilization, the search for truth, the extension of knowledge. These have long been the heritage of the civilized world and especially of our profession. Such a possibility was beyond any limit of indignity which a free people would suffer for the sake of peace. Of course, when the Empire went to war so did the Canadian people. Hence on the first of September it was my privilege, on your behalf, to pledge the support of the Institute and its members to the Canadian Government. In this action I know I have your approval.

The old year brought us war. What of the new one? It would be a rash man who at this time would venture any prophecy. However, we should take stock and see wherein we as engineers and as an Institute can be of service. We have been told again and again that this is not to be a war like those of the past, but that it is to be essentially mechanical and technical, that, in fact, it is to be an engineer's war. All evidence available at present tends to support this idea. We then must be prepared individually and as a body to do what is expected of us. But we are not always the best judge, ourselves, of the place in which our service may be of greatest value. Hence we must school ourselves to wait till that place is decided for us and the call comes. Since the declaration of war I have been privileged to meet with and talk to engineers in all provinces of Canada, other than Prince Edward Island. I have found all engineers anxious to serve and merely waiting till they can learn where and how this may be done to the best advantage.

Also I have seen the country as a whole, looking ahead with calm confidence to the struggle, not as a glorious adventure but as a nasty job that must be done. I have visited the garrisons of our western coast defences, and a few weeks ago I stood on the decks of transports in an eastern harbour and talked with the men and officers just about to sail. The bearing and attitude of these men are typical, I believe, of our whole Canadian people. This war must be won to save civilization, which the ideology of the dictators threatens to destroy. The engineers of Canada to-day are united as never before. Like the people of the Empire they have only one purpose, one ideal, the defence of all we hold so dear. There is not a shadow of a doubt as to the outcome, be it swift or long drawn out. No nation with the spirit which animates the Canadian people or those of the Empire to-day can be defeated.

Hence I can see no room for pessimism either for our nation or our profession. We must look forward to the New Year cheerfully, optimistically, and courageously. May I then wish you one and all a very Happy New Year.

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LIMIT DESIGN

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Paper to be presented before the General Professional Meeting of The Engineering Institute of Canada, at Toronto, Ontario, on February 9th, 1940.

SUMMARY—Limit design is defined and shown to be implicit in various current practices and in open use abroad. It includes the selective use of any theory or method appropriate and convenient, but accents the prior use of common sense in the selection of the best procedure.

Introduction

Limit design is the name given to that method of structural analysis which seeks to determine the point of failure of a given structure, after which working loads are determined by dividing the ultimate loads by a factor selected in accordance with the designer's judgment as to the conditions which will obtain during its useful life.

It may also be used as a name for such procedure as sets arbitrary limits within which failure is practically certain not to occur, the object being simplification of what is as yet unsolved, or of avoidance of a calculation that is tedious and difficult.

Our usual design method assumes a set of unit stresses, and so proportions the structure in hand that these stresses will not be exceeded, usually on the basis of various simplifying assumptions such as these: that stresses meet in a point; that there are no secondary stresses; that stringers are simple beams; that the length of truss members or of floor beams is the distance centre to centre of intersections, and the like.

When an elastic method is used, this assumes that the stresses never exceed the proportional limit; that erection is perfect; that exterior conditions are always determinate and unchanging.

It will be seen that limit design is free to use the usual method, and in the majority of cases it will do so, bearing in mind its inaccuracies, and that it is free to use any appropriate elastic method, but also keeping in mind the fact that in many instances the elastic limit may be exceeded, that erection may not attain an ideal perfection and that end conditions may be other than those assumed or may change.

Limit design is in some measure a return to Hooke's Law "*ut tensio, sic vis*," which may be paraphrased "Watch the distortions to find the stresses"; current practices generally reverse this procedure. Up to the proportional limit there is appreciably a straight line relationship between stress and strain in many steels; above this point this is no longer true, and limit design recognizes this fact and seeks to make intelligent use of the region above as well as of that below this point.

There are two features about limit design that may entitle it to a name: first, its open recognition of facts; and second, its invitation to explore the possibilities.

History of Development

It has long been in current use in Holland, in Budapest, in Hamburg, and in other cities on the Continent.

In America it was apparently first discussed by Professor Van den Broek, in lectures here and there, in his work at the University of Michigan, and in a paper published in the Proceedings of the American Society of Civil Engineers for February, 1939.

It will perhaps be of interest to cite certain cases where the underlying ideas of limit design are used. In any rivet group forming an end connection we divide the stress in the member by an arbitrary rivet value, and shut our eyes to any possibility of elastic deformations. Limit design is willing to recognize ductile permanent deformations in the end rivets, but calls attention to a resulting danger if the stresses are reversible, a point insufficiently investigated in our laboratories.

In reinforced concrete formulae there is a curved stress-strain line, while in structural steel it is straight. Limit design is therefore used here, when a factor of the breaking load is really taken, although the formulae purport to give stresses at varying loadings.

In welding work, ductility of welds is recognized and instead of a straight line from maximum tension to maximum compression two rectangles of stress are often assumed, so as better to account for test results.

The modulus of rupture is quite different from the usual modulus in a beam; while this is familiar to all, it would never occur to many that there exist cases where this fact may be used in design. The Considère-Engesser column treatment employs the fact of ductility. Professor Hardy Cross in his Column Analogy outlines a method of using the factor of ductility in rigid frames. Professor August Föppl in his Vorlesungen über Technische Mechanik (six volumes and nearly 3,000 pages) tells us that in a bridge to catch possible falling objects (as transmission lines over a street) we should figure, not on elastic theory, but on the basis of ductility, allowing the bridge to deflect a foot or so rather than an inch or so.

Simplification Made Possible

Usually, limit design leads to simplification. In his Materials of Construction, Professor J. B. Johnson, speaking of flat plates, says in a footnote "these proximate solutions are offered as illustrative of simple approximate methods which may often be applied to very complicated problems of this class." In this case a special application of limit design is used; a limit is arbitrarily set for a case which is mathematically hideous, a limit which eliminates the hard work and gets much the same result.

Some masts or radiators are guyed at many levels. Some of these may be designed by first assuming them straight, then finding the deflection and the stress if one guy point alone moved due to a wind load; this second stress will sometimes be trifling, and it is rather a long task to calculate the action of guys and of the mast in combination, since the changing sag in each guy presents a tedious problem.

Suppose we have a fixed beam carrying uniform vertical loading. The architect would perhaps say that a moment of $wl^2/8$ for a simple beam ought to be all right. The elastic computation gives $wl^2/12$, but at the ends this time, with half this at the centre. Limit design says that before any appreciable deflection takes place the three moments at end and at centre will be equal, and in consequence the maximum moment is $wl^2/16$ instead of $wl^2/12$ or $wl^2/8$.

In a viaduct tower with plus and minus bracing the stresses are often made equal for tension and compression diagonals in the same panel. Often, however, these members are figured as taking tension only. We accept either of these solutions, since obviously the second is on the side of safety. But it would be difficult to persuade the conventional engineer to accept something between. He accepts two limits, but he recognizes nothing at all between them. In an earlier time it was necessary to guarantee transmission towers to carry agreed loads under test in order to avoid the condemnation of structures, with this and other novel features, by well-meaning engineers whose criteria came largely from text books and specifications. The first designs for towers for the Hydro-Electric Power Commission of Ontario were condemned by four eminent authorities, and the weakest of the two first towers, tested in 1910, carried a fifty per cent overload.

Riveted railway bridges are undoubtedly stronger than pin structures under the same specifications. Probably multiple intersection bridges are stronger than comparable single truss bridges. A chain is no stronger than its weakest link, but a bridge or a tower may be, and often is, stronger than any of its component parts. Stringers may carry a part of the load of the bottom chord; laterals a part of that of the top chord. When a connection in a bridge is overstressed, it may give a little, after which it will be self-adjusted for a certain secondary stress, and get less of it, while the material itself will have had its elastic limit raised.

Important Effect of Distortions on Stress

Modern theories as to combined stress, as those of Sandel and of Schleicher, which have good agreement with tests, are solidly based on distortions, instead of on mathematics, and are relatively simple to handle. In Bethlehem's last handbook, pages 279 to 289, there is a "Simplified Analysis of Torsional Stresses in Structural Beams." In the Zeitschrift des Vereins deutscher Ingenieur, 1917, page 694, Professor Föppl gave an approximation, according with tests of relatively thin open sections such as angles, channels, zees, and I-beams, where the polar moment of inertia is taken as $J = \frac{1}{3} \Sigma Lt^3$, in which L is the length and t the thickness of the several rectangles into which the section may be divided. A working formula should be one with which it is easy to work.

In the Second Report of the Steel Structures Research Committee, Department of Scientific and Industrial Research, published by H. M. Stationery Office, in London, page 316, under Summary and Conclusions, one finds paragraph (k) to read:

> "Tests on a two-bay frame, which was designed to be symmetrical showed that the stresses at corresponding sections which would have been equal had the frame been truly symmetrical differed by more than 50 per cent. Calculations showed that the unsymmetrical stress distribution was due to variations in the rigidities of the beam connections of the same order as those already measured in the tests on the single-bay frame."
>
> "Since these large differences in stress were brought about by connections which, as far as the designer could tell were identical, it was considered necessary to investigate the matter further. Another two-bay frame was erected as it would be in practice and, on loading, serious lack of symmetry was again detected. Since the stresses were clearly affected by some slight differences in the connections it was thought worth while to determine the behaviour of a frame built up with the greatest care. In the third two-bay frame, therefore, new and carefully fitted connections were used, but in spite of these precautions discrepancies of about 25 per cent were observed in the stresses."

Common Sense in Wind Bracing Design

The first workmanlike presentation of a wind bracing method the author encountered was by Dr. Robins Fleming, that most lucid and most practical structural engineer, to whom we owe so much, in Engineering News, 1913, page 493. Here are clearly set forth three methods, that of the cantilever beam, the portal method, and the continuous portal method.

Since that time we have had many methods presented here and there, some of them usable, some of them not. The method of slope-deflection purports to be "exact," but is very tedious indeed, too long to be usable. Incidentally, the method appears to be the end tangent method renamed, used in Germany by Kleinlogel and doubtless others prior to its appearance in America. For a so-called "exact" method Unold's book presents what appears to be the most nearly usable method, although far from attractive. The method of moment distribution and Goldberg's method are both measurably usable. In the June, 1939, Proceedings of the American Society of Civil Engineers, appears the sixth report of the Society's Wind Bracing Committee, of which Professor C. R. Young is chairman. Professor Francis P. Witmer appears to have played a large part in developing a method which is definitely practical and amply theoretical for anyone of good sense. It is the best yet, the author holds, by long odds.

Now we know that our best efforts to erect mathematical edifices on the shifting sands of many assumptions are found to result in an approximation. The British Steel Structures report assures us of this, although it tells but a small part of the story. And we know also that almost any well designed and well-detailed steel skeleton in a completed building will show good results in strong winds. The writer has in several cases checked designs, for high buildings in Detroit, by a vastly simpler method. The dimensions of columns in the usual cases vary but little in any one storey, and in consequence one may arbitrarily select contraflexure points, figure the wind moments in each storey, and compare the sum of the capacities of the columns provided, checking next the resulting moments in adjacent beams from those of individual columns. Of course, if the building is of the flatiron type or otherwise of unusual design, one must go farther than this on one's analysis.

Overworking of Elastic Theory

In a recent number of Civil Engineering the author offered a note as to a two-storey bent, without diagonals, carrying side loads. In a recent text book the problem was solved in five and a half pages; in a previous article in Civil Engineering by an almost equally extensive process involving the antiquated method of least work; in the note in one line. But it would have been quite as good, from the merely practical standpoint, to have assumed a few points of contraflexure, and avoid elastic theory entirely.

Elastic theories are interesting; one prefers them to crossword puzzles. All they can do, however, is to give an approximate idea of what may happen in a structure when built, and then only up to a point below the strength of the structure. It would seem a proper procedure to size up all the conditions, so far as possible, and to select the limits to which we should design any structure according to its expected time of use, the probable frequency of use, the insurance risk, the deflections permissible, the numbers of paths the applied loads may follow to ground, and other such factors. Specifications, more or less faithfully copied from ancestral specifications, may make this impossible. Rivet values may require us to put in so many rivets that the structure as a whole is weakened, or the appearance hurt by sprawling gusset plates. We may be cramped by an excessively complicated and highly theoretical contraption of a column formula, used for everything from a flagstaff to a short column fixed at both ends. We are almost universally required to use the reduced column load for column bending, cheerfully ignoring both theory and experiment.

This paper has been as discussive as brief. It is but an introduction to a subject already familiar in certain isolated cases, but which needs to be brought into the open and frankly discussed.

There is in existence no extended treatment of limit design.

One may say, perhaps, that limit design invites us to face all the facts we can gather together, and then throw away those we believe non-essential, making our structure accordingly, and with the least amount of design work which is economically consistent with the importance of the work in hand. The theory—if one can call it a theory —might be thought of as the application of common sense to whatever problem comes up, with a resulting determination as to what should be done. One may call it the method of the open mind. We may be led through flowery paths of differential equations and unknowns and determinants, and we may be led to plain arithmetic. Let the chips fall where they may, and let us be sensible about it.

THE ECONOMIC FRONT

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Paper to be presented before the General Professional Meeting of The Engineering Institute of Canada, at Toronto, Ontario, on February 8th, 1940

Introduction

Our war aim is to defeat the enemy, an objective we wish to attain with the minimum loss of life and the minimum of permanent impoverishment of our country. We should take a realistic view of the problem and not underrate the task ahead. Aggressors expect to win and it would be safer to assume that the German Government is well informed and shrewd. For all we know, we face a long and exhausting war, one that will tax our resources to the limit. The outcome will largely depend upon the effectiveness with which we utilize our industrial facilities, our natural resources and our manpower. The early mobilization of these is imperative, but we must first have some idea of what the nature and scope of the requirements are, and, then, we must plan carefully and proceed systematically. This takes time. To meet the situation as it develops we may be forced to undertake drastic reforms that we never would have believed possible, and, if we plan intelligently, we may well emerge from the war with our national economy in a stronger position than ever.

Putting Our House In Order

The Germans no doubt are banking on the efficiency of their form of government, and in some important respects our own country suffers in comparison. Even on a peace time basis our governments cost us over a quarter of our national income, which is another way of saying each of us works on the average three months of the year for the Government. We have ten governments where Britain, with four times the population, gets along with one. From one end of the country to the other our resources are being sapped by needless governmental expenditure. As an example of their waste, several of our provinces are currently spending thousands of dollars on valuing public utility property when it is anybody's guess what the value will be six months hence, with the price changes that are bound to occur under war conditions. Pressure groups load us up with Hudson Bay Railways and force upon the country wheat subsidies without much consideration of their soundness or fairness to other sections of the farming community. We allow ourselves to be bribed with our own money spent on extravagant public works. With our system of indirect taxation the cost is concealed from the lower income groups, the very ones who suffer most. These abuses cannot be corrected in a day, but if we as individuals will only bestir ourselves, we can make real progress through moulding public opinion along proper lines.

For war purposes the totalitarian system of government has many advantages, but it has also its weaknesses. In Russia almost from the very start the deadening influence of bureaucracy and political intrigue made itself felt and industry never had a chance to become efficient, but in Germany industry was already highly developed and operating efficiently when totalitarianism was superimposed upon it. Notwithstanding this, the quality of German export goods had begun to fall off even before Munich and there were evidences of German industry being bogged down by the red tape of officialdom, excessive taxation, assumption of control and diversion of manpower from productive enterprise. However, it is perhaps too much to expect that the deterioration will proceed rapidly enough to be a factor in Germany's early defeat. On the other hand, Germany has apparently achieved a unity of purpose and a co-ordination of effort that we lack; with her strong arm methods she has put her unemployed to work and can draw on her best men to fill the key positions; and she does not have to consider sectional jealousy when placing her war orders or building a munition factory or selecting a site for an air training school. We should aim to achieve these advantages, but through co-operation rather than coercion.

We have with us the enemy within, who is effectively sabotaging our war effort, often without malice aforethought. We see cities or provinces bringing pressure to bear to get "their share" of war orders or alleging the superiority of their particular locality for air training purposes. These questions should be decided strictly on their merits. Regardless of sectional demands war orders should be placed where they can be filled most efficiently and the air schools should be established where the training can best be carried out all things considered. Special pleading is bound to prejudice the judgment of those responsible for the choice and so vitiate our war effort. Those guilty of it should be made to realize that they are doing our country a great disservice in time of need. Then, we must distinguish between constructive and destructive criticism. There are those who rake up the past for the purpose of embarrassing the Government. In a democratic country politicians have no alternative but to defend their actions, and their energies should not be diverted from the pressing war problems to answer captious criticism. At the same time we must recognize that our governments are not infallible and that the last war might have been lost had not public pressure forced the then British Government to organize the large scale production of munitions.

Trade and Exchange

This war differs from the last in several important respects. With the mechanization of the armies war materials are required in much greater volume, particularly aeroplanes, motor vehicles, tanks and above all gasolene. Britain, however, was far better prepared than at the start of the last war and at the moment has no pressing need either for men or materials except perhaps in a few specialized lines. Through the construction of shadow factories she has stepped up the war potential of her munition industry to an amazing degree, but to operate it to capacity she must have raw materials in correspondingly greater volume. While many of these raw materials are obtainable in sufficient quantity within the British and French Empires, the Allies are nevertheless dependent upon neutrals to a considerable degree, notably in the case of crude oil, mercury and antimony. After the defaults following the last war it is no longer possible to finance these purchases through borrowing money from neutrals, nor can they be financed in sufficient volume by the liquidation of British owned American securities, should it be a long war. To make the resources of neutrals available to the Allies their exchange is indispensable, particularly American exchange, and this is only obtainable in sufficient amount through exports and the curtailing of non-essential imports. On account of Canada's favourable balance of trade with Britain and our debt to the United States, our non-essential imports from the United States are sure to be cut drastically. The sooner we all grasp this and take steps to meet the situation, the less we will suffer in the process. Our Government gets a high mark for its early realization of the importance of American exchange and for losing no time in putting into force stringent regulations for its acquisition and control.

The functioning of international trade and exchange can best be understood by studying the development of trade from its very beginning. In Bolivia the Indian from the lowlands in the headwaters of the Amazon transports his tropical fruits by llama train to La Paz, where he trades them with other Indians for potatoes and wool brought down from the Andean plateau just as in the time of the Inca. While their standard of living is low, it is better than if each practised economic self-sufficiency. In more advanced communities the goods are bartered for cowrie shells or some other prized article that can be exchanged when desired for other goods, thus broadening the basis of trade. From here it is a short step to the use of gold and silver currency. With the introduction of banking the transactions are accounted for without the inconvenience of handling large sums in metallic currency, but the transactions themselves remain ones of barter notwithstanding. Thus money, or, in the case of international trade, exchange, is nothing more than a means whereby goods and services can be conveniently bartered. Without money the more complex transactions of modern civilization would be impossible, but people must have confidence in the stability of its purchasing power for the free exchange of goods and services to continue. The vicious spiral of rising prices and wages so easily started in wartime can quickly destroy such confidence and the Government has acted with commendable promptness in establishing a board to prevent unjustified price increases.

Capital transactions likewise are barter. When money is loaned or credit advanced, the lender is merely exchanging goods which he now has at his disposal for goods and services to be delivered to him in the future. Credit is only obtainable when the lender is satisfied that the debtor is both willing and able to carry out his end of the bargain. Repudiation strikes at the very root of our civilization. The Americans, however, cannot in fairness blame the Allies for the repudiations following the last war, since it was their own high tariff policy designed to protect their home markets that precluded the repayment in goods, the only means the Allies had of repayment; nevertheless, we need not expect the Americans to supply us again with war materials on credit. We should also learn from this that the advancing of huge credits to our allies for the purchase of our own goods may prove embarrassing to us when the time of repayment comes. Our better plan would be to take all the goods we can from them now, and to this end, if it be politically possible, remove our tariffs against them and so reduce the post-war dislocation of trade to a minimum. We would at least have more champagne while the war lasts.

International trade appears complicated because of the multiplicity of the transactions involved, each in itself simple, and because we are inclined to think in terms of money rather than in terms of the goods and services it represents. The issue is further confused by the fact that the transactions may involve more than two parties; for example, A provides B with goods, B in turn supplies C with other goods and C completes the transaction by furnishing A with still other goods.

We entered the war with a huge debt to the United States that is likely to have far-reaching effects on our war economy. Our industries had been extensively financed with American capital. Our governments had financed their extravagant projects on money borrowed directly in New York or indirectly by diverting Canadian money from our own industries. As a result it takes several hundred million dollars a year to service our American debts. Our export and import trade with the United States were about in balance, but we had a favourable balance in our trade with Britain large enough to service our debts to the United States. Thus, it was our trade with Britain that was providing us with the wherewithal to balance our accounts with the United States, and Britain in turn was obtaining this, in part at least, from American tourists and from carrying American goods in her ships, sources of income in American funds now drastically curtailed. But Britain herself, with her income in American funds sadly reduced now, needs these in greatly increased volume to purchase crude oil, aeroplanes and raw materials for her munitions industry. She proposes paying us with Canadian securities for repatriation, but this does not provide us with the needed American exchange wherewith to meet our obligations to the United States. Under present circumstances we have not a hope of getting the necessary American funds from Britain and we, therefore, have no alternative but to step up our exports where possible to the United States and other neutrals, to encourage American tourists to visit Canada while spending as little as we can on travelling in the United States, and to curtail drastically our imports from neutrals. The Americans on their part should recognize that it is only by this means that we can honour our debts to them, that for every dollar by which their exports to us are so reduced their exports to Britain and France will correspondingly increase, and that every dollar they spend in Canada helps their own trade.

Exchange, through its command of the resources of neutral countries, may well be the decisive factor in winning this war. This is borne out by the experience of other countries in the recent past. Bolivia, for example, failed to win the Chaco war largely through her inability to purchase war materials in sufficient volume, even though in her desperation to obtain exchange imports other than of war materials were restricted to a tiny fraction of normal, and exporters were forced to give nearly all their foreign exchange to the Government, all with the result that her currency dropped to a tenth of its former dollar value. Japan likewise finds herself limited in her war effort in China through exchange difficulties, and even Germany prior to the war was moving heaven and earth to get exchange to purchase the raw materials needed for her munitions industry. Through the use of her special exchange currency, the so-called "swindle" marks, she was able to manipulate the prices of her exports to meet the exigencies of the moment and in some instances was selling manufactured goods at little above the bare cost of the raw materials entering into them. This policy, while providing her with her pressing needs, would have been ruinous to her future trade.

Canada holds a key position in regard to exchange. In world export trade we are already fourth. Our exports to neutrals can be stepped up and we can develop new markets, but it is in the curtailing of our imports from neutrals by substituting our own products and those of our allies that we can do our most effective work. We can improve our tourist facilities and so induce more Americans to spend their money in Canada. In this one respect the depreciation of the Canadian dollar works in our favour.

When we are at peace it is good business to exchange the goods that we can produce efficiently for those other countries are better fitted to turn out, as thus we raise the standard of living all around and promote commercial activity, but when at war it is essential that we and our allies produce every last thing we can within our own boundaries, as by so doing we can purchase in correspondingly greater volume the indispensable war materials we ourselves cannot produce. Any additional cost so caused represents expenditures within our country, which are relatively unimportant. These are largely a matter of "taking in each other's washing" though they do constitute a drain on our man-power, a serious matter in the later stages of a war. Even war debts, if internal, have little effect on our national economy as a whole. The fact is countries like Japan, although apparently bankrupt, keep going and we need not expect an early collapse in Germany's economic structure. It also follows goods produced by our allies and ourselves should be used even at considerably greater cost than those imported from neutrals, but to avoid the evils consequent upon price increases every endeavour should be made to keep the price spread to a minimum.

Stepping Up Exports to Neutrals

One way in which our exports to neutrals can be increased is by stepping up our gold production. Many of our gold mines have rich developed ore reserves that it is good mining practice to conserve, but now it will be in the best interest of the country to increase the gold production temporarily by mining the richest ore first. The mining companies, however, should not be penalized in excess profits tax for their patriotism.

It is surprising the wide range of manufactured goods that are available in Canada for export. Many of our companies, particularly the smaller independent ones, are ready and anxious to do what they can in this direction, although the margin of profit is naturally small. Unfortunately there are a few foreign companies with Canadian subsidiaries that do not allow their Canadian plants to manufacture for export, although they do not hesitate to take full advantage of our protective tariff in exploiting the Canadian market. In developing our foreign trade we should not overlook the fact that too aggressive competition with local products may invite reprisals in the way of dumping duties that would do us more harm than good.

Curtailing Our Imports from Neutrals

Our pre-war imports from neutrals ran to half a billion dollars per year, of which at least a third we could either do without or obtain satisfactory substitutes for, either locally or from our allies, at little inconvenience or increase in cost. We spend millions of dollars on imported fruit and vegetables notwithstanding that those from British Columbia, the Niagara peninsula and the Annapolis valley are unsurpassed. We bring in lettuce that might as well be cotton wool, tomatoes that are tasteless and strawberries out of season that, except for their extreme acidity, are flavourless. Thanks to the subtle propaganda of the citrus growers we use thousands of tons of oranges, although we have grape juice, tomato juice and apple juice of our own. With the improved technique in canning and refrigeration it is absurd that an agricultural country like Canada should be importing such products. A campaign to promote the use of Canadian fruits and vegetables would make us realize the high quality and tastiness of the home grown article. The citrus fruits of the British West Indies are unsurpassed and are cheaper than those imported from neutrals.

High up on the list of imports we find machinery and agricultural implements. While it would be folly under present circumstances, when the conservation of capital is so important, to equip plants to turn out highly specialized articles such as aeroplane engines, a great deal of the machinery imported could be manufactured by any well equipped engineering works, of which we have at least a dozen. The drilling and field equipment used in Turner valley is a case in point. Practically all of it is imported, although with few exceptions it could readily be manufactured in Canada. The oil producers can hardly expect to sell their oil in eastern Canada unless they in turn are prepared to use Canadian equipment, and our eastern manufacturers should show more enterprise and seek this business as a public duty even if the margin of profit be small. A little publicity on the percentage of Canadian manufacture entering into the various makes of automobiles might extend the use of Canadian manufactured automobile parts. The western farmers should realize that in buying Canadian agricultural machinery they are providing the Government with the means of pegging wheat and furnishing agricultural relief.

Utilizing Our Own Oil

At the top of the list of our imports we find crude petroleum and petroleum products. The main source of these within our boundaries is the Turner valley field in Alberta, which now supplies most of the Prairie market, although Albertans themselves still persist in buying some of their gasolene from Montana. The wells are being operated under proration and at the moment are producing less than a quarter of their potential capacity. The annual production of the existing wells could easily be doubled, if the market could be extended to eastern Canada. By drilling new wells in the proven area the production could be stepped up still more, but this would be in the best interest of the country under present circumstances only if the pressure on exchange could be relieved by having all additional equipment needed manufactured in Canada. Without endangering its own revenue the Alberta Government could assist by rebating the royalties on all gasolene shipped East of, say, Port Arthur. If the various parties concerned could be brought together in just this one case, some twenty or thirty million dollars of exchange would be released annually, sufficient to buy four or five hundred fighting planes. In mechanized warfare oil and gasolene are indispensable and we should do our best to relieve the pressure on other sources of supply.

The utmost we can hope to do in stepping up our crude oil production will fall far short of supplying our domestic requirements. The need of exchange for war purposes may make it desirable to curtail the domestic consumption of petroleum products as the war proceeds. Canadian coal might well be substituted for oil and gasolene wherever this is practicable. The oil burning locomotives operating through the mountains could be converted to coal, as also household oil furnaces. As we become adjusted to a war basis gasolene for private automobiles may have to be rationed as in England, and the use of busses and trucks may have to be stopped altogether where passengers and goods can be transported by rail. This all would reduce the pressure on the sources of supply and release tanker capacity for transport of oil from North and South American ports to the theatre of war, and so make available additional supplies of oil and gasolene vital to the successful conduct of mechanized warfare.

Utilizing Our Own Coal

Coal is one of our chief imports but our own mines, which turn out a wide range of coal, are not being operated to anything like capacity. The short flame bituminous mines in the Rockies produce a satisfactory substitute for anthracite for use in house furnaces where blowers are installed, particularly if the coal is cleaned to reduce the ash content, but unfortunately the coal is friable and does not yield a large proportion of lump. Nova Scotia, Alberta and British Columbia all produce good steam coal and even the better grade lignites from the Prairie can be used satisfactorily for domestic purposes where the furnaces are equipped with fireboxes of sufficient volume. With modern heating and steam power plants it makes little difference what fuel is burned, but with household furnaces the results will be disappointing unless the installation is modified where necessary to suit the fuel being used, and even then the inherent conservatism of the customer must first be overcome. At a later stage of the war, when gasolene and oil may have to be rationed, coal will come into its own. We should always bear in mind that Welsh anthracite is the very best and makes an excellent return cargo for the ships used in our overseas trade.

We must recognize that the more remote sections of Canada, the very places that produce our coal, are seriously handicapped by their geographical position. They are not populous enough to produce economically most of the goods they use, and heavy freight rates have the double disadvantage of increasing the cost of what they consume and shutting out their goods from the markets of Ontario and Quebec. The encouragement of the use of Canadian coal would be a step in the right direction in ironing out this inequality and in making for a better balanced national economy.

The new exchange control board could extend the use of Canadian coal by withholding exchange permits for the purchase of American fuel, but the consumers in Ontario and Quebec cannot be expected to acquiesce to a higher price unless they are satisfied they are being fairly dealt with by both the employers and the employees of the coal and transportation industries. Operating the coal mines at full time should substantially reduce the cost of production per ton, and this saving should be passed on to the consumer. With the coal miners it is the annual income that counts, and as their contribution they should be prepared to work full time, for a lower hourly wage but one that would still give them a substantial increase in their annual income; so also with the railway workers. The railway companies in turn should haul the coal to the central markets for the bare additional cost. Through co-operation between the diversified interests concerned it should be possible with exchange in our favour to lower the price of Alberta coal delivered in the East sufficiently that the consumers there would accept it in the national interests. We should not overlook that if under war conditions our coal is produced, transported and marketed efficiently, there will be a good chance of retaining a substantial part of the market once the war is over, and so obtaining a better balanced national economy.

The Transportation Problem

The substitution of our own products in the case of bulky commodities like coal, oil and sugar is dependent upon low cost long distance transportation, and in the transportation field we find chaos. Railways are the only means whereby cheap long distance transportation can be provided over the country as a whole and are therefore indispensable to our national well-being. It would be only common sense to treat them as essential services and give them every opportunity to operate to best advantage so that they can carry long distance freight at the very minimum rates, but this is far from what is being done. In the short haul traffic they have to face the unrestricted and unregulated competition of busses and trucks, while they themselves are stringently regulated and are forced to maintain a high standard of service and to operate facilities not justified by the traffic, but they are not allowed to recoup themselves for the loss of the short haul traffic by raising their rates with respect to traffic which the busses and trucks cannot handle to advantage. The busses and trucks can be operated with one man, but the trains have a minimum of five, each one of whom is paid several times the hourly rate that the bus or truck driver gets, although the work requires no more skill. Whenever the railways attempt to bring their wages more into line, the leaders of the strongly organized running trades rush to parliament and, with over half the men in the employ of a government-owned railway, the answer is a foregone conclusion. The railways provide free transportation for members of parliament and many government officials. When there is a drought they are expected to transport supplies to the affected area free or at reduced rates. To make matters worse, the Government spends huge sums on competing facilities, such as air services and toll-free canals, and freight rates are forced upon the railways that divert traffic by favouring grain shipments through Pacific ports. Our treatment of the railways not only is dishonest and unfair, but is destructive to a service on which our national prosperity depends.

The railways themselves are partly to blame for the condition in which they find themselves. The administration of large companies is apt to become bureaucratic and to lose sight of the larger economic features of their business. Thus, we see pretentious stations and hotels built to attract a class of traffic that can never be other than a minor factor in the railways' business.

Increasing Exports to Our Allies

In addition to helping provide the so badly needed American exchange, we can supply our allies with automotive equipment and other manufactured articles that we are equipped to produce efficiently. Our agricultural production can be stepped up by further mechanization, particularly in the West. Our wheat can be milled in Canada and our farm products can be shipped, processed as far as possible. In this way, by relieving the pressure on agriculture and industry overseas, we can make more manpower available there for the overtaxed munition factories and the armies.

In building up our industries and our agriculture we should plan for the conditions we will have to meet after the war. If, for example, we are geared up for a high production of bacon and we should then lose our market, the result will be disastrous. To avoid this it is imperative that we keep down the price and keep up the quality. Our aim should be efficiently to produce, cure, transport and market the bacon, that is to say, with the minimum use of manpower. We are fortunate in Canada in having a Department of Agriculture fully alive to the possibilities of the situation and thoroughly competent to advise and direct the farmers and packers.

We should take advantage of the markets for our farm products opened up by the war to advance the programme of placing our prairie agriculture on a sounder basis. In the areas suitable for mixed farming, the farmers should be encouraged to raise products other than wheat. Those areas not fertile enough or too dry for growing wheat commercially could be switched over to stock raising where feasible, particularly in conjunction with small irrigation projects to produce green feed. In the areas suited only to the growing of wheat, the size of the farm should be expanded concurrently with further mechanization of the farm. This would enable the wheat farmer to increase his production per man-hour, or, in other words, to reduce his cost per bushel and also to lessen his chance of crop failure by his possessing sufficient land to have some in summer-fallow. The population released could readily be absorbed in the irrigated areas. In this way both the quantity of wheat produced and the cost of production per bushel could be reduced, thereby lessening the need of pegged prices, a dangerous and costly expedient.

In planning our war measures, we in the East should recognize that the West presents a problem in which we are all vitally concerned. The westerner claims, not without some reason, that he must sell in a world market but buy in a protected one. He is inclined to exaggerate the extra price he has to pay on this account, and to overlook the fact that this increase arises in the main from the heavy taxation on industry, for which he is in part responsible with the Hudson Bay Railway and similar ventures and with his preference for publicly-owned telephone and other utilities that make no contribution to the Dominion tax revenue. We should remember that the West provides an extensive market for eastern industries and contributes largely to the support of our financial and commercial institutions. The prosperity of the East is directly dependent upon the prosperity and the development of the West, and we should make it our business to study the West's troubles and rectify them wherever possible. We should establish branch industries there even at somewhat greater cost, so that the industrial population will provide a local consuming market for farm products. We should use their coal, oil and beet sugar and we should recognize that their farm products cannot be sold abroad unless we in eastern Canada are prepared to take imported goods in exchange. This of course would be restricted to our allies during the war but, by now adopting a liberal attitude towards imports from them, we may go far to break down economic nationalism after the war.

Raising The War Potential of Our Industries

Due to her "shadow factory" plan Britain's facilities are more than adequate for her present munition requirements, but as the war intensity increases this may no longer be so and we should consider stepping up the war potential of our own industries so as to be ready when the time comes. Under the "shadow factory" plan selected manufacturers were asked to put up munition plants adjacent to their own peace time factories and to man these with skeleton crews quite apart from their own organizations. The Government reimbursed the companies for the cost and paid them a small commission. It then placed small trial orders on a cost plus basis until sufficient data had been gathered to enable orders to be placed on a unit price basis. By this means the British Government combined the advantage of efficient private management with that of cheap government money, and at the same time acquired the ability to turn out munitions in huge quantities at short notice while avoiding the building up of large stocks of munitions that might become obsolete before they were required. We might follow the same plan, but we should realize that in some cases it will be more economical to draw on the United States for our peak load requirements than to build factories to be operated for a short period only, and this makes it all the more important to build up a strong exchange position in the meantime.

TAXATION

We should recognize in this connection that our system of taxation is an effective bar to industrial expansion. Taxes have been levied where they are easiest to collect, without regard to their effect on our economic structure. The duplication of the corporate and personal income taxes, both federal and provincial, offers little incentive to initiate and finance new industries. Furthermore, the exemption of interest on debt puts a premium on unsound financing where companies could raise money by the sale of preferred or common stocks instead of by bonds and debentures were it not for the additional income tax for which they would become liable. In contrast to all this, under the system in England income is taxed only once, there being no corporate income tax and the personal income tax being collected at the source. With more money than ever to be raised, there is pressing need of tax reform so that those who now escape will pay their just share. For example, the customers of privately-owned utilities make a large contribution to the Dominion Treasury, but those of publicly-owned ones do not.

MANPOWER

We cannot divert the flower of our manhood into our armies and the production of war supplies without serious dislocation of our economic life and the lowering of our standard of living. When the war gets into its stride, the

(Concluded on page 24)

DISCUSSION ON THE 18 FOOT DIAMETER STEEL PIPE LINE AT OUTARDES FALLS, QUEBEC

Paper by A. W. F. MacQueen, M.E.I.C.[1] and E. C. Molke, A.M.E.I.C.[2], published in The Engineering Journal, April, 1938

F. NAGLER[3]

The paper on the Outardes Falls Penstock by Messrs. A. W. F. McQueen and E. C. Molke is of a type for which the Institute is to be congratulated. Little of this nature has previously appeared in Canadian literature and not very much elsewhere. It covers one of the most extensive applications of the shell theory to large penstock design, that has entered into American practice.

The writer was particularly concerned with fabrication methods, since the design was in such capable hands. The principal feature of those fabrication methods is found in the extensive application of welding. This is of interest as it constitutes probably the largest field welding job so far attempted in Canada. The magnitude of the work is indicated by the fact that somewhere between 15 and 20 tons of weld rod was used on the job, most of it being placed in the field. Some of the significant features of the welding are contained in the following figures:

Linear feet of welding, approximately 10,000. This was divided equally between down welding and vertical welding.

Weld rod spatter loss, including butts, approximately 40 per cent.

Weld metal deposited per man hour, 1 to 1½ lb.

As many as 40 welders were used on the work.

These figures are interesting, since the only real precedent for this work was the 14 ft. penstock built in 1935 for the High Falls plant of the James Maclaren Company. Weld metal deposit rates were increased by 50 per cent over previous work, in spite of the fact that most of the circumferential seams at Outardes were position welding, that is, they were made without rotating the pipe.

The utmost care was taken to secure progressive annealing of the welds, by using a large number of successive thin coats. The authors' mention, on page 10, of the Charpy test specimens is, perhaps, worthy of some elaboration. This is a comparatively new tool in Canadian practice and an extremely valuable one. As a matter of fact, it is much more valuable than making more elaborate test bars and pulling them.

Ultimate strength tests give little or no indication as to the quality of a weld, nor in the opinion of the writer, does the x-ray. An electrical weld, made with a piece of haywire, by the most careless garage mechanic, may pull between 50,000 and 60,000 pounds per square inch and almost equal a weld deposit by properly applied covered wire. Both may show equally good results under the x-ray. The haywire weld may even have a higher yield point than the covered wire weld.

Elongation of the test specimen tells a little more of a true story, but the Charpy impact test covers it all. The bare wire weld may run from 2 to 8 ft. lb., not much better than a good piece of cast iron. A good weld should show well up between 30 and 40 ft. lb., or practically equalling results from the plate to which it is joined.

The smallness of the test bar, the ease with which it is prepared and the quickness with which the results are obtained, make it a tool of the utmost value to engineers associated with welding.

The Institute is to be congratulated on presenting to the engineering fraternity so complete and thorough an analysis of the theory behind these large diameter penstocks and so complete a description of the particular example in question.

J. B. MACPHAIL, A.M.E.I.C.[4]

The authors deserve a compliment on the clear account they have given of the forces represented by the rather difficult analysis. It is to be hoped that the further paper

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4. Shawinigan Engineering Company, Limited, Montreal.

proposed by one of them will appear soon, and that it will continue this desirable practice.

The first step in all practical applications of the theory of elasticity, namely, the finding of stresses or deflections as functions of loads, dimensions and elastic constants has received much attention, but the next step, of selecting the stresses to be used, so that dimensions appropriate to given loads may be calculated, has received less consideration. It would be interesting to know what stresses were found for the 45 ft. spans which were considered in Fig. 10a. The 22½ ft. spans actually used, as appears by scaling Fig. 1, probably give quite conservative stresses, and one might guess that the risk of carrying such loads over sand has been accompanied by the prudent requirement that the line should be safe even if one support failed.

The Schorer papers, and others of the same kind, all treat only the case of a pipe continuous over supports, and one wonders what modification is needed for the cantilever or end spans which occur at expansion joints. Any remarks the authors care to make on this point, and on the details of the expansion joints, and on the deflections observed during filling, will be appreciated.

Mention might be made of another large penstock which has not yet reached the technical press. It was designed by the Chicago Bridge and Iron Works for the Anglo-Newfoundland Development Company, and is now being installed at Grand Falls, Newfoundland. It is 1,800 ft. long, 20½ ft. in dia., of 9-16 in. plate, resting in semi-circular saddles 8¼ ft. apart. The longitudinal joints are butt welded; the circumferential joints are riveted with an outside strap and welded in addition, and there are no stiffeners. The saddles are shaped so that the horizontal diameter of the penstock is 2 in. more than that of the nominal circle, and the vertical diameter 2 in. less. Limitations of water level required that this penstock be in a rock cut for its full length, a case admirably suited for saddles with only a small volume of concrete. A proper comparison between this and the Outardes Falls penstock cannot be made without consideration of stresses, deflections and behaviour in operation, but that would be a useful task for the future.

Harry C. Boardman[5]

The authors have presented a paper which is very interesting and instructive to the layman as well as to the professional engineer. Even a casual reader untrained in mechanics can get from it a fairly clear conception of the system of principal tension and compression stress trajectories which, like interwoven cables, enable the pipe shell to resist the internal pressures and carry the liquid weight to the ring supports. Such a reader can also gain an understanding of the fact that a pipe line precisely full of water could be cut lengthwise along the top element without causing failure, and of how, like a moving picture, the trajectory lines shift in direction and vary in stress intensity with changing conditions of loading.

However, it is a bit confusing to any reader to find the successive statements:

(a) "It is evident that the element B will not deform in a manner similar to element A, but will take a rhombic shape, although the forces acting on elements A and B are identical."

(b) "It follows that while element A has only forces acting normal to its edges, there must be shearing forces S acting along the edges of the element B in addition to the assumed forces T_1 and T_2. These are required to produce the angular deformation."

Can it be truly said of two square elements of equal area that one becomes rectangular and the other rhombic when subjected to identical forces?

5. Chicago Bridge and Iron Works, New York.
6. Design of Large Pipe Lines, Herman Schorer, American Society of Civil Engineers, Proceedings, September, 1931.

Designing engineers should not be misled into assuming, without careful analysis, that widely spaced ring girder supports for large steel pipe lines are invariably more economical than closely spaced saddle supports. The pipe line for the Anglo-Newfoundland Development Company, Ltd. at Grand Falls, Newfoundland, which is partly welded and partly riveted, is 20 ft. 6 in. in dia. for most of its length, and is supported on half-circle concrete saddles—one under every other ring. This construction was chosen largely because it lends itself to easy erection.

The authors state that for the type of support illustrated in Fig. 2, the *approximate* form of the bending moment diagram is shown in Fig. 19b, which gives relative moment values in accordance with Fig. 8 of Mr. Herman Schorer's first paper[6]. These values are based on the *assumption* that each post reaction is always vertical and that its line of action crosses the extension of the horizontal diameter of the pipe at a distance of 1.04 R from the center of the pipe, R being the ring radius and .04 R the post eccentricity. The authors' use of the word *approximate* is, therefore, commendable because it indicates a recognition of the fact that the theoretical moments of Fig. 19b could exist only if the short posts, at their connection to the ring, offered no resistance to rotation or to horizontal translation. It seems to the writer that, in discussions of supporting ring design, too much attention has been given to the theoretically ideal but practically unattainable post eccentricity, and too little to the actual effect of the posts upon the behaviour of the rings. The entire system of shell, ring, posts, and foundations must be analyzed to give a correct result. Even though precision in regard to the eccentricity were possible, it would often be futile, in view of the fact that partial liquid loadings may produce moments and stresses in the supporting rings appreciably greater than those due to full liquid loading.

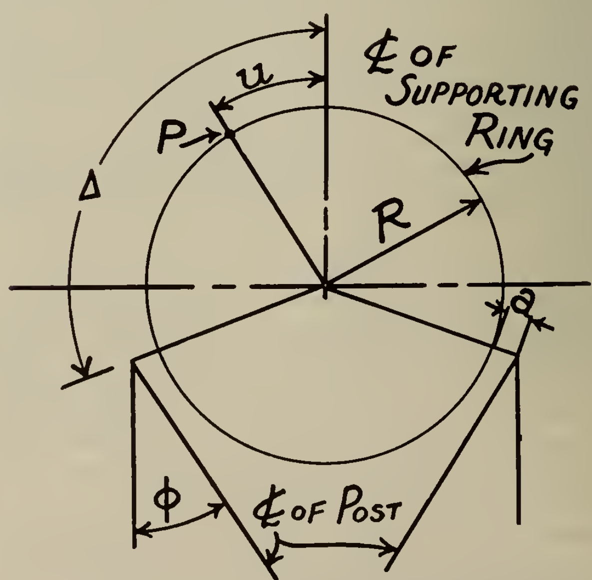
Those who wish to delve into the niceties of the theoretical moment variations in the supporting rings *for full liquid* loading and different combinations of post eccentricities, slopes, and points of attachment to the ring, may do so by means of the following equations, which are believed to be mathematically correct:

$$I.\quad M1_{T} = \frac{KQR}{2\pi}\ A\ \ \cos u + \sin\triangle(u \sin u) - (\pi-\triangle)(1+\frac{a}{R})$$

$$II.\quad M2_{T} = \frac{KQR}{2\pi}\ B\ \ \cos u - \sin\triangle(\pi-u)\ \sin u + \triangle(1+\frac{a}{R})$$

$$III.\quad M1_{R} = \frac{kQR}{2\pi}\ \ 1+\cos\triangle\ (u \sin u) + C \cos u$$

$$IV.\quad M2_{R} = \frac{kQR}{2\pi}\ \ 1-\cos\triangle\ (\pi-u) \sin u + D \cos u$$



P = Any point on centre line of supporting ring.

In these formulae:

R = *Radius to centre line of ring, in.*

Q = *Total load on one ring, lb.*

a = *Eccentricity, in.*

$\triangle$ = *Counterclockwise angle from a vertical radius of the ring to a radial line passing through the point of attachment of the left post.*

ϕ = *Angle between the centre line of the left post and the vertical-positive as shown in the Figure, and negative on the other side of the vertical.*

u = *Counterclockwise angle between the vertical radius of the ring and a radial line passing through any point* P *on the centre line of the ring.*

$K = \sin\triangle - \cos\triangle \tan\phi$.

$k = \cos\triangle + \sin\triangle \tan\phi$.

$A = (1\frac{1}{2} + \frac{2a}{R}) \sin\triangle + (\pi - \triangle) \cos\triangle$

$B = (1\frac{1}{2} + \frac{2a}{R}) \sin\triangle - \triangle \cos\triangle$

$C = \frac{1}{2} \cos\triangle - (\pi - \triangle) \sin\triangle$

$D = \frac{1}{2} \cos\triangle + \triangle \sin\triangle$.

$M1_T$ *and* $M1_R$ = *Moments due to tangential and radial components of post loads, respectively, in the supporting ring, for values of u from 0 to* $\triangle$.

$M2_T$ *and* $M2_R$ = *Moments due to tangential and radial components of post loads, respectively, in the supporting ring, for values of u from* $\triangle$ *to* π.

In describing the Outardes Falls pipe line, the authors state that "a short section of plate at each ring stiffener is ⅛ in. heavier than the corresponding plates on either side, in order to take care of rim bending stresses." In this connection, the writer suggests a consideration by engineers of the feasibility of constructing each supporting ring of a high pressure pipe so that its interior diameter is greater than the exterior diameter of the pipe shell by the amount that the latter will expand under the normal operating pressure and, by hydraulic jacks or other suitable means, expanding the pipe during erection so that it fits the unstressed ring, then welding or riveting together the pipe and ring when thus assembled. If this were done, the longitudinal bending stresses in the shell at the rings under operating conditions would be eliminated, and the ring would be free from pressure stresses.

Before attempting such a procedure, the manufacturer would do well to think of the precision necessary to attain the desired result. A diameter of 13 ft. 0 in. would increase only 1-16 in. under a pressure causing a circumferential stress of 12,000 lb. per sq. in. of gross plate section. Local deformations of this or greater magnitude are induced by normal fabricating, assembly and welding operations, and are quite ignored in design, without noticeably harmful results. It, therefore, seems open to question whether the rim bending stresses merit the attention commonly given to them. Perhaps they should be treated with no more respect than the so-called secondary stresses in the members of bridge trusses.

It is gratifying to the American Welding Society to know that the welding operators for the Outardes Falls pipe line were qualified in accordance with the A.W.S. Rules for the Qualification of Welding Processes and Testing of Welding Operators. The writer hopes that these Rules, in their latest revised form, will come into such extensive use that buyers of welded products will specify only the desired quality of the welding, and leave to the manufacturer the selection and use of the qualified process by which the quality is to be attained.

P. Stokes, A.M.E.I.C.[7]

Messrs. McQueen and Molke have done a considerable amount of original research and have gone to great trouble to render graphically the various formulae of the elastic membrane theory and much credit is due to them for the excellent paper that they have presented. The theory is so original and the results so startling that a graphical illustration goes a long way to enable one to convince himself that the formulae obtained can be used with perfect safety.

Perhaps a point that was not sufficiently stressed in the paper is that in referring to Fig. 3a, the stress lines as shown are an infinite number of horizontal planes in a rectangular beam symmetrically loaded which are the resultant of the horizontal tensile or compression stresses and the vertical shearing stresses. The figure shows that the lines at the supports are nearly vertical because at the ends of the beam the B.M. and therefore the horizontal tensions are approaching zero, whereas the shearing forces are at a maximum, and at the centre the lines are horizontal because the stress is all tension and the shear zero.

An interesting time can be spent figuring various tensile and shear stresses and plotting the slope of the resultants obtained at any point on the vertical surface of the beam. The lines obtained will probably not join each other but will give a general idea as to the slope of the stress lines, which are obviously an indication of the direction of pure tensile or compression stresses in the beam.

In a somewhat similar manner but with much more complicated formulae the tension and shear stresses may be figured for any point on the surface of a cylinder supported at the ends by a ring or membrane preventing any deviation of the cylinder from a true circle and the illustrations shown are the stress lines obtained in this manner.

With the above explanatory remarks the writer would like to elaborate a few points pertaining to the actual design of the Outardes penstock.

On account of the grade and the consequent changes in head pressure, the thickness of the shell was gradually increased from ½ in. plate at the inlet end to ¾ in. plate at the discharge into the surge tank tee.

The supporting rings were approximately 22½ ft. centres and the rings were placed centrally on the 57 in. wide rim plates as described in the paper. Between these were placed two courses of shell proper about 9 ft. wide, each in three sections.

The ring stresses in the shell were figured by the Schorer formula and approximated very closely to a check made by the familiar $\frac{PD}{2t}$ method, the former taking into consideration the weight of the shell as described in the paper and thus being slightly greater at its maximum value.

The longitudinal beam stress and the maximum rim bending stresses in the rim plates were added together and tabulated for the various thicknesses, the rim being made ⅛ in. thicker than the intermediate shells. A rather interesting point was noticed in examining these stresses, that the rim bending and ring stresses in the shell which have no relation to the distance between the supports were many times greater than the longitudinal beam stresses which are of course governed by this distance. The centres of the supports for the Outarde pipe could have been considerably increased, had the pipe been running along level ground and had the subsoil been sufficiently stable to support the heavier loads involved. The ring supports, however, were so designed that in the event of the footings under any one ring subsiding, the adjacent rings were strong enough to take the whole load of the pipe and water between them without any help at all from the centre ring.

The specifications originally called for self-lubricating pads of gunmetal with graphite inserts under the feet of the ring to take up the movement due to expansion. The frictional resistance between the pad and the ring feet, due to the heavy load, were such as to require heavy reinforcement of the brackets connecting the ring feet to the ring and it was found more advantageous in the long run to dispense with this reinforcement and place the feet on the standard type of bridge roller, this making a much more

7. *Chief Draughtsman*, Industrial Department, Canadian Vickers Ltd. Montreal, Que.

efficient job although the rollers in themselves were more expensive than the original pads.

The supporting rings were made up of a 5/8 in. web plate 18 in. wide with 5 by 3½ by 9-16 in. flange angles rivetted to the web. In quantity it was thought to be more satisfactory to rivet these flanges to the web than to weld them. The web was made thicker than usual for a built up girder of this type as it was extended out between the outer flanges to form a bracket for the ring feet.

Being circular the web segments had to be cut from plate and welded together, the joints of the web being placed at the points of zero stress as shown on diagram No. 19B in the paper. The flange angles were rolled in half circles and the ends welded together after they had been rivetted to the web. These joints were also kept as close as possible to the zero stress points, the ends being staggered around the ring to allow at least two rivet pitches between any individual flange angle joint.

Being under no restriction as to the centres of the feet $\frac{a}{r}$ was kept to .04 in order to minimize the bending stresses in the ring. The bending stresses due to the reaction of the supports, the shear stresses due to the weight of the pipe and water, and the stresses due to the hydraulic pressure were added together and tabulated for the various pressures and were kept at a conservative figure keeping in mind the possibility already mentioned of subsidence in any one ring.

The rings were kept identical as far as possible, the depth of the web being 18 in. in all cases and the outer diameter of the outer flange angles constant. The inner angles attached to the rim projecting from 1/8 in. to 3/8 in. beyond the web to allow for the different outside diameters of the rim due to the varying thicknesses of the rim plates.

During the filling of the pipe as illustrated with the description of the fire hose in the paper the pipe tends to become oval and during this time bending stresses actually do occur in the shell. These stresses were figured for the lightest section of the shell and also the ring at the time the pipe would be half full and were found, however, to be negligible.

There is no doubt that using the elastic membrane theory as a basis of design for this pipe line has saved an enormous amount of both weight and welding, an early consideration of the usual type of pipe supported on saddles showing a need for a slightly thicker shell plate with heavy reinforcing rings placed at 4 to 4½ ft. centres.

The Authors

The authors are grateful for the very generous discussions that have been presented and would like to thank each of the contributors for them and for having amplified and given additional point to several important phases of the subject matter.

As pointed out by Mr. Boardman, the authors were perhaps unfortunate in the use of the word "identical" to describe the forces acting on elements A and B of Figure 14-a. For the sake of simplicity, the forces acting on the large square element of Figure 14-a are assumed not to vary in intensity along any particular boundary of the element. The force field within the boundaries of this element may, therefore, be said to be identical at all points. The small square elements A and B are therefore situated in identical force fields, but their orientation with respect to the force field is different. It is this latter characteristic which causes the effect of the force field on the two small elements to be different; *e.g.*, causes a different type of deformation.

Mr. Boardman is on sound ground in calling attention to the fact that the principle of design used at Outardes Falls may not be economically applied for every pipe line. The studies made for Outardes Falls proved conclusively that the adopted design would be the most economical. Despite this fact, the specifications were framed to allow the use of conventional-type saddle supports. No tenders using this design were received, and Mr. Stokes has explained the reason for its non-adoption by his company.

The effect of the support on the stresses in the supporting ring and adjacent portions of the shell was carefully considered. After the contract had been let and additional time was available for study, it soon became apparent that a better provision for free translatory movement of the support on its base would have to be provided than that tentatively selected. Mr. Stokes has explained how this was accomplished. Another detail was also provided. This consisted of a steel "aspirin tablet" between the base plate of the post and the upper plate of the roller assembly. The upper and lower surfaces of the tablet were machined to form portions of spherical surfaces and corresponding surfaces were machined in the two bearing plates. This provision was made primarily to take care of slight inaccuracies in alignment that were bound to take place in the field erection of the supporting rings. At the same time, it would tend to minimize the effect that any rotation of the post might have on the free action of the rollers. As can be seen from Figure 7, the posts are very short and exceedingly stiff, and any rotation due to load must be very small indeed. The top of an "aspirin tablet" is just visible in Figure 4.

The four equations for moment in the supporting rings given by Mr. Boardman are an interesting and valuable contribution to the subject. If $\phi = 0$ and $\triangle = 90$ deg., the equations reduce to Schorer's equations (51) and (52).

The stresses allowed for the constructed pipe were those usual for this type of structure. For the case of partly-filled pipe: (*a*) an increase of 20 per cent was allowed in all stresses in the supporting rings, and (*b*) an increase of 20 per cent was allowed for combined bending and direct stress over the normal direct stress requirements. In all cases, a factor of safety against buckling of not less than five was required.

While the nature of the foundation material was such that differential settlement of the footings might be anticipated, it was not thought necessary to provide for the entire failure of one support as a design requirement within any specified limit of stresses. The specifications required that a settlement reducing the loading due to the pipe on any one footing to two-thirds of the theoretical value would not cause, in any part, stresses higher than those specified. As Mr. Stokes points out, the pipe was actually built much stronger than this requirement demanded.

For a fuller development of the shell theory than that given in this paper, including the treatment of cantilevers, reference may be made to the paper, "Principles of Concrete Shell Dome Design," by E. C. Molke and J. E. Kalinka.[8]

While no measurements were made on the pipe at Outardes Falls during filling, no noticeable deflections were observed.

In the opinion of the authors, Mr. Nagler's statements regarding the value of the Charpy impact test are very much to the point. The Charpy tests described in the paper were carried out at his suggestion and the high values of the test results indicate the excellent quality of the welding done by the two companies associated in the work of fabrication and erection.

8. American Concrete Institute, Proceedings, May-June, 1938.

FLAME-HARDENING AND ITS APPLICATION IN MODERN INDUSTRY

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Paper presented before a joint meeting of the Montreal Branch of The Engineering Institute of Canada and The American Society for Metals on October 26, 1939

Introduction

The "flame-hardening" process embraces the use of the oxy-acetylene flame to raise the temperature of the surface of ferrous material above the critical transformation point so that subsequent quenching will produce a desired hardness and structure.

The hardened layer varies in depth from a mere skin to ¼ in. according to the operating practice and type of material being treated. This method forms a hardened case on the surface of the parts being treated without altering the chemical composition, so must not be confused with such processes as carburizing, cyaniding, or nitriding that require the addition or absorption of other elements.

Metallurgically, the treatment is the same as furnace hardening, the difference being one of localized, rather than general, heating. Questions may arise regarding method, depth of hardness, degree of hardness, selection of material, pre-treatment, and post-treatment, but most of these have been answered in whole or part by laboratory or field experience.

Advantages of the Flame-Hardening Process

One advantage is immediately evident. The metal can be heat-treated to develop desired core properties, with the assurance that these properties will not be destroyed by the subsequent flame-hardening treatment. The designer frequently desires the combination of a hard wear-resisting surface with a tough shock-resisting core, and while this combination has been obtainable to some degree by carburizing methods, flame-hardening offers a great advantage because a selection may be made from a large list of steels, cast iron, and even malleable iron.

The tendency to distort is minimized by the very nature of the process. The fact that heating is localized tends to maintain the surface condition intact because the cool core resists deformation. Generally speaking, the distortion produced is well within the manufacturing tolerances.

The fact that the surface of the material is rapidly heated and often drastically quenched would appear to encourage checking or cracking. However, the effects of volume changes are confined to a comparatively thin section and insufficient tensional stresses are created to cause rupture. It has been found that steels sensitive to furnace hardening can be flame-hardened with comparative safety if care is exercised to avoid overheating.

The case characteristics obtainable by the process vary both with regard to depth and degree of hardness. The depth is a function of the heating time and can be varied between 1-16 in. and ¼ in. or more. The degree of hardness depends on the carbon and alloy content and the quenching medium. The hardness of flame-hardened articles is at least equal to that of furnace hardened material of the same composition. Much assistance is given the external quench by the rapid conduction of heat into the mass of the metal. In fact, certain applications are self-quenching; that is, the surface is raised to the critical temperature, the flame is removed, and heat is extracted so rapidly by the relatively cool core that a hardened surface is produced.

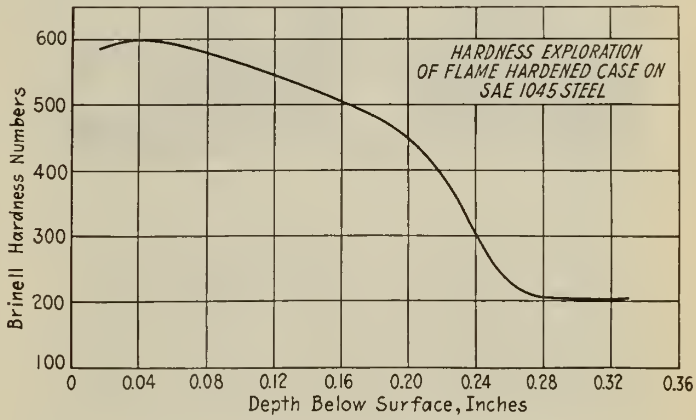

Fig. 1—Hardness Exploration of Flame-Hardened Case on S.A.E. 1045 Steel

Suppose that in order to obtain certain core properties a steel is selected which is capable of being hardened to a Brinell hardness number of 600. If the desired surface hardness is 400, the quenching may be deferred until some time after transformation has taken place, before applying the coolant to avoid drawing to a lower order of hardness. Similar results are often obtainable through the use of a mild quench, but it is not always convenient to employ a

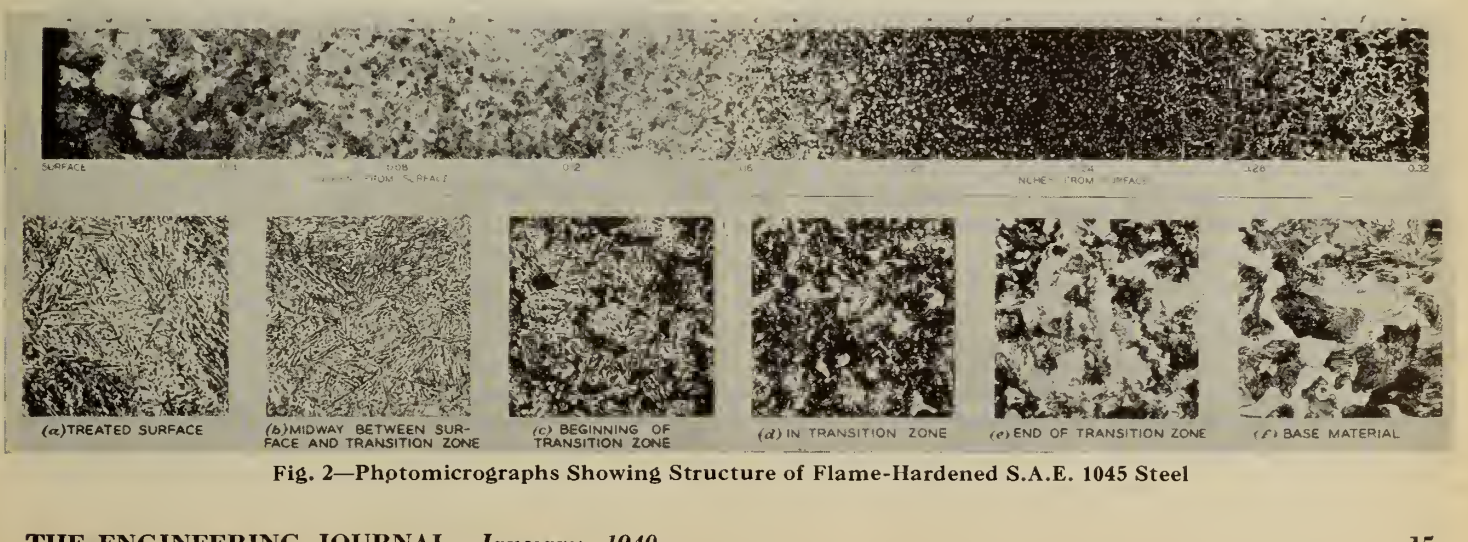

Fig. 2—Photomicrographs Showing Structure of Flame-Hardened S.A.E. 1045 Steel

quench other than water. The point is that the process is flexible and can be varied to produce the desired results or conform with local conditions.

An additional advantage is that the tool can be brought to the work. Articles too large to be accommodated in furnaces are quite as easy to flame-harden as small articles, and the portability of the equipment makes it practicable to apply the process in the field remote from any shop or furnace facilities. Thus it is now possible to harden articles which heretofore could not be so treated.

As has already been noted, the results obtainable may be varied by changing the heating time and quenching time. Several other factors also contribute to the final result. The

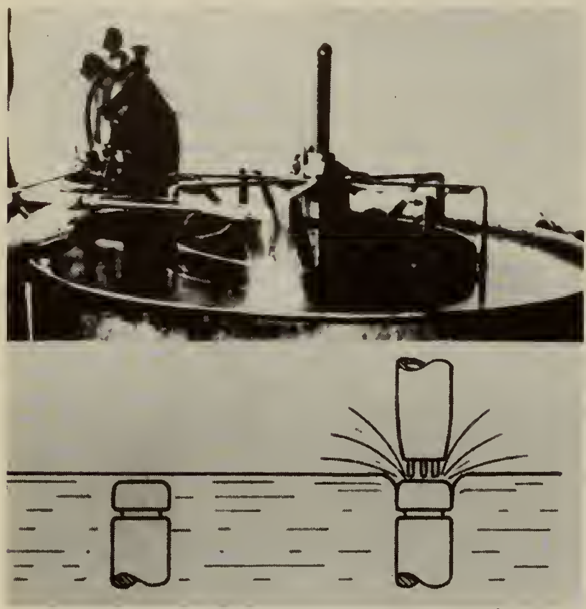

Fig. 3—Spot Hardening of Valve Stems

distance of the heating head from the work, the oxygen and acetylene pressures, and the quench pressure, the tip arrangement, and the condition of the material each has an effect. These several variables must be properly controlled in order to reproduce consistently the desired depth and degree of hardness.

Materials Suitable for Flame-Hardening

While many steels can be flame-hardened, the straight-carbon and low-alloy steels have been found to be most satisfactory. Steels containing at least 0.35 per cent carbon, either plain or with alloy additions, respond favourably. Table 1 gives particulars of a number of steels suitable for flame-hardening.

High-carbon steels and tool steels are easily overheated and will check or crack unless extreme care is used in applying the process. Pearlitic cast iron, either with or without special alloying elements, is rather easily flame-hardened to produce high hardness. Malleable iron has been satisfactorily flame-hardened by so modifying the technique as to permit resolution of the carbon. Allowances must be made for the characteristic decarburized surface by casting a thicker section at those locations subsequently to be flame-hardened. The decarburized surface can be ground off, or be permitted to wear off in service.

The flame-hardening of carburized articles offers great advantages in so far as distortion is concerned. Following carburization, the article can be finally straightened while hot. After cooling, it can be flame-hardened with little likelihood that there will be measurable distortion. Obviously, it is not necessary to carburize selectively because the flame will be applied only to those surfaces which require hardening.

Table 1—Types of Steel Suitable for Flame-Hardening

Flame-Hardening Steels	Type Analsyis	*Case Hardness	
		Scleroscope	Brinell
S.A.E. 1035-1070	C-.30-.80, Mn-.70 max.	50-90	350-700
S.A.E. T1335-T1345	C-.30-.50, Mn-1.60-1.90	75-90	550-700
S.A.E. 2340-2350	C-.35-.55, Ni-3.25-3.75	70-80	500-600
S.A.E. 4140-4150	C-.35-.55, Cr-.80-1.10, Mo-.15-.25	70-85	500-650
S.A.E. 4640	C-.35-.45, Ni-1.65-2.00, Mo-.20-.30	70-80	500-600
S.A.E. 5140-5150	C-.35-.55, Cr-.80-1.10	70-85	500-650
S.A.E. 6135-6150	C-.30-.55, Cr-.80-1.10, V-.15-.20	75-85	550-650
Carbon-Vanadium	C-.45-.65, V-.15 min.	70-90	500-700
Cromansil	C-.30-.45, Cr-.40-.60, Mn-1.00-1.30, Si-.70-.90	75-85	550-650
Manganese-Molybdenum	S.A.E. T1335 or T1340 plus Mo-.15-.25	75-85	550-650

*Hardness determinations on flame-hardened parts should preferably be made with the scleroscope. The Brinell numbers shown here have been converted. Hardness figures are for water-quenched materials.

Metallography

The appearance and constitution of the flame-hardened case may be described most easily by an examination of etched sections and micrographs from the surface downward to the core material. Figure 1 illustrates the variation of hardness with depth below surface in flame-hardened S.A.E. 1045 steel. The photomicrograph of the same steel reproduced in Fig. 2 is typical and shows clearly a fully hardened layer about ⅛ in. thick, a transition zone about ⅛ in. thick, and then, unaltered core material. The case thickness and transition-zone thickness can be varied by modifications of the heating and quenching technique.

Methods of Flame-Hardening

Flame-hardening is both a maintenance and production process. The nature of the work will indicate whether a simple hand blowpipe or a fully automatic machine is required. Surprisingly good results have been obtained by hand-treatment and as an introduction to the simplicity and effectiveness of the process it is suggested that a trial be made by locally hardening a small scrap piece of medium-

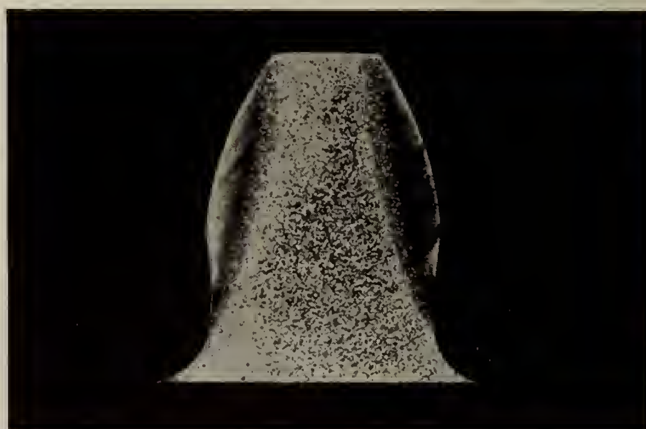

Fig. 4—Flame-Hardened Gear Tooth Showing Case Contour

carbon steel. It is only necessary to heat a small area of the surface with a welding blowpipe or the preheating flames of a cutting blowpipe and then quench with water. The increase in hardness can be tested easily with a file.

Possibly an article has worn in service to a point where it is necessary to build up worn surfaces with fresh metal. The deposited metal may be one responsive to heat-treatment, such as chrome-molybdenum rod, and after machining it can be flame-hardened. If the metal, as deposited, is too hard to be machined, the hardness can be reduced considerably by local annealing with the blowpipe. This process is known as flame-softening.

While a considerable amount of flame-hardening has been satisfactorily accomplished by hand, the method is not conducive to consistent results from the standpoint of uniformity either as to depth or degree of hardness. Production flame-hardening requires the use of mechanical aids, either manually or automatically controlled. The methods

Fig. 5—Straddle Type Gear Heads

employed are commonly referred to as: (a) stationary, (b) progressive, (c) spinning and (d) combination.

THE STATIONARY METHOD

The stationary method refers to those operations where the blowpipe and work are motionless during the treatment. This is sometimes known as spot hardening. (See Fig. 3.)

THE PROGRESSIVE METHOD

The progressive method refers to those operations where the blowpipe and the work move with respect to each other and the metal is quenched as heated. Illustrative of this method is the flame-hardening of flat surfaces such as ways for machine tools.

For flame-hardening a plane surface, the lighted blowpipe, with a head producing sufficient flame area to cover the path to be hardened, is directed along the surface at the maximum speed which will heat the surface zone above the critical point. Immediately behind the flame is a stream or spray of water which progressively quenches the heated surface. Speed is determined by operating variables such as flame intensity, type of steel being treated, and the temperature desired. It may vary from 4 to 10 in. per min. although the usual speed is from 6 to 8 in. per min.

The blowpipe head should be placed so that the tips of the inner cones are from 1-16 to $\frac{1}{8}$ in. from the surface being hardened.

The progressive flame-hardening of a gear tooth furnishes an excellent example of the inherent advantages of flame-hardening. The designer desires a hard wear-resisting working face supported by a tough shock-resisting core. This combination is readily produced by flame-hardening and the contour of the case is of maximum depth at the pitch line, precisely where the greatest strength is needed. A case such as shown in Fig. 4 is reproducible from tooth to tooth through control of heating and speed of traversing.

Figure 5 shows the heads up for flame-hardening spur-wheel teeth; in Fig. 6 the whole equipment is shown. Experience has developed certain factors which should be observed in all gear hardening in order that satisfactory service life may be assured:

1. Shallow cases are to be avoided as possible sources of spalling difficulties. It has been observed that a satisfactory case should equal one third of the tooth thickness, but not exceed $\frac{1}{4}$ in. at the pitch line.

2. Avoid overheating, which produces the conditions necessary to promote checking and cracking.

3. Do not harden the tops of gear teeth. This condition, if present, is usually found on the ends of the teeth and is caused by a failure to maintain the proper heat balance as the end of the tooth is approached. Typically this condition causes failure by spalling of the end of the tooth along the transition zone.

4. It is important that flame-hardened gears be carefully aligned when placed in service. The high degree of hardness presents a stiff unyielding surface which will not "wear in" in the same manner as untreated gears.

While a uniform case is to be preferred, experience has shown that this is not a necessary condition for satisfactory service life. Thousands of gears have been flame-hardened by hand with entirely satisfactory results. The variation in case depth and hardness attendant upon hand hardening does not cause differential wear and does not materially reduce the life of the gear.

It has been the practice of many manufacturers to machine heat-treated gear blanks in order to obtain maximum face hardness without further heat-treatment. Flame-hardening permits machining steel either fully annealed or heat-treated to produce desired core properties.The saving in machining costs is obvious. One plant reported a machine shop saving of $15,000 during the past year by virtue of lower machining costs and fewer gear replacements.

It is of interest to observe that flame-hardening fits into the modern method of gear manufacture employing oxy-acetylene shape-cut steel plates welded together.

SPINNING AND COMBINATION METHODS

The spinning method and the combination method are applied to rounds. In spinning, the blowpipe is stationary and the work is rotated before the flames. When the entire area has reached hardening temperature the quench is applied while the work is still rotating. In the combination method the work is rotated before the heating head which gradually traverses the piece longitudinally, followed by the quenching nozzle. It is thus a combination of spinning and progression.

The flame-hardening of bearing areas is a good example

Fig. 6—Hardening Large Spur Gear

of the spinning method. Sufficient heat is supplied to elevate the entire bearing surface to the critical temperature in not over 2 min. (for thin cases the time may be as short as 10 sec.), after which it is quenched. To obtain maximum hardness it is essential that the quenching be done simultaneously with the removal of the heat source. (See Fig. 7.)

ROLL OR SHAFT HARDENING BY COMBINATION METHOD

The flame-hardening of the entire area of shafts or rolls is most satisfactorily accomplished by the combination

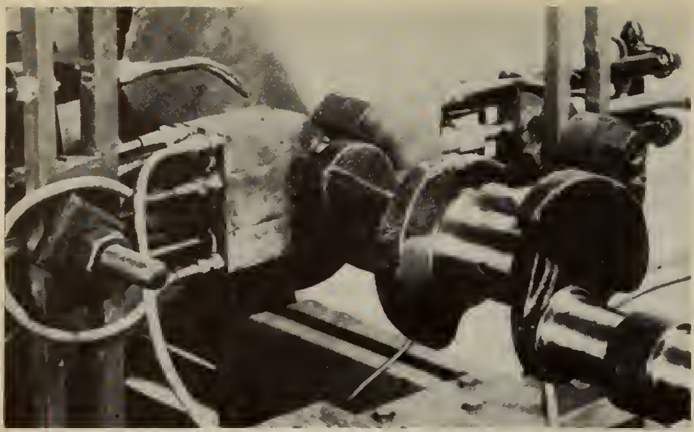

Fig. 7—Hardening a Crankshaft Bearing

method. Best results are obtained when the round is rotated in a vertical position, care being taken to centre the piece carefully so that a uniform case will be produced. The speed of rotation is not critical and with a well-arranged burner need not exceed a peripheral speed of 50 ft. per min. A great advantage of flame-hardening in the vertical position is the ease with which uniform and precise quenching can be done. Rounds of various diameters and lengths have been flame-hardened and there does not appear to be any practical limitation to the size or length which can be treated. An advantage of this method is its comparative freedom from distortion. This is explained by the absolute uniformity of heating and the highly localized area heated at one time.

The flame-hardening of rolls offers several attractive features. The absence of distortion has already been mentioned. In addition, it is now entirely practical to surface harden large-diameter steel rolls to a depth of 3-16 or ¼ in. with full knowledge that at some later time the roll can be softened by the oxy-acetylene flame, machined or repaired, and again flame-hardened. This is an advantage not possessed by chilled cast iron rolls. The two progressive methods about to be described, while considerably simpler from an equipment standpoint, develop greater distortion. Figure 8 shows the application of the process to the wobbler ends of a roll.

SPIRAL AND LONGITUDINAL FLAME-HARDENING OF ROUNDS

These two methods are in reality simple progressive hardening. In spiral hardening a single heating head follows a helical path from one end of the round to the other. Longitudinal hardening is done by a succession of passes parallel to the longitudinal axis of the round. The great disadvantage of both methods is the formation of a zone of lower hardness between each pass. While this zone can be held to a narrow width it is objectionable for many classes of service. Both of these methods are extremely simple from the standpoint of both oxy-acetylene and shop equipment. A single flame-hardening head and an old lathe are ideally adapted to spiraling. The longitudinal method requires only rectilinear motion and may, therefore, employ an oxy-acetylene cutting machine or lathe tool carriage.

Circular work of large diameter such as power-shovel roller-path rings is most successfully hardened by heating and quenching during one rotation of the part. Either the work or the heating heads may be stationary. This is an application of the progressive method already described for rounds.

The zone of lower hardness which will be produced at the start and stop points may not only be held to a narrow band, but in addition it may be positioned at an angle so that the line contact of rollers will not at any one instant bear entirely on the softer metal. This expedient has produced excellent service results.

Equipment and Applications

Various papers on the subject which have appeared during the past year have illustrated the types of apparatus employed in the flame-hardening process. From the apparatus manufacturer's standpoint the equipment divides itself into two groups, the first of which includes the parts which are used to a sufficient extent to warrant manufacture in quantity, and which are therefore considered as stock items; and the second group comprises special equipment developed for particular jobs.

In addition to the gas-handling apparatus essential in the process, various types of machines are also required as motivating units. Here again, types of equipment vary with the nature of the work.

Fig. 8—Hardening Wobbler Heads of a Roll

Post Treatment

Quenching arrangements are attached to the heating head for progressive or combination hardening. This insures a fixed relation between heating and quenching. Many devices may be used ranging from a simple stream of water from a round nozzle to a carefully designed spray nozzle. Spinning operations are better controlled by quenching with a large volume of water under low head which simulates total immersion.

Certain steels are too sensitive to be quenched in water. It has been found that a milder quench is obtainable by using soap-water solutions or a soluble cutting oil in water. If machine tools are used for flame-hardening, the cutting-oil systems can be used for quenching. Several steels respond to air quenching and such arrangements are easily provided.

It has been recommended that flame-hardening should be immediately followed by a low-temperature draw to relieve quenching stresses. This need not exceed 400 deg. F. and can conveniently be done in an oil bath or oven. Few users of the process have followed this recommendation, and further research may show that this recommendation is unnecessary in the great majority of cases. By carefully controlling the quantity and application of the quenching medium, or delaying its application, the treatment may be made self-drawing. Obviously, this technique is rather delicate if precise results are specified, but a proper balance of heat and quench can be established and maintained on a production basis.

Costs and Applications

For general estimating purposes, 1 cu. ft. each of oxygen and acetylene will harden 4 sq. in. of surface. Shop figures have been presented as high as 8 sq. in. per cu. ft. of each gas and it is believed that the figure of 4 sq. in. will be found quite conservative. Labour is difficult to estimate because so much depends on the surfaces to be treated. For assistance in estimating, the usual speed in progressive flame-hardening is from 6 to 8 in. per min. and in roll or shaft hardening from 3 to 6 in. per min. Spinning operations are seldom longer than 1-min. heating period.

A complete list of the articles or parts that have been flame-hardened would be too long to be included here. The following list has been selected as suggesting possible applications:

Machine-tool ways
Cams and cam surfaces
Crankshafts
Power-shovel roller-path rings and track
Car axle bearings and journal guides
Rail ends and rails
Valve stems, seats, and plugs
Oil-well-tool joints
Pulp knives and hog knives
Sprockets, sheaves, and crane wheels
Wobbler pads, coupler boxes, and mill turndown screws
Piston rods, sucker rods, pump plungers
Wrench jaws
Tractor shoes
Internal area of cylinders
Internal area of relatively small holes for bearings

Fig. 9—Flame-Hardened Cam

Summation

In closing, the several inherent as well as important advantages of the flame-hardening process seem worthy of summation:

1. The equipment is ready for use instantly.
2. Simple straight-carbon or inexpensive low-alloy steels can be used.
3. The operation is rapid.
4. Hardening is confined to the surface and can be done exactly where desired.
5. Core properties are retained.
6. The case depth can be varied easily.
7. The degree of hardness can be varied.
8. The size of the article is not a limiting factor.
9. The quality is uniform.
10. The tendency to distort is greatly minimized.
11. A relatively small number of pieces are tied up in the hardening equipment.
12. The equipment is truly portable.
13. The process can be applied to a large list of steels, cast iron, malleable iron, and carburized parts.
14. The equipment used for flame-hardening can also be used for flame-softening.

ANNUAL MEETING, TORONTO, ONT., FEBRUARY 8th and 9th, 1940

THE OPTIMUM THICKNESS OF INSULATION FOR CANADIAN HOMES

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The design of any building for Canada, be it dwelling, school, theatre or office building, must allow for insulation against excessive heat loss. This is a problem of especial importance for Canada because the severe winters have meant a large national bill for fuel and the justification—and necessity—for insulation lie primarily in the fact that by means of insulation the cost of heating can be reduced. The heat supplied to any building by the combustion of fuel must eventually find its way to the exterior through the walls, roof, windows and doors and any method which can retard this movement of heat will result in decreased heating costs. Insulation when applied correctly to walls and roofs increases the resistance to heat flow.

In the use of insulation, however, it must be borne in mind that the saving to be gained obeys the law of diminishing returns. Consider the following points: (1) A house cannot be perfectly insulated; that is to say, it is impossible to eliminate completely the heat exchange between the inside and the outside. No matter how much insulation is added there will always be a temperature drop through the wall and while this drop may be distributed over as large a thickness as desired, thus making the temperature gradient small, yet there must always be some gradient and consequently a transfer of heat. (2) If the insulation value of a wall is doubled, the heat loss through that wall is halved. The saving made in heating, however, depends on the initial insulation of the wall, since the heating cost is computed on the basis of the number of B.T.U.'s lost. To take a specific example, suppose we have three walls whose thermal coefficients are 1.00, 0.50 and 0.25 B.T.U. per hr. per sq. ft. per deg. F. respectively. The thermal resistance of the second wall is double that of the first and that of the third is double the second but the saving in one case is 0.50 B.T.U. and in the other only 0.25. Since we pay for B.T.U. the saving in the second case is only one-half of what it was in the first case. Moreover, to double the insulation of the second wall required a greater amount of insulation than to double the first so we see that we have not by any means obtained a comparable saving. This fact may be expressed mathematically by saying that the reduction in heat loss through a wall decreases geometrically while the cost of heating decreases arithmetically.

The above example explains why it is that, while it pays to add a certain amount of insulation to a wall, it is not an economic propostion to go on adding insulation *ad infinitum*. In most construction in Canada the thickness of insulation to be used is judged solely on an empirical basis without any consideration of the estimated cost of the heat loss through the wall. It is the intention in this paper to study and analyze as far as it is possible the various factors which contribute to the problem and to find out in what way they influence one another.

The first point that is obvious in such a study is that the insulation requirements of any house will vary according to the climate of the district in which it is built. A Vancouver house, for instance, would require much less protection than one built in the prairies. It is essential, therefore, to include as a first consideration the climatic conditions existing in the different parts of Canada. Secondly, the cost of the fuel will have an influence on the amount of insulation that should be used. Obviously, if fuel is very cheap the saving to be effected by insulating the house is correspondingly reduced. Conversely, if insulation is cheap and fuel expensive it will pay to use more of the former. Thirdly, in insulating a building the outlay on insulation must be applied where its effect will be greatest. It would hardly be justifiable to spend money insulating walls if 80 per cent of the heat loss was through the windows. It is for this reason that the first consideration of Canadian homes should be double windows and weatherstripping. Lastly, one must not overlook certain purely economical factors such as maintenance costs, interest on investment, depreciation, etc.

In this paper the intention is to attack the problem in the following way:

(1) To analyze the weather conditions in the different parts of the country and to compute degree-days for the various districts.

2. To analyze the distribution of the heat loss from a typical house.

3. To determine the amount, and cost, of the fuel required to heat the house under different conditions.

4. To determine the cost of insulating the house on the basis of equal yearly payments spread over a period of time.

5. To combine these factors so as to find the thickness of insulation which is economically justifiable.

The Weather Conditions in Different Parts of the Country

As already pointed out any estimate of the amount of insulation to be used in a building must make allowance for the weather conditions prevailing where the building is to be built. As regards fuel consumption the important feature is not necessarily the minimum temperature which may be experienced but rather the combined effect of low temperature and length of heating season. The minimum temperature does have a direct effect on the heating arrangements in that the heating equipment must be of sufficient size to take care of the minimum but the consumption of fuel depends on the length of the heating season as well as on the temperature difference.

In order that both these factors should be included in an estimate of fuel consumption the concept of degree-days has been introduced. This, as its name implies, is a unit based upon temperature difference and time. For any one

TABLE I.—DEGREE-DAYS FOR CANADIAN CITIES

City	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Vancouver	899	756	713	510	341	180	62	93	270	496	660	756	5,736
Edmonton	1,829	1,512	1,302	720	434	240	124	186	450	713	1,230	1,519	10,259
Regina	2,139	1,876	1,581	840	465	180	31	124	420	806	1,320	1,767	11,541
Winnipeg	2,139	1,820	1,581	810	403	90	.....	62	330	744	1,320	1,829	11,128
Toronto	1,333	1,204	1,116	720	372	60	.....	.....	180	558	870	1,209	7,622
Ottawa	1,674	1,484	1,271	690	279	30	.....	.....	217	589	990	1,457	8,681
Montreal	1,612	1,428	1,209	720	310	.....	.....	.....	180	558	960	1,395	8,372
Fredericton	1,612	1,400	1,209	880	434	150	.....	31	279	620	990	1,426	9,031
Halifax	1,302	1,176	1,085	780	496	210	.....	.....	210	496	780	1,147	7,682

day there exist as many degree-days as there are degrees Fahrenheit difference in temperature between the average outside air temperature, taken over a 24 hour period, and a temperature of 65 deg. F. The choice of 65 deg. F. as the base temperature has been made as the result of an investigation carried out by the American Gas Association which showed that in the heating of residences the gas consumption varied directly as the difference between 65 deg. and the outside temperature. It has subsequently been found that this also holds good in the case of other fuels. A summation of the degree-days for each day in the year gives the total degree-days in the year. This forms a basis upon which the yearly fuel consumption can be estimated.

In Table 1 the number of degree-days for each month is given for various Canadian cities; the total number of degree-days per year is given in the last column. These figures have been calculated on the basis of the mean monthly temperature as given in "The Canada Year Book, 1931". For the purpose of this paper it is not essential to carry through the calculations for each individual city and it will be sufficient to classify these cities into four arbitrary groups according to the number of degree-days. These groups are as follows:

1. Vancouver and the Pacific Coast. (Degree-days between 5,000 and 6,000).
2. Halifax and Toronto. (Degree-days between 7,000 and 8,000.)
3. Ottawa, Montreal, Fredericton and neighboring districts. (Degree-days between 8,000 and 9,000).
4. The prairie cities. Winnipeg, Regina, Edmonton. (Degree-days between 10,000 and 11,000).

The Distribution of Heat Losses from a House

The general design of a building is of fundamental importance because such things as ratio of window area to wall area, the area of the roof, the number of doors and windows are all factors which affect the heat loss from a house. The method of construction is also of importance since it is obvious that a thick stone or masonry house will have different thermal properties from a light, thinly constructed, frame dwelling. The workmanship and the quality of materials used are also factors which cannot be overlooked. But while these are all essential points in any calculations involving individual houses they cannot be given commensurable weight in a general study such as this. We are interested in showing, first of all, that there is a definite optimum thickness of insulation and secondly, in obtaining a rough estimate of this thickness for various parts of Canada. In order to carry this out it is necessary to choose some sort of a typical house on which to base our calculations and to neglect variations in heating load caused by the factors of design and construction. One house, as representative as possible, may be taken, and with this as a model, the variation of heating costs with changing conditions may be computed.

A house which may be regarded as typical of many constructed in Canada is the dwelling specified in Example 6, page 144 of the 1938 Guide of the American Society of Heating and Ventilating Engineers. This is a two story, six room, frame house, 28 by 30 ft. foundation and has the following characteristics:

Area of outside walls	1,992 sq. ft.
Area of glass	333 sq. ft.
Area of outside doors	54 sq. ft.
Cracks around windows	440 ft.
Cracks around doors	54 ft.
Area of second floor ceiling	783 sq. ft.
Volume, first and second floors	13,010 cu. ft.
Ceilings	9 ft. high

The walls are constructed of 2 by 4 in. studs with wood sheathing, building paper and wood siding on the outside and wood lath and plaster on the inside. The windows are single glazed, double-hung, wood frames without weatherstrips. The second floor ceiling is metal lath and plaster, without an attic floor. The roof is of wood shingles on wood strips with rafters exposed. The area of the roof is 20 per cent greater than the area of the second floor ceiling.

The following thermal transmissions have been assumed for the various parts of the building, based on coefficients published in the A.S.H.V.E. guide for 1938.

Walls:	overall transmission	U = 0.25	B.T.U./hr./sq.ft./deg.F.
Glass:	" "	U = 1.13	" " "
Doors:	" "	U = 0.52	" " "
Second floor ceiling:		U = 0.69	" " "
Roof:	overall transmission	U = 0.46	" " "
Roof and ceiling combined	"	U = 0.31	" " "
Window crack:	air leakage	= 21.4	cu. ft./hour/ft.
Door crack:	"	= 42.8	" "

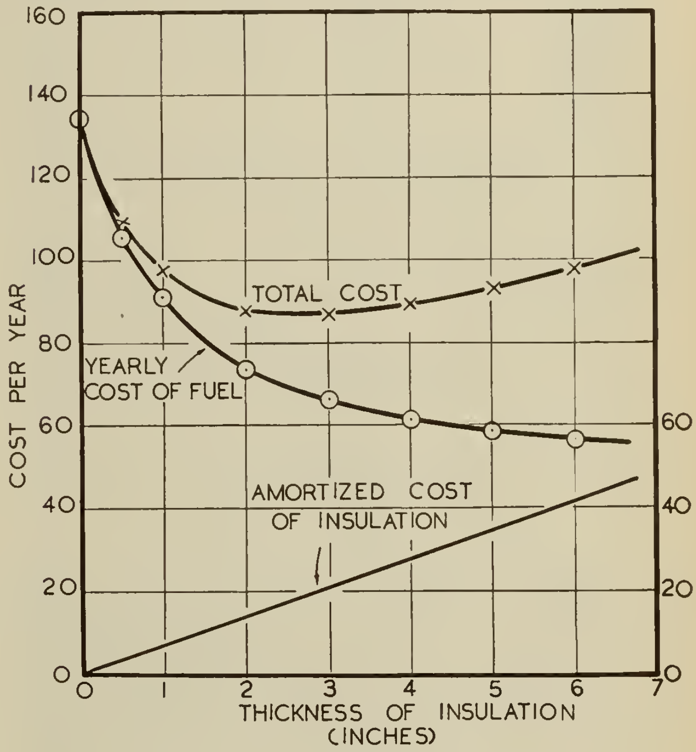

Fig. 1—Group I: Degree-Days 5500

On the basis of these figures it is easy to determine the heat losses through the various parts of the house per day per deg. F. temperature difference. The various figures obtained are as follows:

Walls = 0.25 by 1,992 by 24 = 12,000 B.T.U./day/deg. F.
Roof = 0.31 by 783 by 24 = 5,830
Glass = 1.13 by 333 by 24 = 9,030
Doors = 0.52 by 54 by 24 = 674
*Air leakage, windows = 0.018 by 21.4 by 40 by 24 = 4,070
*Air leakage, doors = 0.018 by 42.8 by 54 by 24 = 998.
*Cf. A.S.H.V.E. Guide 1938, p. 127.

By adding these figures together we obtain 32,602 B.T.U. as the total heat loss from the house per day for each degree F. temperature difference between the outside and the inside. If this is multiplied by the number of degree-days in the year the total yearly heat loss is obtained.

The house as assumed above is completely uninsulated and such a house would never be used in Canada. All Canadian homes with few exceptions are provided, as a first step in the protection against cold, with double windows and in most cases the doors are weatherstripped. By this means, not only is the heat loss by transmission through the glass reduced but also the heat loss by air infiltration is materially lessened. The coefficient of heat transmission U for a double glazed window is 0.55 while the air leakage per foot of window and door crack under these conditions may be taken as 15.5 cu. ft. and 31.0 cu. ft. respectively. When we make these improvements in the house we find that the heat loss per day per degree F. is reduced from 32,602 B.T.U. to 25,777.

Having provided the house with double windows and doors it is time to insulate the house proper; in other words, some material or materials must be used in the construction of the walls and roof of such a nature and in sufficient thickness that the heat transmission will be appreciably reduced. There are a great number of these so-called insulating materials on the market and they are available in various

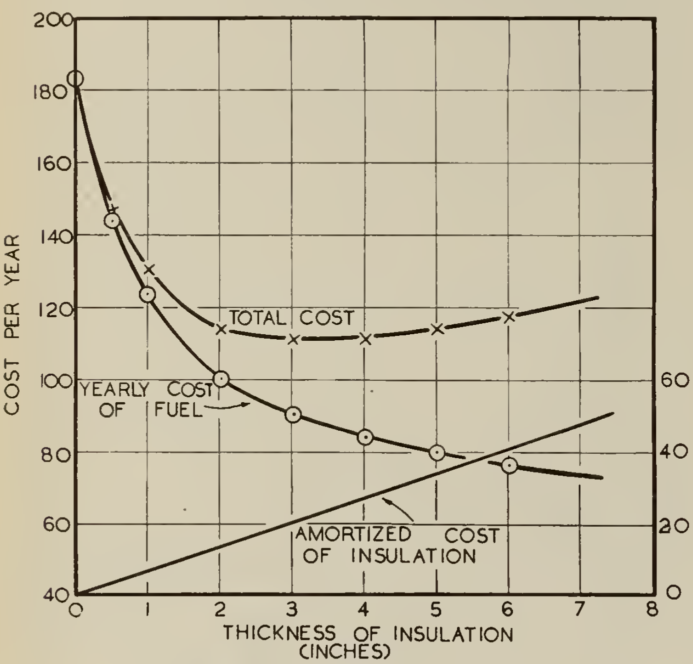

Fig. 2—Group II: Degree-Days 7500

forms ranging from loose fill materials such as rock wool, shavings, peat moss, etc., to rigid fibre boards constructed from wood pulp, corn stalks, wheat straw, etc. These materials, of course, vary not only in insulating value per inch thickness but also in cost. In certain cases the material may serve some other constructional purpose besides that of insulation. Thus a fibre board may be used as a plaster base, or even, in some cases, in place of the wood sheathing. In this case, however, a standard insulation should be taken, for example, a hypothetical material having a thermal conductivity (k-value) of 0.30 B.T.U per hr. per sq. ft. per deg. F. temperature difference per inch thickness. This is a fairly representative value as an inch of this material would be equivalent to ⅞ in. of rock wool or to 1¼ in. of fibre board.

The parts of the house which must be insulated are the outside walls and the second floor ceiling. It is assumed that there is no attic floor and that the insulation is placed directly above the plaster of the second floor ceiling. It is desired to determine the effect on the heat loss resulting from the application of different thicknesses of the standard insulation to the house. In Table II is given the overall transmission U of the walls and roof with different thicknesses of this insulation.

Table II

	Thermal Transmission U	
	Wall	Roof
No additional insulation	0.25	0.31
½ inch insulation	0.18	0.20
1 " "	0.14	0.15
2 " "	0.093	0.101
3 " "	0.071	0.076
4 " "	0.058	0.060
5 " "	0.048	0.053
6 " "	0.042	0.045

Using these coefficients the heat loss per day per deg. F. can now easily be determined in a similar method to that used for the uninsulated house. The results are given in Table III.

Table III

Calculated heat loss from the house under various conditions:

	B.T.U./day/deg. F.
Uninsulated house	32,602
Double windows	25,777
½ inch insulation	20,317
1 " "	17,457
2 " "	14,127
3 " "	12,767
4 " "	11,847
5 " "	11,233
6 " "	10,803

The product of the B.T.U. loss per day per deg. F. and the number of degree-days per year gives the number of B.T.U. which are lost from the dwelling in a year. This is shown in Table IV.

This represents the number of B.T.U. which must be supplied to the house by the fuel that is burned during the winter. The next step is to relate this figure to the number of tons of coal, gallons of oil, cords of wood, etc., which will be used. Although the number of B.T.U. in a ton of coal can be easily determined by laboratory tests, yet these B.T.U.'s are not all available for heating, since no furnace is 100 per cent efficient. In actual furnaces part of the coal goes unburned and is thrown out with the ash, while some of the hydrocarbon gases are unburnt. In all cases heat is lost up the chimney with the gaseous products of combustion. Since these factors vary with different types of furnaces and also with individual furnaces according to whether the furnace is running at full capacity or is burning slowly, considerable uncertainty exists in any estimate of the number of B.T.U. in a ton of coal actually available for heating. It must also be borne in mind that the different varieties of coal have widely different B.T.U. content.

In order to have some basis of computation it is necessary to select a typical method of heating which will furnish conditions near enough to the average. In this way the results will be close enough to indicate general trends. Take for our example a furnace burning anthracite coal. The B.T.U. content of anthracite coals varies but an average would be a coal having a heat value of 13,200 B.T.U. per lb. or 26,400,000 B.T.U. per ton. It may be assumed that

TABLE IV

B.T.U. LOSS PER YEAR

City Groups	Average Degree—Days	Uninsulated House No Double Windows	Double Windows	½ in. Insulation	1 in. Insulation	2 in. Insulation	3 in. Insulation	4 in. Insulation	5 in. Insulation	6 in. Insulation
I	5,500	179,400,000	141,800,000	111,700,000	96,000,000	77,600,000	70,100,000	65,100,000	62,700,000	59,400,000
II	7,500	244,500,000	193,300,000	152,200,000	131,000,000	106,000,000	95,600,000	88,900,000	84,200,000	81,000,000
III	8,500	277,500,000	219,000,000	172,700,000	148,300,000	120,100,000	108,300,000	100,700,000	95,500,000	92,900,000
IV	10,500	342,300,000	270,300,000	213,300,000	183,200,000	148,300,000	134,000,000	124,300,000	118,000,000	113,300,000

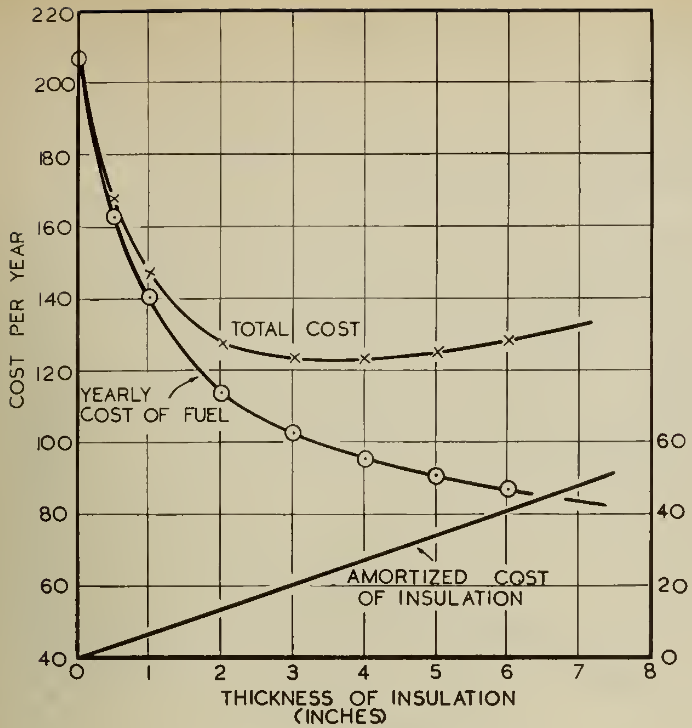

Fig. 3—Group III: Degree-Days 8500

the heating equipment is 60 per cent efficient, i.e., that throughout the heating season 60 per cent of the theoretical B.T.U. content of the coal is made directly available for heating purposes. Thus each ton of coal will supply 15,840,000 B.T.U. to the house. The cost of a ton of such coal will be taken as $15.00. Actually, of course, the cost of coal varies from year to year and from place to place, but this figure should, under ordinary conditions, be near enough to the actual cost to justify general conclusions.

Under these assumptions Table V shows the number of tons of coal required to heat the model house per year in the different degree-day groups and with different thicknesses of insulation. The corresponding cost of this coal at the standard price is also given in the appropriate columns.

Yearly Cost Attributable to Insulation

The figures given in Table V represent the money which must be paid out for fuel under the different conditions assumed. Any strict method of computing heating costs would, however, include in the yearly fuel bill a term representing the increased cost of the house due to the insulation. This must now be taken into consideration.

For this purpose it is necessary to fix a price for this insulation. As in the case of coal this means another arbitrary assumption. There are as many possible costs as possible varieties of insulation and moreover these costs are not permanent. A probable figure is 3.5 cents per sq. ft. per in. thickness of insulation installed. The total area of the house which requires insulation is 2,775 sq. ft. Under these conditions the cost of putting one inch of insulation in the house is $97.125.

In order to estimate how the cost of insulation affects the yearly fuel bill it is necessary to distribute the initial cost of the insulation over the life of the building. Assuming that the insulation is paid for in 25 equal yearly instalments computed on a five per cent basis, it is found from annuity tables (of Accountant's Handbook: Saliers, Ronald Press: p. 507) that $100 may be written off in 25 years at five per cent by a yearly payment of $7.0953. On this basis $7.0953 must be added to the yearly fuel bill for every $100 invested in insulation. In Table VI is given the yearly cost of various thicknesses of insulation computed in this way.

TABLE VI

Thickness of Insulation	Initial Cost	Yearly Payment
½″....................	$ 48.562	$ 3.446
1″....................	97.125	6.891
2″....................	194.250	13.782
3″....................	291.375	20.673
4″....................	388.500	27.564
5″....................	485.625	34.455
6″....................	582.750	41.346

Total Yearly Cost for Heating

TABLE VII

City Group	½ in.	1 in.	2 in.	3 in.	4 in.	5 in.	6 in.
I	$109.0	$ 97.8	$ 87.3	$ 87.0	$ 89.2	$ 93.0	$ 97.5
II	147.6	130.9	114.1	111.3	111.7	114.1	117.9
III	166.8	147.5	127.5	123.3	123.0	124.9	128.3
IV	205.3	180.7	154.3	147.7	145.3	146.3	148.4

In order, therefore, to obtain the total cost of heating the house for a year the yearly cost of insulation as given in Table VI must be added to the cost of the fuel as determined in Table V. These figures are given in Table VII for the different conditions. It can immediately be seen that for each city group there is a certain thickness of insulation at which the cost is a minimum. These points are brought out more clearly by the graphs in Figs. 1 to 4. Here are plotted both the actual cost of the fuel as given in Table V and the total cost as given in Table VII. The yearly cost of the insulation alone is also represented on the figure but the scale for this has in some cases a different zero. The minimum in the curve for total yearly cost is clearly shown. From these graphs the following figures are taken as representing the conditions under which the total yearly cost is a minimum.

Group I = 2½ inches of insulation
Group II = 3 " "
Group III = 3½ " "
Group IV = 4 " "

The minima shown in these curves are very broad so that within wide ranges of thickness the total cost remains practically the same. For instance, there is only an increase of a few dollars per year if the insulation is changed by

TABLE V

City Groups	Uninsulated House		Double Windows		½ in. Insulation		1 in. Insulation		2 in. Insulation		3 in. Insulation		4 in. Insulation		5 in. Insulation		6 in. Insulation	
	No. of tons of coal	Cost	No. of tons of coal	Cost	No. of tons of coal	Cost	No. of tons of coal	Cost	No. of tons of coal	Cost	No. of tons of coal	Cost	No. of tons of coal	Cost	No. of tons of coal	Cost	No. of tons of coal	Cost
I	11.32	$170.0	9.05	$134.2	7.04	$105.6	6.06	$ 90.9	4.90	$ 73.5	4.42	$ 66.3	4.11	$ 61.6	3.90	$ 58.5	3.75	$ 56.2
II	15.47	232.0	12.21	183.2	9.61	144.2	8.27	124.0	6.69	100.3	6.04	90.6	5.61	84.1	5.31	79.6	5.11	76.6
III	17.52	263.0	13.83	207.7	10.90	163.4	9.36	140.6	7.57	133.7	6.84	102.6	6.36	95.4	6.03	90.4	5.80	87.0
IV	21.63	325.0	17.09	256.2	13.47	201.9	11.58	173.8	9.36	140.5	8.46	127.0	7.85	117.8	7.45	111.8	7.16	107.3

½ in. in either direction. It should be noticed, however, that the increase in cost is much greater if we decrease the thickness by an appreciable amount than if we increase it. This is especially noticeable in the city groups which have low degree-days.

For this study it has, of course, been necessary to make specific assumptions in order to be able to carry out the calculations. This somewhat limits the application of the results, but the results do show how the problem may be tackled in any particular case. At the same time the figures determined serve as a general guide to the thickness of insulation that should be used in different parts of the country and give, on scientific grounds, a lead towards determining the best and most economical amount of insulation.

It is instructive in conclusion to note the assumptions which have been made and the ways in which they may be expected to influence the results.

1. Estimate of degree-days. This figure is obtained by the use of statistics of average temperatures. For the individual cities it should, over many years, give a fairly reliable estimate of the weather to be expected. An error in degree-days would only affect the insulation results to a minor degree.

2. Assumption of a specific house. This would affect the result in that the amount of fuel saved depends on the ratio of the fixed heat loss to the heat loss through the walls and roof which can be influenced by insulation. It would be uneconomical to use as thick insulation in a house with a large ratio of window area to wall area as in a house with a smaller ratio.

3. Assumption of cost of fuel. All the assumptions with regard to the fuel may be summed up by the one assumption of a cost per B.T.U. Different fuels, different furnaces, different localities will all affect the cost per B.T.U. With a large B.T.U. cost the economical thickness of insulation will increase. With a low B.T.U. cost the economical thickness is less.

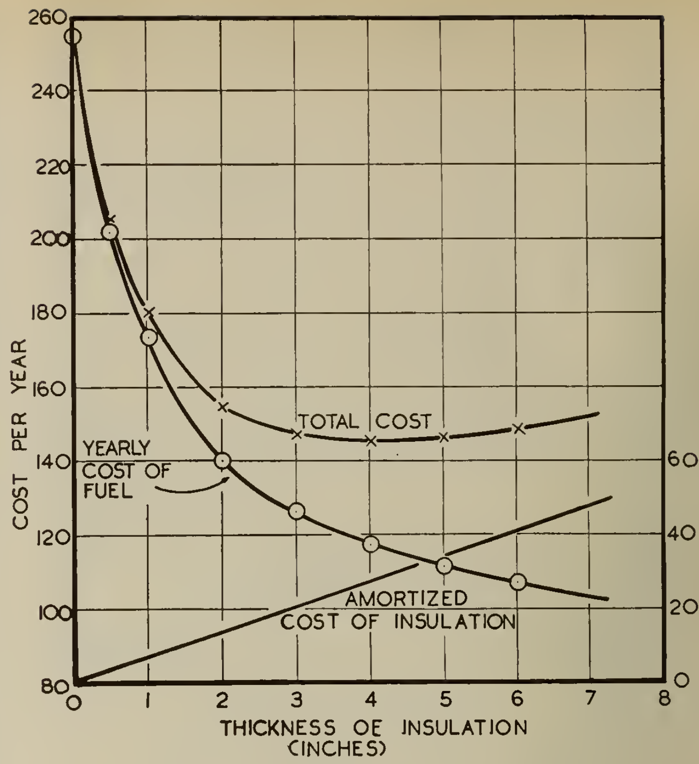

Fig. 4—Group IV: Degree-Days 10500

4. Type and cost of insulation. The cost of different varieties of insulation should be compared by estimating the cost to obtain insulation value equivalent to an inch of material having the k-factor equal to 0.30. It is obvious that with a material having a cost greater than the assumed value the thickness used should be less and with a cheaper material the thickness should be increased.

THE ECONOMIC FRONT

(Continued from page 11)

extent of our war effort will directly depend upon the effectiveness with which we can organize and conserve our manpower. Although we have thousands of unemployed, they do not represent the reserve of manpower their numbers would indicate. Many are temperamentally or constitutionally unfitted for work; others are specialists whose services under changing conditions are less needed, and as a whole they are below average in intelligence and physique.

As more and more men are needed for war purposes, our peace time construction activities, large or small, public or private, should be tapered off. To tide over, we should improvise and resort to temporary expedients. What cannot be deferred until after the war should be done now before the shortage of manpower becomes acute. New projects, replacements and betterments use up exchange to the extent that imported materials are incorporated in them. They deplete our manpower, and they divert capital indispensable for war financing. They aid the enemy.

The St. Lawrence Waterway, so long as the allocation of cost is just and it can be shown the cost of transportation will be reduced, taking into account the carrying charge of the new works and the loss of traffic to the railways, is the very thing to construct after the war, to tide over post-war readjustment. A spirit of co-operation with our neighbours is indispensable, but the Americans are a sensible people and will realize that now we are at war we are in the position of a man defending himself against a highway robber.

Conclusion

When the war starts in earnest, we may be unpleasantly surprised. Our war effort cannot be overdone, as better equipment for our armed forces means corresponding fewer casualties. Per capita, Britain is currently spending over four times our anticipated expenditure for the first year of the war. Even to approach the British figure, we must first put our own house in order. Apart from their excessive cost, our multiplicity of governments breed sectional jealousy and discontent. A better understanding between the various sections of our country is badly needed, and we should treat the French-speaking Canadians with the same tolerance they treat the English-speaking minority in Quebec. We should also continue to cultivate the friendship of our neighbours to the south.

We engineers are trained in the scientific approach, and we deal with economic problems in our everyday work. We can be of real service in promoting sound ideas among the public, since in democracies the government can only move when it has public opinion solidly behind it. We can use our good offices in reconciling the conflicting interests of the consumer, the producer, and labour. Only by all working together, can we effectively use our manpower and resources in this war, and lay the foundation for a lasting prosperity. Our aim should be to provide our Government with constructive support.

NOTE—The opinions expressed by the author are his own and do not necessarily represent the opinion of The Engineering Institute of Canada as a body.

MODERN MILITARY ENGINEERING

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Address presented before a joint meeting of the Montreal Branch of The Engineering Institute of Canada and the Military Engineers' Association of Canada on December 14, 1939

There appears to be a rather general impression, even among engineers, that military engineering differs in some fundamental way from civil engineering (using the latter term in its broadest sense), and that military engineering contains at least some elements to which the ordinary practices of engineering do not apply. The purpose of this talk is to show that the impression referred to is almost entirely incorrect, and to indicate briefly some of the main tasks of the army engineer in the field, and their close parallelism to the tasks of the engineer in civil life.

In general terms, the function of the engineer in his civil aspect, is to provide, for the community at large:

(a) Shelter and protection from the elements for men and goods.

(b) Facilities for transportation of men and goods.

(c) Facilities for inter-communication.

(d) Power.

(e) Materials, both for his own use and for non-engineering purposes.

(f) Water.

(g) Disposal of wastes.

The above headings, expanded in some cases to cover very large fields of endeavour, will be found capable of including everything which the properly designated engineering profession comprises. With very slight modifications in terms they will also describe all the activities of the military engineer in war.

Let us discuss each one in turn and attempt to determine whether this statement is true, and if it is, whether the military engineer uses, in carrying out his functions, any principles or methods which differ radically from those of ordinary practice.

Shelter

The military engineer is responsible for providing shelter from the elements for the community (the forces in the field). For the sake of brevity, we will call this community the army, although it may contain all three of the forces on sea, land and air. The only difference between the military and the civil engineer in this matter is that the former works without benefit of the architect, since the structures used are entirely utilitarian, and are generally of the simplest possible type. There is certainly nothing new or novel in the designs, unless we except the various kinds of pre-fabricated and portable buildings which have been produced. These are attained simply by a sacrifice of safety factors, comfort and durability, none of which have the importance which they hold in civil life. Much ingenuity, however, has been exercised in obtaining the minimum of weight with the maximum speed of erection and dismantling, particularly in some of the larger buildings such as aeroplane hangars. One very clever factory-built semi-portable hangar might be mentioned which uses very light angles throughout, with framed towers as columns for lateral stiffness, and with many of the parts interchangeable, the whole structure being field bolted.

There is one feature of the provision of shelter for the army, however, which is definitely apart from anything met with in civil life, and that is shelter against the man-made destructive elements which the soldier must weather if he is to be kept alive. Actually, even here the boundary between civil and military requirements is disappearing in these days of air bombing, and the private citizen at home has to be protected against enemy activity almost as fully as the soldier at the front, a fact which we in this country have hardly yet begun to appreciate. Shelters of this character differ radically, of course, from the buildings in which we live normally, although they actually have their counterparts in the cyclone cellars and earthquake shelters of some unlucky parts of the world. They are characterized by their subterranean location and their very great structural strength, and by their restricted size in comparison with the numbers whom they are designed to hold. They vary from the small family air-raid shelters intended to be sunk in the ground in the back garden by the householder, to gigantic underground workings like the Maginot fortifications, and huge artificial caverns used for protection of oil and gasoline reserves. They include also open trench systems for protection of troops in front line positions and those massive-walled hollow concrete cubes which we have come to know as pill-boxes. The most famous example of the large subterranean shelter is, of course, the Maginot Line, which has had almost as much publicity in recent months as a new movie star. The Maginot Line is a truly colossal work. It is difficult to get any accurate figures as to its total cost, but it would appear to have been in the neighbourhood of 500 or 600 million dollars, or from two to three million per mile of its length. It involved a tremendous amount of tunnelling, and a large number of vertical shafts, and it was probably built largely by contractors experienced in city subway construction. It is reasonably safe to say that the only parts of it which are distinctly military in character are the arrangements for handling gun ammunition and the gun turrets themselves. This is not intended in any way to detract from the work of the French army engineers who planned it, but merely to point out that the engineering methods were those of normal civil practice, and that the military aspect of the work lies in the purpose for which it is intended, and the manner in which it was planned so as to fulfil its function most effectively.

It might be well to note that the purpose of the Maginot works, as in all other protective works in a battle zone, is to protect the fighting equipment, the ammunition and the manning personnel against destruction by the enemy's long-range attack, i.e., by shelling or bombing, so that the garrison may be always ready to man its weapons on the surface when the enemy advances to drive home his attack by means of men and man-carried weapons, aided, perhaps, but not yet superseded by those small moving forts which we call tanks.

It would, perhaps, be worth while to digress for a moment at this point to discuss the possible effect of the tank on warfare, since this is actually the only really new weapon which has emerged in modern times, so far as fighting on land is concerned. The tank is simply a means whereby destructive weapons and their manning crews can be moved into and through the enemy's defence organizations so as to attack more effectively such points of resistance as cannot be subdued by long-range attack or by unprotected men. It is a highly effective weapon against an opponent who is himself deficient in similar equipment, or who is not properly armed for defence against tanks. In a war of movement it may have great tactical value. Some day we may see a battle between tank fleets, just like a naval battle, on dry land. But for the attack of well fortified defensive positions, the value of the tank is very doubtful. It is not as difficult to stop as some people imagine. A fairly large trench of proper shape will do the trick, and so will various types of surface obstacle, such as the concrete teeth which the Germans are using, or a chevaux-de-frise of railway rails firmly set in earth or concrete. The tank is an easy target when it has been stopped, and it cannot be armoured against even a small shell. Consequently, it would seem that the course of events is not likely to be altered very greatly by the presence of tanks on both sides of the present conflict. The new weapon, in other words, loses much of its superiority once it is no longer new, and once an effective defence against it has been devised. We have excellent examples of this phenomenon, by the way, in the case of the submarine and the bombing aeroplane.

To return to the general matter of provision of shelter, and to sum up, it may be said that the outstanding feature of this phase of the military engineer's act is the production of the two great belts of fortifications on the Franco-German border, the French system highly developed underground and deliberately constructed, while the German system has been more hastily built, has more surface structures and is distributed over a wider zone. It is impossible to say which will prove the more effective, but there seems to be little doubt that the French line is much the more comfortable for the troops to live in.

Transportation Facilities

The engineer service in our army does not provide and operate road vehicles. It does, however, provide and operate everything which runs on rails, and it also provides the roads on which vehicles must move. It is rather a paradoxical fact that the introduction of mechanical transport, with its greater speed, which it would seem at first sight should reduce the number of vehicles on the roads, has had precisely the opposite effect. This is due to several factors, such as the large increase in the amount of munitions to be provided, the large proportion of the troops who now ride where they used to walk, the multiplicity of new equipment which has to be carried on vehicles, and so on. The fact remains that an ordinary infantry division possesses some 6,000 motor vehicles for transportation purposes, plus the machines which tow guns, tanks, machine-gun and troop carriers, and all the rest. The result is that the engineer's job of making and maintaining roads in this war is going to be immensely greater than it was in the last one, if the fighting ever becomes really active. The same will be true of his railway work. Nevertheless, there is no such thing in actual fact as a "military" road or a "military railway"; there are only ordinary roads and ordinary railways built for military purposes, and, perhaps sometimes not so well built when haste is the only watchword. It is true that our handbooks of military engineering show various methods of building roads and of overcoming unusually difficult conditions, but there is not one of these which has not been used in a pinch in civil practice, from corduroy to fascine mat. Even the special units which we have for road and railway building are only slightly modified construction crews, with the engineer, the foreman and the section boss provided with military ranks and titles. They will take the field armed with the tools and equipment familiar to many of you, and probably including some of the latest things in dirt-moving machinery. Ditching machines, by the way, are already in use in France, making the tank traps which have been mentioned before.

Mention should not be omitted that the engineers of our army have a marine branch. They do not go to sea, but they operate wherever there are inland waterways, and did a lot of useful work the last time on the Belgian canals.

The question naturally arises as to the effect which mechanization is likely to have on the actual speed of movement of conflicting armies during a campaign. No information on this point can yet be gleaned from the present war. The German movement into Poland hardly furnishes a useful example, as this was, apparently, met by very little, or at least very poorly organized, resistance. As a result, the German mechanized columns were able to penetrate into Poland at speeds which are extremely high, when compared with any similar operations in the past. What might have happened if the Poles had been properly equipped and organized for defence against a mechanized force it is still impossible to say. It is, however, reasonable to say that an army forced to fall back, but in good order, and with an energetic engineer arm, should be able to slow down the movement of ordinary wheeled motor transport to a rate of not more than one or two miles per day over a belt of say twenty to thirty miles in average country. As the general speed advance of a large force is governed largely by its ability to get supplies forward, the speed of movement of the fighting troops would be correspondingly slowed. Tanks and other tracked vehicles are more difficult to deal with, from the engineer's point of view, but if the retreating force is properly armed and handled, it should not be possible for tanks to work very far ahead of their infantry and artillery. It is, therefore, quite likely that in a campaign such as that on the Franco-German front, rapid long-distance movements on either side are unlikely to occur until the resistance of one force or the other has been worn down to a point where it becomes disorganized. The only alternative to this would appear to be a large-scale flanking movement which, if successful, would take the attacker around the flank and to the rear of the defender, thus giving a chance of disorganizing the defence and giving an opportunity of rapid large-scale movements over the defender's territory. This alternative is, of course, fully recognized by both sides, as is evidenced by the persistent rumours of a German flanking movement by way of Holland or Belgium or Luxembourg or Switzerland, as the case may be.

Another very interesting question is one as to the endurance of motor vehicles generally under war conditions, and particularly if a really vigorous war of movement were to occur, i.e., something similar to the earlier stages of the Japanese invasion of China. The evidence of that campaign tends to support the idea that continued large scale movement of troops will not be practicable, because of the exhaustion and depletion of motor-vehicles. Destruction of roads and wastage of equipment is likely to increase at such a rate, if the operations are in a fairly large territory, that they will slow movements practically to a halt in a few months.

The net impression which the foregoing rather rambling discussion is intended to convey is that the engineer in modern wars will construct roads and railways as in previous wars, but will use more mechanical equipment than heretofore. He will also have more work to do because of the great increase in motor vehicles. At the same time, the task of repairing roads and track during an advance will be much heavier than before, because the ability of the engineer to destroy has likewise been greatly improved by the use of mechanical aids. The destruction of roads by cratering, for example, can be carried out very rapidly and extensively, as compared with the slow and laborious methods of the last war. We may, therefore, expect to see long stretches of road made impassable as against the isolated cross-road craters which war veterans will remember.

Facilities for Inter-communication

While communications form a very important branch of engineering in the civil community, they are no longer the concern of the army engineer. All work of this description is grouped under the one comprehensive head of "signals" and signals is one of the many activities of the fighting forces which were originally children of the engineer arm, but which, as they grew to adult size, went off on their own and now (sometimes) even think that they are "bigger men than daddy." The story of these offspring of the engineers is a familiar one to most soldiers, but there may be no harm in repeating it briefly for the benefit of those who have not heard it before.

The first, and the most obstreperous of the engineer children was the artillery. This child was born a long time ago—back in the seventeenth century or thereabouts, but it is a historical fact that ordnance, i.e., firearms too heavy to be carried by a man, was first used by the sappers of those early days, and quite logically, for its job was to break the walls of fortresses, and this was for the sappers to do. Later, when artillery came to be used directly against troops, and its use was consequently very much increased, it became a separate arm. The close association between gunners and sappers has, however, continued to this day, and their uniforms, their colours and their badges still retain many points of similarity.

The second offshoot of the engineers was submarine mining. There was a time when we had special submining units who looked after harbour defences. Then, just about the beginning of the twentieth century, say 1904 or 1905, it was decided that this sort of work should be done by the navy, and the old amphibian sappers disappeared, to the great regret of many, for it was an interesting job.

Next came mechanical transport. This came into being as a very wobbly infant about 1900, when most of the vehicles were steam-driven lorries. The whole business was an engineer stunt, and was looked on in those days with a certain amount of derision by the rest of the army. However, it grew and grew, and finally, about the beginning of the last war, it was taken over by the Army Service Corps and the Army Ordnance Corps more or less both at the same time. Its history since then has been fairly colourful, not to say hectic in spots, but it is too long a story to tell here. At any rate, the engineers handed it over, because they were very busy bringing up two very new babies which appeared almost at the same time. These were the Air Force and the Signals. The former began as a series of experiments with large kites, the idea being to use them for observation purposes. Then the Wright brothers came along, and the kite enthusiasts turned their attention to flying machines. The sappers were mixed up in flying right up to the beginning of the last war, and many of the earliest pilots of the R.F.C. were engineers who had been in the experimental sections and wanted to stick to flying. Signals remained an engineer job right through the war, by which time it, in its turn, had become large enough to stand on its own feet, and the Royal Corps of Signals was formed. These people are, actually, engineers still, for their officers are all fully trained electrical engineers who have specialized in communications.

And, finally, the latest child has just grown up and left the old homestead within the past year or so. For many years, the handling of searchlights, both on coast defences and for anti-aircraft work, has been the job of the engineer. Now, however, because these lights always work in conjunction with guns, it has been decided that they should be handled by gunners.

In case anyone should feel that the poor old Engineer Corps must now be pretty well denuded of its family, it might be well to point out, in conclusion, that there are still something like two hundred separate types of engineer units which may be required in a big war, so that there is no lack of either numbers or variety in the sapper family. Whether any of the remaining children will, in course of time, again grow to the status of an independent arm or corps, it is hard to say. At present it does not look that way.

Power Supply

The army engineer will seldom, if ever, be asked to instal any large-scale power plants in the field, for very obvious reasons. Nevertheless, he will probably have in operation in the aggregate, a quite respectable horsepower in portable and semi-portable plants operated by internal combustion engines. In the last war, electric light in our service was a great luxury, enjoyed only by the chosen few, and even then, in many cases, only through the enterprise and ingenuity of some engineer officer. Now, however, electric power will be provided as a regular service to all higher formations, the plants being carried in special trucks.

Provision of Materials

The obtaining of materials from natural sources, and the manufacture of synthetic materials is, as you all know, a very important function, indeed, of the engineer in civil life. The mining engineer, the chemical engineer, the metallurgist and the forestry engineer are all key men in our civilization. The army engineer, on the other hand, has his materials fed to him, for very obvious reasons, and is concerned very little with their production. In other words, he depends on his colleagues at home to do this part of the job. There are, however, two fairly important exceptions—the supply of timber and the supply of road metal. The last war showed that the use of special army units for the rapid production of lumber from the forests of Great Britain and France, for the use of the army itself, was an excellent idea. It conserved a lot of shipping. So the Forestry Corps will probably appear again one of these days, if the war becomes active, and it will be surprising if we are not called on to furnish a lot of expert lumbermen again, as we did the last time.

The other material—road metal—is one which obviously must be produced more or less on the job. In the last war, we had not realized this, and sometimes it was pretty hard to get, so that roads got into desperate condition. This time we are forewarned, and one of the many odd engineer units is one for quarrying and crushing rock. Its product, of course, will also be available for concrete making.

Water Supply

In his rôle as water provider, the army engineer again uses practically all the methods to which we are accustomed in civil practice. In fact, the principal development in this function has been that civil methods are more extensively applied than in the past, and more mechanical aids are used. We now have a special unit designed for the drilling of wells, for example, and portable power pumps replace the old-time hand pumps for taking water from lakes and streams. It may be noted, by the way, that the water supply duty of the engineer is one of the few—perhaps the only one—which has been lightened by the disappearance of the horse, since horse-watering used to be the most difficult part of the job, and called for the greater part of the supply.

Disposal of Wastes

Sewage disposal, naturally, cannot be a very elaborate or scientific affair with an army in the field. It is, nevertheless, a real and constant responsibility for the army engineer, and a good deal of thought and ingenuity have gone into the development of field methods of sanitation, especially those for standing camps.

Camouflage

To the list of functions of the engineer in civil life, we may add just one which is peculiar to the military engineer, and has no counterpart in ordinary experience. That is, the art or science of camouflage. It is a little difficult to understand why this should have been laid on the doorstep of the engineers originally, because it is compounded of a great deal of art and a very small amount of engineering.

In conclusion, it may be said, in a very general sort of way, that while the army engineer still has to be pretty much a jack of all trades, the tendency is rather towards narrowing his field of activity to what we are accustomed to think of as the functions of the civil engineer, leaving the mechanical and electrical sides to other specialized arms of the service. There is also a definite trend toward the use of more mechanical equipment, and to adopt equipment of well-tried commercial type in many cases, rather than to produce special military types. And, finally, the similarity between military and civil engineering is becoming greater as the army's demands, particularly in the main fields of shelter and transportation, become heavier, and render the old-time military engineering makeshifts less and less capable of meeting the requirements.

Abstracts of Current Literature

Contributed abstracts of articles appearing in the current technical periodicals

LOW HEAD PRODUCES HIGH CAPACITY

By George Willcock, Trollhättan, in *Power*, December, 1939

Abstracted by R. C. Flitton, A.M.E.I.C.

The newest and most notable of Sweden's hydro-electric plants is the Vargön Station in which two 18,000 h.p. Kaplan turbines operate at the extremely low head of 11.5 to 16.5 ft.

This plant is at the head of the Gotha River, where it leaves Lake Vänern, 50 miles from the City of Gothenburg. Below Vargön are the Trollhättan plant, operating under 105 ft. head and Lilla Edit with a head of 21.5 ft., all owned and operated by the Royal Board of Waterfalls of Sweden.

The turbine runners at Vargon are 26.25 ft. in dia. the largest in the world. Were it not for the fact that a dam had to be constructed to control flow from Lake Vänern, this plant probably would not have been economical. Cost of putting turbines in this dam was kept low by placing the runners above headwater level in syphon settings, rendering headgates unnecessary and reducing rock excavation for draft tubes.

Lake Vänern, Sweden's largest and Europe's third largest lake, with 5.5 ft. drawdown stores sufficient water to generate 850 millions of kw.h. which is 60 per cent of the power generated by the three plants on the Gotha River. The regulating section of the dam is controlled from Trollhättan plant 12 miles downstream.

Intake openings to each unit are 62.5 ft. wide by 32 ft. high. The draft tubes are 59 ft. deep measured from the centre of the runners and their outlets are 67.5 ft. wide by 24.3 ft. high. Each runner has four blades of stainless steel, which are adjusted by a governor-operated servomotor to an angle corresponding to head and the load on the unit.

Crown plate and gate rings are of cast iron in segments. Weight from above is carried down into the foundation by twelve stay vanes. The draft tube is lined for 28 feet by steel plate, chrome-nickel being used in the top half and mild steel in the bottom half. Removal of runner blades is made possible by having a segment of liner removeable. The gates, twenty-four in number, are 10 ft. 6 in. high. One unit has vertical gates controlled by a single servomotor, while in the other they are at an angle and controlled by two servomotors. Each governor has a capacity of 440,000 ft. lb.

The shafts are 34.25 in. in dia. and are guided by white-metal bearings bolted to crown plate and having force-feed oil lubrication. A labyrinth water seal is provided where shaft passes through crown plate.

Control at this plant is a feature. The actuators are driven by synchronous reaction motors receiving their current from a synchronous generator driven from the main shaft by the same gearing as that which drives the exciter. and the governor oil-pressure pump. Speed changes bring about the desired changes in gate position and blade position by the servomotors. The flume is filled by evacuating air from it by a large ejector, which requires about four hours. A small ejector, actuated by a contact on the float-operated rheostat that indicates water level in the turbine chamber, is designed to remove air from the top of the syphon. The use of this ejector has been found to be unnecessary as any air collecting is carried down through with the water.

Two air valves for emptying the syphon are provided, being held closed by governor oil pressure and can be controlled from the turbine control panel. They are only opened in emergency and empty the syphon in a few seconds.

A mechanism which combines movement of runner blades with that of the gates, known as a combinator, moves the runner blades to their normal position after the turbine starts. Blade position is indicated on the control board by signal lamps.

To stop the turbine, the gates are closed and held by a catch, after which the combinator motor turns the runner blades to the open position ready for starting. Operation of the combinator motor is interlocked with the catch on the gates to prevent incorrect operation sequence. If oil pressure goes below a predetermined value, the blade servomotor supply is cut off and the gate servomotor operated to close. Oil supply for gates is ensured in emergency by cutting off supply to blade servomotor. If for any reason power to actuator motors fails, the gates are automatically locked for the load for which they are set. The protective device at fault is indicated on the main control board and when the fault is removed the gates are unlocked by push-button on the control panel. For overspeed a centrifugal switch energizes a magnet which causes the gates to close. Should this protection fail, the unit is stopped by opening the vacuum breaker valves, which can be relied upon to stop the unit in emergency, as the water ceases to flow to the unit. Another centrifugal switch opens the exciter field circuit and when the unit is closed down by any means, the generator circuit breaker and exciter switch open automatically.

The generators, which are of the outdoor type, are of 12,000 k.v.a. capacity at 11,000 volts, one being 25 cycle and the other 50 cycle. Their speed is 46.9 r.p.m. and therefore their dimensions are large, being 38 ft. in diameter. The thrust bearing capacity is 1,600,000 lb.

The Vargön plant is considered part of the Trollhättan station and is, therefore, controlled remotely from it. Starting and synchronizing is, however, done at the plant itself.

Control from Trollhättan includes operation and supervision of the generator breaker position; also supervisory control of transformer-voltage-ratio regulator, two sector regulating gates, turbine-gate opening, governor operating range and voltage regulation setting for each unit. Meters at Trollhättan show water level in turbine flumes, head and tailwater levels, turbine gate opening, governor position, voltage, frequency, kw. load and the kw.h. generated at Vargön. Alarm signals are provided for low flume level, and high temperature windings. Control may be transferred to either plant. Carbon dioxide fire protection is provided in the generators.

SUBMARINE WARFARE IN 1917 AND 1939

***Engineering*, October 13, 1939**

In a recent issue of the French weekly periodical, *Le Journal de la Marine Marchande,* Commandant Jean de Fussy discussed submarine warfare at some length in an article appearing under the general heading of "La Défense des Routes Maritimes." In the belief that they will be of interest to our readers, we give below the substance of his remarks.

Commander de Fussy observes that the torpedoing of the British liner Athenia, at a point some 200 miles west of the Hebrides, less than 24 hours after the declaration of war, points, on the one hand, to premeditation on the part of Germany, and, on the other, to her intention to indulge in unrestricted submarine warfare, as in 1917. As was emphasized by Mr. Chamberlain in the House of Commons, on September 13, it was manifestly impossible for submarines, having a maximum surface speed of 15 knots, to reach the region west of the Hebrides on September 3, unless they had left their bases and received orders before the declaration of war. Germany's intention to wage unrestricted submarine warfare was proved by the facts that, in the first place, the Athenia was a passenger liner carrying 1,400 persons, 300 of whom were Americans; secondly, that she was proceeding from Europe to the United States, thus rendering it extremely unlikely that her cargo included any war material; and, thirdly, that the 1936 Convention, to which Germany was a party, prescribed that a submarine must call on a vessel to stop before proceeding to seize her. The sinking of the Athenia thus constituted a more serious crime than the torpedoing of the Lusitania, which took place nine months after the declaration of the war in 1914, when this vessel was proceeding to Great Britain.

Commander de Fussy contended, however, that the submarine was at present infinitely less of a menace than it was in February, 1917. At the commencement of 1917 the enemy had between 150 and 175 submarines in service and were constructing a further 200; whereas, on May 1 of the present year, they possessed only seven flotillas, comprising 52 vessels, and were building 19 further ships. Furthermore, he added, in her haste to reconstruct her submarine fleet and to train crews, Germany had sacrificed quality to quantity. Of the 52 vessels in service, as many as 28 were small 250-ton units, while 16 were of 500 tons, and eight of 740 tons. These last were the only ones capable of undertaking long cruises; the radius of action of the others was very limited, and, in the absence of bases or of floating revictualling and refuelling depots, they could do little more than cruise in the Baltic or North Sea. Further, the 250-ton submarines were armed with one small-calibre anti-aircraft gun and three torpedo tubes only, and their maximum speed was 13 knots, on the surface, and seven knots when submerged. Thus, from the point of view of endurance, these vessels could not compare with the large 1,400-ton French submarines, carrying one 100-mm. (3.9-in) gun and 12 torpedo tubes, and capable of a surface speed of upwards of 20 knots.

During the course of the war of 1914-18, the efficiency of the submarine as an instrument of warfare was a revelation and it was only towards the end of 1917 that the Allies were able to put into operation effective measures for the protection of shipping. On the other hand, of all war instruments, the submarine had, perhaps, progressed least during the past 20 years. It was, perhaps, less vulnerable than formerly, but no sensational increase in its fighting power had manifested itself. Taking dimensions into account, the speed and radius of action, on the surface and when submerged, had remained practically the same as they were during the last war. The submarine was still slower, when submerged, than the slowest cargo vessel. In striking contrast with this, the anti-submarine defence measures introduced in 1917 had developed continuously during the last 20 years, and, moreover, the increases in the speed of merchant ships and in the efficiency of patrolling aircraft had greatly augmented the difficulties of submarine attack.

Admiral Lord Jellicoe* stated that, in September, 1916, 1,749 merchant ships had been provided with defensive armament, and that this number had increased to 2,899 on February 22, 1917, to 3,253 on May 15, 1917, and to 3,656 at the end of December, 1917. During the period January 1 to 25, 1917, 310 armed British merchant ships were attacked by submarines. Of these, 236 escaped, 62 were sunk without warning by torpedo attack, and only 12 were sunk as the result of gun fire. During the same period, 302 unarmed vessels were attacked; 67 escaped, 30 were sunk by torpedo attack without warning, and 205 were sunk by shell fire or by bombs. These figures indicated the importance of arming merchant ships; as, after sighting a merchantman carrying guns an enemy submarine would not, in the majority of cases, run the risk of trying shell fire and must, therefore, submerge and endeavour to carry out its attack by torpedo. The latter, however, was a capricious weapon; and a submarine, which carried shells sufficient to sink a hundred merchantmen, had at its disposal a maximum of 12 torpedoes to last for the entire cruise.

The convoy system adopted at the end of the last war was another highly-effective means of combating the submarine menace. Admiral Lord Jellicoe, in the book already quoted, stated that the convoy system enabled 1,037,116 men to be conveyed across the Atlantic, between January 1 and November 30, 1918, the total loss of life amounting to 637, or 0.061 per cent. With the introduction of satisfactory defence measures, the losses of enemy submarines were high. The Germans lost 63 submarines in 1917 and 69 in 1918, or about a third of the average number of vessels in service during each year. These results were due to the mine barrages in the North Sea and in the Straits of Dover, and also to the action of patrol vessels of all types, including destroyers, trawlers and armed yachts.

To combat 170 German submarines in 1917, the Allies had at their disposal 270 destroyers and upwards of 800 trawlers; against the 52 German submarines now in service, their situation regarding patrol vessels was, in proportion, much superior. Moreover, aircraft patrols would be far more effective in combating the submarine menace than was the case 20 years ago. Hence, it appeared that the German submarine methods of warfare were bound to fail, even if partial successes, such as the sinking of H.M.S. Courageous, were sometimes secured. The submarine menace, however, should not be under-estimated, nor, on the other hand, should it be over-exaggerated. At the present time, the German Navy did not possess sufficient vessels to conduct an unrestricted submarine campaign. The enemy could, however, construct these vessels fairly rapidly, hence it was absolutely imperative that measures for the protection of mercantile fleets, similar to those so successfuly utilized in 1917, should be adopted without delay.

* Commander de Fussy quoted *Le Péril Sous-Marin;* presumably he referred to *The Crisis of the Naval War.*

COMPULSORY APPRENTICESHIP IN FRANCE

***The Engineer*, November 24, 1939**

In May, 1938, a decree was published instituting a system of compulsory apprenticeship which was to come into operation on January 1st, 1940. A pre-apprenticeship period begins at schools where it is proposed to extend the leaving age by a year, during which time boys will be given opportunities for showing their predilection and aptitude for particular trades by working in shops. They will then be apprenticed to those trades unless parents should give reasons for desiring that their boys should follow other occupations. Employers are required to train a number of apprentices representing a certain percentage of the total number of the personnel employed, or else they can organize the training collectively in professional schools or in other ways. The training comprises a minimum number of hours for technical instruction. All this entails a vast organization all over the country which already exists in its main lines and was not entirely completed on the outbreak of war. Skilled workers are now needed in the metallurgical and engineering trades more than ever before. It is not possible to put the compulsory apprenticeship law into operation at the beginning of next year, so far as concerns the pre-apprenticeship organization, but employers in the engineering trades must arrange for the training of the required percentage of apprentices either in their own works or collectively from the first of January next. This temporary arrangement during the war also includes the training of specialized women workers.

FIFTY-FOURTH ANNUAL GENERAL

TORONTO - ROY

Thursday and Friday

A. E. BERRY,
General Chairman and Chairman of the Hotel Arrangements Committee

PROGRAMME

THURSDAY, February 8th

10.00 a.m.—Annual Meeting.

12.30 p.m.—Luncheon.

2.30 p.m.—Technical Session.

4.00 p.m.—Address of Retiring President.

7.30 p.m.—Banquet.

10.30 p.m. to 2.00 a.m.—Dance.

FRIDAY, February 9th

9.30 a.m.—Technical Session.

12.30 p.m.—Luncheon.

2.30 p.m.—Technical Session.

Evening—Free for social gatherings privately arranged.

Dr. F. Cyril James, Principal of McGill University, will be the guest speaker at the banquet on Thursday night.

O. HOLDEN,
Chairman of the Luncheons, Dinner & Entertainment Committee

A. ROSS ROBERTSON,
Chairman of the Finance Committee

W. E. BONN,
Chairman of the Reception Committee

Special return tickets will be supplied by the railways at the rate of one and a third of the regular one-

AND PROFESSIONAL MEETING

AL YORK HOTEL

February 8 and 9, 1940

PAPERS

The Economic Front by G. A. Gaherty, M.E.I.C.

Soil Mechanics at the Shand Dam by A. W. F. McQueen, M.E.I.C. and R. C. McMordie, A.M.E.I.C.

Practicable Forms for Flight Test Reporting by Elizabeth MacGill, A.M.E.I.C.

Highway Control and Safety by Angus D. Campbell, M.E.I.C.

Limit Design by C. M. Goodrich, M.E.I.C.

The Present Status of Grounding Practice with Particular Reference to Protection Against Shock by W. P. Dobson, M.E.I.C.

Developments in Alloys During the Last Twenty Years by O. W. Ellis.

C. R. YOUNG,
Chairman of the Papers & Meetings Committee

D. D. WHITSON,
Chairman of the Publicity Committee

SPECIAL EVENTS FOR LADIES

Under the convenorship of Mrs. A. E. Berry and Mrs. J. J. Spence

Thursday, a.m.—Registration.

" p.m.—Afternoon Tea—Library, Royal York Hotel.

Friday, a.m.—Tour of T. Eaton Company, Limited, Departmental Store.

" noon—Luncheon, Georgian Room at Eaton's.

" p.m.—Theatre Party.

F. H. C. SEFTON,
Chairman of the Registration & Information Committee

way fare. Necessary certificates will be mailed shortly along with a programme of the entire meeting.

Editorial Comment...

CO-OPERATION IN NOVA SCOTIA

It will be good news to members of the Institute to know that the proposed cooperative agreement with the Association of Professional Engineers of Nova Scotia has met with the approval of the qualified voters, both of the Institute and of the Association. The agreement itself was published in the December Journal, and the result of the Institute ballot appears elsewhere in this issue.

When a similar agreement was reached with Saskatchewan, it was said that it was "the first firm step toward full co-operation between engineering bodies in Canada." Thus this becomes the second "firm step" toward that worthy objective. It seems only right that an early agreement should have been reached with Nova Scotia, because it was one of the provinces that long ago discussed the subject seriously with the Institute. In 1934 a provincial plan was underway and had made considerable progress before it was set to one side to await the outcome of the activities of the Consolidation Committee.

Within the last two years many engineers have worked long and seriously over this agreement. They have seen it approved by all committees only to be upset by legal complications. They have gone on again with a determination that would not be beaten, to finally complete a document that has met approval from all sides. It must be gratifying to them to see their work finally crowned with success, and comforting to know that they have had a hand in bringing about such an advance in the affairs of the profession within their province.

The chairman of the Committee on Professional Interests reports that negotiations are underway in other provinces as well. Local committees are discussing the matter and doubtless will communicate with the Council committee when some satisfactory basis has been decided upon among themselves. Such negotiations are a hopeful sign for they indicate that the advantages of cooperation between engineering societies are appreciated, and are not considered as an ideal beyond the reach of the profession. With Nova Scotia now joining Saskatchewan in this forward movement, it is definite that real progress is being made.

"GOOD APPOINTMENT"

Under the above heading the *Lethbridge Herald* makes editorial comment in the appointment of P. M. Sauder, M.E.I.C., vice-president of the Institute, to the position of Director of Water Resources for Alberta. The editorial goes on to say:

> "Mr. Sauder has been connected with irrigation and water development in Alberta for most of his engineering career, and we doubt if there is any man better qualified to step into the shoes of L. C. Charlesworth, who recently vacated the post on superannuation. . . . . He has seen the Lethbridge Northern project grow from a dustbed where 75,000 acres of wheat blew out of the ground in June, 1920, to a garden spot where close to 1,000 farm families have an assured and comfortable living."

The announcement will be well received by members of the Institute, particularly those in the West who are more familiar with the excellent work which has been done by Mr. Sauder on irrigation in southern Alberta. The words of praise and commendation appearing in all the western papers are no more than is due him.

MODERN HISTORY

Newspapers have recently given publicity to an event which is of unusual interest to members of the Institute, but only within a few days of this writing have full details been released. The culmination of a short six months of steady effort was the first flight of the new Maple Leaf Trainer II at Fort William on October 31, which had been designed by Elizabeth MacGill, A.M.E.I.C., chief aeronautical engineer of one of Canada's leading manufacturers. The plane was also built under her supervision and the first flight was made with her at the instruments. This appears to be aviation history in the making.

The "ship" has met and exceeded generous expectations. It is believed to have reached new levels of performance for its class, and to have brought general satisfaction to all who have been associated with it. It is designed as a primary training machine and beyond a doubt readily fulfills all the requirements.

Company officials explain that from the day Miss MacGill began the design until the first flight was made, exactly six months elapsed. This is a splendid achievement and reflects great credit on the engineering organization and on the shops as well. It appears that the men in the plant took an unusual interest in this machine, and by intensive effort were able to rush it to completion in spite of a heavy production schedule on other contracts.

Miss MacGill is a graduate of Toronto in electrical engineering and insists she is a "School man." She took her master's degree at Michigan and had done additional study in aeronautics at Massachusetts Institute of Technology.

She will deliver a paper at the Annual Meeting of the Institute at Toronto in February, which no doubt will prove to be an outstanding feature of the programme. A photograph and a description of the plane with some performance figures appear on the opposite page.

PAST PRESIDENTS' PRIZE

The committee, under the chairmanship of Professor R. DeL. French, has selected the topic for the 1939-1940 competition for this prize from the subjects suggested by the various branches. The topic, "Engineering in National Defence," seems to be the one most appropriate to the time, and most frequently referred to under various headings in branch recommendations.

By way of a guide as to what the committee has in mind, the following suggestions are made: the subject is intended to cover the work of the civilian engineer, although it is not intended to debar the military engineer from the competition. For example, a civil engineer might write upon transportation under war conditions, on the construction and maintenance of air training centres, barracks, dockyards, etc. The mechanical engineer might write on the production of munitions, shipbuilding, aircraft construction, etc. The electrical engineer might deal with the additional demands on power and communication systems due to wartime activities, special electrical devices such as searchlights used on active service, etc. The mining engineer might produce a survey of the mining industry and the changes which take place in it under wartime economy.

Recently the number of papers submitted for this competition has been discouragingly small. Subjects selected from year to year have varied from the technical to the general in an endeavour to find something that would appeal to the greatest number, but success has not crowned the efforts. Last year not one paper was submitted, and yet the subject was thought to be of a sufficiently general nature to touch the work and interest of many members. The prize is one hundred dollars in cash which of itself should attract attention and justify an effort from several sources. The competition closes June 30th, 1940. The committee hopes that better results will be obtained this year.

CORRESPONDENCE

L. AUSTIN WRIGHT, GENERAL SECRETARY,
E.I.C., 2050 MANSFIELD STREET, MONTREAL.

Dear Sir:

I trust you will forgive me the long delay in answering your last letter, but my change of residence, the new duties I have assumed, the war and future events which it is too early to mention yet, have prevented me from doing so.

The conditions under which I write to you tonight arevery different from those of a few months ago. The most apparent differences of course, are physical: windows blacked-out, streets unlit, gardens dug up, a big mound at the end of it, concealing our "Anderson" shelter; people about with gas-masks slung across the shoulder, uniforms, etc. But there is abroad a changed atmosphere, that of a determination, of the resoluteness of a made-up mind, the satisfaction of knowing where we stand. Conversations are pungent with it, and its aroma penetrates even the most trivial every-day act. It is a very heartening feeling, that of knowing a people awakened from its "laisser-faire" and it is the most catching disease. Nobody can help being proud of Britain and France, and you can believe me, there are no flags waving about.

Everybody does his bit. In our profession, where it is forbidden to volunteer, production is increased through longer hours and increased individual efficiency. I have accepted the direction of two large boiler contracts, and expect a third soon. One of these boilers is the first of the reheater type to be built by the company. It is also the largest output and highest pressure attempted; 300,000 lb. per hr. at 1500 lb. per sq. in. The work involved is most interesting, consisting in the design of the details of fabrication and in the supervision of a couple dozen men. The experience certainly repays for the increased responsibility.

I have also assumed the duties of a gas warden at the works, attending lectures, rehearsals, etc., and am now proud to advertise myself as qualified ARP worker. These duties involve evenings and week-ends on guard on the company's premises and consequently a scantier family life.

Please accept my good wishes. Sincerely yours,

November 10, 1939. (Sgd.) GERALD MARTIN, Jr.E.I.C.

HOSPITALITY IN HOUSTON, TEXAS

An excellent example of fraternalism among engineers is shown in the following letter. If any members visit Houston it is hoped they will call at the Club and extend greetings from the Institute.

L. Austin Wright, General Secretary,
E.I.C., 2050 Mansfield Street, Montreal, Que.

Dear Sir,

The Houston Engineers' Club extends an invitation to the members of The Engineering Institute of Canada to make use of its Club quarters and facilities located at 2615 Fannin Street, Houston, Texas, and to participate in the luncheon meetings held on alternate Tuesdays at the Rice Hotel.

The Club was organized in 1918. Its membership was increased from 75 to approximately 700 within the period of eight months ending June 1, 1939.

Quarters for the Club consist of a lounge and recreation room, refreshment bar, library and reading room. A full time secretary is in charge of the facilities which include limited office space for engineer members of the Club, and equipment for handling preparation and mailing of letters and notices for the Club and other technical organizations.

The Club is making its quarters available for meetings of local engineering and scientific groups; and local sections of the national societies will be invited to make the Club their official headquarters. Club activities stress co-operative effort between all branches of the profession and active participation of the engineer in civic affairs. A placement service is in process of organization.

We will appreciate advance information concerning prospective visits to Houston of distinguished engineers so that proper recognition may be accorded by local engineers, the press, and public generally.

Our Club quarters are open every day in the year, and properly identified visiting engineers will be made welcome in true Southern style.

Yours very truly,

(Signed) Charles H. Topping,
November 1, 1939. Secretary-Treasurer.

THE MAPLE LEAF TRAINER II

The Maple Leaf Trainer II, an ab-initio or primary trainer, was designed and built by Canadian Car & Foundry Company, Limited, at their Fort William plant.

The aircraft is a two-seater, open cockpit, single engined biplane, fully aerobatic in accordance with British Air Ministry specifications—A.P. 1208.

The Maple Leaf Trainer II at Fort William, Ont.

A few of the many excellent features of this aircraft from a training point of view are its excellent visibility on the ground and in the air, its stability and controllability at take-off and on landing. The take-off run is exceptionally short and the initial rate of climb excellent. The stalling speed is low—45 m.p.h. with a gross load of 1,865 lbs.—and the machine has no tendency to spin from the stall.

Specifications

Span	32 ft.
Length	22 ft. 11 in.
Engine	Warner Super Scarab 145 h.p. at sea level.
Gas Capacity	Main tank, 25½ Imp. Gals. (30½ U.S. Gals.). Reserve tank, 5 Imp. Gals. (6 U.S. Gals.).
Oil Capacity	2½ Imp. Gals. (3 U.S. Gals.).
Weight (Empty)	1,278 lb. (with metal propeller).
Weight (Gross)	1,865 lb.
Speed (Maximum)	120 m.p.h.
Speed (Cruising)	101 m.p.h.
Climb	At sea level at 1,865 lb. gross weight 840 ft. per minute.
Stalling Speed	45 m.p.h. (1,865 lb. gross weight).
Service Ceiling	14,400 ft.
Absolute Ceiling	16,600 ft.
Range at Cruising Speed	346 miles.

Performance figures obtained with 6.9 ft. metal propeller and relate to landplane (wheels) only. The aircraft can be fitted with either metal or wooden propeller.

MEETINGS OF COUNCIL

A meeting of the Council of the Institute was held at Headquarters on Saturday, November 25th, 1939, at nine-thirty a.m., with Vice-President H. O. Keay in the chair, and thirteen other members of Council present.

Mr. Larivière reported that in accordance with Council's instructions his committee had been investigating the question of allowing engineers to make income tax deductions for expenses and depreciation on their cars. The committee had learned from the Commissioner of Income Tax that the whole question of such exemptions was at present under revision, and that he would be glad to receive any suggestions from the Institute. After discussion, it was resolved that Mr. Larivière be empowered to act on behalf of his committee and submit recommendations as requested by the Commissioner.

A report was submitted by Professor French, as chairman of the Past-Presidents' Prize Committee, in which a number of suggestions were made as to the desirability of changes in the present rules for the Past-Presidents' Prize. After considerable discussion it was decided that a further effort should be made to secure papers under the present rules before adopting alternative proposals. Council's thanks were accorded to Professor French and his committee in recognition of the large amount of work involved in the report presented.

In presenting the monthly financial statement, which was satisfactory, the chairman of the Finance Committee drew attention to the beneficial results arising from the continuance of visits by the President and the General Secretary to the branches of the Institute throughout Canada. Mr. Newell was of opinion that such visits did much to promote the well-being of the Institute.

Five resignations were accepted; one reinstatement was effected; two Life Memberships were granted, and a number of special cases were dealt with.

Council noted a resolution from the Edmonton Branch expressing appreciation of the General Secretary's visits to the western branches.

A tentative programme for the forthcoming annual meeting was submitted by the Toronto Branch, providing for a two-day meeting on February 8th and 9th. This draft programme was approved.

Council considered and approved the proposed amendments to the by-laws put forward by the Ontario branches, and also accepted for submission to the annual meeting amendments drafted by a committee in compliance with the directions of the annual meeting to propose the elimination of the class of Associate Member.

Vice-President Dunsmore expressed the appreciation of the Maritime branches for Council's support in the Maritime Professional Meeting at Pictou in September last.

In response to a request from Dr. Tory, the head of the Technical Section of the Voluntary Registration Bureau, it was resolved that Mr. W. H. Munro be nominated as the Institute's representative on the Advisory Committee of that Bureau.

Council noted and approved of a resolution which had been adopted at a joint meeting of the Association of Professional Engineers of Alberta and the Lethbridge Branch of the Institute stressing the need of water conservation in the southern portion of the province of Alberta, and recommending to the Provincial Government of Alberta and the Dominion Government, the immediate consideration of this question.

Mr. Findlay reported that following the example of the Toronto Branch, the Montreal Branch had held a Student Night, at which four papers had been presented by university students. This was noted with approval.

A number of applications were considered and the following elections and transfers were effected:

ELECTIONS

Member	1
Associate Member	1
Juniors	3
Affiliates	3
Students admitted	57

TRANSFERS

Junior to Associate Member	5
Student to Associate Member	1
Student to Junior	5

The Council rose at one forty-five p.m.

A meeting of the Council of the Institute was held at Headquarters on Saturday, December 16, 1939, at nine thirty a.m., with Vice-President E. V. Buchanan in the chair, and six other members of Council present.

After considering the subjects suggested by the various branch executive committees, the Past-Presidents' Prize Committee recommended that the subject for the year 1939-1940 should be "Engineering in National Defence." This recommendation was approved, with the suggestion that the committee add to the title a description of the field intended to be covered.

The Secretary reported that Mr. Gaherty had now received a reply to the personal letter which he had written to the Hon. Mr. Howe asking for an expression of opinion as to whether or not the Institute could do anything towards assisting in the solution of the industrial problems now before the country. Mr. Howe's reply indicated that at the present time there was nothing that the Institute could do. He pointed out that the situation could change very quickly, and he thought that possibly in the spring the Government would welcome the formation of a committee as suggested by the Institute.

Discussion took place on the recommendation of the Finance Committee that conditions should now be defined under which remission of Institute fees would be granted to members joining the Canadian Forces. Accordingly, it was resolved that a small committee be appointed to study this question and report to Council.

Discussion took place on possible arrangements for a meeting of the Committee on the Training and Welfare of the Young Engineer, after which it was decided that, if possible, a meeting of this committee should be held in Toronto in February at the time of the annual general meeting.

Council approved the action of the Institute's Committee on Professional Interests in complying with the request of the Nova Scotia Association of Professional Engineers to send out the Institute's ballots on the proposed agreement at the same time as those of the Association. Council also appointed the scrutineers to open the ballots and report the results. Seven resignations were accepted: one Life Membership was granted; a number of special cases were considered, and the names of five Members, ten Associate Members, three Juniors, and seven Students, in arrears for three years, from whom no response to various communications had been received, were removed from the membership list.

A number of applications were considered and the following elections and transfers were effected.

ELECTIONS

Members	2
Associate Members	7
Juniors	4
Affiliate	1
Students admitted	6

TRANSFERS

Junior to Associate Member	1
Student to Associate Member	1
Student to Junior	2

The Council rose at twelve o'clock noon.

BALLOT ON THE NOVA SCOTIA AGREEMENT

The scrutineers appointed to canvass the ballots on the revised proposed agreement between the Institute and the Association of Professional Engineers of Nova Scotia, have reported as follows:

Ballot of Members of Council

Total ballots received		32
Valid ballots	30	
Invalid ballots	2	
Votes approving agreement		30

Ballot of Corporate Members in Nova Scotia

Total ballots received		72
Valid ballots	69	
Invalid ballots	3	
Votes approving agreement		66
Contrary votes		3

(Signed) HUET MASSUE, M.E.I.C.
E. A. RYAN, M.E.I.C.
JOHN G. HALL, M.E.I.C.

ELECTIONS AND TRANSFERS

At the meeting of Council held on December 16th, 1939, the following elections and transfers were effected:

Members

Circé, Armand, B.A.Sc., C.E., (Ecole Polytechnique), Dean, Ecole Polytechnique, 1430 St. Denis St., Montreal, Que.

Stairs, James Alfred, (Grad. R.M.C.), "Plasco" Regd., 389 St. Paul St. West, Montreal, Que.

Associate Members

Augustine, William Percival, B.A.Sc. (Univ. of Toronto), instructor of mechanical drafting, Windsor Walkerville Vocational School, Windsor, Ont.

Charnley, James (City & Guilds of London), engr., Shawinigan Engineering Company Ltd., Montreal, Que.

Coté, Eugène, engr., Shawinigan Water & Power Company, Ltd., Montreal, Que.

Dowler, John B., B.A.Sc. (Univ. of Toronto), ap'tice supervisor, apprentice school, Ford Motor Company of Canada, Windsor, Ont.

Jones, Ernest Harold (Heriot-Watt College), res. engr., Dept. of Highways of Ontario, North Bay, Ont.

Weaver, Ralph Crowell, B.S.(Mech.), (Tufts College), res. engr., Consumers Cordage Co., Dartmouth, N.S.

Yong, Mark, B.S.E. (C.E.), M.S., (Univ. of Mich.), 383 Princess St., Kingston, Ont.

Juniors

Henry, Doward Alexander, B.A.Sc. (Univ. of Toronto), dftsman., Massey Harris Co. Ltd., Toronto, Ont.

Ronson, James Kenneth, B.A.Sc. (Univ. of Toronto), engrg. dept., Ford Motor Company of Canada, Windsor, Ont.

Wilson, Harold Oliver, B.Sc. (Queen's Univ.), dftsman., Shawinigan Engineering Company Ltd., Montreal, Que.

Wotherspoon, Richard Bradbury, (Grad. R.M.C.), plant engr., Steel Company of Canada Ltd., Gananoque, Ont.

Affiliate

Ashton, Ernest, cost clerk, C.N.R., Winnipeg, Man.

Transferred from the class of Junior to that of Associate Member

D'Aoust, Joseph Gilbert, B.A.Sc. (Univ. of B.C.), junior engr., Powell River Co. Ltd., Powell River, B.C.

Transferred from the class of Student to that of Associate Member

McCabe, Russell I., B.Sc. (McGill Univ.), chief of studies dept., telephone divn., Northern Electric Co. Ltd., Montreal, Que.

Transferred from the class of Student to that of Junior

Craster, James Edmund, B.A.Sc. (Univ. of B.C.), junior dftsman., Cons. Mining & Smelting Co., Trail, B.C.

King, Hector Irons, B.Sc. (Univ. of N.B.), asst. purchasing agent, Bathurst Power & Paper Co. Ltd., Bathurst, N.B.

Students Admitted

Dodd, Geoffrey Johnstone, Jr. (McGill Univ.), 209 Carlyle Ave., Town of Mount Royal, Que.

Hunt, Frederick A. (Queen's Univ.), 331 Earl St., Kingston, Ont.

Main, Hardy Lawrence (Queen's Univ.), "Rosel," Dundas, Ont.

Morris, Ronald William (Univ. of Man.), 20 Lipton St., Winnipeg, Man.

Rowan, Russell Gillespie (Queen's Univ.), 318 University Ave., Kingston, Ont.

Simpson, C. Norman (Queen's Univ.), 313 University Ave., Kingston, Ont.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Sylvio Antoine Desmeules, A.M.E.I.C., died in the hospital at Quebec, on October 12th. He was born at Murray Bay, Que., on March 14th, 1878. He received his early education at the local public schools and from 1893 up to 1900 he was with his father, a land surveyor, in the North West Territories on surveys and on the St. Lawrence River doing hydrographic studies. For some years later, he was engaged in railway engineering on location and construction work. From 1916 to 1929 he was connected with the construction of various projects of hydro-electric developments. For the past ten years he had been doing some survey work and wharf construction. Latterly he was town manager for St. Joseph d'Alma, Que.

Mr. Desmeules joined the Canadian Society of Civil Engineers as a Student in 1905 being transferred to Associate Member in 1909.

William Stewart Drewry, A.M.E.I.C., died in the hospital at Victoria, B.C., on December 2nd. He was born at Belleville, Ont., on January 20th, 1859, and received his primary education at Oswego, N.Y. In his early years, he was engaged on surveys and civil engineering projects. After a few years spent on railway construction, he became associated with T. O. Boger of Belleville in a private engineering practice. Mr. Drewry went West in 1891 when he was sent out by the Dominion Government to the Kootenay Lake district, where he introduced into British Columbia the system of map surveying by the use of photographs. About ten years later, he was in partnership with H. T. Twigg of Victoria, in New Denver, B.C., where they had an extensive mineral claim and mine-surveying practice. Afterwards, Mr. Drewry practised as surveyor and engineer in Nelson, B.C. Some time later he was controller of water rights for the British Columbia government and also acted for a period as inspector of surveys. In recent years, he had been in bad health.

Mr. Drewry joined the Canadian Society of Civil Engineers in 1887. He had been made a life Member of the Institute in 1918.

Arthur Edward Hodgins, M.E.I.C., died at Victoria, B.C., on December 18th, 1939. He was born at Toronto on April 15th, 1861, and was educated at the Royal Military College, Kingston, where he was graduated in 1882. At the time of his death, he was one of the oldest surviving graduates of the College. Upon graduation he joined the staff of the Canadian Pacific Railway and stayed with that firm in various capacities until 1892, when he went to Nelson, B.C., as Public Works engineer. When the Boer War started, he was engaged in private practice at Nelson, B.C., and became commanding officer of the Rocky Mountain Rangers from that West Kootenay city which joined the Royal Canadian Regiment for service in South Africa in the first contingent. He saw action at Paardeberg and Bloemfontein and rose to the rank of Major, later becoming officer in charge of construction of military railways in the Transvaal and Orange Free State. Returning to Canada after the campaign he joined the construction staff of the old Grand Trunk Pacific Railway, retiring in 1909. In 1915 he organized and recruited the First Canadian Pioneer Battalion, First Division, and was assistant director of light military railways after going to France. He was invalided home after 14 months of service.

Mr. Hodgins joined the Canadian Society of Civil Engineers in 1887 as an Associate Member and was transferred to Member in 1904. He was made a Life Member of the Institute in 1929.

Honourable C. D. Howe, M.E.I.C., Minister of Transport in the federal cabinet, has been given jurisdiction over the War Supply Board, which was previously under the Minister of Finance. This is a tribute to a prominent engineer, new to politics when he was elected in 1935 and who has handled heavy organizing tasks in the past four years, outstanding among them being the establishment of the Trans-Canada Air Lines and creation of the National Harbours Board.

R. A. C. Henry, M.E.I.C., vice-president of the Montreal Light, Heat and Power Consolidated, has been appointed executive assistant to the Minister of Transport at Ottawa to help in the war effort. Mr. Henry had been connected with the Department of Railways and Canals and with the Canadian National Railways in various capacities until 1930 when he became vice-president and general manager of the Beauharnois Light, Heat and Power Company. His work has made him familiar with transportation problems and he is recognized as an authority in the matter.

Lesslie R. Thomson, M.E.I.C., has been appointed as assistant to R. A. C. Henry, M.E.I.C., in the Department of Transport. Mr. Thomson has been a constant student of Canada's great economic problems and he has made many contributions to the technical literature among which are: "The St. Lawrence Problem," and "The Canadian Railway Problem."

G. H. Duggan, Hon.M.E.I.C., chairman of the board of directors of the Dominion Bridge Company Limited and a past president of the Institute, was made an honorary life member of the Canadian Engineering Standards Association, at an executive meeting held at Montreal last month. One such membership is bestowed each year and the honour was conferred on Mr. Duggan in recognition of his long service in the Association.

Professor E. A. Allcut, M.Sc., M.E.I.C., professor of mechanical engineering at the University of Toronto, has been elected a Fellow of the Royal Aeronautical Society, with which is incorporated the Institute of Aeronautical Engineers. There are only four Fellows of the Society in Canada.

Past-President Vaughan receives Honorary Membership in A.S.M.E. from President A. G. Christie. With him is Roy V. Wright, who read the citation.

Past-President H. H. Vaughan, M.E.I.C., was honoured on December 6th at Philadelphia when the American Society of Mechanical Engineers conferred an Honorary Membership upon him at the time of their Annual Meeting. Mr. Vaughan was Vice-President of the Society in 1910 and 1923, and is now one of the few living Honorary Members.

H. I. King, S.E.I.C., has accepted a position as civil engineer with the Saguenay Power Company at Arvida, Que. Since graduation in civil engineering from the University of New Brunswick in 1937, he had been in the purchasing department of the Bathurst Power and Paper Company Limited, at Bathurst, N.B.

P. M. Sauder, M.E.I.C., has recently been appointed Director of Water Resources for Alberta, succeeding L. C. Charlesworth, M.E.I.C., who has retired. He also becomes a member of the Provincial Irrigation Council.

In 1904 Mr. Sauder graduated from Toronto University with a diploma in mechanical and electrical engineering.

In 1904 he joined the staff of the irrigation branch of the Dominion department of the Interior. In 1904 and 1905 he acted as draftsman in the Regina office; 1905-06, as assistant engineer on contour survey in southern Alberta; 1906-09, as inspection engineer; 1909-20, as chief hydrometric engineer in charge of hydrometric surveys of Alberta and Saskatchewan and also acting commissioner of irrigation during the temporary absences of the commissioner.

P. M. Sauder, M.E.I.C.

In 1920 he joined the staff of the Lethbridge Northern Irrigation District, serving for three years as division engineer in charge of location, design and construction of the works in the eastern portion of the project. Later he was assistant project manager in charge of maintenance and repairs of the works. From 1924 until the present he has acted as project manager and district engineer in full charge of the operation and maintenance of the works of the project.

He received a commission as a Dominion Land Surveyor in 1916 and passed an examination for Alberta Land Surveyor in 1917.

Mr. Sauder joined the Institute in 1908 and has occupied the positions of branch chairman, councillor and vice-president. He has been president of the Association of Professional Engineers of Alberta, and is now the representative of that organization on the Dominion Council of Professional Engineers.

He also represents the Association in the Senate of the University of Alberta. It is expected that he will move to Edmonton shortly.

Major G. S. Brown, A.M.E.I.C., a veteran of the First Great War, is officer commanding the 112th Field Battery, R.C.A., Lethbridge.

George Sandles Brown was born in Woodmancote, Sussex, England, on March 12, 1892. He was educated at Brighton, England, where he studied engineering. Coming to Canada in 1910 he joined the service of the C.P.R., working on railway construction in Alberta and British Columbia from

1911 to 1914. He enlisted with the Alberta University Company of 196th Battalion, Canadian Expeditionary Force, and served in France with the Canadian Engineers and railway troops from 1916-1918.

Returning to Canada, in 1919 and 1920 he was engaged in construction of the Taber Irrigation District and upon completion was transferred to the Lethbridge district as assistant engineer to S. G. Porter, superintendent of operation and maintenance of the C.P.R. irrigation system. From 1930 until the present he has been canal superintendent of the system.

He was chairman of the Lethbridge branch of the Institute during the year 1928. He acted as councillor during 1929, 1936 and 1937. He has also been an active member of the Professional Engineers of Alberta and is now a councillor of that body. He joined the Institute in 1910.

L. C. Charlesworth, M.E.I.C., of Edmonton, has retired from his position of chairman of the Irrigation Council of the Province of Alberta and is now manager of the Eastern Irrigation District. A graduate of the School of Practical Science of Toronto in 1893 he practised in Ontario until 1903 when he became district engineer for the government of North West Territories, with headquarters at Medicine Hat, Alta. In 1905 he was appointed director of surveys for the Government of Alberta and a year later acting deputy minister and chief engineer of Public Works, a position which he retained until 1915 when he was made deputy minister and chief engineer of the Department. In 1922, he took over the office of chairman of the Irrigation Council of Alberta, from which he just retired. He has been replaced by **P. M. Sauder,** M.E.I.C.

C. W. Ryan, A.M.E.I.C., along with Mrs. Ryan and their daughter, flew up from New York to Montreal, on November 3rd last, to spend the week-end with **M. W. Maxwell,** A.M.E.I.C., Commissioner of Development and Natural Resources for the Canadian National Railways, and to see the McGill-Queen's football game. Since graduation from McGill University in 1916, Mr. Ryan has been engaged on construction work with various firms in New York. He is now president of the Ryan Contracting Corporation of New York. This firm has built thirty-five structures at the New York World's Fair, 1939, among which are those of the Radio Corporation of America, the State of Virginia, Pullman, Coca Cola, Heineken's Aan De Zuiderzee and the Taffenetti's Restaurant.

M. Jacobs, M.E.I.C., has relinquished his position as chief engineer of the Brown Company at Berlin, N.H., to join Chas. T. Main, Inc., consulting engineers, Boston, Mass., and take charge of a department in pulp and paper mill engineering. He is a graduate in civil engineering of Norwich University, Northfield, Vt., from the class of 1912. Upon graduation, he entered the pulp and paper field as a draughtsman with Burgess Sulphite Fibre Co., Berlin, N.H. In 1916, he went with H. P. Cummings Construction Company, Ware, Mass., as construction engineer on pulp and paper mill extensions and hydro-electric developments. He retained this connection until 1920, except for a period of ten months in 1918 when he was a lieutenant in the United States Army. After a few years as designing engineer on pulp and paper developments with Management Engineering and Development Company, Dayton, Ohio, Mr. Jacobs came to Montreal in 1924 as manager and chief designing engineer with H. S. Taylor, consulting engineer. In this capacity he was associated with all the major developments in the pulp and paper industry in this country, until 1935 when he became chief engineer of the Brown Company at Berlin, N.H.

Richard Thorn, Jr.E.I.C., has recently joined T. Pringle & Son, consulting engineers of Montreal. Educated at Gresham College, England, he served a four year apprenticeship with Marshall & Sons & Company Limited of Gainsboro until 1929 when he came to Canada as a mechanical draughtsman with Canadian Vickers Limited. He was later connected in the same capacity with various firms in Montreal, including E. A. Ryan, consulting engineer, Canadian Industries Limited, McDougall and Friedman, consulting engineers and W. J. Armstrong, consulting engineer.

Norman A. Eager, A.M.E.I.C., has been appointed recently assistant sales manager with the Burlington Steel Company, Limited, Hamilton, Ont. He received his education at McGill University where he obtained the degree of B.Sc. in 1922. He went to Cornell University and he was graduated in 1923 with the degree of M.C.E. Upon graduation he went with the Illinois State Highways as resident engineer and a year later he was with the Canadian Vickers Limited in Montreal. He then became superintendent of construction with Church & Ross Company, contractors of Montreal. In 1926 he joined the Shawinigan Water & Power Company and had been engaged since in structural and development engineering and power sales research work.

F. M. Schwieder, S.E.I.C., has accepted a position in the designing department of the International Harvester Company at Hamilton, Ont. Since graduation, in mechanical engineering from the University of Saskatchewan last spring, he had been employed with the W. C. Woods Company in Toronto.

L. C. Carey, Jr., S.E.I.C., is now in the transmission department of the Hydro-Electric Power Commission of Ontario, at Toronto. A graduate in civil engineering from the Nova Scotia Technical College in the spring of last year, he had been employed for the past months by the Canadian Inspection and Testing Company Limited of Toronto.

E. F. Brown, S.E.I.C., has resigned from the Dominion Bridge Company Limited, Montreal, to accept a position with the Royal Canadian Mint, at Ottawa.

S. Davis, S.E.I.C., of St. John, N.B., has obtained his M.Sc. degree in civil engineering from the Massachusetts Institute of Technology. He had obtained his B.Sc. degree from the University of New Brunswick in 1938.

I. N. MacKay, S.E.I.C., has accepted a position with the Mechanical Engineering Division of the National Research Council, at Ottawa. A graduate in mechanical engineering of the class of 1935 from McGill, he had been employed since with the Dominion Engineering Works Limited, in Montreal.

C. C. Cuthbertson, S.E.I.C., has recently been transferred from the Metallurgical Laboratory in Toronto to the Alkali Division of Canadian Industries Limited in Shawinigan Falls. His position is now that of works chemist.

VISITORS TO HEADQUARTERS

C. W. Ryan, A.M.E.I.C., President of the Ryan Contracting Corporation, from New York City, on November 4.

Alfred Peterson, Jr.E.I.C., of the Department of Public Works, Rimouski, Que., on December 2.

S. Davis, S.E.I.C., of St. John, N.B., on December 13.

Dean E. P. Fetherstonhaugh, M.E.I.C., of the Faculty of Engineering and Architecture of the University of Manitoba, Winnipeg, Man., on December 15.

Vice-president E. V. Buchanan, M.E.I.C., general manager, Public Utilities Commission, London, Ont.; **E. Viens,** M.E.I.C., director of the Testing Laboratories, Department of Public Works, Ottawa; **E. B. Wardle,** M.E.I.C., chief engineer, Consolidated Paper Corporation Limited, Grand'-Mère, Que., on December 16.

E. P. Muntz, M.E.I.C., of Dundas, Ont., on December 18.

L. P. Cousineau, A.M.E.I.C., of the National Electricity Syndicate, Cadillac, Que., on December 21.

C. J. Mackenzie, M.E.I.C., Acting President of the National Research Council, from Ottawa, on December 22.

Robert J. G. Schofield, S.E.I.C., of the Canadian Cottons, Limited, from Hamilton, Ont., on December 23.

A. C. Davidson, Jr.E.I.C., from Toronto, Ont., on December 27.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

BORDER CITIES BRANCH

G. E. Medlar, a.m.e.i.c. - - *Secretary-Treasurer*
Donald S. B. Waters, s.e.i.c. - *Branch News Editor*

The November meeting of the Border Cities Branch was held in Chatham on November 18, 1939. During the afternoon, from 4 to 6.30 p.m., a large number of members from Windsor joined members from Sarnia and Chatham in an interesting inspection tour of the plant of the Canada and Dominion Sugar Co. in Chatham. Mr. A. W. McIntyre of the same company was in charge of the inspection trip and the members observed in detail the entire process.

Beets are floated in long concrete flumes into the factory, where they pass through a mechanical washer and emerge clean. They are sliced then into square shaped ribbons called cossettes. Water is then passed through a series of cells containing the cossettes, thus soaking out the sugar and gradually increasing in temperature to about 80 deg. C. The spent cossettes are dried in another process and sold as cattle feed. Impurities in the diffusion juice are removed by adding measured quantities of milk of lime and carbon dioxide, causing precipitates which are filtered from the liquid. Sulphur dioxide added, liberates the lime salts and the liquid is then concentrated by a series of low pressure evaporators. After further filtering and sulphur gas treatments, the sugar is boiled, which produces the sugar crystals, the size of which is determined by boiling conditions and the length of time of boiling. This requires the most skillful operators in the process.

The rich brown "stuke" as it is called is gently agitated as it is fed into the centrifugal machines where the sugar crystals are separated and washed. After drying and cooling the crystals are screened and packed for shipment. Each ton of beets produces approximately 260 lb. of sugar, 80 lb. of molasses and 100 lb. of cattle feed.

At this time of the year the plant operates at full capacity, producing about 800,000 lb. of refined beet sugar per day and employing 400 men.

At the conclusion of the tour a dinner was enjoyed in the Wm. Pitt Hotel, where Mr. George McCubbin acted as chairman, assisted by Mr. T. M. S. Kingston. Mr. McIntyre delivered a paper accompanied by lantern slides, dealing with the history of the beet sugar industry.

Pure sugar or sucrose as it is called by chemists, is a compound having the formula $C_{12}H_{22}O_{11}$ and is therefore the same whether extracted from beets, cane or any other of the many vegetables containing it. Although it is a compound of only three common elements, no chemist has ever produced synthetic sugar, he said.

Sugar was unknown to the ancients except in India. Although sugar cane flourished in Arabia, Egypt and Spain, it did not become important until the 14th century. In 1500, the price was $53.00 a hundred in London, and even at the beginning of the 19th century world sugar production was less than one hundred thousand tons. Beet sugar research was stimulated by Napoleon who was prohibiting the import of British goods, including cane sugar. By his edict of 1811, he appropriated one million francs for sugar beet schools. Beets of that time produced 5 per cent sugar, compared with 18 per cent today. By 1912, 50 per cent of the world sugar production was beet sugar. In Canada, the industry began in 1881 in Quebec and has grown to such an extent that today there is a greater demand than the available supply of beets can fulfill.

At the conclusion of his address, Mr. McIntyre answered many questions.

CALGARY BRANCH

F. J. Heuperman, a.m.e.i.c. - *Secretary Treasurer*
G. W. O'Neill, a.m.e.i.c. - - *Branch News Editor*

A general meeting of the Calgary Branch was held on November 2, 1939, at which dinner was served through the kindness of the Canadian Western Natural Gas Company. The purpose of this meeting was primarily to make new members feel at home, particularly the younger members who joined the Branch since last spring.

The meeting was well attended, some 64 members and one guest being present.

Through the courtesy of the Imperial Oil Co., Mr. McRae, the guest of the evening, showed some moving pictures of the visit of the King and Queen to Canada and the United States. This was followed by a talking picture "Safari on wheels" depicting the adventures and tribulations of a motor caravan on its trip through Africa from Algiers to Nairobi.

On November 16th, 1939, a branch general meeting was held in the Palliser Hotel attended by sixty-seven members and guests. At this meeting Mr. D. F. Kobylnyk, one of the younger members of our Branch presented an informative paper on **Electrical Distribution in Alberta.** The lecture was illustrated by slides. He was followed by Mr. H. B. Le Bourveau, who gave a running commentary on colored moving pictures, made by him, during the construction of the steel power line from Ghost Dam to Calgary. The pictures told the entire story from the first preliminary surveys to the completion of the line. A hearty vote of thanks to both speakers was moved by Mr. T. Schulte, which was carried with applause.

Our Branch General Meeting of November 30th, 1939, was addressed by Major F. K. Beach, who spoke on the timely subject **Military Engineering.** Mr. Beach sketched the history of military engineering which, he said, is as old as the armies. It has been a constantly changing profession in the sense that its actual works have changed, but a never changing one in so far that it has always had to invent, adapt and devise new defenses for the army, then invent, adapt and devise new methods of breaking down the defenses. In addition it has always had to look after communications, water supply and housing. He traced the development of engines of war from the bow and arrow to the present day flying fortresses. Peace time training of military engineers, Mr. Beach stated, includes training with the rifle and light automatic rifle; training in foot drill, and training in internal economy to bring about team work. Also training in the use of explosives and in rowing and handling of boats on water.

Some slides showing the construction and use of rafts, and the building of bridges and trenches brought the talk to a close.

Mr. J. J. Hanna moved a hearty vote of thanks to the speaker and after some discussion the meeting adjourned.

EDMONTON BRANCH

B. W. Pitfield, a.m.e.i.c. - - *Secretary-Treasurer*
J. W. Porteous, Jr.e.i.c. - - *Branch News Editor*

At the regular meeting of the Edmonton Branch held at the Macdonald Hotel, on December 5, the members were entertained by a very interesting talk on **The Grand Coulee Dam.** After supper, an intermission and a small amount of business, the chairman, Mr. Garnett, introduced Mr. H. R. Webb of the University of Alberta, who discussed the engineering problems met with in the construction of the Grand Coulee Dam. Mr. Webb first outlined the geological data in connection with the district and then proceeded to describe the construction work on the dam proper and also the equipment used. Mr. Webb has had an opportunity of seeing the dam at several stages in its construction and being a proficient amateur photographer, he illustrated his talk well with photographs.

In conclusion a short time was taken up with the consideration of the economic aspects of the project. A great deal of interest was shown during the discussion and the meeting adjourned at about 10.00 p.m.

HALIFAX BRANCH

L. C. Young, A.M.E.I.C - - *Secretary-Treasurer*
A. G. Mahon, A.M.E.I.C. - - *Branch News Editor*

A reception for the President of the E. I. C. and Mrs. H. W. McKiel was held by the Halifax Branch of the Institute at the Nova Scotian Hotel, Saturday evening, December 9th. Honoured guests for the occasion were the Honourable Angus L. MacDonald, Premier of the Province of Nova Scotia, and his Worship, Mayor Walter Mitchell, of the City of Halifax. Approximately eighty persons attended the function, including members and lady guests.

The reception began with a short interval before dinner when members and guests met the President of the Institute and his wife. Dinner was served at 7.30 with Mr. R. L. Dunsmore presiding. Dean McKiel spoke regarding his tour, in the interest of the Institute, throughout Western Canada to the Pacific Coast. He outlined the activities of the various branches of the E. I. C. and mentioned the healthy conditions of the Institute throughout the Dominion. Dean McKiel then related some of his experiences during the trip.

Following dinner the ladies retired to the lounge and the annual meeting of the Branch was proceeded with. The retiring chairman, Allan D. Nickerson, outlined the activities of the Halifax Branch during the year, making special mention of the effort which his branch has been making to encourage young engineers to become interested in the Institute. The finance report was read by the Secretary, Mr. L. C. Young, and the other business of the meeting was carried out with dispatch. Mr. Charles Scrymgeour was elected chairman for the coming year, with Mr. S. L. Fultz, Mr. P. A. Lovett, Mr. G. F. Bennett, Mr. F. C. Wightman, and Mr. A. B. Blanchard, replacing the retiring members of the executive.

After the meeting the members joined the ladies and the remainder of the evening was given over to a Casino entertainment and dancing. The Casino prizes were presented by Mrs. McKiel and won by Mrs. A. D. Nickerson, Mrs. S. W. Gray, Mr. W. W. Donnie, Mr. G. L. Colpitts, with Mr. W. G. Hamilton receiving the consolation prize.

The members of the Committee who were responsible for this function were Mr. L. C. Young, Mr. S. W. Gray and Mr. A. G. Mahon, assisted by Mr. A. D. Nickerson, Mr. B. H. Zwicker and Mr. Jos. Sears.

HAMILTON BRANCH

A. R. Hannaford, A.M.E.I.C. - *Secretary-Treasurer*
W. E. Brown, Jr.E.I.C. - - - *Branch News Editor*

On December 12, 1939, in the Lecture Theatre at McMaster University, Mr. E. C. Bacot, B.Sc., addressed the Branch on a subject entitled, **Why Fire Occurs in Industry.** Mr. Bacot is resident engineer of the Factory Mutual Fire Insurance Companies, Toronto and Boston. His subject dealt with the general causes of fires and the most suitable methods of preventing fire and of fighting fires. He showed that industrial fires are in proportion to industrial business, losses are higher when production is greatest and there is perhaps less time for giving thought to precautionary measures. Poor maintenance of electrical equipment and wiring caused many fires and, on that account, the speaker stressed the importance of good maintenance in all phases of industrial activity.

Dust explosions in plants could be entirely eliminated by proper cleaning methods, said Mr. Bacot, a strong advocate of the use of vacuum cleaning, as he enumerated several ways in which precautionary steps could be put into practice.

The pictures presented proved that oil and gasoline fires could be extinguished by water when large hose spray nozzles were used and at the same time the hose handlers were protected by a light spray of water much like mist.

The speaker stressed the value of the sprinkler system and the great necessity for its proper maintenance. He said that the advice of the fire underwriters and the local fire departments should be made welcome rather than criticized.

Mr. Bacot was introduced by John R. Dunbar and a vote of thanks was moved by Alec Love.

The usual coffee and sandwiches were served in an adjoining room after the lecture. Attendance was sixty-two.

KINGSTON BRANCH

J. B. Baty - - - - - - *Secretary-Treasurer*
H. W. Harkness, M.E.I.C. - - *Branch News Editor*

At an appropriately arranged dinner meeting, held on the evening of November 22, at the Badminton Club, the Kingston Branch honored Colonel Alexander Macphail, retired Head of Civil Engineering at Queen's University, and welcomed Dean H. W. McKiel, President, and Mr. L. Austin Wright, General Secretary of The Engineering Institute of Canada. The event was well attended by the local members and a large group of Queen's engineering students. The guest list included Dr. W. E. McNeill, Vice-Principal of Queen's University, and Brigadier Kenneth Stuart, Commandant of the Royal Military College. Out-of-town members in attendance were Dr. W. L. Malcolm, Director, School of Civil Engineering, Cornell University, Ithaca, New York, and Mr. H. Alton Wilson of Belleville, Ontario.

Dean McKiel presented the framed certificates signifying the awards of the E.I.C. prizes for 1939 to Mr. Bruce G. McIver, Science student at Queen's University, and Lt. G. C. Baker (in absentia), ex-cadet of the Royal Military College.

Captain G. G. M. Carr-Harris, chairman of the Branch, welcomed the guests and proposed a toast to the engineering profession, introducing President McKiel.

Dean McKiel spoke of the impression which had been left with him after his visit to the twenty-five branches of the Institute. He pointed out that the spirit of unity and national solidarity among the engineers of Canada is very marked, and the ideals and conduct of the members of the engineering profession are beyond reproach.

The President paid a high tribute to Colonel Macphail and referred to his own college days as a student under him. He spoke of the feeling of affection and respect entertained by the large numbers of engineers in Canada who had once studied under "Sandy." In concluding he wished Colonel Macphail long years of happy, contented retirement, but expressed the hope that even in retirement we might continue to hear from him. He suggested that the Kingston Branch might propose that Colonel Macphail's name be placed on the Life Membership List of the Institute.

Professor Ellis proposed the toast to Colonel Macphail. He said that, as a young student, he had stood in awe of "Sandy," in fact the word he used was "terrified." It appears that he has in later years overcome some of this. In a very apt and breezy manner Professor Ellis gave what he called a "worm's eye view" of Colonel Macphail's career at Queen's. He joined the Civil Engineering staff at Queen's about 35 years ago and was one of a group of McGill men who have done a great deal for the Faculty of Science at Queen's. In the early days of the School of Mines, Professor Macphail taught surveying, hydraulics, structural engineering and several other subjects, but despite this load he found time to enter into many other activities such as music, chess, the organization of a rifle team and the formation of the Fifth Field Company in the School of Mining, of which he was O.C. In 1910 he was elected to the Provincial Parliament in Prince Edward Island.

At the outbreak of the last war, he enlisted and went overseas with the First Canadian Division as Captain of the First Field Company. He was rapidly promoted in the field to O.C. of the Field Company and finally to C.R.E. of the First Division. In addition to the D.S.O. awarded for gallant work at Ypres he has the C.M.G. and the Croix de Guerre. During this period of rapid advancement he remained the warm friend of his old students. Professor Ellis recounted many incidents where Colonel Macphail trod ruthlessly over the barriers of rank to fraternize with his old students when he met them in France.

Returning to Queen's after the war he took up his academic duties again. During the lean years he took over the re-organization of the O.T.C. and with his patience and perseverance instilled new life into it. Now again we are reaping the benefits of his efforts in a strong and efficient corps. In later years his interests have been literary and he has acted as editor of the Queen's Quarterly for many years.

His work at Queen's has been characterized especially by the deep affection which has always been felt for him by his own students inspired by his own genuine qualities and his kindness and consideration for them.

Colonel Macphail's reply to the toast was in reminiscent mood. He recalled his first experience with the great inventions which have appeared during his lifetime, treating them in his inimitable manner.

Dr. W. E. McNeill, Vice-Principal of Queen's University, then spoke of Colonel Macphail's contribution to Queen's as being not only that of an engineer but rather the contribution of a man interested in every phase of life and learning. His activity in the University has ranged from lectures to the Theological Faculty upon the English Bible and editorship of the Queen's Quarterly to active service in the militia units connected with the University.

In speaking of his experiences with the forces in France during the Great War, Dr. McNeill reminded his hearers of the intimate friendship which had sprung up between Rudyard Kipling and Colonel Macphail. He had been referred to by Kipling as the man who built bridges with one hand and wrote poetry with the other.

Mr. Wright spoke briefly in regard to Institute affairs.

Colonel L. F. Grant, Councillor from this Branch, in a few words expressed the appreciation of the Branch for the visits of President McKeil and Mr. Wright.

The wives of the members of the Kingston Branch entertained Mrs. H. W. McKiel, wife of the president of the Institute, and Mrs. G. McKiel, Dean McKiel's mother, of Guelph, at tea in the Faculty Players' Lounge at Queen's University in the afternoon of November 22.

LAKEHEAD BRANCH

H. Os, A.M.E.I.C. - - - - *Secretary-Treasurer*

The regular monthly dinner meeting was held at the Shuniah Club, Port Arthur on October 31.

J. M. Fleming, chairman of the Branch, presided. He welcomed Mr. Dobson, a new member of this branch transferred from Montreal, and expressed his pleasure at seeing present an out of town member, Mr. C. D. MacIntosh of Kenora. He also congratulated Miss MacGill on the success of an aeroplane test which the General Secretary, Mr. Wright, and some members of the branch had witnessed during the afternoon.

Mr. L. Austin Wright, General Secretary of the Institute and guest speaker of the evening, was introduced by S. E. Flook. Mr. Wright commenced his address by explaining in detail work of registration of engineers made by the Engineering Institute for the Department of Defence. He said that this registration was primarily undertaken for the use of industries when the need for additional technically trained men would be required. Many expressions of impatience by engineers registered that little or no use had been made so far of data collected had been represented to the Institute. Mr. Wright explained that he had been informed that it would take at least nine months to a year before any definite increase in production would be accomplished or before industries could be changed to wartime production and require more experienced men to any extent. One question the speaker said he was asked everywhere was "How is Mr. Durley ?", and he was very pleased to inform the meeting that Mr. Durley was back from a holiday in England which he had enjoyed very much. Mr. Durley asked to be remembered to the Branch.

The secretary discussed the contemplated change in Institute by-law eliminating the class of Associate Member as favoured by the Council. This change he contended would facilitate dealings with the Professional Associations. The fee had been an important consideration as it was feared that if a straight increase of $2.00 for Associate Membership was imposed the by-law might be defeated. It was likely that the fee for the new membership would be worked out on the basis of returning about the same revenue as at present, which would mean an increase of $1.00 for present Associate Members and a decrease of the same amount for present Members.

The speaker gave details of broadcasting of features of engineering work to acquaint the public with the importance and extent of engineering in modern civilization. He also mentioned that a recent issue of the Financial Post had been published as an engineering feature in collaboration with the Institute. The secretary then dealt with problems of the Engineering Journal.

P. E. Doncaster questioned Mr. Wright regarding the aims and growth of the A.T.E. organization and its connection with the Institute. Mr. Wright replied that he knew very little about this group excepting that it was a trade union movement showing little growth so far and stated that this organization had no connection with the Institute.

Mr. J. Antonisen moved a vote of thanks to the speaker which Mr. Bird, Sr., seconded. Twenty-three members and guests attended.

LETHBRIDGE BRANCH

E. A. Lawrence, A.M.E.I.C. - *Secretary-Treasurer*

The Lethbridge Branch held a joint dinner meeting with the Association of Professional Engineers of Alberta at the Marquis Hotel on October 28, 1939. Branch chairman A. J. Branch presided and the guests included Senator W. A. Buchanan, Mayor D. H. Elton, Alderman J. A. Jardine, President C. A. McMillan of the Lethbridge Board of Trade, Philip Baker, Chairman of the Southern Alberta Water Conservation Council, and City Manager J. T. Watson, President of the Association of Professional Engineers of Alberta. After dinner, community singing was indulged in under the leadership of Bob Lawrence. Vocal solos by R. Standen and Geo. Brown, Jr., were heartily applauded, and instrumental music was rendered by George Brown's Instrumental Trio.

The speaker of the evening was Major F. G. Cross, Superintendent of Operation and Maintenance, Irrigation Branch, Canadian Pacific Department of Natural Resources, who spoke on **The Need of Water Conservation,** a subject of vital importance to southern Alberta where precipitation during the growing season is somewhat less than the evaporation. The speaker outlined the historical background of irrigation development, and listed the water sources available for irrigation. These streams rise in the United States and the apportionment of the waters in them is determined by the International Joint Commission. There is more than enough water available in the early part of the year but not enough for irrigation in the later part of the summer. The United States has constructed reservoirs to conserve the spring run-off and stabilize the flow of irrigation water throughout the season. No such steps have been taken in Canada to date and there is danger that the American projects will soon take all the surplus water unless Canada constructs reservoirs to permit our portion of the flow to be controlled and used when required.

At the conclusion of Major Cross's address the following resolution was passed unanimously:

"RESOLVED: That this joint meeting of the Association of Professional Engineers of Alberta and the Lethbridge Branch of The Engineering Institute of Canada fully recognizes the urgent need of water conservation in the southern portion of the Province of Alberta, and recommends to the Provincial Government of Alberta, and the Dominion Government of Canada, the immediate consideration of the creation of suitable storage reservoirs so that the economical and agricultural stability of this area may be maintained for future generations, and that immediate and creative action be taken by the proper authorities; and that a copy of this resolution be forwarded to the Headquarters of The Engineering Institute of Canada for suitable action and to the Premier of Alberta and the Prime Minister of Canada for their consideration; and that a committee of three be appointed from the Lethbridge Branch of The Engineering Institute of Canada to assist in all possible ways."

A hearty vote of thanks was tendered the speaker for his very interesting address by Mayor D. H. Elton.

LONDON BRANCH

D. S. SCRYMGEOUR, A.M.E.I.C. - *Secretary-Treasurer*
JOHN R. ROSTRON, A.M.E.I.C. - *Branch News Editor*

A regular meeting of the Branch was held on the 6th December, 1939, in the Board Room of the Public Utilities Commission at the City Hall.

This meeting was devoted to a discussion on the **Training and Welfare of the Young Engineer.**

A national committee of the Institute has been set up with the chairman of this branch as convenor.

The special topics discussed were pre-college student guidance, engineering education, employment, and post-graduation activities of interest to the young engineer.

The discussion was opened by the Branch chairman, H. F. Bennett, who described in some detail the formation of the Institute Committee and the work that they had done in gathering information in an attempt to determine the attitude of the Institute generally towards the problem.

The replies which have been received to the questionnaire issued by the Committee had been very gratifying, especially as many of the leading engineers in Canada had given considerable attention to the subject and indicated by their replies that they were greatly interested in the young men entering the profession.

It was quite definitely disclosed that the Institute should assist young men in determining their adaptability to the engineering profession prior to their undertaking a university course. Training of these young men prior to their college years should be given special attention, as it is very necessary that they should show marked ability in mathematics, the physical sciences and in both written and spoken English. The general opinion was that a complete academic training is necessary for an engineering course just as much as it is for the other professions.

The United States authorities have stated that only 30 per cent of the young men who enter the freshman year at engineering colleges graduate within the prescribed period. It has been found that this percentage in Canada varies from 25 to 60 per cent. Some attention has been given to the entrance requirements at the several universities, and it is the opinion of the Committee and of the Institute generally, that these should be standardized at a high level in order to provide a cultural education to the student, prior to his concentrating on technical subjects.

The curricula of the universities have been studied but this is a matter for further discussion by the committee.

The relationship of the Engineering Institute generally to the young graduate engineer should be improved, especially in the branches where junior sections are not now operating. Study clubs have been suggested, where the needs of the young men can be met, especially on subjects which are not necessarily technical. This matter is receiving further attention by the committee.

Considerable discussion followed Mr. Bennett's remarks, among those taking part being Vice-President E. V. Buchanan, Councillor J. A. Vance, F. G. McAllister, Vice-Chairman of the London Board of Education, W. A. McWilliams, Principal of the H. B. Beal Technical School, V. A. McKillop, J. P. Carrière, and others. It was evident from the discussion that educational authorities generally are interested in this work which has been undertaken by the Institute. They are definitely anxious that the several professions would assist them in advising their students as to their future prospects, and the move made by the Engineering Institute meets with their whole-hearted approval.

Included at the meeting were several high school students who were definitely interested in the subject matter of the discussion, and it would appear that these young men are ready to accept advice before they decide on entering the engineering profession.

OTTAWA BRANCH

R. K. ODELL, A.M.E.I.C. - - *Secretary-Treasurer*

Problems relating to the carrying out of **Canada's Defence** were briefly outlined in a noon luncheon address on Thursday, December 7, by Brigadier K. Stuart, D.S.O., M.C., commandant Royal Military College at Kingston, Ontario, before the Ottawa branch of The Engineering Institute of Canada. These were divided by the speaker into problems relating to direct defence or the defence of interests in Canada itself and those relating to indirect defence or the defence of Canada's outside interests.

The possibility of "hit and run" raids upon Canada's coastal ports and shipping have to be taken into account in planning Canada's defences, stated the speaker. By way of example of the importance of this, altogether apart from the successful conduct of the war, Brigadier Stuart cited the fact that some two million people in the Canadian West primarily depend for their livelihood upon wheat shipments overseas, and if these are seriously interfered with these people will be at once affected.

The probable forms and scales of attack in modern warfare are not immutable, stated the speaker, and the unexpected often happens. Therefore defence operations cannot altogether be based upon what takes place at any one time but must provide for possible contingencies. At no time more than the present did he consider that the public should have a clearer understanding of this feature of defence policy.

PETERBOROUGH BRANCH

A. L. MALBY, Jr.E.I.C. - - - *Secretary-Treasurer*
D. R. MCGREGOR, S.E.I.C. - - *Branch News Editor*

The Junior Section held its first discussion meeting of the season on November 27, in the Lecture Room at the Canadian General Electric Co.

These meetings consist of a short talk by one of the junior members, followed by a comprehensive discussion of the speaker's subject by everyone present. At this meeting, two members spoke; Mr. E. Whiteley and Mr. F. P. Athey, both student members and both employed in the Engineering Department at the Canadian General Electric Co.

Mr. Whitely spoke on **Telephone Influence Factor.** He outlined the history of the question of the influence of transmission lines and power equipment on telephones and telephone equipment, and discussed the present standards for the maximum allowable influence. He showed how T.I.F.—telephone influence factor—could be calculated by applying a weighting curve to the various harmonics in the voltage wave, and he described the circuits in the T.I.F. meter which give this meter a response curve similar to the weighting curve for the various harmonics.

Mr. Athey in **An Engineer Speaks** outlined the developments in the art and science of public speaking in recent years. He pointed out that successful public speaking has been reduced to a few simple formulae, which should appeal to engineering minds; he then outlined these formulae for several types of public speech.

Both papers were followed by considerable discussion.

SAINT JOHN BRANCH

F. L. Black, Jr.E.I.C. - *Secretary-Treasurer*

The opening meeting for the fall season was preceded by a luncheon at the Admiral Beatty Hotel on Dec. 11. Mr. H. F. Morrisey, chairman of the Branch, asked Mr. Sidney Hogg to review the activities of the Maritime Professional Meeting held this summer at Pictou Lodge. Mr. Hogg, the local Councillor, gave a resumé of the Council Meeting and the Maritime Meeting which followed. His remarks were especially interesting to those who had not had the pleasure of attending this meeting.

The speaker for the evening was Mr. Geoffrey Stead, and his subject was **European Trip in 1938.** This subject was vividly presented as a travelogue. The speaker's references to places in Scotland, England, and Germany, which appear so much in the news to-day, were extremely interesting and his presentation was most entertaining.

Lieutenant-Colonel H. F. Morrisey, chairman of the Branch, presided at the monthly supper meeting of the Saint John Branch of The Engineering Institute of Canada in the Admiral Beatty Hotel on December 7, 1939. There was a large attendance of members.

Among those present at the meeting was Dr. Frederick A. Gaby, President of the Institute in 1935. Dr. Gaby was warmly welcomed by the Branch and expressed his deep appreciation at being able to attend.

Unless we discipline ourselves, the Government must step in and appoint a registrar of motor vehicles with dictatorial powers for we shall have the worst record on the highway of any community in North America! This was the warning note sounded by Prof. E. O. Turner, head of the Department of Civil Engineering at the University of New Brunswick, in his address to the Saint John Branch on **Public Safety on the Highways.**

Beneficial results attained in England and some larger centres of the United States from the adoption of maximum speeds for the open road and thickly settled communities were cited by Prof. Turner in advocating enforcement of such measures in this Province. He also considered the scheme of compulsory insurance as another move in the right direction.

Prof. Turner was extended a hearty vote of thanks at the close of his address by Major W. H. Blake and Mr. Geoffrey Stead.

TORONTO BRANCH

J. J. Spence, A.M.E.I.C. - - - *Secretary-Treasurer*
D. D. Whitson, A.M.E.I.C. - - *Branch News Editor*

While Diesel engines have been in use in marine and stationary fields for a number of decades, it is only in recent years that they have come to be extensively used in the transportation field, either in locomotives, rail cars, or buses and trucks, was the statement made by J. L. Busfield, in an address on **Modern Application of Diesel Engines** before the Toronto Branch of The Engineering Institute of Canada at a meeting held at Hart House on Thursday, Nov. 30, 1939, with Dr. A. E. Berry in the chair.

Canada was stated to have been a pioneer in Diesel rail car development, but had fallen a long way behind other countries as there are still practically none but the original pioneer units in the country. Prior to the outbreak of war, there were nearly 4,000 Diesel rail cars in service in 33 countries of the world, of which Germany had over 700, France nearly as many, then Italy, Argentine, Belgium, Roumania, in numerical order, with some hundreds each, the United States with only 60, Great Britain 50, and Canada 29.

In the case, however, of Diesel locomotives, the United States was a strong supporter of this type of motive power, having nearly 500 units, out of a world total of over 2,000, and being second only to Germany with over 1,200 locomotives. Great Britain had 60, and Canada 5, all but one being in shunting service. Diesel locomotives on the Chicago to the Coast run go the whole distance and return, a job that on steam roads requires 4 locomotives. Most of the Diesel locomotives are multi-engined, which makes it possible to do a good deal of the maintenance work on individual units during the run as all the engines will only be used together on the steeper grades.

The development of Diesel engines, through various phases, from heavy stationary units to light portable power plants, was explained by Mr. Busfield. Attention was also drawn to the important part they are playing to-day in war activities, as they are in use under practically every condition where power is required, be it on land, on water, or in the air. Apart from such activities, the statement was made, the almost sole reason for using a Diesel engine was that of its economy of operation. In other words, it was almost invariably selected to do a specific piece of work because it would do that work cheaper than other available means of power. Mr. Busfield pointed out that closely the same efficiency was obtained from Diesel installations of either large or small size. While in small units the Diesel engine could compete with the cost of hydro-electric power, such was not the case when it came to large central stations. In installations up to 100 hp. costing $75 per hp. with 15 per cent written off for interest and depreciation, the standby cost would be about $1 per hp. per month with the power cost from 0.9c to 1.5c per kwh. These charges are similar to electrical power company charges, in many cases.

The speaker commented on the effect of propaganda on the general public, which in recent years had become Diesel conscious. Even the small boy to-day wants his toy locomotive or train to be a Diesel. This has come about to a very great extent through the spectacular development of Diesel trains in the United States.

A large number of views of actual applications of Diesel engines were shown, and explanations were given of the characteristics of the various types of mechanical and electric drives used in modern rail car and locomotive equipment.

In connection with road transportation, the field most suitable for Diesel power was in heavy long distance constant service hauling which allowed the high initial cost of good Diesel equipment to be balanced against mileages of 50,000 per year and upward. A Diesel truck hauling two trailers in this type of service could show costs of two cents per mile against a possible five cents for gasoline driven equipment.

VANCOUVER BRANCH

T. V. Berry, A.M.E.I.C. - - - *Secretary-Treasurer*
Archie Peebles, A.M.E.I.C. - *Branch News Editor*

On Monday, Dec. 4, the Vancouver Branch of the Institute met jointly with the Vancouver Section of the A.I.E.E. This is an annual feature of the programmes of these two branches.

The speaker was Mr. J. R. Bain, District Manager, Dominion Sound Equipment, Ltd., who presented an excellent paper on **Architectural Acoustics.** The subject was covered under three headings: sound conditions in various types of rooms, the measurement of sound, and sound correction in auditoriums.

The acoustical properties of any room depend principally on the reverberation period of sounds produced in it. This is the time required for sounds reflected back and forth from various surfaces in the room to diminish below the level of audibility. The shape and nature of these surfaces determine the average reverberation period, the length of which should be adjusted to the volume of the room. Some reverberation is desirable to give depth and quality, and to maintain sufficient volume for listeners remote from the sound source. Prolonged reverberation, however, results in echoes which can be distinguished from the direct sound, and are therefore objectionable. Curved surfaces of non-absorbent materials often concentrate reflected sounds at a focal point within the room, creating an area where hearing conditions are particularly bad. Many instances of this arise through building for appearance only, without any consideration of the acoustical conditions.

Sound measurement introduces many problems, including units of measurement, the separation of extraneous sounds, reverberation, variable absorption, and the different types of sound incident to speech and direct or reproduced music. The decibel scale is commonly used to indicate sound intensity. An automatic sound level recorder was demonstrated to the audience, as the instrument used in evaluating the acoustical properties of a room. Necessary measurements also include the relative absorbency of materials used in construction, decoration and furnishing.

A room can be so proportioned and built as to have desirable acoustical properties, and this is the practice in many modern theatres and broadcasting stations. Most buildings are designed without reference to this aspect of their use, and unsatisfactory conditions result. Remedial treatment may consist of reshaping the walls or ceiling by false panels which will alter the direction of reflected sounds, thereby changing the reverberation period. Absorbent and non-absorbent materials may be proportioned and disposed to alter the period of reverberation while still maintaining quality and volume. Treatment will vary, depending on the use of the room and the type of sound involved. Amplifying systems cannot be placed at random, but must be adjusted to the sound dispersing properties of the room.

The address was well illustrated by about thirty lantern slides showing in graphic form the many relationships incidental to sound measurement. Two excellent sound films were also shown, adding considerable interest and information to the discussion. The latter were designed for classroom use in the teaching of general science.

Mr. K. Haspel of the B.C. Telephone Co. presided over the meeting, which was attended by about forty members of the two societies.

VICTORIA BRANCH

Kenneth Reid, Jr.E.I.C. - - - *Secretary-Treasurer*

At a general meeting of the Victoria Branch called to receive nominations for the officers of the branch for the ensuing year, and held on December 7, 1939, a large number of members heard a very interesting and instructive address delivered by Mr. F. C. Green, Surveyor General for British Columbia, on the subject, **The Use of Aerial Photography for Mapping.**

In introducing the subject Mr. Green stated that triangulation was used as a basis for all photographic mapping in British Columbia. The first attempts at photographic mapping were made by the late Mr. W. S. Drewry in the Kootenay region of the province in the year 1898, Mr. Drewry being sent out from Ottawa for the purpose. A survey by means of photographic topography was conducted in 1912 along the C.P. Railway property and south to the border. Following the war the first aerial photography efforts in B.C. were made by A. S. G. Musgrave, but the costs of such surveys were excessive in those days. Mosaic maps from photographs were made for mining interests, etc., but these were not practical.

In 1930 a combination of aerial photography and ground topography was used for mapping purposes with increasing success and this is the method in use to-day in the province—in fact, British Columbia was the pioneer, not only in North America, but in the world, in this form of aerial photography for mapping.

The speaker then entered into a technical description of the cameras and equipment used for aerial photograph work, the best possible lenses being used and cameras with a fixed focal length being an essential necessity in order to obtain a definite relationship between plate positions and focal length. Ground photography consisted of cameras mounted on tripods and levelled, the position and direction being fixed by triangulation methods and the exact position of the camera determined. This appeared at first to be a perfect method for ground photography but ground photographs do not take in every point on rough terrain such as is usually found in most of B.C., consequently many important points cannot be obtained. It is interesting to note that originally the cost of ground photography in the Kootenay region of B.C. was around $39.50 per sq. mi. This cost was decreased considerably with experience and improved methods.

Aerial photography was conducted from an elevation of 15,000 feet and of the vertical type. The use of oblique photography was not extensive and was restricted to special cases only. For the most part the province of B.C. is in high relief. On a course traverse the course of the plane was plotted, photographs being taken at regular intervals with points overlapping and with triangulation control being maintained. Vertical photographs provide little means for determining altitude or elevation, a decided weakness in this method of mapping. Likewise, it is practically impossible to keep a plane operating on a straight line due to drift, etc.

In 1931 a combination of vertical and horizontal photography was developed, a method which provided many points that could be fixed as to location and elevation. With the use of the stereoscope as developed during the time of the Great War applied to aerial photographs points in relief could be brought out from which contours could be followed and extensive use of aerial photographs for mapping was made possible. The present cost of aerial mapping is from $2.00 to $6.00 per sq. mi. in B.C. and the cost of combined aerial and ground photographic mapping by modern methods is around $25.00 per sq. mile.

Mr. Green then dealt briefly with the three proposed routes for Alaska highway and the possibilities for aerial mapping of these routes. He stated that some 150 miles of the Finlay Valley route had been surveyed by the above methods during the past year showing contours at 100 ft. intervals for a width of about ten miles. The 400 mile Finlay Fork route could be thusly surveyed at a cost of around $80,000 or less than one per cent of the cost of construction. It was not hard to convince engineers of the economy and savings made possible by aerial surveys for such undertakings. Likewise, the value of these surveys was very great to forestry and mining engineers and prospectors.

As a means of illustrating the address the speaker provided a stereoscope together with numerous photographs both vertical and oblique of British Columbia terrain, particularly of the regions mentioned in the address, and many members availed themselves of the opportunity to study the subject for themselves.

At the conclusion of the talk, Mr. A. S. G. Musgrave moved a hearty vote of thanks to the speaker for his most instructive address.

Library Notes

Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

ADDITIONS TO THE LIBRARY

PROCEEDINGS, TRANSACTIONS, ETC.

The Institution of Mechanical Engineers:
Proceedings, Vol. 141, 1939.

The New Zealand Institution of Engineers:
Proceedings, Vol. 25, 1938-39.

TECHNICAL BOOKS, ETC.

The Design of Propeller Pumps and Fans:
By M. P. O'Brien and R. G. Folsom. University of Calif. Press, Berkeley, Calif., 1939. 18 pp. 8½ by 11 in. paper.

Enjine! Enjine!
By K. H. Dunshee. Home Insurance Company, New York, 1939. 63 pp. Illus. 8¾ by 9 in. paper.

Forging Handbook:
By W. Naujoks and D. C. Fabel. The American Society for Metals, Cleveland, Ohio, 1939. 630 pp. illus. 6¼ by 9¼ cloth.

Refrigerating Data Book:
Vol. 1. Refrigerating Principles and Machinery. The American Society of Refrigerating Engineers, New York, 1939. 527 pp. illus. tab. charts. 6½ by 9½ in. cloth. $4.00 (in U.S.), $4.50 (elsewhere).

REPORTS, ETC.

American Institute of Steel Construction:
Annual Report, 1939.

American Society for Testing Materials:
Stress, Strain and Structural Damage, H. F. Moore (Edgar Marburg Lecture, 1939).

Amos Tuck School of Administration and Finance:
A Reading List on Business Administration. (Dartmouth College, Hanover, N.H.).

British Columbia, Department of Lands:
Annual report of the Lands and Survey Branches.

Canada Department of Labour:
Investigation into an alleged combine of wholesalers and shippers of fruits and vegetables in western Canada. 1939.

Canada Bureau of Mines:
The Canadian Mineral Industry in 1938; The Mining Laws of Canada.

Canada Mines and Geology Branch:
Annual report of the Explosives Division of the Bureau of Mines for 1938; Report of Mines and Geology Branch for 1938.

Connecticut Society of Civil Engineers:
Annual Report, 1939.

National Research Council of Canada:
Twenty-first Annual Report, 1937-1938.

Ontario Department of Mines:
Annual Report, Vol. 47, pt. 9, 1938.

Portland Cement Association:
Continuous concrete bridges.

The Smithsonian Institution:
Utilizing Heat from the Sun by C. G. Abbot.

Société Française des Electriciens:
Remise de la Médaille Mascart. 1939.

The Society of Naval Architects and Marine Engineers:
General Information Book, 1939.

South East London Technical Institute:
Foremanship by A. P. Young, 1938.

U.S. Bureau of Mines:
Practices and methods of preventing and treating crude-oil emulsions. (Bulletin 417)

U.S. Bureau of Mines:
Physical and chemical properties of cokes made or used in Washington; Carbonizing properties and petrographic composition of sewell bed coal; Production of explosives in the United States. (Technical Papers 597, 601, 606).

U.S. Geological Survey:
Spirit leveling in Missouri, Pt. 7, Central Missouri, Pt. 8, West-central Missouri, 1896-1938; Spirit leveling in South Carolina, Part 1, Northern South Carolina, 1896-1938; Subsurface geology and oil and gas resources of Osage County, Oklahoma, Pt. 2 and 3; The coal resources of McCone County, Montana (Geological Survey Bulletins 890-A, 898-G, H, 900-B, C, 905). Geology and ground-water hydrology of the Mokelumne area, California; Surface water supply of the United States, 1937, Pt. 1, North Atlantic slope basins; Artesian water levels and interference between artesian wells in the vicinity of Lehi, Utah; Ground water in the United States, a summary; Summary of records of surface waters of Texas, 1898-1937; Surface water supply of the United States 1938, Pt. 7, Lower Mississippi river basin; Pt. 9, Colorado river basin. (Water-supply Paper 780, 821, 836-C, 836-D, 850, 857, 859). Foraminifera, diatoms, and mollusks from test wells near Elizabeth City, North Carolina; Fossil plants from the Colgate member of the Fox Hills sandstone and adjacent strata; Areal geology of Alaska (Professional Paper, 189-G, I, 192).

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

ABSORPTION SPECTROPHOTOMETRY and Its Applications; Bibliography and Abstracts, 1932 to 1938.

By O. J. Walker. London, England, Adam Hilger, Ltd., 1939. 68 pp., 10 x 6 in., linen, apply.

A comprehensive list of references covering the developments and applications of absorption spectrophotometry for the period 1932 to 1938. In order to facilitate the task of obtaining quantitative absorption data concerning any particular problem, the references have been classified under various general headings and are numbered serially. There is an author index.

ANNUAL REVIEWS OF PETROLEUM TECHNOLOGY

Vol. 4 (covering 1938), ed. by F. H. Garner. London, Institute of Petroleum, 1939. 478 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, 11s.

This annual compilation contains reviews by experts of developments within 1938 in the whole range of petroleum technology: geology, geophysics, drilling and production, transportation and storage, refinery operations, fuel oils, gasoline and oil engines, lubrication, road materials, analysis and testing, etc. In addition to chapter bibliographies there is a general review of petroleum literature in 1938, and the last chapter furnishes production and commercial statistics.

AUDELS NEW RADIOMAN'S GUIDE

By E. P. Anderson. New York, Theo. Audel & Co., 1939. 756 pp., illus., diagrs., charts, tables, 7 x 5 in., cloth, $4.00.

This practical, comprehensive work covers the fundamentals of sound, electricity, and radio principles; describes broadcasting and receiving equipment, including design, operation and maintenance details; and discusses allied apparatus such as marine and aircraft communication, public address systems, the radio compass and beacons, automatic alarms, and electronic television. Underwriters' standards, symbols, abbreviations and units are given, and questions or problems with answers are included in various chapters.

DIE-CASTINGS

By A. Street, London, Emmott & Co., Ltd., 1939. 160 pp., illus., diagrs., tables, 8 x 5 in., cloth, 4s. 6d.

Intended particularly as a source of information for users of die-castings, this small volume describes briefly the methods and materials for die-casting work. Some technical problems are considered, the factors which make for the best results are explained, and a bibliography is included for those who wish to investigate any part of the subject in more detail.

DIESEL ENGINEERING HANDBOOK, 1939-1940, De Luxe Edition

Edited by L. H. Morrison. New York, Diesel Publications, 1939. 940 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $6.00.

This handbook, revised and enlarged, provides a great amount of practical up-to-date information upon the operation and maintenance of diesel engines, valuable both to the owner and operator. The treatment is exhaustive and profusely illustrated from actual practice. Two chapters of engineering fundamentals are devoted to brief description of useful general engineering terms and equipment.

DRILLING AND PRODUCTION PRACTICE, 1937, 1938. Two Vols.

Sponsored by the Central Committee on Drilling and Production Practice of the American Petroleum Institute, New York, 1938-1939. Illus., diagrs., charts, tables, 11 x 8 in., cloth, 1937, 446 pp. $3.00; 1938, 458 pp., $3.00.

The American Petroleum Institute annually publishes these collections of selected papers on drilling and production practice presented at its meetings. The papers are divided into four groups: drilling practice, production practice, materials, and miscellaneous. A bibliography of district-meeting papers, following the main text, contains abstracts and references as to where the complete papers have been published.

ELEMENTARY DESIGN OF STRUCTURAL STEEL AND REINFORCED CONCRETE

By C. Kandall. 2 ed. New York, Federation of Architects, Engineers, Chemists and Technicians, 1939. 162 pp., diagrs., charts, tables, 8½ x 5½ in., cloth, $2.00.

This book is based upon a review course in structural design given to students preparing for the New York State licensing examinations for Registered Architect and Professional Engineer. The fundamental theories of elementary structural design, in both steel and concrete, are briefly reviewed and illustrated by the solution of problems, including problems from previous examinations.

FAULTS AND FAILURES IN ELECTRICAL PLANT

By R. Spieser and others; translated by E. Hunking. London, Sir Isaac Pitman & Sons; New York, Pitman Publishing Corp., 1939. 408 pp., illus., diagrs., charts, tables, 8 x 6 in., cloth, $10.00.

The paucity of collected information on electrical plant troubles has inspired the translation from the German of this book on the causes, results, cure and prevention of faults and failures in heavy current machines, apparatus and plant. The first three parts cover installation an operational faults of electrical machines, transformers and auxiliary apparatus. Part IV considers the materials employed and the troubles directly owing to them.

LES FLUCTUATIONS ÉCONOMIQUES ET L'INTERDÉPENDANCE DES MARCHÉS

By B. Chait. Brussels, Belgium, R. Louis, Rue Borrens 37-39, 1938. 344 pp., diagrs., charts, tables, 10 x 6 in., cloth, 150 frs. belgian; paper, 135 frs. belgian.

The author examines the subject of economic fluctuations, establishes certain quantitative criteria for the stability of price systems, and derives a general law to explain shifts in prices, from which he draws certain basic conclusions with regard to our economic mechanism. Numerous graphs accompany the text, and a glossary of terms, a list of symbols, and a bibliography are appended.

GREAT BRITAIN

Department of Scientific and Industrial Research. Building Research.
Technical Paper No. 22. Studies in Reinforced Concrete. V. Moment Redistribution in Reinforced Concrete, by W. H. Glanville and F. G. Thomas. 52 pp., 40c.
Technical Paper No. 24. Studies in Reinforced Concrete. VII. The Strength of Long Reinforced Concrete Columns in Short Period Tests to Destruction, by F. G. Thomas. 29 pp., 25c.
Technical Paper No. 26. The Solubility of Cements, by F. M. Lea. 17 pp., 15c.
London, His Majesty's Stationery Office, 1939. Illus., diagrs., charts, tables, 10 x 6 in., paper (obtainable from British Library of Information, 50 Rockfeller Plaza, New York).

Technical Papers No. 22 and No. 24 are concerned with the effect of inelastic deformations (creep) in reinforced concrete, and describe investigations pursued along this line, listing the resulting data. No. 26 presents the results of a study of methods for testing the relative susceptibilities of various cements to loss of lime by leaching when soft waters percolate through them.

HUMAN-RELATIONS MANUAL FOR EXECUTIVES

By C. Heyel. New York and London, McGraw-Hill Book Co., 1939. 253 pp., diagrs., charts, tables, 8 x 5 in., cloth, $2.00.

Hundreds of ideas for selecting, developing, stimulating, safeguarding and guiding the working force are presented in the form of case examples of what actual companies are doing successfully to solve their personnel problems. Application check points, consisting of pertinent questions on the preceding material, accompany each chapter.

INTRODUCTION TO CHEMICAL PHYSICS

By J. C. Slater. New York and London, McGraw-Hill Book Co., 1939. 521 pp., diagrs., charts, tables, 9 x 6 in., cloth, $5.00.

The purpose of this book is to provide a unified presentation of the subjects common to both physics and chemistry, aimed especially at those who wish to obtain the maximum knowledge of chemical physics with the minimum of theory.

INTRODUCTION TO MINE SURVEYING

By W. W. Staley. Stanford University Press, Stanford University, Calif., 1939. 275 pp., illus., diagrs., charts, tables, 8 x 5 in., fabrikoid, $3.50.

This first American text on mine surveying in twenty-five years is based on extensive correspondence with mine engineers in North America, as well as on the author's personal experience. It represents tested present-day practice, the illustrations and examples are of a practical nature, and the material is easily handled in the field or the classroom.

MARINE DIESEL MANUAL

Edited by L. R. Ford; produced and distributed by Diesel Publications, 192 Lexington Ave., New York, 1939. 207 pp., illus., diagrs., charts, tables, 6 x 5 in., paper, 50c.

This brief practical manual covers the principles, types and details of marine diesel engines, including fuel systems, lubrication, operation and maintenance instructions, auxiliary equipment, and electric and gear drives.

MATTER AND LIGHT, the New Physics

By L. de Broglie; translated by W. H. Johnston. New York, W. W. Norton & Co., 1939. 300 pp., diagrs., tables, 9 x 5 in., cloth, $3.50.

In this volume the distinguished French physicist has collected a number of studies on contemporary physics written both from the general and the more metaphysical point of view. The subjects include: a general survey of contemporary physics; matter and electricity; light and radiation; wave mechanics; philosophical studies on quantum physics; and philosophical studies on various subjects. Except in two chapters, the reader requires no mathematics.

MODERN BLAST CLEANING AND VENTILATION

By C. A. Reams. Cleveland, Ohio, Penton Publishing Co., 1939. 213 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $4.00.

The whole field of blast cleaning of metallic surfaces is surveyed from a practical viewpoint. Both compressed air and centrifugal methods are considered, including equipment, procedures, proper conditions and protective devices. The use of surface blasting for increasing the fatigue resistance of metal is discussed, and the subjects of ventilation, maintenance, and selection of equipment receive attention. Various specific types of jobs are described and there is a list of uses for blast cleaning equipment.

(The) RECTIFICATION OF ALTERNATING CURRENT

By H. Rissik. London, English Universities Press; Hodder & Stoughton, 1938. 219 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, 21s.

Fundamental circuit relations and the general characteristics of rectifier circuits are discussed in Part I. Part II covers the physical principles underlying rectification phenomena, electric discharges, boundary layers, etc. In Part II four methods of alternating-current rectification are described: mechanical, electron discharge, arc discharge, and by unipolarity of boundary layers. The book is intended both for students and practising engineers and has a large bibliography.

SPARKS, LIGHTNING, COSMIC RAYS, an Anecdotal History of Electricity

By D. C. Miller. New York, Macmillan Co., 1939. 192 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $2.50.

The nature of electricity, from the experiments with amber by the Greek philosophers to the latest phenomena of cosmic rays, is presented by anecdotal reference to the many significant experiments and discoveries made by the important workers in that field. The second section of the three comprising the book is devoted to that versatile investigator, Benjamin Franklin. The book embodies the Christmas lectures for young people at the Franklin Institute, 1937.

STOKER HANDBOOK

By H. D. Airesman. New York and Philadelphia, J. B. Lippincott Co., 1939. 201 pp., illus., diagrs., charts, tables, 8 x 5 in., cloth, $3.00.

This manual describes the installation, operation and maintenance of domestic and small commercial stokers in simple, practical fashion. Both bituminous and anthracite stokers are included, and the information covers applications to hot-water, warm-air and steam heating plants.

STRATEGIC MINERAL SUPPLIES

By G. A. Roush. New York and London, McGraw-Hill Book Co., 1939. 485 pp., diagrs., charts, tables, 9½ x 6 in., cloth, $5.00.

This book presents a concise picture, from both a military and general industrial viewpoint, of the status of the United States with respect to supplies of those materials of mineral origin of which the domestic supply is inadequate. Each of these twelve minerals, mostly metals, is discussed in detail as to uses, substitutes, ore reserves, sources of supply, imports, exports, stocks, tariff and political and commercial control, as they affect the domestic situation.

SUPERCONDUCTIVITY

By D. Shoenberg. Cambridge, England, University Press; New York, Macmillan Co., 1938. 111 pp., diagrs., charts, 8½ x 5½ in., paper, $1.75.

The phenomenon of superconductivity as exhibited by certain metals, metallic compounds, and alloys is discussed, mainly from the point of view of recent developments. The experimental results cited are for the purpose of making clear the essential principles involved. Each chapter has a list of references, as has also the appendix of numerical data.

TECHNOLOGY AND LABOR

By E. D. Smith and R. C. Nyman. New Haven, Conn., Institute of Human Relations, Yale University Press, 1939. 222 pp., 10 x 6 in., cloth, $2.50.

This "study of the human problems of labor saving" is based upon firsthand observations in Southern cotton mills where the "extended labor" system was being introduced. The difficulties encountered, the ways in which they were overcome, and the effects of the changes in method, both temporary and lasting, are discussed.

PRELIMINARY NOTICE

of Application for Admission and for Transfer

December 29th, 1939.

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

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

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

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

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

The Council will consider the applications herein described in February, 1940.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

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

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

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

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

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

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

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

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment 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

ADLAM—ARTHUR EDWIN, of Asbestos, Que. Born at Chamberlain, Sask., June 22nd, 1910; Educ.: B.Sc. (Civil), Univ. of Sask., 1935; Summers: 1933, engrg. office, dftng. and blueprinting; 1934, rodman, Dept. of Highways, Sask.; 1935, Dept. of Mines, Ottawa, water resources of prairie provinces; 1936, timekpr., Dept. of Highways, Sask.; 1937—(4 mos.), asstng. engr., Anglin-Norcross, Toronto; (3 mos.), sales engr. of insulating materials, Brantford Roofing Co., Brantford; (2 mos.), salesman for insulating materials, Laidlaw Lumber Co., Toronto; Oct., 1937, to date, asst. mining engr., i/c of surveying and mapping, Canadian Johns-Manville Co., Asbestos, Que.

References: C. J. Mackenzie, R. A. Spencer, G. M. Williams, A. R. Greig, W. E. Lovell.

BALES—ROBERT P., of Montreal, Que. Born at Toronto, Ont. March 29th, 1915; Educ.: B.A.Sc. (Chem.), Univ. of Toronto, 1938; 1933-37 (total of 3 years), lab. asst., Dunlop Tire Company; 1938 (May-Nov.), plastic moulding investigation, RCA Victor Co., Montreal; at present, chemical engr., Dominion Rubber Co., Montreal.

References: T. M. Moran, R. Ford, R. E. Loudon, R. E. Smythe, E. A. Allcut.

BEIQUE—JEAN, of 69 Courcelette St., Outremont. Que. Born at Montreal, Aug. 29th, 1898: Educ.: B.Sc. (Civil), Mass. Inst. Tech., 1921; 1922, Grad., Ecole de Papeterie, Grenoble, France; R.P.E. of Que.; 1917-25, surveying, estimates, valuation, constrn., supervision, etc., as asst. to Paul A. Beique, C.E., A.M.E.I.C.; 1923-24, dfting., testing, etc., for Newfoundland Power & Paper Co. at Shawinigan Falls; 1925, technical adviser to Rene T. Leclerc Inc.; 1926 to date, consltg. engr. and surveyor, surveying, expropriations, valuations, constrn., supervision, expert evidence, consultations, as asst. to Paul A. Beique, C.E., A.M.E.I.C., Montreal, Que

References: P. A. Beique, J. G. Chenevert, A. Surveyer, E. Gohier.

CARISS—CARINGTON CARYSFORT, of Brantford, Ont. Born at Liverpool, England, June 19th, 1880; Educ.: Night classes, mach. design, thermodynamics, Woolwich Polytechnic; Member, Am. Soc.M.E.; Member of Council, Assn. Prof. Engrs. Ont., 1929-30. 1937 to date, Lieut.-Governor's representative on same Council; 1895-1900, ap'ticeship, Easton, Anderson & Goolden Ltd., Erith, Kent, engines, boilers, waterworks equipment, etc.; 1903-16, dftsman. and chief dftsman., E. Leonard & Sons, London, Ont.; with Waterous Ltd., Brantford, Ont., as follows: 1916-18, gen. estimating, followed by supervision of 4.5 shell dept.; 1918-19, supervision of boiler shop during constrn. large marine boilers; 1920-35, asst. chief engr., in charge of drawing office; 1935 to date, chief engineer.

References: H. A. Lumsden, C. B. Hamilton, Jr., I. Leonard, E. P. Muntz, R W. Angus, W. P. Dobson, F. P. Adams.

CRAIK—OLIVER STANLEY, of 25 Park Avenue, Gatineau Mills, Quebec. Born at Waterville, Que., Apr. 7th, 1894; Educ.: B.Sc. (E.E.), McGill Univ., 1923; 1915-19, overseas; 1922 (summer), testing, and 1923-25, apprentice course, Canadian Westinghouse Company, Hamilton, Ont.; 1925-26, i/c trunk lines between exchanges, Montreal divn., Bell Telephone Company; 1926 (Mar.-Nov.), dftsman. on elec. layout, installn. of 2 paper machines, Belgo Pulp & Paper Co., Shawinigan Falls, Que.; 1926-27, supt. i/c of installn. of prim. substation, Gatineau Mills, Que.; for Canadian Comstock Co., constrn. of mill; 1927-33, asst. elect'l. supt., and 1933 to date, elect'l. supt., International Paper Company, Gatineau Mills, Quebec.

References: R. M. Prendergast, J. T. Thwaites, D. W. Callander, R. C. Silver, C. V. Christie.

HIGGINS—ALEXANDER, of 1106 Frontenac Ave., Calgary, Alta. Born at Ayr, Scotland, Oct. 31st, 1883; Educ.: 1899-1905, Royal Technical College, Glasgow; Member, Am.Soc.M.E.; R.P.E. of Alta.; 1899-1904, ap'ticeship, Campbell, Binnie & Co., Mining Engrs., Glasgow; 1904-06, night foreman, heavy naval gun shop, Wm. Beardmore & Co., Glasgow; 1906-08, outside foreman, E. Simpson & Co., Engrs., Scotland; 1909-10, chief power plant engr., Alberta Clay Products, Medicine Hat, Alta.; 1910-12, chief power plant engr., Ogilvie Flour Mills, Medicine Hat, Alta.; 1913-16, master mechanic, Chinook Coal Co., Lethbridge, Alta.; 1916-18, instructor in mining and steam engrg., Provincial Institute of Technology, Calgary, and Calgary Soldiers' Civil Re-establishment Centre; 1918-20, leased and operated, Yoho Coal Mine, Rosedale, Alta.; 1920-23, mine mgr., Jewel Collieries, Wayne, Alta.; 1923-24, mine mgr., Palisade Mine, Three Hills, Alta.; 1924-26, consltg. heating engr. in Detroit, Mich.; 1926-29, instructor in engrg. maths., 1929-32, head of mining dept., 1932-36, supervisor of engrg. correspondence instruction, Provincial Institute of Technology Calgary; 1936-39, consltg. mining and mech'l. engr., Examiner Bldg., Calgary; at present, supervisor of engrg. correspondence instruction and night class organization in mining centres, Provincial Institute of Technology, Calgary, Alta.

References: F. N. Rhodes, F. M. Steel, B. L. Thorne, S. J. Davies, J. B. deHart, J. W. Young, L. Green, P. T. Bone.

ROGERS—JOHN HENRY, of 49 Yates St., St. Catharines, Ont. Born at St. Catharines, Ont., March 23rd, 1917; Educ.: B.A.Sc., Univ. of Toronto, 1939; 1937 (summer), rodman, Dept. of Highways of Ont., Grimsby; 1938 (summer), instr'man., St. Catharines waterworks and St. Catharines works dept.; May 1939 to date, asst. to city engr., St. Catharines, Ont.

References: C. R. Young, A. L. McPhail, G. F. Hanning, M. B. Atkinson, R. W Angus, F. E. Sterns.

STIRRETT—GORDON PARK, of Vancouver, B.C. Born at Forest, Ont., June 15th, 1886; Educ.: 1903-06, S.P.S., Univ. of Toronto; 1904-08, surveys, mining in Nor. Ontario, Sask. and California; 1908-11, dftsman., transitman, res. engr. (constrn.), G.T.P. Ry.; 1911-16, res. engr. (constrn.), Can. Nor. Pac. Ry.; 1916-19, Overseas, Can. Engrs., Can. Rly. Troops, Capt.; 1919-20, private practice, Vancouver; 1920-25, asst. engr., Vancouver Harbour Commissioners; locating engr., C.P.R., Dept. Nat. Resources, B.C.; res. engr., B.C. Prov. Public Works Dept., engr., A. & L. Logging Co.; res. engr., Alouette Stave Tunnel, B.C. Electric Railway; 1925-29, asst. engr., with W. G. Swan, M.E.I.C.; 1929-39, managing director, B.C. Appraisal Co., Vancouver; Sept. 1939, works engr. (civilian), R.C.A.F., Western Air Command; at present, inspection engr. for B.C., War Supply Board.

References: H. N. Macpherson, C. E. Webb, W. G. Swan, J. P. Mackenzie, J. Robertson, T. V. Berry, P. H. Buchan, W. H. Powell.

TEASDALE—JOSEPH EPHREM, of Church Road, St. Foy, Que. Born at Shawinigan Falls, Que., Sept. 8th, 1900; Educ.: Royal Can. School of Military Engineering, studied gen. constrn., stresses, military field work, etc., 1922-23-24. Qualified Military Foreman of Works and Bldg. Construction Estimator; 1920-24 (summers), practical work on bridge bldg., roadways, explosive demolition, laying submarine cables, boat dock constrn., gen. mil. engrg. field work, dfting.; Mil. Dist. No. 6, Halifax; 1925-26, res. supt., in charge of new constrn. and mtce. for Levis forts, camp, drill hall and all military properties, Mil. Dist. No. 5, Quebec; 1927-30, same as above, but on large scale in Quebec Mil. District and City; 1930-31, assisted Senior Eng. Officer for designing and estimating of Valcartier Arsenal, main and drains, in addition to duties of general foreman and estimator; 1931-36, detail sketches, estimating and personal supervision, incl. material traffic for total reconstrn. of Quebec Citadel and City Walls, fortifications, gates and stone bldgs., along with work already mentioned and more intensively; 1937-38-39, cont. along same lines, incl. mtce. of out of town mil. properties; organized supervision of small camps, huts, alien concentration camps for 1939 mobilization: at present, military works estimator and gen. foreman. Warrant Officer in Royal Canadian Engineers, Quebec, Que.

References: A. J. Kerry, W. S. Lawrence, E. D. Gray-Donald, J. B. Dunbar, A. D. Mann, C. R. S. Stein.

(Continued on page 47)

Employment Service Bureau

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

SITUATIONS VACANT

ELECTRICAL ENGINEERS AND DRAFTSMEN —Junior, 25-40 years of age. At least two years experience in substation work. State qualifications, age, length of experience and present location. Apply to Box No. 1985-V.

MAN witb science degree, chemistry, engineering and practical knowledge of steam boiler plant operation. Strong personality and progressive nature are required to sell tbe tecbnical service and product of this company. Apply to Box No. 2003-V.

NATIONAL RESEARCH COUNCIL VACANCIES

The National Research Council invites applications for positions in the Radio Laboratory, Division of Physics and Electrical Engineering. Applicants must be British subjects. Vacancies may be applied for in the following categories depending on the training and experience of the applicant. These positions are temporary, the term of employment depending on war requirements. Applications of unsuccessful candidates in any particular grade may be considered for the next lower grade if tbe candidate so requests: Senior Researcb Assistant, $1,680-$2,040; Junior Researcb Physicist, $2,100-$2,700; Assistant Researcb Physicist, $2,820-$3,300; Associate Research Physicist, Gr. I., $3,480-$3,720; Associate Research Physicist, Gr. II., $3,840-$4,200. **Duties**—To carry out tests and measurements; to design and to supervise construction of apparatus and equipment; to standardize and calibrate apparatus; to perform the requisite field tests of apparatus and equipment. In case of the more senior positions the candidate must have had experience in directing men. **Qualifications**—Graduation in Honours Physics, Engineering Pbysics, or Electrical Engineering from a recognized university. Post-graduate training and experience in radio is desirable. Experience in the design and operation of radio frequency equipment. Experience in transmitter design and construction. Mathematical ability in the theoretical type of calculations arising from radio work. Applications and credentials should be addressed to the Secretary-Treasurer, National Research Council, Ottawa, and should include a statement of name in full, age, place of birth, marital status, race, citizenship, period of residence in Canada, birthplace of parents, academic degrees and honours, publications, experience, possibly a recent photograph, and the names and addresses of suitable referees. Reference may be made to previous applications if already on file at the National Research Council, but the material should be brought up to date. **Applications should be received as early as possible.**

SITUATIONS WANTED

CIVIL ENGINEER, grad. '29, eleven months on construction, three months on road location, five months in draughting office, desires position on construction or would like to enter draughting office with possibilities in steel and reinforced concrete design. At present employed. Apply to Box No. 352-W.

CIVIL ENGINEER, M.A. (Cantab.). A.M.Inst. C.E., A.M.E.I.C. Age 35. Married. Experienced general construction, reinforced concrete, roads, hydro-electric design and construction, surveys. Apply to Box No. 751-W.

MECHANICAL ENGINEER, B.A.SC., A.M.E.I.C. Eigbt years experience in shop practices, field erection, draughting, design and estimating. Advanced training in Industrial Management. Would like to work with an industrial engineering firm or act as an assistant to a manufacturing executive to gain further training in industrial leadership. Married. Age 32. Apply to Box No. 1543-W.

REFINERY ENGINEER, B.SC. (E.E.), Man. '37. Experienced in supervising operations and maintenance of small refinery. Registered provincial 3rd class steam engineer. Executive background. Also experience in sales and road construction. Consider any location and reasonable offer. Available on short notice. Apply to Box No. 1703-W.

CIVIL ENGINEER, B.SC., S.E.I.C. Married. Six months surveying; mill site; water supply, power line location, earthwork, drainage, topographic. Has given field instruction in surveying. Three months bridge maintenance, asphalt paving inspection in two provinces. Five montbs draughting. Excellent references. Speaks some French and Spanisb. Will go anywbere. Available on two weeks notice. Apply to Box No. 1860-W.

MECHANICAL ENGINEER, A.M.E.I.C. Age 37. Married. 1st Class B.O.T. Certif. 1st Class Ontario Stat. Engr's Certif. Tborough technical and practical training. Specialist in maintenance and general plant supervision, refrigeration, power plant. Available on short notice. Box No. 1963-W.

ELECTRICAL ENGINEER, B.SC. (Alta. '36) S.E.I.C. Age 25. Single. Two years experience in engineering sales as power apparatus specialist and in special products sales for leading electrical manufacturing firm in Canada. Experience in promotion and sale of power line hardware equipment as well as in public address and radio broadcast equipment. References. Location immaterial. Will go anywhere on short notice. Apply to Box No. 2011-W.

ELECTRICAL ENGINEER, B.SC. (Manitoba '34) A.M.E.I.C. Married, Canadian. Experience includes year and balf with British electrical firm in England on apprenticesbip course and erection work. Three years as sales engineer of wide range of electrical apparatus. Work included draughting and outside erection of diesel driven generating equipment, etc., also draugbting and layout design. Experienced in office routine and correspondence and can meet public. References are available and will consider any location. Box No. 2022-W.

CIVIL ENGINEER, B.A.SC. (Tor. '34). Age 27. Single. Two years experience with well known firm of consulting engineers in surveying, waterworks and sewer design and construction and municipal engineering. Three and one half years experience in the design of mining machinery of all kinds including sales engineering work in tbe mining districts of Nortbern Ontario and Quebec. Well experienced in structural and mechanical detailing. References. Apply to Box No. 2041-W.

SALES ENGINEER, fifteen years experience in sales and sales management, oil burners, heating, industrial heavy oil burners and air conditioning equipment. McGill graduate. Apply Box No. 2046-W.

PRELIMINARY NOTICE (*Continued from page 46*)

FOR TRANSFER FROM THE CLASS OF JUNIOR

TAPLEY—DONALD GORDON, of Calgary, Alta. Born at Pointe du Chene, N.B., Aug. 7th, 1911; Educ.: B.Sc. (E.E.), N.S. Tech. Coll., 1934; 1929-31 (summer work), timekpr., checker, tracing, etc.; 1934 to date, with the Can. Gen. Elec. Co. Ltd., as follows: 1934-35, test course, Toronto and Peterborough; 1935, contract service dept.; 1935-36, switchboard design; 1936, head office sales divn., training in air conditioning, commercial refrigeration, and electric distribution systems; Oct., 1936, to date, designing and selling air cond. commercial refrigeration systems in Alberta, including industrial heating, texcope drives and gen. engrg. (St. 1934, Jr. 1936)!

References: R. S. Trowsdale, R. Mackay, W. P. Copp, E. C. Williams, I. F. McRae!

FOR TRANSFER FROM THE CLASS OF STUDENT

DOUCET—JEAN, of Plessisville, Que. Born at Montreal, Feb. 10tb, 1912; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1936; 1936-37, topogr., dftsman., instr'man., C.N.R.; 1937, bridge dept., Prov. of Quebec, figuring structure, slabs, estimating work; 1937 to date, designer, time study man, and since January, 1939, supt. of the Plessisville Foundry, Plessisville, Que. (St. 1935).

References: E. Gobier, A. Frigon, J. G. O'Donnell, S. A. Baulne, L. Trudel.

EAGLES—NORMAN BORDEN, of 97 Dufferin St., Moncton, N.B. Born at Moncton, Oct. 4th, 1912; Educ.: B.Sc. (E.E.), Univ. of N.B., 1935; 1935 (summer), Flying Training Course, Camp Borden, Ont.; July, 1936 to date, asst. city elec'l. engr., Moncton, N.B. (St. 1935).

References: A. F. Baird, J. Stephens, V. C. Blackett, T. H. Dickson, G. L. Dickson, E. B. Martin.

GUNNING—MERLE PERCY, of 40 Aberdeen St., St. Lambert, Que. Born at Coverdale, N.B., Sept. 23rd, 1912; Educ.: B.Eng. (E.E.), McGill Univ., 1935; 1934-35 (summers), macbine shop, drawing office, pattern sbop, J. & R. Weir Ltd., Montreal; 1935-36, demonstrator in descriptive geometry, McGill University; 1936-37, mine work, sampling, surveying, Cons. Mining & Smelting Co., Kirkland Lake, Ont.; 1937-39, macbine shop, inspection, Nortbern Electric Co. Ltd., Montreal; at present, elec. engr., engrg. dept., elect'l. distribution divn., Montreal Light Heat & Power Cons.; (St. 1935).

References: L. A. Kenyon, S. H. Cunha, H. Milliken, R. N. Coke, A. B. Hunt, E. Brown, C. V. Christie.

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References: F. O. White, C. M. McKergow, H. A. Thompson, J. E. Cade, E. Brown.

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References: H. G. Welsford, J. G. Notman, C. E. Herd, J. H. Ingham, E. Brown, R. E. Jamieson.

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References: J. L. Lang, H. J. Leitcb, E. Brown, J. B. Phillips, C. Stenbol..

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References: P. G. Delgado, F. C. Woods, C. L. Stevenson, J. Weir, R. DeL. Frencb!

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References: R. L. Dunsmore, C. Scrymgeour, B. P. Rapley, F. L. West.

SCHEEN—MARCEL, of 1228 St. Hubert St., Montreal, Que. Born at Montreal June 5th, 1912; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1937; 1933-34 (summers), land surveying, Associated Engineers Ltd.; 1934 (Aug.-Oct.), hydrographic surveying, Quebec Streams Commission; 1935 (summer), land surveying; 1937-39, with Lalonde & Valois, Cons. Engrs., highway surveying, location, planning, estimating, i/c office work; June, 1939 to date, mech. and struct'l. dftsman., R. A. Rankin & Company, Industrial Cons. Engrs., Montreal, Que. (St. 1937).

References: J. G. Papineau, C. C. Lindsay, J. P. Lalonde, A. C. Rayment.

SENKLER—EDMUND JOHN, of Sherbrooke, Que. Born at Santa Barbara, California, Sept. 11th, 1910; Educ.: B.A.Sc., Univ. of B.C., 1936; 1928-31, compassman, B.C. Forest Brancb; 1934-36, instrumentman, B.C. Timer Cruiser; 1933-34 and 1936-37, miner and surveyor, Britannia Mining & Smelting Co.; 1937, designer, Dominion Bridge Co. Ltd., Lachine; 1937-38, sales engr., Mason Regulator Company; 1938, sales engr. and designer, Farand & Delorme, Montreal; 1938 to date, industrial engr., Julius Kayser & Co., Sherbrooke, Que. (St. 1938).

References: G. V. Rooney, R. M. Calvin, R. H. Findlay, C. S. Gzowski.

WATSON—HOWARD DALTON, of 23 Standisb Ave., Toronto, Ont. Born at Vancouver, B.C., Sept. 8th, 1907; Educ.: B.A.Sc., Univ. of B.C., 1931; 1925-30 (summers), operating engr., gasoline and Diesel boats, B.C. Fisbing & Packing Co.; with the Linde Canadian Refrigeration Co. as follows: 1931-35, design and estimating refrigerating equipment, erection and repairs to same; 1935-39, design, estimates and sales of refrigerating equipment, and at present, branch manager, Toronto Office. (St. 1931).

References: H. A. Babcock, A. W. Haddow, C. J. Timleck, H. F. G. Letson, I. S. Patterson.

Industrial News

Industrial development — new products — changes in personnel — special events — trade literature

REPORTS OF THE DOMINION BUREAU OF STATISTICS

The Mining, Metallurgical and Chemical Branch of the Dominion Bureau of Statistics, Department of Trade and Commerce, has issued the following annual reports:

Non-Ferrous Smelting and Refining Industry, 1938

This report includes statistics of the industry, which, as defined by The Dominion Bureau of Statistics, "comprises firms engaged primarily in the smelting of non-ferrous ores or concentrates and the refining of metals recovered therefrom."

Primary Iron and Steel Industry, 1938

This contains statistics for the primary iron and steel industry including all establishments in Canada which are engaged *chiefly* in the manufacture of (a) pig iron, (b) Ferro-alloys, (c) steel ingots and steel castings, (d) hot rolled iron and steel products, (e) cold rolled and cold drawn steel bars, strips and shapes.

Miscellaneous Metals in Canada, 1938

Metal-bearing minerals, mined in relatively small quantities by a comparatively few operators, have been grouped by the Dominion Bureau of Statistics for consideration as a single industry. Included with the finally revised statistics relating to the Canadian production of these, are notes and statistical data pertaining to various rare or semi-rare metals or metalliferous ores produced in other countries. Metals or metal-bearing ores produced in Canada during 1938 and classified as miscellaneous include—antimony, bismuth, cadmium, mercury, molybdenite, radium and uranium products, selenium, tellurium and titanium ore. In addition to particulars relating to these metals or products, the bulletin contains notes of a summary nature on beryl and beryllium, lithium, magnesium, sodium, tungsten, calcium, aluminium, tin, iron ores, vanadium and zirconium.

Salt Industry, 1938

Statistics of Canadian salt production show that in 1938 salt was produced in Nova Scotia, Ontario, Manitoba and Alberta and that Ontario contributed 388,130 short tons or 88 per cent of the *total* output for the year 1938.

Gypsum Industry, 1938

This report is divided into two sections—Part 1, The Gypsum Mining Industry. Part 2, The Gypsum Products Industry.

Coke and Gas Industry, 1938

Statistics of the production of coke and gas in Canada during 1938 show that 30 coke and gas works were operated, including 8 by-product plants, 2 bee-hive plants and 20 retort coal and water gas plants.

OLD RELICS RECALL BEGINNINGS OF ELECTRIC POWER INDUSTRY

The Smithsonian Institution recently added to its treasures four time-scarred veterans of the electric power era, fore-runners of the modern apparatus that harnesses electricity to its unnumbered chores.

Puny and awkward by comparison with their streamlined counterparts of today, the machines were presented to the United States National Museum by the Westinghouse Electric & Manufacturing Company as a permanent exhibit of the early days of the electrical industry. The Smithsonian described the antiques as a Tesla motor, Cardew voltmeter, a Gaulard and Gibbs transformer, and a Shallenberger meter. Long since retired from active work, these crude structures are representative of the first practicable achievements in the transmission of alternating-current electric power over long distances from a central generating station and its application in electric lighting and industrial uses.

The Gaulard and Gibbs transformer, no larger than a soap box, was utilized by George Westinghouse as an important tool in developing the alternating-current electric system in America. It formed the basis on which successive generations of engineers and inventors have developed the modern transformer.

Lucien Gaulard, a French engineer, and John Dixon Gibbs, his English financial backer, devised and patented this transformer, which they called a secondary generator.

Development of the Tesla motor marked one of the greatest advances ever made in the use of electric power for industrial purposes. It is a classic example of the joining of theory and application. The principles of the rotating magnetic field were discovered independently by Nikola Tesla, an Austro-Hungarian, and Galileo Ferrarris, an Italian, at about the same time, shortly before 1888. Ferraris mathematically demonstrated the possibility of a rotating field by use of alternating current, but Tesla built an experimental model of an induction motor which actually worked.

Basic patents were granted to Tesla in the United States May 1, 1888, and Tesla himself entered the employ of the Westinghouse Company. At that time the motor was not at all practical, and engineers immediately began to make refinements on it.

The voltmeter, devised by Major P. Cardew in 1883, was the first instrument for measuring the voltage on alternating current systems. It measured the pressure of the electric current by a system of pulleys and the expansion of about two yards of thin wire which was heated by the flow of current through it.

A few years later an accident removed one of the most serious handicaps to the extension and use of alternating current, since it provided for the first time an accurate means for measuring the power supplied to a customer. Oliver B. Shallenberger, an electrical engineer, saw a small spiral spring fall into the mechanism of an arc lamp which other engineers were adjusting. The spring landed on the discs at the end of the main magnet of the lamp and began rotating slowly. Shallenberger reasoned that the rotation was caused by magnetic or electrical action and, as a result of the accident which happened in 1888, within a month the engineer had invented his ampere-hour meter.

Norman A. Eager, A.M.E.I.C.
Newly appointed Assistant Sales Manager of Burlington Steel Company, Ltd., Hamilton, Ont.

PRELIMINARY ESTIMATE OF CANADA'S MINERAL PRODUCTION, 1939

Canada's mineral production, valued at $470,179,000, reached an all-time high in 1939, according to a report just issued by the Mining, Metallurgical and Chemical Branch of the Dominion Bureau of Statistics at Ottawa. This is an increase of 6 per cent over 1938 and 3 per cent over the previous high record of $457,359,092 established in 1937.

New output records were established for antimony, gold, copper, zinc, nickel, cadmium, crude petroleum, natural gas, gypsum, sulphur and lime. Several new gold mines reached the production stage and the gold productive field was widened.

Iron ore was produced on a commercial scale for the first time in sixteen years and considerable prospecting and development work occurred in connection with the search for metals and ores which have not as yet been produced to any great extent in Canada but are strategic for war purposes in the manufacture of various alloys. These include such metals as molybdenite, manganese, mercury, and tungsten.

Several new wells were brought into production in the Alberta petroleum field. In the output of refined copper, nickel, lead and zinc, Canada is now in a better position to assist in the successful prosecution of the war than at the outbreak of the World War in 1914. In fact, since that time, large refineries have been established in the Dominion for the production of the above metals.

WARM AIR CONDITIONER

With increased emphasis on quiet operation, abundant air circulation and humidity control, General Electric has recently placed on the market a new oil-fired warm air conditioner, type LB-22. A larger and slower-speed fan, isolated from the frame of the unit by rubber mountings and canvas connectors, contributes to noise reduction. Even the motor-compressor unit is spring mounted. Air circulation during the summer may be provided by running the fan without operating the burner. The unit is constructed so that at any time cooling equipment may be installed in combination with it, providing complete year-round air conditioning. Improved humidity control, involving the availability of equipment to meet the varying requirements of each installation, provides the correct humidity in each case.

STEAM-JET VACUUM REFRIGERATION UNIT

Bulletin W-207-B1, 8 pages, issued by Worthington Pump and Machinery Corporation, Harrison, N.J., contains design information, specifications and engineering data as well as illustrations and descriptive drawings of the Worthington steam-jet vacuum refrigeration unit.

PROFESSIONAL ENGINEERS OF ONTARIO ANNUAL MEETING

W. P. Dobson, president of the Association of Professional Engineers of Ontario, announces that the general meeting of the association will be held at the Royal York Hotel on Saturday, January 27th. During the afternoon the engineers will meet to consider the report of the retiring executive on the activities of the association, and for the transaction of general business.

This meeting will be followed by a banquet in the Roof Garden. Mr. Dobson will preside, and J. W. Rawlins, president-elect, will be inducted. Guest of honor and speaker of the evening will be Dr. R. C. Wallace, principal of Queen's University, who will discuss "The Engineer in Education and in Life."

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 23 | FEBRUARY 1940 | NUMBER 2

PUBLISHED MONTHLY BY
THE ENGINEERING INSTITUTE
OF CANADA
2050 MANSFIELD STREET - MONTREAL

Price 50 cents a copy, $3.00 a year, in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

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THE ENGINEERING JOURNAL

VOLUME 23 | FEBRUARY 1940 | NUMBER 2

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PRACTICABLE FORMS FOR FLIGHT TEST REPORTING

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Paper to be presented before the General Professional Meeting of The Engineering Institute of Canada, at Toronto, Ontario, on February 9th, 1940.

SUMMARY. A series of forms—to be used for ground and flight test reporting on aeroplanes, is presented, on which to tabulate for convenience and completeness, pertinent data identifying the machine and the essential test returns from which general design data and performance information (including the flight test requirements for the British Certificate of Airworthiness) may be determined.

Introduction

The advantage of having properly prepared forms at hand, is that they are ready for immediate use, and render less likely the omission of pertinent data. To this end, these forms for ground and flight test reporting on aeroplanes have been prepared.

In the mind of the author, a complete set of forms for flight testing should be made up of three parts, namely, the description of the aeroplane, the qualitative tests, and the quantitative tests.

The **description** should enable the aeroplane to be identified and should link the test data to the machine so that a change in performance later on, may be traced to a change in a component (*i.e.* different propeller, size of wheel, etc.) or conversely, a change in a component will call for reconsideration of the performance figures.

The **qualitative tests** should determine the relative ease or difficulty of operating the machine on the water, or ground and in the air, and should provide information to serve as a basis either for improvement of the machine or of comparison between machines of a similar type and purpose.

The **quantitative tests** should furnish figures from which may be determined the actual performance characteristics of the aeroplane (maximum speed, rate of climb, etc.), including those figures required before governmental approval of the aeroplane can be obtained.

The Order of the Forms

The order of the forms is considered important. Listing the components and the limitations of the aeroplane first (in the description) may draw attention to some deficiency or improper condition more easily eliminated before the machine is taken to the airport than afterward, and hence may result in saving time and money. Also, to save time and expense, the qualitative tests should be performed before the quantitative ones, for any curable shortcomings will probably be revealed by the former, and the consequent modifications must be carried out before final performance figures can be obtained.

Description of Aeroplane

The description of the aeroplane to be tested may be set down in Forms 1 and 2.

Form 1 lists the components of the aeroplane. It has been made fairly general in order to embrace the common types of aeroplanes in Canada—landplanes, skiplanes, float seaplanes, single- and multi-engined machines, aeroplanes equipped with fixed pitch or controllable or constant-speed propellers, and those used for military, commercial or private purposes.

Form 2 sets forth the limiting gross weight and centre of gravity positions to be used during the tests. The weight stated is the maximum permissible gross weight, and the centre of gravity positions are the normal position and the most extreme positions.

Qualitative Tests

The qualitative tests are outlined in Forms 3 and 4.

Form 3 is applicable to all aeroplanes, and is subdivided as follows:

Ground Observations.
Flight Observations.
1. Take-off and climb.
2. Controllability in flight.

Landing Observations.
1. Approach.
2. Landing.

If the observations are noted carefully, a fairly clear picture of the relative handling characteristics and suitability of the aeroplane for its proposed duty should emerge, and any equipment and control deficiencies should be apparent.

The more extreme manoeuvres of Form 4 (Manoeuvring Tests) are applicable to aerobatic aircraft only, (*i.e.*, trainers, military machines, etc.). If, following the handling tests for Form 3, the effectiveness of the controls is still in doubt, the manoeuvres of Form 4 should enable the pilot to pronounce positively upon the subject. References 1 to 4 inclusive, and Reference 6 deal in part with qualitative tests.

Quantitative Tests

The quantitative tests are outlined in Forms 5 to 11, inclusive.

The tests are:
Form 5. Longitudinal Stability Test.
Form 6. Take off and Climb.
Form 7. Calibration of Airspeed Indicator Test.
Form 8. Level Top Speed Test.
Form 9. Stalling Speed Test.
Form 10. Partial Climbs Test.
Form 11. Take-off and Landing Runs.

The tests outlined are considered to be the minimum number which will provide general performance data on the aeroplane. From them the speeds at any altitude, best rate of climb at any altitude, ceilings, distances traversed and time required for taking-off and landing may be determined.

To fulfil the flight test requirements for the British Certificate of Airworthiness the tests of Forms 6, 7, 8, 9 and 11 must be performed and the results must satisfy Reference 5.

Flight Tests and the Prototype

The order of the procedure is more important when the aeroplane is a prototype machine than when it is a production model. In the former case, the flight tests are an integral part of the prototype development; in the latter, they simply confirm that the characteristics of the production machine check with those of its prototype.

The part played by flight testing in the development of a prototype is very important. It should be emphasized that the development of the prototype is not completed before the test flights: these flights are part of the development work. The real job of the test pilot is to help the designer perfect his machine. The test pilot should be considered a close collaborator with the designer, not as an independent checker and debunker of the designer's plans. Familiarity of the test pilot with the type of machine is of great advantage in the development work, but—as in every other branch of experimental science—the most important single characteristic to be desired, is an open mind on the part of the experimenter. The pilot whose mind is filled with preconceived notions of how the aeroplane will behave, is more likely to misinterpret or to miss entirely the significance of certain reactions, than he who, having an open mind, looks, not for the confirmation of his own opinions, but for what there is to be found. Since the designer must lean heavily upon the test pilot and must consider his every opinion in the light of improvements to be made, this point cannot be emphasized too strongly.

FORM 1.

DESCRIPTION OF AEROPLANE

1. AEROPLANE
   Owner:
   Manufacturer:
   Type: (Two-place biplane, landplane, skiplane, etc.).
   Model: (name).
   Manufacturer's Serial No.:
   Date of Manufacture:
   Duty: (Passenger, military, training, etc.).
   Registration:

2. ENGINE(s)
   Manufacturer:
   C.A. or A.T.C. or A.M. No.:
   Number:
   Type: (9 cylinder, radial, air-cooled, etc.).
   Model: (name and series).
   Manufacturer's Serial No(s).:
   Manufacturer's Dwg. No.:

   Power: Take off bhp., at r.p.m., at in. Hg.
   Climb maximum, r.p.m. in. Hg.
   Climb recommended, r.p.m., in. Hg.
   Cruising, bhp., at r.p.m., at in. Hg.
   Normal, bhp., at r.p.m., at in. Hg.
   at feet altitude.
   Maximum Power bhp., at r.p.m., at in. Hg.

   Manufacturer's Data: Power Curve No. Date
   Fuel Required: Gasoline, specification and octane number.
   Oil Required: Specification.
   Propeller Reduction Gear Ratio:
   Direction of Rotation: (viewed from rear).
   Crankshaft:
   Propeller Shaft:

   Permissible Temperatures and Pressures:
   Authority: (Manufacturer's Engine Handbook).
   Oil Temperature: Permissible Range.
   Oil Pressure: Permissible Range.
   Cylinder Head Temperature: Permissible Range.
   Fuel Pressure: Permissible Range.
   Coolant Temperature: Permissible Range.

   Engine Equipment:
   Starter:
   Manufacturer:

   C.A. or A.T.C. or A.M. No.:
   Type:
   Model:
   Serial No.:

   Generator:
   Manufacturer:
   C.A. or A.T.C. or A.M. No.:
   Type:
   Model:
   Serial No.:

   Fuel Pump:
   Engine Pump:
   Manufacturer:
   C.A. or A.T.C. or A.M. No.:
   Type:
   Serial No.:

   Hand Pump:
   Manufacturer:
   C.A. or A.T.C. or A.M. No.:
   Type:
   Serial No.:

   Cowling:
   Type:

   Carburetor Heating:
   Type:

   Tanks:
   Gasoline Tank:
   Maximum Capacity: Number:
   Service Capacity: Position:

   Oil Tank:
   Maximum Capacity: Number:
   Service Capacity: Position:

   Coolant Tank:
   Maximum Capacity: Position:
   Service Capacity: Fluid:
   Number:

   De-icing Tank:
   Maximum Capacity: Position:
   Service Capacity: Fluid:
   Number:

3. PROPELLER(s)
   Manufacturer:
   C.A. or A.T.C. or A.M. No.:
   Number:
   Type: (2-setting controllable pitch, etc.).
   Material: (aluminum alloy, steel, wooden, etc.).
   Number of blades per propeller:
   Blades: Type No.: Serial No(s).:
   Hub: Type No.: Serial No(s).:
   Diameter:
   Pitch Setting(s): Minimum degrees at 42 in. radius.
   Maximum degrees at 42 in. radius.
   De-icing Equipment:
   Manufacturer: Serial No.:
   Type: Fluid:

4. WHEEL, SKI OR FLOAT UNDERCARRIAGE
   Type: (General description).
   Shock Strut(s):
   Manufacturer: Model:
   Number: Serial No(s).:
   Type: Length (fully compressed): inches.

   Wheels (Main and Tail):
   C.A. or A.T.C. or A.M. No.:
   Manufacturer: Serial No(s).:
   Number: Size:
   Type: Brakes:

   Tires (Main and Tail):
   Manufacturer:
   C. A. or A.T.C. or A.M. No.:
   Type: Serial No.: Size:
   Pressure: lb. per sq. in.
   Deflection: at stated pressure, inches.

   Floats:
   Manufacturer:
   C.A. or A.T.C. or A.M. No.:
   Type: Serial No(s).: Number:
   Maximum displacement per float:
   Float setting: (deck datum at degrees to thrust line).

   Skis:
   Manufacturer:
   C.A. or A.T.C. or A.M. No.:
   Type: Serial No(s).:
   Material: Number:
   Maximum capacity per ski:
   Trimming gear:
   Pedestal(s):
   Manufacturer:
   C.A. or A.T.C. or A.M. No.:
   Type: Serial No(s).:

5. INSTRUMENTS
   Engine Instruments: (list each instrument).
   Manufacturer:
   C.A. or A.T.C. or A.M. No.:
   Type: Serial No.: Range:

   Flight Instruments: (list each instrument).
   Manufacturer:
   C.A. or A.T.C. or A.M. No.:
   Type: Serial No.: Range:

   Radio:
   Manufacturer:
   C.A. or A.T.C. or A.M. No.:
   Type: Serial No.: Range:

   Instruments installed for Flight Testing only: (list each instrument).
   Manufacturer:
   C.A. or A.T.C. or A.M. No.:
   Type: Serial No.: Range:

   Fire Extinguisher(s):
   Manufacturer:
   Type: Serial No.: Number:

6. Control Surface Data
Ailerons:
Type: (Balanced, Frise, *etc.*).
Rigging Angle:
Travel: Degrees Up Down
Reference line: (from which travel measured).
Flaps:
Type:
Travel: Degrees Up Down
Reference line:
Elevators:
Type: Travel: Reference line:
Stabilizer:
Type: Travel: Reference line:
Rudder:
Type: Travel: Reference line:
Fin:
Type: Offset: Reference line:
Tabs:
Type: Setting: Reference line:

7. Night Flying Equipment
Lamps:
Manufacturer:
C.A. or A.T.C. or A.M. No.:
Number: Power: Position

8. Armament
Fixed Guns and Flexible Guns:
Manufacturer:
C.A. or A.T.C. or A.M. No.:
Type: Number:
Model: Position:
Calibre: Ammunition Load:
Bomb Equipment:
Racks:
Manufacturer:
C.A. or A.T.C. or A.M. No.:
Type: Position:
Model: Capacity:
Bombs:
Manufacturer:
C.A. or A.T.C. or A.M. No.:
Type: Capacity:

9. Limiting Speeds (Design)
Speed in terminal velocity dive:
Speed with flaps down:
Diving speed at maximum r.p.m. of engine:

FORM 2

FLYING WEIGHTS AND CENTRE OF GRAVITY POSITIONS

Horizontal datum: (distance below thrust line).
Vertical datum: (distance forward C.L. propeller).
Leading Edge—Wing: (distances from H. and V. data).
Length of M.A.C. (mean aerodynamic chord):
L.E. of M.A.C.: (distance from V. datum).
1. Normal Gross Weight with C.G. in normal position.
2. Normal Gross Weight with C.G. in most rearward position.
3. Normal Gross Weight with C.G. in most forward position.
Table I is prepared for each of the three C.G. positions.

TABLE I

Item	Group Wt. lb.	Item Wt. lb.	Horizontal		Vertical	
			Arm, in.	Moment, in.-lb.	Arm, in.	Moment, in.-lb.
1. Tare Weight of Aeroplane	—		—	—	—	—
Weight special equipt.		—	—	—	—	—
2. Aircraft equipped for test flying	—		—	—	—	—
3. Useful Load	—	—	—	—	—	—
(a) Oil (—Imp. gal. at – lb. per Imp. gal.)		—	—	—	—	—
(b) Fuel (—Imp. gal. at – lb. per Imp. gal.)		—	—	—	—	—
(c) Pilot and parachute		—	—	—	—	—
(d) Observer and parachute		—	—	—	—	—
(e) Ballast		—	—	—	—	—
4. Take-off Weight	—		—	—	—	—

Centre of Gravity Position
Horizontal distance from L.E.—Wing.
Vertical distance from L.E.—Wing.
Horizontal and vertical distance in per cent of M.A.C.

FORM 3

PILOT'S HANDLING TESTS AND COMMENTS GROUND OBSERVATIONS

1. Cockpit(s) or Cabin
(a) Comment on aids to entrance and egress.
Ample steps? Handles? Emergency exits? Ease in case of emergency jump?
(b) Comment on cockpit(s). Size? Comfort? Head clearance for bumpy air flying? Protection in case of nosing-over?
(c) Comment on seats. Comfort? Height? Size? Size with winter clothing? Adjustability?
(d) Comment on safety belt. Type? Sufficient adjustment?
(e) Comment on projections to catch clothing, injure personnel.
(f) Comment on windscreens. Protection afforded? Visibility? Material? Safety? Distorted vision? Reflections? De-icing provision? Anti-fogging provision?
(g) Comment on removable hatches. Ease of operation? Possibility of jamming?
(h) Comment on ventilation. Draughty?
Do exhaust gases enter cockpit or cabin?
(i) Comment on cockpit heating. Adequate?
(j) Can members of crew change places during flight?

2. Cockpit Controls
Comment on location, operation and interference of:
1. Ignition switch.
2. Throttle.
3. Mixture.
Are throttle and mixture interconnected?
4. Spark.
5. Propeller.
6. Starter switch.
7. Fuel cock.
8. Manual fuel pump.
9. Stabilizer.
10. Tabs. Elevator. Rudder. Aileron.
11. Carburetor heat.
12. Radio.
13. Stick.
14. Flaps. Is there a position indicator?
15. Landing Gear. If retractable, is there a position indicator? Easy of operation? Freedom from vibration? Does position indicator operate correctly?
16. Rudder control. Is leg length adjustable?
17. Brake control. Toe brakes? Heel brakes? Are brakes easily applied for all rudder positions?
18. Carburetor heat control.

3. Instrument Board(s)
(a) Comment on instrument arrangement and installation.
(b) Comment on suitability and adequacy of instruments.
(c) Comment on visibility for pilot. For co-pilot.
(d) Comment on vibration of board.

4. Instruments
(a) Compass
1. Does the compass check N,E,S,W?
2. Comment on vibration in smooth air. In bumpy air?
3. Is the heading affected by change in r.p.m.?
(b) Altimeter
Comment on vibration.
(c) Airspeed
Does instrument read zero when aeroplane stationary?
(d) Rate of Climb
Does instrument read correctly in a pull up?
(e) Does the radio operate satisfactorily?

5. Night Flying Equipment
(a) State number and position of lights.
(b) State approximate angle of light beams to ground when the aeroplane is in the tail-down position.
(c) Is the instrument board lighted directly or indirectly? Is the lighting adequate?
(d) Is the cockpit equipment lighted satisfactorily?
(e) Comment on glare, reflections, intensity of light.
(f) Is sufficient control of light intensity provided?
(g) Can charts or maps be read easily?

6. Armament
(a) Does the armament function satisfactorily?
1. Fixed guns.
2. Flexible guns.
3. Bomb racks.
(b) Can the flexible guns be used effectively during manoeuvres?
(c) Comment on the field of fire of the guns.
(d) Is heating provided for the guns?

7. Taxiing. (Wheels or skis)
(a) State wind velocities.
(b) Comment on ground condition.
(c) Comment on visibility from cockpit(s) when in tail down position.

(d) Taxi at various speeds up to 30 m.p.h. and comment on:
  1. Track.
  2. Shock absorption.
  3. Main landing gear action on runway. On rough ?
  4. Braking action. Sufficient for stopping ? For manoeuvring ?
  5. Condition of brakes. Heat generated ?
  6. Tail wheel (skid or ski) operation. Steady ? Sluggish ? on runway; on rough ground. Steerable ?

(e) Comment on rudder control for ground manoeuvring.
(f) Comment on response to controls without brakes.
(g) Is there a tendency to porpoise ?
(h) Comment on ground handling of aeroplane.
(i) Does carburetor function satisfactorily while taxiing ?

8. Taxiing (Floats)
(a) State winds and sea conditions.
(b) Taxi at various speeds up to 40 m.p.h. and comment on:
  1. Wave-making of floats.
  2. Spray action.
  3. Aeroplane attitude.
  4. Weaving of float undercarriage.
  5. Freedom of propeller(s) from spray and icing.
  6. Freedom of windscreen from spray.
  7. Effectiveness of water rudders. Are they retractable ?
  8. Does tail dip in water ?
  9. Is there a tendency to porpoise ?
  10. Comment on float undercarriage action.
  11. Comment on rudder control for water manoeuvring.
  12. Does carburetor function satisfactorily while taxiing ?
  13. Comment on visibility from cockpit while taxiing.

9. Handling Facilities
(a) Comment on ground handling facilities:
  1. Hand holds on fuselage. At wing tips.
  2. Tie-downs on fuselage. At wings.
  3. Jacking facilities.

(b) Is lifting sling available ?
(c) Comment on water handling facilities.

FLIGHT OBSERVATIONS

1. Take-off and Climb
(a) State weight and C.G. position.
(b) State stabilizer setting. Flap setting.
(c) Comment on length of run: long, medium, short.
(d) Comment on vibration of:
  1. Engine and mounting.
  2. Propeller in fine pitch; in coarse pitch.
  3. Cowling.
  4. Instrument panel and equipment.
  5. Controls.
  6. Control surfaces.

(e) Comment on engine operation: smooth, rough.
(f) Are engine temperatures and pressures within permissible range ?
(g) Comment on fuel pressure fluctuations with varying r.p.m.
(h) R.p.m. limits of propeller(s).
(i) Time required to change pitch of propeller(s) from coarse to fine.
(j) Does the carburetor operate satisfactorily during take-off ?
(k) Comment on tendency of aeroplane to swing on take-off.
(l) Comment on initial full-throttle climb with propeller in coarse pitch: steep, flat, normal.
(m) Comment on speed of take-off with flaps, without flaps. High or low for type ?
(n) Comment on flap operation. Ease ? How many positions ?
(o) Comment on visibility during take-off and climb.

2. Controllability in Flight
(a) State aeroplane weight: normal, light.
(b) State C.G. position: normal, forward, aft.
(c) Comment on effectiveness and operation of controls at slow speeds, at high speeds:
  1. Approx. I.A.S. and altimeter readings.
  2. Ailerons: light ? heavy ? ample ?
  3. Elevators: light ? heavy ? ample ?
  4. Rudder: light ? heavy ? ample ?
  5. Stabilizer: light ? heavy ? ample ? excessive trim ?
  6. Tabs: light ? heavy ? ample ? excessive trim ?
  7, Order of effectiveness of controls.
  8. State if any control is unsatisfactory or marginal.
  9. Comment on harmonization of controls.

(d) Comment on buffetting or burbling.
(e) Comment on change of trim necessary with change of power. Does nose rise or fall when engine throttled ?
(f) Comment on visibility during climb; during level flight.
(g) Are engine temperatures and pressures within permissible range during full-throttle climb and full-throttle level flight ?
(h) Comment on vibration in flight.
(i) Comment on mixture control setting for:
  1. Maximum power.
  2. Best economy.

(j) Will the engine(s) pick up after one tank is dry ?
(k) Comment on drop in r.p.m. when carburetor heat is on:
  1. Top speed condition.
  2. Cruising condition.

(l) Comment generally on range of speed giving satisfactory:
  1. Lateral stability.
  2. Longitudinal stability.

(m) Comment on tendency to hunt when light.
(n) Comment on deflection of:
  1. Wings.
  2. Tail.
  3. Fuselage.

(o) Comment on twisting of:
  1. Wings.
  2. Tail.
  3. Fuselage.

(p) After the following sudden manoeuvres, if control is returned to neutral, does aeroplane return to normal level flight ?
  1. Roll—right and left.
  2. Yaw—right and left.
  3. Pitch—nose up and nose down.

LANDING OBSERVATIONS

1. Approach
(a) Comment on glide: steep, normal, flat.
  1. Without flaps.
  2. With flaps.

(b) Comment on speed of approach.
(c) Comment on trimming requirements.
(d) Comment on visibility.
(e) Comment on change of attitude due to:
  1. Throttling engine.
  2. Lowering flaps.

(f) Comment on controllability during approach.

2. Landing
(a) Comment on controllability during landing run.
(b) Comment on visibility during landing run.
(c) Comment on length of roll: short, medium, long.
  1. Without brakes, without flaps.
  2. With brakes, with flaps.

(d) Comment on tendency to float; to settle.
(e) Comment on range of stabilizer (or elevator tab) setting used in the sequence of take-off, climb, level flight and landing.

FORM 4

MANOEUVRING TESTS

Perform the following manoeuvres and comment on them:

1. Vertical banked level turns through 360 degrees.
   (a) Left turn. (b) Right turn.
2. Figures of eight with vertical banked level turns.
3. Slow rotation through 180 degrees by means of ailerons in a steep dive without engine followed by a pull-out.
   (a) Left. (b) Right.
4. Short dives at various throttles, turning while pulling out.
5. Short dives at various throttles, without turning while pulling out. (a) Left. (b) Right.
6. Climbing turns through 180 degrees.
   (a) Left. (b) Right.
7. A half slow roll, to right, to left diving out.
8. Normal loop.
9. Slow roll to right, to left.
10. Half loop and roll out at top to right, to left.
11. Sideslips, to right, to left.
12. Terminal velocity dive.
    (a) While diving operate control surfaces and note any tendency toward structural oscillations.
13. Stalls, with engine on and engine off.
    (a) Comment on aileron and rudder control up to the stall.
    (b) At stall, does nose drop gently ?
    (c) At stall, is there a tendency to drop a wing ?
    (d) Comment on aileron and rudder control after nose drops.
14. Spins, 4-turn spins to right and left.
    (a) Describe sequence leading up to spin.
    (b) Spin flat or vertical ?
    (c) Wings level ?
    (d) Nose steady ?
    (e) Height lost in 4-turn spin to right; to left.
    (f) Describe sequence leading up to recovery.
    (g) Number of turns required before out of spin.
    (h) General comment on spin.
    (i) State C.G. positions at which aeroplane spun.
15. During manoeuvres, are engine temperatures and pressures within permissible range ?
17. In dive, is cooling excessive ?
18. Do coolant or de-icing tanks overflow during manoeuvres ?
19. Is fuel flow satisfactory during manoeuvres ?
20. Comment on vibration during manoeuvres.

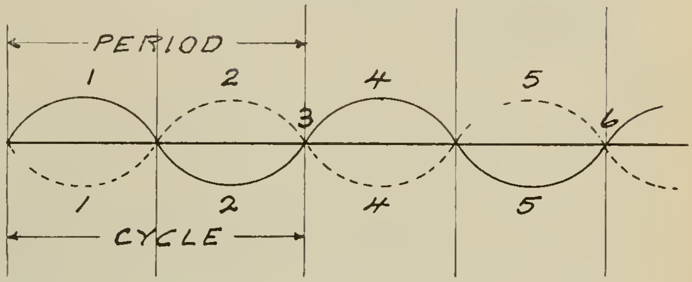
FORM 5

FLIGHT TEST RETURNS

LONGITUDINAL STABILITY TEST

Date. . . . .
Airport. . . . .
Weather. . . . .
Ground Conditions:
Temperature. . . . .
Barometric pressure. . . . .
Wind direction and velocity. . . . .
Pilot. . . . .
Observer. . . . .

Gross Weight of Aeroplane. . . . .
C.G. Position. . . . .
Flap Setting . . . .
Propeller Setting. . . . .
Oil Cooler. . . . .



Run No.	Strut Temp.	Altimeter Reading	Stabilizer position at trim	R.P.M.	I.A.S. at trim	1		2		3		4		5		6		Remarks
						I.A.S.	Time	I.A.S.	Time	I.A.S.	Time	I.A.S.	Time	I.A.S.	Time	I.A.S.	Time	
	Dive																	
1.	—	—	—	rated	—	—	—	—	—	—	—	—	—	—	—	—	—	
2.	—	—	—	cruising	—	—	—	—	—	—	—	—	—	—	—	—	—	
3.	—	—	—	low	—	—	—	—	—	—	—	—	—	—	—	—	—	
	Climb																	
1.	—	—	—	rated	—	—	—	—	—	—	—	—	—	—	—	—	—	
2.	—	—	—	cruising	—	—	—	—	—	—	—	—	—	—	—	—	—	
3.	—	—	—	low	—	—	—	—	—	—	—	—	—	—	—	—	—	

This test is carried out for the normal, most forward and most rearward positions of the C.G.

Procedure: Trim aeroplane for level flight at desired r.p.m. and altitude.
(a) Dive until I.A.S. has increased 10 m.p.h. Release stick, take readings at noted points on curve.
(b) Climb until I.A.S. has decreased 10 m.p.h. Release stick, take readings at noted points on curve.

FORM 6

FLIGHT TEST RETURNS

TAKE OFF AND CLIMB TEST

Date. . . . .
Airport. . . . .
Airport Altitude. . . . .
Weather. . . . .
Ground Conditions:
Temperature. . . . .
Barometric pressure. . . . .
Wind direction and velocity. . . . .
Pilot. . . . .
Observer. . . . .

Gross Weight of Aeroplane. . . . .
C.G. Position. . . . .
Maximum R.P.M. on Ground. . . . .
Idling R.P.M. . . . .
Flap Setting. . . . .
Propeller Setting. . . . .
Stabilizer Setting. . . . .
Oil Cooler. . . . .

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Run No.	Take-off Run		722 ft.		1180 ft.		Strut Temp.	Oil Temp.	Oil Press.	Fuel Press.	Manifold Press.	Carburetor intake Temp.	Stabilizer position	Coolant Temp.	Remarks
	I.A.S.	Time	I.A.S.	Time	I.A.S.	Time									
1.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
3.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	

Procedure: The aeroplane is stationary, head to wind with engine idling at. . . r.p.m. The sensitive altimeter is set at zero. On the word from the observer the throttle is opened and the two stop watches started. One watch is stopped at the instant that the aeroplane leaves the ground. The other watch is stopped when the sensitive altimeter indicates 1,180 feet. A reading on the watch is taken as the aeroplane passes 722 feet.

A number of runs are made and the best I.A.S. for climbing is determined for use in the Partial Climbs Test. This speed is recorded as. . . .m.p.h.

FORM 7

FLIGHT TEST RETURNS

CALIBRATION OF AIRSPEED INDICATOR TEST

Date....................................
Airport.................................
Airport Altitude........................
Weather.................................
Ground Conditions:
Temperature.............................
Barometric pressure.....................
Wind direction and velocity.............
Pilot...................................
Observer................................

Gross Weight of Aeroplane.............
C.G. Position.........................
Flap Setting..........................
Propeller Setting.....................
Stabilizer Setting....................
Oil Cooler............................

Length of Speed Course................
Direction of Speed Course.............

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Run No.	Direction of run	Altimeter Reading	Strut Temp.	Stabilizer position	R.P.M.	I.A.S.	Carburetor Intake Temp.	Manifold Pressure	Oil Temp.	Oil Press.	Fuel Press.	Hottest cylinder head Temp.	Colant Temp.	Elapsed time	Remarks
1.	(East-West)	—	—	—	—	—	—	—	—	—	—	—	—	—	
2.	(West-East)	—	—	—	—	—	—	—	—	—	—	—	—	—	
3.	(etc.)	—	—	—	—	—	—	—	—	—	—	—	—	—	
4.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
6.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
7.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
8.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	

Procedure: At take-off, the sensitive altimeter is set at zero. The speed and altitude are held constant for about one mile before entering the course. All instruments are noted as steady before entering the course. The observer sights the course markers and lines them up with a fixed point on the aeroplane when taking readings of elapsed time. Runs are made up and down the course (*e.g.* east-west, west-east).

Runs are made at, at least, three different r.p.m. (or manifold pressures) to obtain three points for plotting a calibration curve.

FORM 8

FLIGHT TEST RETURNS

LEVEL TOP SPEED TEST

Date....................................
Airport.................................
Airport Altitude........................
Weather.................................
Ground Conditions:
Temperature.............................
Barometric pressure.....................
Wind direction and velocity.............
Pilot...................................
Observer................................

Gross Weight of Aeroplane.............
C.G. Position.........................

Flap Setting..........................
Propeller Setting.....................
Stabilizer Setting....................
Oil Cooler............................

1	2	3	4	5	6	7	8	9	10	11	12	13
Run No.	Altimeter Reading	Strut Temp.	I.A.S. Reading	R.P.M.	Oil Temp.	Oil Press.	Manifold Press.	Carburetor Intake Temp.	Fuel Press.	Hottest cylinder Temp.	Coolant Temp.	Remarks
1.	—	—	—	—	—	—	—	—	—	—	—	—
2.	—	—	—	—	—	—	—	—	—	—	—	—
3.	—	—	—	—	—	—	—	—	—	—	—	—

Procedure: The aeroplane is trimmed for full throttle, level flight at rated altitude and rated engine r.p.m. and manifold pressure. As soon as all instruments are steady, readings are taken.

If the engine is permitted a 5-minute higher boost rating, a run is made under these conditions.

FORM 9

FLIGHT TEST RETURNS

STALLING SPEED TEST

Date.......................................
Airport.......................................
Airport Altitude.......................................
Weather.......................................
Ground Conditions:
Temperature.......................................
Barometric pressure.......................................
Wind direction and velocity.......................................
Pilot.......................................
Observer.......................................

Gross Weight of Aeroplane.......................................
C.G. Position.......................................
Flap Setting.......................................
Propeller Setting.......................................
Stabilizer Setting.......................................
Oil Cooler.......................................

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Run No.	Altimeter Reading	Strut Temp.	I.A.S. (at stall)	R.P.M.	Oil Temp.	Oil Press.	Mani-fold Press.	Carb-uretor Intake Temp.	Fuel Press.	Hottest cylinder Temp.	Throttle	Coolant Temp.	Remarks
1.	—	—	—	—	—	—	—	—	—	—	—	—	—
2.	—	—	—	—	—	—	—	—	—	—	—	—	—
3.	—	—	—	—	—	—	—	—	—	—	—	—	—

Procedure: The aeroplane is flown level at best climbing I.A.S. with the stabilizer set at minimum incidence, the stick being moved backwards slowly. The speed at which the nose or a wing drops fairly rapidly is the I.A.S. for stalling. The test is carried out for full-throttle engine, and engine throttled back.

FORM 10

FLIGHT TEST RETURNS

PARTIAL CLIMBS TEST

Date.......................................
Airport.......................................
Airport Altitude.......................................
Weather.......................................
Ground Conditions:
Temperature.......................................
Barometric pressure.......................................
Wind direction and velocity.......................................
Pilot.......................................
Observer.......................................

Gross Weight of Aeroplane.......................................
C.G. Position.......................................
Flap Setting.......................................
Propeller Setting.......................................
Stabilizer Setting.......................................
Oil Cooler.......................................

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Run No.	Altimeter Reading	Elapsed Time	I.A.S.	Strut Temp.	R.P.M.	Mani-fold Press.	Oil Temp.	Oil Press.	Fuel Press.	Carb-uretor intake Temp.	Hottest cylinder Head Temp.	Stabi-lizer setting	Coolant Temp.	Remarks
	(example)													
1.	2000–3000	—	—	—	—	—	—	—	—	—	—	—	—	—
2.	2000–3000	—	—	—	—	—	—	—	—	—	—	—	—	—
3.	5000–6000	—	—	—	—	—	—	—	—	—	—	—	—	—
4.	5000–6000	—	—	—	—	—	—	—	—	—	—	—	—	—
5.	10000–11000	—	—	—	—	—	—	—	—	—	—	—	—	—
6.	10000–11000	—	—	—	—	—	—	—	—	—	—	—	—	—

Procedure: Three or four altitudes, including the rated altitude of the engine, are chosen at which to run the tests.
At the desired altitude, the aeroplane is trimmed to climb at its best climbing speed and a steady climbing speed is obtained before reaching the starting height. The time to climb 1,000 feet between starting height and finishing height is taken by a stop watch. Clouds are avoided because of the air currents about them.

FORM 11

FLIGHT TEST RETURNS

TAKE-OFF AND LANDING RUNS

Date. . . . .
Airport . . . .
Airport Altitude . . . .
Weather . . . .
Temperature . . . .
Barometric pressure . . . .
Wind direction and velocity . . . .
Runway Surface . . . .
Runway Condition . . . .
Pilot . . . .
Observer . . . .

Gross Weight of Aeroplane . . . .
C.G. Position . . . .
Oil Cooler . . . .

1	2	3	4	5	6	7	8	9	10
Run No.	Propeller setting	Stabilizer setting	Flap setting	Take-off Run		Landing Run		Brakes	Remarks
				From Start to Take-off		From Touch-down to Stop			
				Time	Length of run	Time	Length of run		
1.	Coarse	—	Without	—	—	—	—	—	—
2.	—	—	With	—	—	—	—	—	—
3.	—	—	—	—	—	—	—	With	—
4.	—	—	—	—	—	—	—	Without	—

Procedure: Take-off—The aeroplane is stationary, head to wind, with engine idling at. . . .r.p.m. The throttle is opened, and the stop watch started. The position of the wheel centre is noted on the ground, The aeroplane is pulled off, the run being as short as possible. The stop watch is stopped when the wheels leave the ground. The last point of contact of the wheels is noted. The length of the run is measured.

Landing—The aeroplane is landed without the use of flaps or brakes and the landing run is measured.
The aeroplane is landed using both brakes and flaps and the landing run is measured.

Abbreviations

Note:—The following abbreviations have been used in the foregoing forms: I.A.S.—Indicated Air Speed. M.A.C.—Mean Aerodynamic Chord. C.A. –Certificate of Airworthiness. A.T.C.—Approved Type Certificate. A.M.—Air Ministry.

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ENGINEERING IN TRANSPORTATION

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Paper presented before the Vancouver Branch of The Engineering Institute of Canada, November 24, 1939

(ABRIDGED)

The part which transportation plays in our economic life is so important that no apology is needed for examining briefly the relation of the art of transport to our national wealth production.

The complicated fabric of commercial and industrial relationships which makes our individual efforts effective would be unworkable without some organized means of transportation. The art of transportation, therefore, in an engineering sense, becomes part and parcel of our commercial and industrial life and cannot be segregated from it.

One curious fact about transportation, however, marks it as different from most of the other arts of commerce and industry. In most instances of industrial effort, there results some visual evidence of increased value, as for example when useless clay is baked into useful brick. In transportation no such change takes place. If the brick is transported from the brick works to the city a place value is created. The brick at the brick works, in an economic sense, had little more value than the clay; it is only when it was transported to a place where it became useful that its value became fully evident. A certain amount of wealth is consumed in the movement of the brick, and it is the relationship between the amount of wealth so consumed and the place value which is created which tests whether or not there has been a net increase in the national wealth.

From a national point of view the efficiency of our transportation may be judged like that of a machine. To apply this test it is necessary to estimate the portion of the national wealth which is dependent upon transportation and also the amount of wealth which is expended in providing the transportation facilities and operating them.

The national capital wealth of Canada is about thirty billions of dollars, and the national income is of the order of five billions of dollars per year. It may fairly be said that nearly all of this vast wealth and income has arisen from the ability to exploit the natural resources of the country, which would be impossible without modern transportation. Thus, much of our national wealth may be considered as being place value brought about by transportation.

A study of the various agencies of transportation develops the fact that the fundamental implement of transport is the steam railway. The only other form of land transport that competes with the railway in amount of service is the highway and motor truck. It may be shown that on the average the cost of service by this medium, in an economic sense, is at least five times as great as by railway. In order to establish the relationship between railway service and national development and national income it suffices at present to point out that the railways handle practically all the raw products of industry and commerce which are transported more than a short distance.

The capital investment in Canadian railways amounts to three billion dollars and the portion of the national income assessable against the railways is four hundred million dollars per year. Viewing these figures in relation to the total capital wealth of the country and the national income, it appears that only eight per cent of our national income has to be diverted to railway transport, notwithstanding the fact that Canada uses more transportation per capita than any other country in the world.

These facts have considerable significance; they result from the following chain of circumstances. First, the railways give us access to our vast natural resources scattered over immense areas; second, the nation's industry has turned these natural resources to good account, and lastly, the railways themselves in carrying on their activities as a transportation agency have been efficient.

It is remarkable that Canadian railways, although faced with disabilities of climate and thin traffic, nevertheless supply the cheapest freight transportation of any comparable country in the world. Railway transportation costs in Canada are as low as those in the United States notwithstanding the fact that the traffic density of the railways in the United States is twice as great as in Canada. Here are the figures of cost of transporting one ton one mile in the various countries of the world:

	Revenue per Ton Mile (cents)
Canada	0.97
United States	0.99
Australia	2.47
Argentina	1.94
Great Britain	2.34
France	2.30
Germany	2.05
Italy	2.13

The circumstances already mentioned give the railway, viewed as an implement of production, a wide margin of usefulness, which accounts for the existence of lines of railways which do not pay in the financial sense, but are nevertheless valuable to the commonwealth and, in fact, vital to the continued development of national wealth. The financial results of many pioneer lines of railway, lines which have opened up forest, mineral or agricultural opportunity, are disappointing from the railway standpoint, but nevertheless, the country as a whole benefits.

The construction of pioneering railways has always proved a losing venture unless heavily subsidized, and the reason is not far to seek. The total value of pioneer activity is not to be found in the efforts of the man who cuts down the forest, mines the minerals, or farms the land, but in the towns and cities of Canada where our citizens are employed in processing and marketing the raw products of pioneers. Thus, the marginal utility of the railway as an implement of production is great, but the marginal utility of the farm, the forest development or the mine is, in itself, relatively small. This means that the producer of raw materials can spare but a small amount of his individual productivity to pay freight rates and therefore freight rates on raw materials must be low.

In order to show that the marginal utility of the railway is very large, viewed in relation to the wealth production of the country, one need only point out that to build, equip, maintain and operate a pioneer line of railway costs of the order of four thousand dollars per mile per year, based, of course, on a minimum of service, and since the average wealth production per gainfully employed person in Canada is of the order of twelve hundred dollars, it is only necessary for a pioneer railway to increase gainful employment by five people per mile before it begins to yield a net surplus in the commonwealth report. Since the average number of gainfully employed people per mile of line in Canada is of the order of one hundred people, it will be seen that railways have a wide margin of utility. Thus, viewed from the national standpoint, it is good business to build a pioneer line of railway to tap known natural resources.

There are on every side evidences of Canada's impressive national wealth. We see cities and towns of which any country might well be proud; schools, colleges, universities, hospitals, homes, all brought into being by an industrious people, busily engaged in developing the country's natural resources. This has been made possible by the construction of the railways, which tap natural resources on a continental scale.

There are those who believe that the highway and motor vehicle have wrought a veritable revolution in land transport similar to that which took place when the steam railway was developed a little over a century ago. There are those who believe that highway transport has rung the knell of the railway. A little study will show that this view is not justified. The transport of freight by motor vehicle on the highway is at least five times as expensive as by railway. It is estimated that if we undertook to handle by highway all of the traffic now moving by railway, our freight transport bill, instead of being two hundred and seventy million dollars as it was last year, would be of the order of one billion three hundred and fifty million dollars. In fact, if all freight were moved by truck on the highway, it is doubtful whether there would be enough able bodied men in Canada to operate and service the trucks which would be required. For these reasons it seems evident that the highway and motor vehicles can never displace the railway. It is true, however, that in a selective sense the highway vehicle may perform certain services more economically than the railway; as a result, when we have developed enough experience to correlate the two services on a sound basis, it will be possible to have a better all-round transportation system than ever before.

This problem is easier to enunciate than to solve. In all countries the highway and railway are engaged in uneconomic competition. Curiously enough, in Canada it is only because the railway has produced a considerable economic surplus that this competition has developed to sizeable proportions. The reasoning which leads to this conclusion is interesting. Canada stands second only to the United States in private automobiles per capita; it is an indication of Canada's relative wealth and one of the best evidences that as a nation we have done rather well for ourselves. Private automobiles, however, are useless without good highways. Therefore, we have proceeded to build and enjoy highways on a large scale. It may be noted that nearly 25 per cent of our national income is expended on highways and the private automobile. Putting it in another way, we spend each year three times as much on the private automobile and the highway as we spend on all the railways in Canada combined. This is not a bad feature; it simply illustrates that a country of high surplus has succeeded in a larger measure than many other countries in distributing its surplus equitably, so that there is a wider than ordinary enjoyment of the good things of life. Further, this highway development has been of great assistance in increasing our invisible export of goods and services in connection with the tourist business, so that from the national standpoint any damage which has been caused to the revenue of railways by the diversion of passenger travel from railway to highway has been more than offset by favourable factors.

It is in the use of these highways for freight purposes that definitely pernicious influences begin to operate. This bad effect is due to two factors. First, the relationship between highway costs and the freight vehicle moving upon it has never been intelligently worked out. The freight truck moving on the highway has been an interloper. The highways were not built primarily for him; his use of the highway has been viewed as incidental and the charges made for this use seem to have been calculated on a by-product basis. Therefore, the truck gets the use, on a nominal basis, of highways constructed for our national enjoyment. From this viewpoint a good deal of today's highway freight transport is parasitic on our national wealth.

The second factor is even more important and it is that the freight rate structure of the railway is constructed on what is known as the value-of-service theory, whereas the freight rate structure of the truck is constructed on the cost-of-service theory. On the former theory the amount charged for handling the same tonnage of freight varies greatly with the value of the article transported. Railways transport bulky low-value products very cheaply—in some cases for as little as one-third of a cent per ton per mile—and inasmuch as the average cost of transport by railways is of the order of one cent per ton per mile, they must, in order to balance their budget, charge many times this average figure for the transportation of high valued commodities. It is not unusual that the freight rate on high valued commodities may be as much as ten cents per ton per mile. In no case, however, is the railway freight rate any considerable percentage of the market value of the commodity, and, therefore, both low and high valued commodities can move great distances to market. This type of rate structure obviously tends to break the barriers of distance, thereby equalizing opportunity, and as such it is admirably adapted to a country of continental extent such as Canada.

In contrast, the cost-of-service theory of rate making ignores the value of the commodity transported. It asks no other question than what is the cost of transporting a particular commodity between two points. On applying that theory over any considerable range of commodities and distances one quickly sees its unsuitability to a policy of national development. If wheat grown on the western prairie had to be moved on a cost-of-service basis the prairies could never have been developed.

The cost of service by motor truck is approximately five cents per ton per mile if standard wages are paid. This means that wherever the railway has assessed a freight rate in excess of this figure there is an apparent saving to the shipper by using the truck. However, since the cost of service by railway is only one cent per ton per mile, it is evident that the apparent saving to the shipper is purchased at a loss to the country of not less than four cents per ton per mile. In the last analysis this must appear as a depletion of our net divisible national surplus. In Canada, although not a very great percentage of our national wealth, it amounts to a very large figure in total. Its estimated value is one hundred million dollars per annum, or approximately two per cent of our national income. The fact that it is only a small portion of our national income explains why such an uneconomic development can persist without bringing quick retribution. The fact that it is substantial in amount, however, indicates that the bleeding of high valued traffic from the railway by motor trucks, which operate without any sense of responsibility to national development, hampers railways in furnishing basic low-rate transportation for low-valued raw products of industry. This matter requires thoughtful consideration. There seems no ready-made cure for the situation, although a good deal could be accomplished if it were possible to co-ordinate the regulative and taxing powers of the various provinces, and to establish a liaison with the Board of Transport Commissioners for Canada. Adequate consideration could then be given to the feature of public convenience and necessity, viewed from in national sense, before a truck licence could be issued for either the private carriage of owner's goods or for contract carriage or for the so-called public carrier, who is never in point of fact a public carrier but only a pick and chooser.

This address has been an attempt to view Canada's railways in the perspective of the task which they are performing. It is believed that Canada's railways are and will remain the chief implement in making available the natural resources of the nation. Canada has in her railway system the most efficient and cheapest land transport of any comparable country of the world, and in the future her railways will continue to justify their existence by the service they will render to industry in every part of the country.

DISCUSSION ON THE FUNDAMENTALS OF PILE FOUNDATIONS

Paper by I. F. Morrison,[1] published in The Engineering Journal, October, 1939

R. F. Legget, A.M.E.I.C.[2]

Professor Morrison's paper is a most valuable addition to the literature of foundation engineering. It is to be hoped that it will be widely read alike for the clarity with which the author explains the action of piles as foundation units and as an implicit answer to the rather loose talk which sometimes suggests that students of soil mechanics want to abolish the use of bearing piles. The light which modern soil studies have been able to throw on the economics of the use of bearing piles is, perhaps, one of the principal features presented by Professor Morrison's paper.

There will be general agreement with all the suggestions outlined in the paper. However, the last section in which pile driving formulae are dealt with (and very properly castigated) seems to call for some additional comment when considered in conjunction with ordinary civil engineering practice. It is for this reason that this note is submitted, in the hope that Professor Morrison will be able to endorse what is here suggested as a complement to his paper rather than a criticism of it. Two points call for mention—the use of test borings, and the use of pile driving formulae on small jobs.

At the outset of the paper "it is assumed . . . . that suitable borings have been taken" and it is well said that without data as to the depth and character of the various sub-soil strata "the rational design of foundations is hopeless." At the end of the paper (p. 434) it is suggested that the necessary expenditure for the driving of a test pile "would be much better made for taking suitable borings." While agreeing fully with these statements, the writer feels that even greater emphasis should be placed—in all such consideration of foundation design—upon the necessary adequacy and accuracy of sub-surface exploration. As will be seen from Professor Morrison's paper, the character and relative position of the foundation strata determine the suitability of a pile foundation design. To attempt such a design without a clear understanding of what lies below the surface is, as is said in the paper, "hopeless". Equally hopeless is it to essay such design work when the only borings taken are a few wash-borings, particularly when put down without relation to the local geology. Yet this is still common practice; one of the last contributions to the subject[3], in dealing with test boring went to great length in describing wash boring methods and even went so far as to state that they "give some indication of the length of piles to be specified." Comparison of this suggestion with Professor Morrison's analysis will demonstrate its questionable character.

This warning as to the danger of wash borings as a preliminary to foundation design, coupled with a reminder of the data now available on sub-surface exploration[4] and soil testing are notes which it is desired to add to Professor Morrison's presentation. They are of special importance in the east of Canada in view of the unusual properties of the pre-consolidated clays found in the St. Lawrence Valley. When once disturbed, clays of this type may lose their original character in consequence of which the driving of piles into such ground may reduce its bearing capacity instead of increasing it. It is to be regretted that no records appear to have been published of construction operations which have demonstrated this phenomenon.

In the case of large construction jobs, test boring and careful foundation design are procedures always to be followed. There are many jobs, however, the size of which renders the cost of preliminary exploratory and soil testing work prohibitive. When such work is carried out by public agencies with test boring equipment and laboratory facilities always available, normal economic considerations may sometimes be forgotten in a desire to achieve certainty in design. But for a consulting engineer or the engineer of a small city to attempt to justify the necessary expenditure for comparable work on small jobs will usually be impossible if only on the grounds of ordinary economy, quite apart from the difficulty of persuading the lay mind of the necessity for such work. In such instances, the use of one of the more rational pile driving formulae (notably the Hiley formula) can be justified, provided always that the limitations of the formulae are kept in mind. Limitations are, as suggested by Professor Morrison, the inability of a formula to show up the existence of hidden weak stratum, the diminution of bearing capacity of a group of friction piles as compared to individual pile driving results, and the difference between static and dynamic loading. Admitting these limitations, the use of a formula such as that of Hiley will still serve at least as a guide to the determination of the number of piles required and the depth to which they should be driven. If correlated with even one good test boring and particularly with a static loading test, pile driving records may still perform a useful function in foundation design. Reliance upon results so obtained is justifiable only in the case of small jobs; certainty of the results will always be conditioned by the limitations mentioned above. Theoretical design considerations must always be reviewed in the light of practical application and economic justification; here is one case where a course of action which may be theoretically unsound must often be followed, with suitable safeguards, because of practical and economic necessity.

Jean P. Carrière, A.M.E.I.C.[5]

Professor Morrison's article interested the writer very much. It is a comprehensive condensation of a complicated branch of foundation engineering, and contains some very sound information and advice.

In the final section of his article, Professor Morrison makes short work of all pile driving formulae by pointing out all their disadvantages and inaccuracies. As there are two sides to this question, the writer wishes to present some points in defence of certain pile driving formulae when used correctly under conditions for which they were developed.

At the outset of this discussion the writer would like to point out the generally misleading use of the term "bearing power" as applied to the results obtained from pile driving formulae; the term "resistance to penetration" will be used in what follows.

Most pile driving formulae are attempts to estimate the resistance to penetration of piles under static loads based on dynamic loads due to the kinetic energy of pile driving hammers while driving the piles. These estimates are quite accurate for single piles driven in uniform and non-cohesive sands and gravels. In the case of piles driven in very fine silts or soft clays, the dynamic resistance to penetration is the sum of small frictional resistance and relatively large point resistance, while the static resistance to penetration,

1. Professor of Applied Mechanics, Department of Civil and Municipal Engineering, University of Alberta, Edmonton, Alta.
2. Assistant Professor of Civil Engineering, University of Toronto, Toronto, Ont.
3. "Probing for Bridge Foundations," N. R. Sack, Engineering News-Record, 12 th October, 1939, p. 69.
4. For example, "Exploration of Soil Conditions and Sampling Operations," H. A. Mohr, Harvard University, Graduate School of Engineering Studies, Bulletin 208, 1936.
5. Assistant Engineer, Department of Public Works, London, Ont.

especially after the piles have set a certain length of time, is the sum of full frictional resistance and small point resistance.

Consequently, whereas the results given by some pile driving formulae for piles driven in granular non-cohesive soils are accurate, certain compensations must be made when cohesive soils are encountered, and these can be made by a study of the characteristics of the soil encountered.

The Hiley Formula[6] is a comprehensive and rational formula because it takes into consideration such factors as make it suitable for practically universal application and its results have shown satisfactory agreement with actual loading tests. This formula does not attempt to recommend "safe loads" but gives fairly accurate values of the "resistance to penetration" of the piles static loading.

From a mechanical point of view, the assumptions on which this formula is based are sound.

Boussinesq's formula, recommended by Professor Morrison's article, was developed to estimate the stresses at any point in "homogenous elastic solids of indefinite extent" due to a concentrated load applied normal to the surface.

Soils are not homogenous, isotropic or perfectly elastic, and since all of these properties are *assumed* in deriving the equations we cannot expect the formula to necessarily give an accurate picture of how stresses vary in soils.

Similarly with pile driving formulae of the Hiley type, the properties enumerated above have to be assumed and since both types of calculation, although different in application, contain assumptions of the same nature, there is no reason why one should be more accurate than the other.

The Author

The author wishes to express his appreciation of the interest in this paper taken by Professor Legget and Mr. Carrière as shown by the discussions which they have contributed. He has no hesitation in endorsing what has been said by Professor Legget with the exception, perhaps, of his remark regarding the use of a pile driving formula as a guide to the determination of the number of piles required. It would appear that the process implied here is that from the results of observation on the driving of one or several piles into the ground at the site an estimate of the safe carrying capacity of a single pile is thereby ascertained. Then the total weight of the structure divided by that carrying capacity per pile gives the number of piles required. If this be the process implied by Professor Leggett, the author takes exception to it, except in the case of bearing piles, in which case, however, the results of a driving formula are of no value. For there is no relationship between the settlement of a group of floating piles and the resistance to penetration of a single pile. The only rational process is to work out the settlement due to the compression of the stratum below the piles.

In connection with Mr. Carrière's discussion, the author is quite prepared to admit, as he has already in this paper, that under proper, though uncommon, conditions, the static resistance to penetration is roughly equal to the dynamic resistance to penetration and that a pile driving formula will give approximately the resistance to dynamic penetration in the case of a single pile. But such result is of little actual value in the design of pile foundations with the exception, perhaps, of cases where the piles are very widely spaced and can therefore be taken to act as individuals, as, for example, in the case of a pile bent in a railway trestle.

The assertion that the assumptions on which the Hiley formula is based are sound is hardly tenable. It is based on a number of assumptions some of which may well be questioned and, moreover, its derivation would not likely survive a vigorous mathematical analysis. Terzaghi has given a more comprehensive formula based on the theory of semi-elastic impact. It is, however, not profitable to indulge in such elaborate mathematical analysis except from the point of view of academic interest.

The author was not aware that he had *recommended* Boussinesq's formula and regrets that his remark should be so interpreted. It is always difficult to know what may be read into one's written statements. For purposes of illustration some formula had to be chosen. It is difficult to follow, however, the argument offered by Mr. Carrière in this connection. Merely because two entirely different formulae are of necessity based on simplifying assumptions is, of itself, no reason to suggest that the order of the accuracy of the one is not higher than that of the other.

The important point in connection with pile foundations is not the resistance of a single pile to penetration but rather the amount of settlement which a group of such piles will suffer under a certain load in a given time interval. Such probable settlement can, and has been, estimated with sufficient accuracy by means of suitable formulae. It is hopeless to expect that any pile driving formula, based on the theory of impact, can ever yield such results. Locally applicable driving formulae based solely on driving experience and subsequent loading tests can, of course, be developed. However, very few loading tests on groups of piles have ever been carried out.

6. Structural Engineer, Vol. 8, July and August, 1930.

REPORT OF COUNCIL FOR THE YEAR 1939

Council is pleased to report to the membership on a year that has been marked with many important events, but which withal has been a successful one for the Institute. The many reports from branches and committees which follow herewith largely make up the history of the year, and indicate the wide field in which the Institute operates. As the progress of the Institute is but the sum of the activities of the branches, it is recommended that these reports be read carefully.

With the Institute as with individuals and other organizations in Canada, the declaration of war has been the principal event of the year. Up to the year's end it has not affected the affairs of the society to any great extent, but it is probable that within the next twelve months the course of Institute history will be greatly altered by it. Many members are taking leading parts in the war activity of the nation. In the active forces, in government and industry, many of the greatest responsibilities fall on the shoulders of engineers whose names are familiar to us all. It is Council's hope that good fortune and success will attend them in their every effort.

Finances

The surplus for this year is larger than has been declared for some time. It is satisfactory to note that it comes from an increase in revenue as well as from a decrease in expenditure. The Treasurer's report and that of the Finance Committee deal with this in more detail. The fine work of the latter deserves special notice. A study of the report will be interesting as well as informative. The changes in the physical characteristics of the Journal, which were recommended by the Publication Committee and were inaugurated at the first of the year, have resulted in a substantial saving in cost, and an increase in advertising space has brought about a nett increase in income. It appears from the comments that have been received that the changes in material and arrangement of the interior of the Journal have met with general satisfaction. Additional changes are planned for the near future which it is hoped will make the Journal still more attractive to the members.

It is regrettable if the advent of war will interrupt the steady improvement in Institute affairs which has been evident in recent years. If it were possible to continue this acceleration, or even to maintain the present level for a few years, Council would be able to enlarge the programme of activities and to prosecute more successfully some of those already underway so that the Institute would more than ever fulfil its objectives.

It is expected that enlistment in the active forces will reduce the numbers participating in branch activities, and consequently adversely affect the revenue of the Institute. Already Council has ruled that fees of members in overseas service shall be remitted upon application, and regulations and instructions that will be appropriate are now being prepared for publication.

Visits to Branches

The President visited every branch at least once within the year, and throughout all his visits was enthusiastically received by branch officers and members. At every opportunity he spoke at the universities to the undergraduate body and in this fertile field spread the gospel of good citizenship, professional status and the work of the Institute. On frequent occasions he addressed service clubs and other non-professional bodies, thus doing much to keep the profession favourably in the public eye. He presided at five Council meetings in five different cities distributed from Pictou, Nova Scotia, to Calgary, Alberta.

The General Secretary visited twenty of the branches, most of them in the company of the President.

Council Meetings

Council has continued the practice of holding meetings away from Headquarters when possible, and perhaps established a new record in the number so held within a year. Out of eleven meetings, five were held away from Montreal, at the following cities, the bracketted figures, which include guests, showing the number in attendance: Pictou (21), Ottawa (38), Toronto (45), Hamilton (37), Calgary (24).

Voluntary Service Registration Bureau

Headquarters, in co-operation with the Canadian Institute of Mining and Metallurgy and the Canadian Institute of Chemistry, completed a very intensive effort to secure for the Government a record of education and experience for all technically trained men in Canada. Over 16,000 questionnaires were submitted to the members of fifteen engineering organizations, including all provincial professional associations. These records have been turned over to the Voluntary Service Registration Bureau at Ottawa, where, under the guidance of Dr. H. M. Tory, the register will be operated for the benefit of industry and governmental departments.

Maritime Meeting

A Maritime Professional Meeting was held at the end of August at Pictou, Nova Scotia. A very efficient committee made up of representatives from all four Maritime branches, prepared a programme of papers and social events that pleased everyone. The attendance was satisfactory, particularly in view of the disturbed international situation which came to a head just at that time, and finally resulted in the declaration of war on the last day of the convention. Such a meeting in the Maritimes was particularly appropriate in view of the fact that a maritime president was in office. President McKiel was present for all functions and presided at the meeting of Council which was held on August 30th.

By-law Changes

As an outcome of the very complete report made last year by the committee on Membership and Management under the chairmanship of Professor R. A. Spencer, certain by-law changes are being sponsored by Council, and will be submitted to the members early in 1940. The effect is to eliminate the present classification of Associate Member, leaving only one class of corporate members i.e., Member, and somewhat changing the qualifications for that classification. It is believed that such an amendment will facilitate negotiations towards closer co-operation between the provincial professional bodies and the Institute.

Provincial Professional Associations

Substantial progress has been made in negotiations with provincial professional associations, as will be seen in the report of the Committee on Professional Interests. This committee has carried on most effectively the work started in previous years and is now able to announce the outstanding event of the year, the completion of a ballot on a proposed agreement with the Association of Professional Engineers of Nova Scotia. The several years of thought and negotiation on the part of many members of the Association and the Institute finally resulted in an agreement which was submitted to and approved by the "electorate" in December. The agreement is to be signed by your President and Secretary in Halifax on January 25th, 1940.

The Institute representatives in other provinces report that conversations are underway which it is hoped will lead to similar agreements with the provincial bodies in other parts of Canada. Council is very happy to know that such is the case and will be glad at any time to assist the provincial joint committees whenever deliberations have proceeded so far that its active co-operation is requested.

Council is pleased to acknowledge the kindness and courtesies received by the Institute and by its officers, from officers of the various provincial associations, and wishes to make special acknowledgment to the officers and executive of the British Columbia Association for the luncheon which they tendered the President and General Secretary of the Institute when they were in Vancouver. The helpful attitude of the officers of the Nova Scotia Association has been very much appreciated, and Council is delighted that these many meetings have resulted finally in a mutually satisfactory agreement.

The Saskatchewan agreement is now in the second year of its operation, and it becomes possible to offer a preliminary report on its effectiveness. The principal advantages of all such agreements are that they establish and encourage a closer co-operative effort by and between engineers. It is difficult to properly appraise such values, although their existence is never in doubt, but cold figures are available that show the results as far as the membership lists are concerned. These are shown elsewhere in the report of the Committee on Professional Interests.

International Relations

One of the most active committees has been that dealing with international relationships. Perhaps the greatest effort ever made by the Institute towards international co-operation was worked out by this committee in the preparations for the British American Engineering Congress, which unfortunately had to be cancelled at the last minute because of the impending outbreak of war. Other activities of the committee are referred to in its annual report.

Training and Welfare of the Young Engineer

During the year a special committee was set up at the President's request, to explore the field of service for the young engineer. This committee has finished a year of great activity and has already accomplished a considerable amount of the work that was assigned to it. The report which follows gives some idea of the immensity of the task and methods that were followed in successfully carrying it out.

The Institute has been fortunate in all its committees, as a survey of the year's activities will show, and the Council is glad of this opportunity to express its appreciation of the time and effort expended by these gentlemen in the interest of the profession.

Julian C. Smith

It is with deep regret that the death of a past-president has to be recorded. Dr. Julian C. Smith, who was president in 1928, passed away on June 24th, 1939. Dr. Smith had never ceased to be interested in the Institute, and was ready at all times to give of his time to officers and councillors who came to him over a long period of years for advice and counsel on Institute affairs. His death has been felt very seriously by all those who knew him, and with his going the Institute has lost one of its strongest friends and most helpful supporters.

Headquarters

During the year Mr. Louis Trudel was installed at Headquarters as assistant to the secretary. Since then he has become familiar with the requirements of the position and given very valuable service. This was particularly true during the absence of the secretary from the office this summer while confined to the hospital as the result of an accident, at which time the burden fell almost entirely on Mr. Trudel's shoulders.

For the second year Council issued Institute Christmas cards. Two thousand were sent out by officers, branch executives and Headquarters. The demand was substantially greater than in 1938

The Fifty-Third Annual General Meeting was convened at Headquarters on January 26th, 1939, and was adjourned to the Chateau Laurier, Ottawa, on February 14th, 1939, where, under the auspices of Their Excellencies Lord and Lady Tweedsmuir, a most successful annual and professional meeting was concluded. A full account of this meeting appeared in the March, 1939, Journal.

Roll of the Institute

During the year 1939, three hundred and fifty-four candidates were elected to various grades in the Institute. These were classified as follows: twenty-eight Members; one hundred and two Associate Members; forty-four Juniors; one hundred and seventy-four Students, and six Affiliates. The elections during the year 1938 totalled three hundred and twenty.

Transfers from one grade to another were as follows: Associate Member to Member, twenty; Junior to Member, one; Junior to Associate Member, fifty-one; Student to Associate Member, twelve, and Student to Junior, twenty-three, a total of one hundred and seven.

The names of those elected or transferred are published in the Journal each month immediately following the election.

Removals from the Roll

There have been removed from the roll during the year 1939, for non-payment of dues and by resignation, twenty-one Members; seventy-one Associate Members; thirteen Juniors; eighteen Students; three Affiliates, a total number of one hundred and twenty-six. Six reinstatements were effected, and sixteen Life Memberships were granted.

Deceased Members

During the year 1939 the deaths of forty members of the Institute have been reported as follows:

Members

Abell, Harry Clinton
Dancer, Charles Henry
Davis, George Sanford
Dow, John
Emra, Frederic Harcourt
Gill, James Lester Willis
Grant, William Roy
Hodgins, Arthur Edward
Japp, Sir Henry
Kaelin, Frederick Thomas
Macallum, Andrew Fullerton
McDonnell, Frank
McKenzie, Bertram Stuart
McLean, Norman Berford
McMaster, Alexander T. Carson
Reid, John Garnet
Risley, Wilfred Cary
Ross, Donald William
Smith, Julian Cleveland
Spencer, Raymond A.
Taché, Joseph Charles
White, Thomas Henry
Wilkie, Edward Thomson

Associate Members

Boast, Richard Griffith
Bonnell, Mossom Burwell
Boulian, Job Ivan
Bourbonnais, Paul Emile
Casgrain, Senator Joseph Philippe Baby
Cassidy, John Francis
Coxworth, Thomas Walker
Cripps, Bernard Harold
Cross, George Esplin
Desmeules, Sylvio A.
Drewry, William Stewart
Evans, George Edward
Landry, Joseph Honoré
Nicholson, Thomas Herbert
Stadler, John Charles
Murray, Robert Roy

Affiliate

Jones, Frank Percy

Total Membership

The membership of the Institute as at December 31st, 1939, totals four thousand, eight hundred and thirteen. The corresponding number for the year 1938 was four thousand, six hundred and thirty.

1938

Honorary Members	16
Members	1,053
Associate Members	2,218
Juniors	496
Students	806
Affiliates	41
	4,630

1939

Honorary Members	16
Members	1,057
Associate Members	2,287

Juniors	496
Students	914
Affiliates	43
	4,813

Respectfully submitted on behalf of the Council,

H. W. McKiel, M.E.I.C., *President.*

L. Austin Wright, A.M.E.I.C., *General Secretary.*

TREASURER'S REPORT

The President and Council:

The finances of the Institute show a substantial improvement over last year with a surplus of $4,210.93 which is gratifying.

Unfortunately this surplus does not represent a liquid asset as most of it went to cover an overdraft of $3,210.94 in the Institute's account in the bank last year. The amount is insufficient to reimburse the moneys borrowed from the special funds some time ago which loan now stands at $3,314.98.

No item of expense has been included to represent the depreciation on the building, nor in the present condition of the Institute finances would anything be gained by so doing.

Your treasurer is pleased at the improvement in the Institute's finances in the last few years and hopes that the present policy will be continued so that a useful cash balance may be shown in the near future.

Respectfully submitted,

De Gaspe Beaubien, M.E.I.C., *Treasurer.*

FINANCE COMMITTEE

The President and Council:

The statement of revenue and expenditure which is presented herewith reflects the healthy condition and satisfactory growth of the Institute during the past year. In the opinion of your committee, this result is largely due to the increase in branch activities and the greater interest in Institute affairs, which have followed successive visits of our presidents and the General Secretary to the branches from coast to coast. The active functioning of the branches is reflected in the increase in new members, current fees paid, and arrears collected. Expenditures have been kept to a minimum commensurate with the requirements of your membership. The decrease in these expenditures from last year is due in no small part to the loyal co-operation of the General Secretary and the Headquarters' staff.

The surplus of revenue over expenditure has enabled your committee to liquidate the bank overdraft and to start the new year with an amount of cash on hand slightly larger than last year. It should be remembered, however, that the Institute has a very difficult year ahead. We should give to our members on active service, every facility to maintain their membership in the Institute without cost to them and to do this we believe we can depend upon loyal co-operation of every member of the Institute.

Respectfully submitted,

Fred Newell, M.E.I.C., *Chair man*

COMPARATIVE STATEMENT OF REVENUE AND EXPENDITURE

For the Year Ending 31st December

Revenue

	1939	1938
Membership Fees:		
Arrears	$ 3,459.52	$ 2,404.50
Current	26,581.91	25,766.28
Advance	406.11	545.15
Entrance	1,894.00	1,438.00
	$32,341.54	$30,153.93
Publications:		
Journal Subscriptions and Sales	$ 7,390.68	$ 7,041.60
Journal Advertising	13,660.24	14,710.43
	$21,050.92	$21,752.03
Income from Investments	$ 457.89	$ 448.21
Refund of Hall Expense	520.00	485.00
Sundry Revenue	5.60	26.69
Total Revenue	$54,375.95	$52,865.86

Expenditure

	1939	1938
Building Expense:		
Property and Water Taxes	$ 2,020.56	$ 2,031.73
Fuel	492.25	373.81
Insurance	229.67	189.32
Light, Gas and Power	311.05	314.90
Caretaker's Wages and Services	913.00	878.00
Maintenance and Repairs	766.59	653.95
	$ 4,733.12	$ 4,441.71
Publications:		
Journal—Salaries and Expense	$15,244.69	$18,275.00
Sundry Printing	457.40	769.61
	$15,702.09	$19,044.61
Office Expense:		
Salaries	$12,534.07	$11,453.64
Telephone, Telegrams and Postage	1,848.45	1,736.28
Office Supplies and Stationery	1,094.11	1,265.29
Audit and Legal Fees	250.00	315.00
Messenger and Express	93.79	111.67
Miscellaneous	555.74	808.85
Depreciation—Furniture and Fixtures	368.70	409.66
	$16,744.86	$16,100.39
General Expense:		
Annual and Professional Meetings	$ 2,316.89	$ 1,873.77
Meetings of Council	449.62	432.88
Travelling	1,244.01	1,267.61
Branch Stationery	242.06	201.23
Students Prizes	46.35	69.79
E.I.C. Prizes	286.25	288.45
Gzowski Prizes	34.50	17.25
Library Salary	600.00	600.00
" Expense	456.36	401.95
Interest, Discount and Exchange	181.45	225.43
Examinations and Certificates	22.75	*11.66*
Committee Expenses	167.08	445.83
National Construction Council	100.00	150.00
Sundry	92.15	......
	$ 6,289.47	$ 5,962.53
Rebates to Branches	$ 6,695.48	$ 6,401.58
Total Expenditure	$50,165.02	$51,950.82
Surplus for year	4,210.93	915.04
	$54,375.95	$52,865.86

LEGISLATION COMMITTEE

The President and Council:

Your Legislation Committee begs to submit the present report concerning its activities in 1939:

(a) The Committee has not been called upon to consider any suggestion or report concerning legislation which might have been made by a Branch or a provincial division.

(b) In regard to legislation, either actual or proposed, which is likely to affect the interests of the Institute or of its Members, the Committee submits the following information:

1. In Quebec, a bill presented early in the year to the Provincial Legislature by the Association of Architects of the Province of Quebec, which might have affected the interests of some members of the Institute, was later withdrawn.
2. In British Columbia, an attempt was made, at the recent 1939 session of the Legislature, to pass a bill for the licensing of contractors of all kinds. This bill was extensive and far reaching. On account of the very little time given to the interested parties to study the bill and of representations made to that effect, the proposed legislation did not receive the approval of the Private Bills Committee and, consequently, was not brought down in the House. It is very probable that a similar bill will be presented next year.
3. To the knowledge of the Committee, no other attempt to pass any legislation was made in 1939 and no other legislation is proposed for 1940, in any province, which is likely to affect the interests of the Institute or of its Members.

(c) At the request of Council, the question of certain income tax concessions granted to a class of professional men and refused to others, among which were the engineers, was studied and representations were made to the Commissioner of Income Tax at Ottawa to the effect that under similar circumstances the members of all professions should be treated alike and further, that, if the difficulties which have arisen in the past with regard to claims for allowance of automobile expenses, depreciation, etc., were due to the lack of proper records showing the amounts actually expended for business purposes, the Department should supply the proper forms to, and enforce their use by, the interested parties so that it may (1) determine, as closely as possible, to what extent the automobiles were used for business purposes and for personal purposes, and (2) make the proper deductions or allowances on the Income Tax returns.

It is too early yet to foresee what will be the decision of the Department of National Revenue concerning this matter.

Respectfully submitted,

Alex. Larivière, M.E.I.C., *Chairman*

COMPARATIVE STATEMENT OF ASSETS AND LIABILITIES

As at 31st December

Assets		1939	1938
Current:			
Cash on hand and in Bank....		$ 432.38	$ 115.82
Accounts Receivable..........	$3,162.93		
Less: Reserve for Doubtful Accounts....................	103.17		
		3,059.76	3,277.71
Arrears of Fees—estimated....		2,500.00	2,500.00
		$ 5,992.14	$ 5,893.53
Special Funds—Investment Account:			
Investments.................	$7,285.14		
Cash in Savings Accounts.....	3,281.70		
Due by Current Funds........	3,314.98		
		13,881.82	12,013.62
Investments at Cost:			
$4,000 Dominion of Canada, 4½%, 1959.........	$4,090.71		
200 Dominion of Canada, 4½% 1958.........	180.00		
100 Dominion of Canada, 4½% 1946.........	96.50		
1,000 Montreal Tramways, 5% 1941...........	950.30		
2,000 Montreal Tramways, 5% 1955...........	2,199.00		
500 Prov. of Saskatchewan, 5% 1959...........	502.50		
2 Shares Canada Perman't Mortgage Corporat'n.	215.00		
40 Shares Montreal Light, Heat & Power, N.P.V.	324.50		
		8,558.51	8,558.51
Advances to Branches.................		100.00	100.00
Advance Travelling Expenses..........		100.00	100.00
Deposit—Postmaster..................		100.00	100.00
Prepaid and Deferred Expenses........		804.23	602.18
Gold Medal...........................		45.00	45.00
Library—At Cost less Depreciation.......		1,448.13	1,448.13
Furniture and Fixtures—At Cost less Depreciation............................		3,708.75	3,687.02
Land and Buildings—at Cost...........		91,495.22	91,495.22
		$126,233.80	$124,043.21

Liabilities		1939	1938
Current:			
Bank Overdraft.......................			$ 3,210.94
Accounts Payable.....................		$ 2,494.13	3,248.08
Rebates due Branches.................		722.03	645.68
Library Deposits.....................		5.00	5.00
Amount due Special Funds.............		3,314.98	3,314.98
		$ 6,536.14	$10,424.68
Special Funds:			
As per Statement attached............		13,881.82	12,013.62
Reserve for Building Maintenance.....		350.00	350.00
Surplus:			
Balance as at 1st Jan., 1939..	$101,254.91		
Add: Excess of Revenue over Expenditure as per Statement attached..	4,210.93		
		105,465.84	101,254.91
		$126,233.80	$124,043.21

Audit Certificate

We have audited the books and vouchers of The Engineering Institute of Canada for the year ended 31st December, 1939, and have received all the information we required. In our opinion, the above Statement of Assets and Liabilities and the attached Statement of Revenue and Expenditure for 1939 are properly drawn up so as to exhibit a true and correct view of the Institute's affairs as at 31st December, 1939, and of its operations for the year ended that date, according to the best of our information and the explanations given to us and as shewn by the books.

(Sgd.) Ritchie, Brown & Co.,
Chartered Accountants.

Montreal, 23rd January, 1940.

PUBLICATION COMMITTEE

The President and Council:

During the year 1938, the Publication Committee, at the request of the Council, made an exhaustive study of matters pertaining to the publications of the Institute, especially the Engineering Journal.

As a result, a report was presented to the Council, in which the opinion was expressed, that it was not advisable to make any sweeping transformation of the Journal which would have the effect of altering the character of this publication, which had been firmly established for over twenty years.

The Committee, however, recognized the fact that owing to the comprehensive character of the Institute activities and the wide scope of professional interests of its members, it was very difficult to provide sufficient technical papers to meet its needs. It therefore recommended that certain additions be made to broaden the interest and increase the diversification of the material published.

To attain this end, a section entitled "Abstracts of Current Literature" was added. This section was to cover all branches of engineering, and a number of members of the Institute were asked to act as advisory Members of the Publication Committee. Thirty-five members kindly agreed to act. Their functions were to consist in preparing, each in his own field of engineering, abstracts of articles of importance published in other periodicals.

It was thought also that short papers, not as a rule exceeding one or two pages in length, would be of interest to the members.

Several other minor changes were also made, all with the object of improving the general tenor of the publication. These changes and additions came into effect in the January issue of 1939, and have been carried out for the whole year.

The Committee met at least once a month during the year. All papers and matters generally connected with the publication of the Journal were submitted by the General Secretary to the Committee for approval. As far as possible, papers were proportionately divided amongst the various branches of Engineering.

It must be noted that to achieve the results anticipated by the new set up of the Journal the support of the Advisory Members of the Publication Committee, together with that of all members of the Institute, must be accorded and continued.

With such support, we may look forward to a publication of which the Institute will be proud.

Respectfully submitted,

A. Duperron, M.E.I.C., *Chairman.*

LIBRARY AND HOUSE COMMITTEE

To the President and Council,

Your committee reports as follows:

Meetings were held throughout the year whenever necessary to deal with matters other than those which are customarily handled as a matter of routine by the staff.

Authorization was obtained for the re-decoration of the washroom early in the year; this was the only major item left over from the programme of last year. In addition, emergency repairs were necessary in the caretaker's premises due to a break in the plumbing; some other alterations were also made to improve the heating system.

The Committee recommends that illumination be provided for the front porch. Due to the lateness of the season, this recommendation is passed to next year's officers.

Some necessary replacements were made to the furniture in the reading room; the accommodations were greatly improved thereby and favourable comment has resulted.

In the past the reading room has been open until 9 p.m. daily (6 p.m. Saturdays). Due to serious inconvenience to the staff and negligible use by the members, Council agreed to our proposal to close the building at 6 p.m., except when meetings are to be held. This has worked out satisfactorily. Any member desiring to use the reading room after hours may do so without restriction by telephoning prior to regular closing time.

It was agreed that photographs of past secretaries of the Institute should be obtained as a matter of record. As soon as all necessary pictures have been secured, they will be suitably framed and properly placed.

Library and Information Service

Your committee regrets that the Library Services are not used as extensively as they might be, and that the library accessions are limited by the small funds available. The statistics for the year 1938 and 1939 are as follows:—

	1939	1938
Requests for information..................	1,222	727
Bibliographies compiled (number of pages)..	70	56
Photostats furnished (number of pages).....	78	129
Accessions to library (largely reports, etc.)...	515	464
Books presented for review by publishers....	35	35

The question of how to reach and maintain the standard at which the Institute Library should aim has been discussed at length, but your committee was not able to approach Council with a definite scheme during the past year. It is recommended, however, for our successors that a subsidiary committee be appointed with capable men in the various branches of engineering to review the library situation and make suggestions for the acquisition of modern current text and reference books; and eventually that an application should be made to Council for an annual grant (of about $150.00) for the purchase of such books as are recommended.

This committee with the General Secretary should also consider how best to obtain for the Journal reviews of the current technical books received from publishers. The library has benefited greatly from this source; in fact it has provided practically all of the additions of text books for some time past. The difficulty of obtaining voluntary co-operation from the membership in this matter adds considerably to the work of the headquarters staff, and some organized scheme should be developed.

Respectfully submitted,

Brian R. Perry, M.E.I.C., *Chairman.*

PAPERS COMMITTEE

The President and Council:

The Committee begs to present the following report for 1939.

An attempt has been made throughout the year to encourage the exchange of speakers and papers among the various branches, particularly the more isolated. In this we have not been as successful as we would like, although many of the Branches have had excellent programmes with good speakers and many papers of merit have been presented.

We are of the opinion that to make the work of the Papers Committee as effective and successful as it should be, a clearing house should be established where copies of all papers presented at Branches would be sent and names of speakers who address the Branches would be registered. In this way we would be able to offer greater assistance to those Branches where there is not a sufficient supply of speakers and papers.

This year a sum of money was voted for travelling expenses for speakers in the Prairie Provinces. We are of the opinion that as much assistance as possible should be given to encourage good Branch programmes and activities.

Respectfully submitted,

James A. Vance, M.E.I.C., *Chairman.*

COMMITTEE ON THE TRAINING AND WELFARE OF THE YOUNG ENGINEER

The President and Council:

By decision of Council at its regular meeting in Hamilton, Ontario, on May 27, 1939, a Committee on the Training and Welfare of the Young Engineer was named.

The terms of reference contained in Minute 9653 of that meeting stated:—

"It is suggested to this Committee that three phases of investigation be pursued for the present—

"(a) The training of the engineer, including the period in high school, with a view to ascertaining if any changes in the Canadian system would seem to be desirable.

"(b) The method of absorption by the profession of the young engineering graduate, and what can be done to facilitate this absorption.

"(c) The relationship of the Institute and the young engineering graduate to organized engineering, and what The Engineering Institute can do to interest and serve this group.

"If, in the course of the study above suggested, it would seem advisable to the Committee to pursue additional lines of investigation, the Council will be glad to receive suggestions as to the enlargement of the scope of the Committee's activities."

The fact that the members of the Committee were scattered from Halifax to Vancouver precluded the possibility of an organization meeting without entailing considerable expense, either to the Institute or to the individual members. The Committee members were canvassed by letter as to the avenues we should follow in our preliminary investigations. The suggestions offered were indicated in a questionnaire which was sent by the Committee to about 460 selected members of the Institute and to several others who are interested in engineering education.

Replies were received from 23 per cent of the inquiries, and are still being received. It is encouraging to note that they have come, generally, from engineers of wide experience and responsibility, and it is encouraging to the Committee to have these valuable opinions on which to base conclusions.

Thirteen of the twenty-two questions submitted could be answered, in whole or in part, by a positive or negative reply. The remaining questions required a statement of opinion or of details amplifying the direct questions. The replies indicated the opinions of the members in the following proportions.

(a) That the Institute should undertake some form of vocational guidance work among high school boys—65 per cent.

(b) That the Institute should have a more direct contact with engineering school activities—86 per cent.

(c) That the Institute should devote more time to young engineer activities and assist him in adapting himself to his profession—75 per cent.

(d) That the entrance requirements to the several Canadian engineering schools should be standardized at a high level—80 per cent.

(e) That the present college period in engineering training is sufficient—80 per cent.

(f) That the essential training of an engineer should be of a general character—90 per cent.

(g) That more attention must be given at some period in the engineer's education, to such cultural and economic subjects as are necessary to equip him for the present day requirements of his profession—about unanimous.

We shall briefly summarize some of the expressed opinions on these several matters, and give the recommendations of the Committee as to positive action necessary to make these proposals effective.

The E.I.C. and Vocational Guidance

It is the opinion of the Committee that the Institute should undertake a systematic collaboration with the educational authorities in the assistance of students in the selection of their professions. It is not intended that we should urge young men to adopt engineering as a profession, but it is evident that the need exists for guidance in the selection of a profession and conversely that the profession should, to some extent, select its students.

The opinion has been expressed by many members of the Institute that this function should be largely advisory, with a carefully selected personnel of those who will be actively engaged in the work.

The problem before the Committee is to propose methods to be adopted by the Institute to best serve the varying conditions in the many communities where this service may be required.

We ask leave to make the following recommendations:—

(a) That a permanent committee of the Institute shall be set up, or that this present committee or its successor be so instructed, to centralize the vocational or student guidance activities of the Institute, and to prepare such instructions, reports, pamphlets, etc., as may be required for the assistance of the Branch Guidance Committees herein proposed.

(b) That each branch of the Institute be asked to appoint a vocational or student guidance committee to undertake personal contacts, addresses to student bodies, co-operation with the local educational authorities, and to co-operate with other related work in the several communities of the branch districts.

(c) That following the establishment of the Central Committee, the educational authorities of the several provinces shall be advised of the readiness of the Institute to co-operate in the student selection for engineering courses, and

(d) That it will be a function of the Institute to bring to prospective engineering students such authoritative information as may be necessary to give them a definite perspective of the educational and cultural requirements, the opportunities of employment, the trends in engineering occupation, the extent and value of the several available courses of study, and other related information.

The E.I.C. and Engineering Student Activities

The future growth of the Institute is definitely dependent on the interest of the young engineers in its activities. It is incumbent on the Institute, therefore, to offer its services to these students while they are attending the several engineering schools. How it can best accomplish this purpose is a matter which requires further discussion by the Committee.

The Dominion Bureau of Statistics in its report "Higher Education in Canada 1936-38," shows that 3,677 students attended Canadian Schools of Applied Science and Engineering in 1937, an increase of 1,456 in 10 years. The same year 537 students graduated, an increase of 206 in 10 years.

These students have their own engineering societies. The Engineering Institute of Canada provides annual prizes, and several of the Institute branches hold joint meetings with these student societies. Other proposals have been made to the Committee and these are to receive our further attention.

The E.I.C. and the Young Engineer and His Adaptation to the Profession

It is agreed that the training necessary for any young engineer cannot be acquired up to his graduation in Applied Science. Much more time must be given to such training after graduation. What The Engineering Instutute can do to stimulate these extra-mural studies and to provide direction in the many fields open for students is still receiving the attention of this Committee.

We are ready, however, to propose to the Institute and to its branches, that more attention should be given to the part taken by the young engineers in branch activities. Where Junior Sections are not possible, these young men should be represented on the branch executives and on many of the committees. They should be encouraged to take part in discussions and a regular meeting each year should be arranged and conducted by them.

Other worthy suggestions have been made, including study clubs, where a variety of subjects could be selected for study and discussion. These, as suggested by Dr. F. H. Sexton of the Nova Scotia Technical College, "would correct the tendencies of the University training which is admitted to be unavoidably narrow and specialized in order to give the student that degree of mastery of science, mathematics and technical knowledge that is necessary for competency in the profession of engineering.

"The study clubs would broaden the young graduate, and perhaps some of the older ones, to enable them to perform their functions in a way which would render wider human service. There is a common feeling abroad that the engineer pursues his activities with a singular efficiency, but without any attention to serious social and economic progress."

The question of assistance to the young engineer in adapting himself to his profession has brought out a diversity of opinion. It is admitted that the older members could take a greater interest in these young men and closer contacts at branch meetings would increase the influence of these older men on them. At the same time the inherent initiative of the young man must not be hampered and he must, on his own, make his way among his fellows.

Entrance Requirements to Engineering Schools

Present examinations for entrance to Canadian engineering schools vary from a minimum of "junior matriculation in English, mathematics, classics, history and geography, chemistry, physics and French with a pass mark of 40 per cent" to a four year course leading to a Bachelor of Science degree, to a maximum of "junior matriculation plus one year in Arts or Science" or "senior matriculation with a pass mark of 65 per cent" to a four year course leading to a Bachelor of Science or Bachelor of Engineering degree.

With this evidence, and the stated opinions of a majority of our members of the necessity, a standardization at a high level of the entrance requirements to engineering is urgently needed. This proposal may be considered drastic but we believe it is vital to the higher academic and cultural standard needed by the Profession if it is to assume its rightful place in our national life.

The Extent and Character of the College Training Period in Engineering

The opinions expressed on these subjects have been many and varied, with an evident unanimity on

(a) The present college years should not be extended;

(b) The essential training of all engineers should be of a general character;

(c) Sufficient technical training is now available,—but

(d) More attention, at some period in the training years, should be given to the humanities, public speaking, English, business administration, engineering law and economics.

The questions of the absorption of the graduate into the profession and the relationship of The Engineering Institute to this problem have received some attention and suggestions have been offered by the Institute members. These will have to be discussed with the idea of evolving something practical which can be adopted in the best interests of the young graduate, the profession and the Institute itself.

The matters for discussion include summer vacation employment, extra-mural studies, increasing branch activities among the university students, and the young graduates, arranging contacts with the older men, extending the field of employment, and quite definitely employment trends and opportunities.

The whole of our studies, so far, indicate the need for the work we have undertaken. Branches of the Institute have discussed the question at regular meetings, in each case placing emphasis on one or more phases. Local education authorities are interested in our activities and they are awaiting a definite programme of co-operation which will lead to a better understanding between the profession and the educationists, and more available information to the students desiring to enter the profession.

In closing this preliminary report, we wish to express the appreciation of the Committee for the assistance given by the members of the Institute, and others, who have given valuable suggestions in the replies to our questionnaire, and to the apparent interest of the profession generally in the Training and Welfare of the Young Engineer.

Respectfully submitted.

Harry F. Bennett, M.E.I.C., *Chairman.*

COMMITTEE ON PROFESSIONAL INTERESTS

The President and Council:

The tangible results of the co-operative agreement between the Association of Professional Engineers of Saskatchewan and the Institute, which has now been in operation for a little over one year, are perhaps the best evidence of the benefits accruing to the engineering profession in a province by the consummation of such an agreement. During the year forty-eight members of the Professional Association, who were not previously members of the Institute, joined the latter body and thirty-three members of the Institute became members of the Professional Association, so that the profession in that province is very rapidly becoming a unified organization. In addition fifty-four members of the Association automatically became members of the Institute with the signing of the agreement in 1938; thus bringing the increase to date up to one hundred and two.

The work of your Committee has been somewhat retarded during a large portion of the year by the enforced inactivity of your Chairman. However, in most of the provinces a closer co-operation between the Institute and the Professional Association has been obtained by the excellent work of your provincial sub-committees and their energetic chairmen. The result of this work is particularly in evidence in Alberta, Manitoba and Nova Scotia.

Your sub-committee in Alberta has submitted a form of agreement which is the result of a series of meetings between a committee appointed for the purpose by the Professional Association and the sub-committee. It has been approved by your Committee on Professional Interests and is now ready for submission to Council. Following approval of Council, the proposed agreement will be submitted by the joint committee to the Council of the Association and then to the members of the Association at the Annual Meeting in March, 1940.

In Manitoba a great deal of work has been done by your provincial sub-committee, and by the accredited representatives of the Professional Association and while it is certain that the majority of the members of the profession in that province are in favour of an agreement, there are some difficulties regarding points of law which have to be settled before anything definite can be accomplished.

In Nova Scotia where it was expected that Past-President Challies would have had the privilege, on behalf of the Institute, of signing an agreement in the early part of 1938, which agreement fell through owing to legal difficulties, it is now the pleasure of your Committee to report that the excellent work of your provincial sub-committee has resulted in an agreement which will be signed on January 25th at Halifax. Your Committee on Professional Interests sincerely wishes the engineering profession in Nova Scotia every success in its new co-operative venture and trusts that the work which has been so well done there will also bear fruit in the other provinces in due time.

Respectfully submitted,

Fred Newell, M.E.I.C., *Chairman.*

MEMBERSHIP COMMITTEE

The President and Council:

Your Committee on Membership has the honour of making the following report:—

The Committee consisted of the following members:—

K. O. Whyte, *Chairman* — H. Massue
J. G. Hall — H. J. Vennes
C. E. Sisson

In an attempt to assist each branch of the E.I.C. to realize the situation regarding membership a photostat copy of a graph made by Mr. Massue was sent to each of them. The graph is reproduced below.

Transfers

An analysis of this graph seems to indicate that:—

(1) University graduates, instead of immediately moving up into the Junior class, retain their Student membership to the age limit and then transfer to the class of Associate Member. This procedure is probably the reason for the static condition of the Junior class as regards numbers.

(2) The Affiliate class could be very considerably enlarged.

(3) a very large transfer could be made from the class of Associate Member to that of Member.

New Members

The formulation of a "new member policy" acceptable to all branches presented a considerable number of difficulties. Your committee has, therefore, restricted its efforts to bringing to the notice of each branch the urgent need of increased membership, each branch being then left to adopt the methods it has found to be best for obtaining new members.

Universities

The disquieting fact that only 22½ per cent of all graduating engineering students are Students of the Institute is shown in the following table.

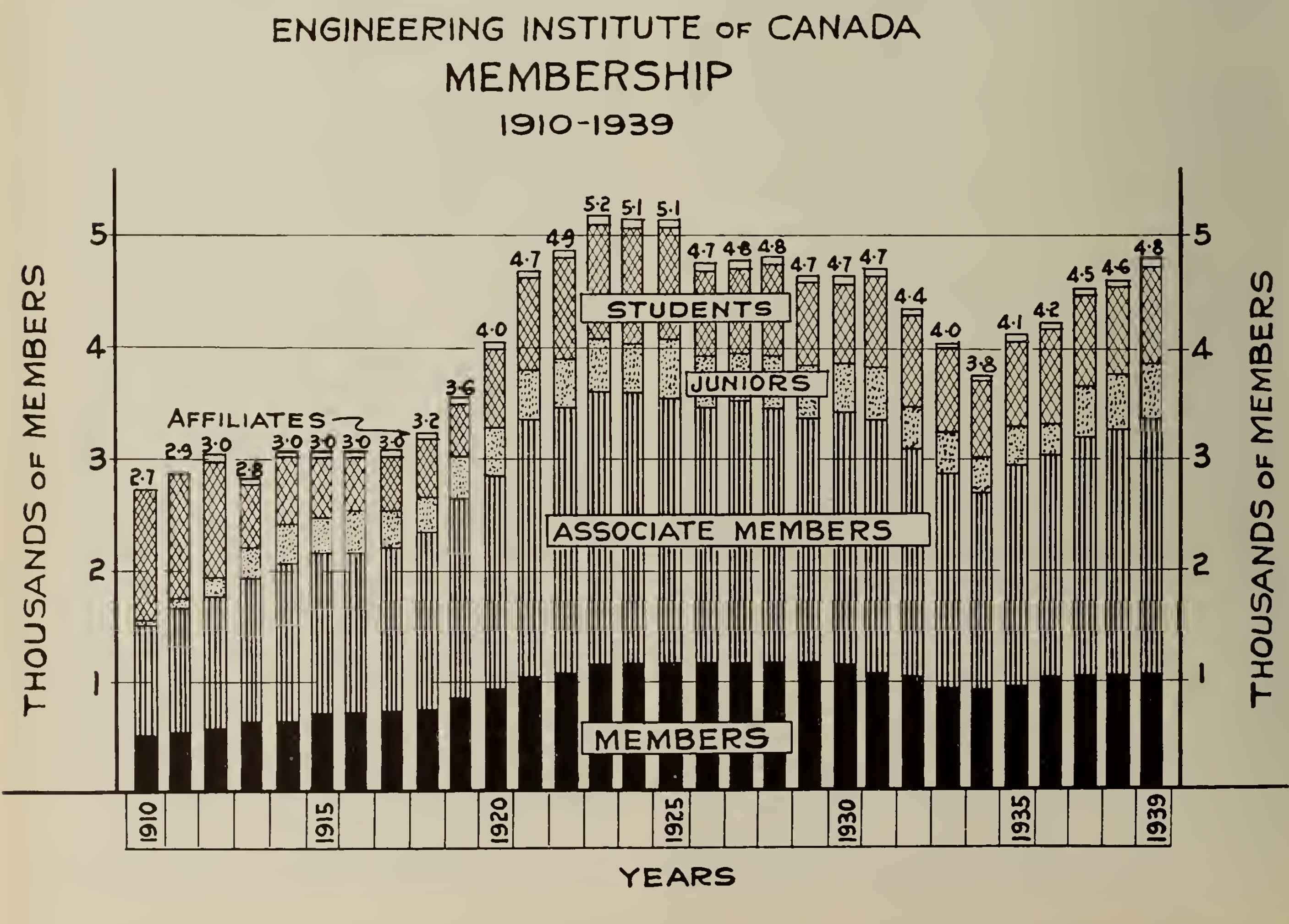
	Number of Graduates	No. of S.E.I.C.	Percentage of S.E.I.C.
Nova Scotia Tech. College	24	8	33⅓ per cent
University of New Brunswick	13	7	50 " "
McGill University	65	20	31 " "
Ecole Polytechnique	26	23	89 " "
Queen's University	124	13	10½ " "
Royal Military College	43	4	10 " "
University of Toronto	140	14	10 " "
University of Manitoba	42	18	43 " "
University of Saskatchewan	28	13	46 " "
University of Alberta	56	17	30 " "
University of British Columbia	71	6	9 " "
	632	143	22½ " "

Your Committee feels that this state of affairs could be considerably improved if one or two professors in the engineering faculties were asked to act on the membership committee of their branch, these gentlemen would then be in a position to point out to each graduating class the many advantages to be gained by joining the E.I.C.

Following instructions given by Council at its Hamilton meeting, your committee has gathered together a few facts regarding the E.I.C. which it thought would be useful to members of Branch Membership Committees. These notes have been printed in a small folder, six copies of which have been sent to the Secretary of each Branch with a request that they be given to the incoming membership committee. One of these folders is attached to this report and we trust that its contents will meet with your approval.

Respectfully submitted,

Keith O. Whyte, A.M.E.I.C.,
Chairman.



BOARD OF EXAMINERS AND EDUCATION

The President and Council:

Your Board of Examiners and Education for the year 1939 has had prepared and read the following examination papers with the results as indicated:

Schedule B

	Number of Candidates	Number Passing
I. Elementary Physics and Mechanics	2	1
II. Strength and Elasticity of Materials	2	0

Respectfully submitted,

C. J. Mackenzie, m.e.i.c., *Chairman.*

COMMITTEE ON INTERNATIONAL RELATIONS

The President and Council:

The principal aim of the Committee on International Relations is to further the traditional policy of the Institute in promoting cordial relations with similarly constituted bodies outside of the Dominion, and in particular with the Engineering Institutions of Great Britain and with the Founder Societies of the United States. It is believed that this very desirable purpose has been carried out during 1939.

An outstanding feature of the fifty-third annual meeting of the Institute, in Ottawa last February, was the presence, as special guests of the Institute, of the sitting presidents of the American Society of Civil Engineers, of the American Society of Mechanical Engineers, of the American Institute of Electrical Engineers, together with the chairman of the Engineers' Council for Professional Development. The visit of these engineers, so distinguished in both professional and official capacities, was appreciated as a real expression of esteem and confidence.

Early in the year, a member of the Committee, Past President Fairbairn, at the request of the Council of the Institute, journeyed to London, England, to confer with the Institution of Civil Engineers and the Institution of Mechanical Engineers regarding the programme for the British-American Engineering Congress, which was to be held in New York in September, with the American Society of Civil Engineers and the American Society of Mechanical Engineers acting as joint hosts. Almost at the last moment, the imminence of war in Europe made it necessary to abandon the Congress, causing keen disappointment on both sides of the Atlantic. But the preliminary planning for the congress, which included the preparation of many authoritative professional papers, fully demonstrated the ability of British, American and Canadian engineering bodies to co-operate constructively in furthering the common interests of the engineering profession.

Advantage was taken of the presence in England during July and August of the Secretary Emeritus to advance a worthy movement instituted by a Past President of the Institution of Electrical Engineers looking to a joint arrangement that would permit members of the British Institutions resident in Canada to enjoy an affiliated connection with the Engineering Institute of Canada and in particular to have the privilege of participating in the activities of its branches.

A member of the Committee, Past President H. H. Vaughan, represented the President and Council of the Institute at the seventy-fifth anniversary of the founding of the school of engineering of Columbia University. On this occasion, Mr. Vaughan presented an illuminated address on behalf of the Institute.

It is a pleasure to report that the American Society of Mechanical Engineers conferred its honorary membership upon Past President Vaughan at its annual meeting in Philadelphia in December last, and that a similar distinction was awarded to Past President Fairbairn by the American Society of Civil Engineers at its annual meeting in New York, on January 17th of this year.

A member of the Committee represented the Institute at the annual meeting of the American Institute of Electrical Engineers in June at San Francisco.

The Chairman of the Committee on International Relations regrets that he was unable to accept the invitation of the Chairman of the Engineers' Council for Professional Development to attend its recent annual meeting in New York. The work which is being accomplished by the E.C.P.D. is of primary importance to engineers on both sides of the international boundary.

J. B. Challies, m.e.i.c., *Chairman.*

RADIO BROADCASTING COMMITTEE

To the President and Council:

The Engineering Institute Radio Broadcasting Committee, appointed for the purpose of co-operating with the Canadian Broadcasting Corporation in an effort to make the Canadian public more conversant with the work of the engineer, was organized in April, and it was decided that any broadcasts should deal more with the romantic and significant achievements of great engineers, rather than with the technical side of engineering.

Correspondence was carried on with other engineering societies, and their experiences in broadcasting were noted. All branches of the Engineering Institute were written to for suggested subjects. From suggestions received from branches and submitted by members of the committee, a number of subjects were selected. The work of compiling bibliographies of these subjects, preparatory to having the scripts written, was to have been done at headquarters. This was not found possible, and later Mr. Hazen Sise, particularly recommended by the Canadian Broadcasting Corporation, was engaged to compile the information and prepare the scripts, trial scripts having previously been prepared by two men, from information readily available, on the engineering skill involved in the construction of the Victoria Tubular Bridge.

On the outbreak of war, it was decided that the broadcasting programme would be improved by enlarging on the outstanding position occupied by the engineer in war time. The committee was advised by the manager of the Canadian Broadcasting Corporation to proceed with the two scripts in preparation, and on October 27th, the first broadcast was given from Montreal—the subject being "An Early Engineering Achievement—Building the Victoria Tubular Bridge." On November 1st, the second broadcast, "Alexander Graham Bell—The Birth of the Telephone," was given. The latter date was altered, as the time was required by the Federal Government. Time did not permit of advising members of the Institute of the change.

Arrangements are now under way for a series of scripts dealing with the engineer's place in the war, which has the approval of the Department of National Defence. These could be prepared without expense to the Institute, but if the broadcasts are to achieve their desired result, the committee should have a small grant for publicity purposes and for any research work it may be necessary to secure, outside of the headquarters organization.

We believe that, with the spade-work done during the past year, the foundation has been laid for a continuous broadcasting programme on the part of the Institute, which will have the approval of the Canadian Broadcasting Corporation, whose courtesy, constant co-operation and assistance are acknowledged with appreciation.

Respectfully submitted,

Fraser S. Keith, m.e.i.c., *Chairman.*

COMMITTEE ON DETERIORATION OF CONCRETE STRUCTURES

The President and Council:

The Committee on the Deterioration of Concrete Structures held a meeting in Ottawa last February at the time of the Annual General Professional Meeting there which was very well attended. At that time the previous policy of the Committee was reaffirmed, namely, that the best interests of the members of the Institute would be served and most progress made if the Committee were to confine their efforts largely to studies of methods for the repair of concrete rather than to the causes for deterioration. This decision was based on the belief that other organizations were ably covering the latter field of work but there was a paucity of reliable information on the former.

During the past year two papers have been prepared by members of the Committee and published in the Journal. The first of these "Comments on Concrete Restoration," by Mr. J. A. McCrory, citing his experience with various methods of repair used in hydraulic structures, was published in the July issue of the Journal; and the second, "Concrete Surfaces Faced with Glazed Tile," by Mr. G. P. F. Boese, describing the resurfacing of disintegrating concrete with clay tile, appeared in the August issue of the Journal. Both of these papers were the subject of much favourable comment.

At the present time the Committee has two other short papers which have yet to be reviewed by them before being submitted for publication in the Journal. Besides these, one other paper is in preparation and another promised.

The Committee thanks all those who have so generously given of their time to further its work and welcomes suggestions both as to sources of data or reports on repair jobs which might be of interest to the Institute.

Respectfully submitted,
R. B. Young, M.E.I.C., *Chairman.*

GZOWSKI MEDAL COMMITTEE

The President and Council:

Your Committee, in view of the merit of the papers named below, would recommend that, if possible, two Gzowski Medals should be awarded this year as follows: To E. A. Hodgson, M.E.I.C., for his paper on "The Structure of the Earth as Revealed by Seismology," and also to G. A. Gaherty, M.E.I.C., for his paper on "Drought—A National Problem."

Respectfully submitted,
A. O. Wolff, M.E.I.C., *Chairman.*

DUGGAN PRIZE COMMITTEE

The President and Council:

Your Committee, appointed to consider the award of the Duggan medal and prize for the year ending June, 1939, have decided that only three papers were eligible for this award. After careful and independent study of them, our opinions were divided between two able, meritorious and extremely useful papers. "The Island of Orleans Suspension Bridge, Prestressing and Erection," by D. B. Armstrong, A.M.E.I.C., and "Welded Steel Pipe for the City of Toronto Water Works Extension," by C. R. Whittemore, A.M.E.I.C. On further consideration we have decided to advise you that Mr. Armstrong should be given the medal and prize. We also strongly recommend that Mr. Whittemore be given a similar prize, the funds being available from last year.

Both of these authors omitted to state definitely their relations to the subject of their papers, but we have verified that these were quite in accord with the regulations. Mr. Armstrong acted as engineer for the contractors for the superstructure of the Isle of Orleans Bridge, and Mr. Whittemore was metallurgist for the contractor for the Toronto Pipe Line.

Respectfully submitted,
F. P. Shearwood, M.E.I.C., *Chairman.*

LEONARD MEDAL COMMITTEE

The President and Council:

On behalf of the Leonard Medal Committee for 1939 I beg to recommend that the Leonard medal be awarded for the paper "The Internal Shaft at Dome Mines, Limited" by Chas. G. Kemsley and A. D. Robinson, as published in the September, 1938, issue of the Canadian Mining and Metallurgical Bulletin.

Mr. Chas. Kemsley, Mechanical Superintendent of the Dome Mines is a member of the Canadian Institute of Mining and Metallurgy and therefore eligible to receive the medal.

Respectfully submitted,
Edgar Stansfield, M.E.I.C., *Chairman.*

PLUMMER MEDAL COMMITTEE

The President and Council:

Your committee, having examined the papers submitted, agreed that none of them was of sufficient merit to be worthy of an award, and therefore recommends that no award be made of the Plummer Medal for the year 1938-1939.

Respectfully submitted,
J. R. Donald, M.E.I.C., *Chairman.*

STUDENTS' AND JUNIORS' PRIZES

The reports of the examiners appointed in the various zones to judge the papers submitted for the prizes for Students and Juniors of the Institute were submitted to Council at its meeting on January 20th, 1940, and the following awards were made:

H. N. Ruttan Prize (Western Provinces)—No papers received.

John Galbraith Prize (Province of Ontario) to J. R. Dunn, S.E.I.C., for his paper "Radio Aids to Aerial Navigation."

Phelps Johnson Prize (Province of Quebec—English) to C. B. Charlewood, Jr.E.I.C., for his paper "Steam Superheaters for Water Type Boilers."

Ernest Marceau Prize (Province of Quebec—French)—No Award.

Martin Murphy Prize (Maritime Provinces)—to D. L. Mackinnon, S.E.I.C., for his paper "Soil Mechanics."

EMPLOYMENT SERVICE

The President and Council:

The Employment Service Bureau is able to report a distinct improvement in the employment situation for 1939 as compared with the previous year.

This statement is supported by the following figures of placements effected by the Bureau during the past six years:

1934	1935	1936	1937	1938	1939
70	77	110	181	61	88

The usual seasonal demand in the spring for civil engineers developed to a point where, during the summer, it was difficult to find suitable men for the vacancies existing. Towards the end of the year, however, many names were replaced on the list of unemployed on account of a falling off in the construction field, especially on highways.

The war has created an abnormal demand for engineers, especially for mechanicals and in a smaller way for electricals. As may be expected the specifications called generally for young graduates with a few years' experience. The number of vacancies registered in those fields has constantly increased and there is now a scarcity of available men.

The Bureau has worked in co-operation with the various governmental bodies established for war purposes. Thus it has been possible to place several senior members of the Institute in important positions.

At the outbreak of hostilities in September, it was found desirable to issue a questionnaire for the purpose of bringing our employment records up-to-date. The questionnaire was addressed to 564 persons who had, at one time or another, registered for employment with the Bureau and had not advised us that they had since found satisfactory positions.

The need for this enquiry was shown by the facts that 41 per cent did not answer, indicating that they were no longer interested. Further, out of the 59 per cent or 332 persons who returned the questionnaire, 18 per cent or 61 persons stated that they wished to remain in their present positions. This shows that at that time 293 men on our active lists had obtained satisfactory employment but had failed to let us know.

Of the 332 persons who answered the questionnaire at that time, eight per cent were unemployed, 17 per cent would have considered a change even to a temporary position and 55 per cent were willing to consider a change to a permanent position.

This survey enabled the Bureau to furnish first hand information to many enquirers and to work efficiently in the national emergency.

The records at the time of writing this report indicate that there are few engineers unemployed.

The following figures show the extent of the Bureau's work for 1939 as compared with the preceding year. It must be remembered that these figures indicate the action taken on vacancies definitely registered with us and the placements effected in such cases. They do not include the results of the many contacts established with employers who had no immediate vacancies.

	1939	1938
Registered members	114	71
Registered non-members	92	42
Number of members advertising for positions	76	79
Replies received from employers	31	25
Vacant positions registered	153	112
Vacancies advertised in the Journal	50	33
Replies received to advertised positions	219	146
Men's records forwarded to prospective employers	323	345
Men notified of vacancies	310	90
Placements definitely known	88	61
Vacancies cancelled	6	....
Vacancies still open	23	....

This report would not be complete without recording the passing, on August 28th, 1939, of Miss Ida L. MacMartin who had been for twenty years a valued member of the staff at Headquarters. Her principal work was in connection with the Employment Service. Her sterling character and long experience enabled her to assist the members with great tact and to handle intelligently the inquiries from employers. Her death has created a serious gap which will be felt for a long time.

L. Austin Wright, *General Secretary.*

NOMINATING COMMITTEE—1940

Chairman: E. V. Buchanan, M.E.I.C.

Branch	Representative
Border Cities	C. G. R. Armstrong
Calgary	R. S. Trowsdale
Cape Breton	M. F. Cossitt
Edmonton	W. E. Cornish
Halifax	H. S. Johnston
Hamilton	W. J. W. Reid
Kingston	D. S. Ellis
Lakehead	E. L. Goodall
Lethbridge	R. F. P. Bowman
London	F. C. Ball
Moncton	G. L. Dickson
Montreal	Walter Hunt
Niagara Peninsula	W. Jackson
Ottawa	E. Viens
Peterborough	W. M. Cruthers
Quebec	A. O. Dufresne
Saguenay	G. F. Layne
Saint John	G. Stead
St. Maurice Valley	A. C. Abbott
Saskatchewan	S. Young
Sault Ste. Marie	J. S. Macleod
Toronto	A. H. Harkness
Vancouver	W. H. Powell
Victoria	K. Moodie
Winnipeg	V. Michie

Abstracts of Reports from Branches

Note—For personnel of Executive Committees **see p. 52.** **For Membership and Financial Statements** **see pp. 78 and 79**

BORDER CITIES BRANCH

The Executive Committee met nine times during the year for the transaction of Branch business.

Eight regular meetings and one special meeting were held during the year previous to the December 15th meeting for the election of Branch officers. Information on the various meetings follows, attendance being given in brackets.

Jan. 20—**The Evolution and Future of the Home Radio Receiver,** by Stanley C. Polk of the firm of Jones and Polk and Radio Jake, Detroit (18).

Feb. 28—**Engineering Medicinally Speaking,** by Harvey M. Merker, Supt. of Manufacture, Parke-Davis & Co., Detroit. Joint meeting of the American Society of Mechanical Engineers, Detroit Section and the Border Cities Branch. Inspection trip through Parke-Davis & Co. plant, Detroit and dinner meeting in the Inter-Collegiate Alumni Club, Detroit (70).

Mar. 17—**The Thousand Islands International Bridge, Constructing the Superstructure, Canadian Section,** by P. E. Adams, Designing Engineer, and George V. Davies, Erecting Engineer of the Canadian Bridge Company, Walkerville (41).

April 21—**The Value of Scientific Research to Industry,** by Arthur W. Underwood of General Motors Research Laboratories Division, Detroit (36).

May 20—**The Inspection of Oil Refinery Equipment,** by Andrew Russell of the Imperial Oil Co. This meeting was held at Sarnia. C. E. Carson, General Manager of Imperial Oil Limited, Sarnia, acted as Chairman of the meeting. (41).

May 31—Special Dinner meeting. President H. W. McKiel addressed the members on **Institute Affairs,** and on the **Place of the Engineer in Industry and Government.** Vice-President E. V. Buchanan also attended this special meeting (29).

Sept. 22—**The Evolution of Worm Gearing Culminating in the Cone Design,** by G. R. Scott, Gear Consultant, Michigan Tool Co., Detroit (25).

Oct. 20—**The Task Facing Canada as a Democracy Today,** by Paul Martin, B.A., M.A. (48).

Nov. 18—**The Sugar Beet Industry,** by A. W. McIntyre, General Manager of the Sugar Company's plant. This meeting was held at Chatham and included an afternoon inspection trip through the Dominion and Canada Sugar Company's plant. Mr. George A. McCubbin, of Chatham acted as Chairman of the meeting (38).

The Border Cities Branch were grieved at the very sudden passing of Raymond A. Spencer, M.E.I.C., Assistant General Manager of the Canadian Bridge Company. Mr. Spencer had been an active member of this Branch for many years.

CALGARY BRANCH

Eleven general and special meetings of the Branch were held during the year. The following summary shows the dates, subjects, and attendances in brackets at these meetings:—

Jan. 6—**The Grand Coulee Project,** by H. R. Webb, Associate Professor, Department of Civil Engineering, University of Alberta (68).

Feb. 2—**The Best Places in the West,** by H. J. McLean, a member of the Calgary Branch (42).
Feb. 9—**Hydraulic Oil Well Pumping,** by W. R. Foster of the Kobe Corporation of California (72).
Mar. 2—**The Rise of Dictators,** by Max Freedman of the *Edmonton Bulletin* (75).
Mar. 11—Annual meeting, following luncheon, and election of Officers for the year 1939-1940 (32).
Oct. 14—**The Engineer in War and Peace,** by Dean H. W. McKiel, President of the Institute (36).
Oct. 14—Reception and dinner in honour of President McKiel, who spoke on **The Importance of the Engineer in Civilization** (83 incl. ladies).
Nov. 2—Dinner meeting. **Safari on Wheels,** sound motion picture (65).
Nov. 16—**Electrical Distribution in Alberta,** by D. F. Kobylnyk, and **Construction of Steel Power Line from Ghost Dam to Calgary,** by H. B. LeBourveau, both speakers are members of the Calgary Branch (67).
Nov. 30—**Military Engineering,** by Major F. K. Beach, a member of the Calgary Branch (50).
Dec. 14—A non-technical outline of **The Cracking Process,** by John Collier, President of the Calgary Chemical Club (69).

During the year, the Branch Executive Committee met eleven times for the purpose of conducting the business of the Branch, and the other Committees held meetings as required.

Obituary

The Calgary Branch records with deep regret the passing away of J. Dow, M.E.I.C., Branch Manager of the Alberta Government Telephones, on August 16th, 1939. Mr. Dow was an active member of this Branch. He was Chairman in 1936 and acted as secretary-treasurer during the years 1933 and 1934.

CAPE BRETON BRANCH

During the year the Branch held four meetings as follows:—

Integral Steam Boilers, by R. E. MacAfee.
Annual meeting and reception to the President.
From England to South Africa by Airplane, accompanied by motion pictures in colour, by H. L. Logan.
Development of the Canadian Artillery in the Last War, by Col. J. A. MacDonald.

EDMONTON BRANCH

The Executive Committee held five business meetings during the year and two luncheon meetings, one of the occasion of Dean McKiel's visit and one on the occasion of Mr. Wright's.

The Papers Committee, under the direction of C. E. Garnett, for the first part of the year, and of E. Nelson, for the latter part, were able to obtain an excellent list of speakers to address the general meetings. The following general dinner meetings were held during the year:

Jan. 24—**Irrigation in Alberta** by L. C. Charlesworth.
Feb. 22—The reading of a paper by C. W. Carry, entitled **Hydraulic Regulating Gates.** This paper was prepared by F. Newell, Chief Engineer of the Dominion Bridge Company.
Mar. 21—Inspection of the new equipment at the City Power Plant and an address by R. G. Watson, on recent additions to the plant.
April 18—**Turner Valley Districts,** 1938, by Dr. R. L. Rutherford.
Oct. 12—A dinner in honor of Dr. H. W. McKiel, President of The Engineering Institute of Canada.
Nov. 7—**The Search for Oil,** by Max Ball.
Dec. 5—**The Columbia River Reclamation Project,** by H. R. Webb.

The Branch regrets the loss of two members who have been exceedingly active in local Institute affairs for a great many years. L. C. Charlesworth has left Edmonton for Brooks, Alberta, where he has taken over his new duties as General Manager of the Eastern Irrigation District, and Dr. Charles A. Robb has gone to Ottawa to be in charge of the Gauge Division of the War Supply Board.

Lieut.-Col. P. L. Debney, Lieut. C. Victor Weir, and Lieut. E. H. Wright, are on active service with His Majesty's Forces.

F. Austin Brownie, who so ably filled the position of secretary-treasurer of the Branch for the past two years, has moved to Calgary.

HALIFAX BRANCH

Since the last Annual Meeting in December, 1938, the Halifax Branch has held the following general meetings:

January —A combined Banquet with the Professional Association
February —General Meeting, Speaker Mr. Weaver, Engineer in Charge of the Consumers Cordage Co.
April —General Meeting addressed by President McKiel and by Brigadier Boak, District Officer Commanding Military District No. 6.
November—Meeting with Engineer Students in Halifax at the Nova Scotia Technical College, at which four papers were presented by students of the Nova Scotia Technical College.

During the summer, the Halifax Branch, in co-operation with the other branches in the Maritimes, arranged for a General Professional Meeting to be held at Pictou, N.S. This proved very successful, although the last session had to be cut short because of the outbreak of war in Europe. Approximately two hundred people attended this meeting.

During the year eight Executive Meetings have been held. Some of these had to be called at very short notice to deal with urgent matters which had arisen.

The activities of 1939 closed with a reception to President and Mrs. H. W. McKiel.

Obituary

The Branch membership deeply regrets the loss of Mr. R. R. Murray, who for the past ten or eleven years has been Secretary to this Branch. His death occurred on March 2nd under the most tragic circumstances, in the Queen Hotel fire. His counsel and friendly advice to the Executive and to all members of the Branch have been sorely missed.

HAMILTON BRANCH

The Executive Committee held eight business meetings during the year with an average attendance of seven. Ten Branch meetings were held as follows, attendance being given in brackets:

Jan. 13—Annual Business Meeting and Banquet held at the Rock Garden Lodge. **The Buttress of Humour,** by Frank Dowsett, Advertising Manager, Gutta Percha and Rubber, Limited. Chairman W. J. W. Reid closed the evening by introducing the new Chairman, John R. Dunbar. (61).
Feb. 13—**A Journey Through Space,** by John A. Marsh, of the Royal Astronomical Society of Hamilton. Held at McMaster University (76).
Mar. 16—**The Lions Gate Bridge,** by W. W. Cushing, Chief Draughtsman, Hamilton Bridge Company. Held at McMaster University (95).
April 21—**Recent Trends in Steel Mill Electrification,** by A. F. Kenyon, Steel mill equipment Engineer, Westinghouse Electric & Mfg. Co., East Pittsburgh. Held in the Westinghouse Auditorium (235).
May 9—**Highway Trends in Ontario,** by C. A. Robbins, District Engineer Dept. of Highways, Toronto. This was a joint meeting of the Hamilton Branch and Queen's Alumni. Held at McMaster University (68).
May 27—President H. W. McKiel held a meeting of Council in the Royal Connaught Hotel. The Branch had the honour of entertaining the President and Members of the Council and the General Secretary at luncheon on this day.
May 29—**Temperature and Life,** by Prof. W. Harvey McNairn, Dean of Geology, McMaster University. Held at McMaster University. Before the meeting a dinner of welcome to Dr. McKiel and Mrs. McKiel and Dr. McNairn and Mrs. McNairn was enjoyed in the University dining room (104).
Oct. 12—**Operating a Large Power System,** by John Dibblee, Assistant Chief Engineer, Hydro-Electric Power Commission of Ontario. This was a joint meeting of the Branch and the Hamilton Group of the American Institute of Electrical Engineers. Held in the Westinghouse Auditorium (192).
Nov. 14—**City Planning and Traffic Control,** by Tracey D. leMay, City Surveyor and Commissioner of City Planning, City of Toronto. His Worship, Mayor William Morrison and the Hamilton City Council attended this meeting as an official visit. Held at McMaster University (71).
Dec. 12—**Why Fire Occurs in Industry,** E. C. Bacot, B.Sc., Resident Engineer, Factory Mutual Fire Insurance Companies, Toronto and Boston. Held at McMaster University (62).

Publicity

The Executive wishes to express appreciation for the courtesies extended to the Branch by the Press, especially the Hamilton Spectator and the Daily Commercial News.

General

At this time the Executive and members of the Branch wish to record their sincere appreciation of all the courtesies extended to us by the Management and Staff of McMaster University.

The Executive Committee wishes to thank members of all grades of the Branch for their support in the work undertaken during the past year.

KINGSTON BRANCH

The Branch met five times during 1939.

Jan. 19—Dinner and lecture by Prof. J. L. McDougall on **An Attempt to Define the Railway Problem.** Prof. D. S. Ellis continued as Kingston branch representative on the Institute Nominating Committee. Messrs. L. H. Brown of R.M.C. and H. S. Edgar of Queen's were presented with framed certificates in connection with the E.I.C. Prize for 1938. $10.00 was voted towards the honorarium and illuminated address presented to the Secretary Emeritus.

Feb. 22—Lecture held in Physics Building, Sound films on **Heat and Celite,** were presented by J. C. Honey and E. V. Tidman representing the Canada Johns-Manville Co.

Mar. 23—Dinner and lecture by Prof. T. V. Lord on his experiences in the mining field in British Columbia. Lt.-Col. L. F. Grant presented an account of the meeting at Ottawa.

Oct. 26—Annual Meeting. Presentation of the report of the Secretary-Treasurer and election of officers. Col. L. F. Grant reviewed the activities of the Council for the past year. **Water Purification and Sewage Treatment,** by Professor J. B. Baty, Department of Civil Engineering, Queen's University.

Nov. 22—Dinner Meeting held in the Kingston Badminton Club to honour Col. Alexander Macphail, retired Head of Civil Engineering at Queen's University, and to welcome Dean H. W. McKiel, President, and L. Austin Wright, General Secretary of the Institute. Dean McKiel presented certificates and prizes for 1938 to the winners from Queen's University and the Royal Military College. The meeting was well attended by local and out-of-town members and a large group of Queen's engineering students.

LAKEHEAD BRANCH

The following meetings were held during the year 1939:

Feb. 10—Dance at the Shuniah Club, Port Arthur.

Mar. 30—Dinner Meeting at the Royal Edward Hotel, Fort William. **Welding,** by D. Boyd, Manager, Canadian Car & Foundry Co.

May 4—Dinner meeting at the Prince Arthur Hotel, Port Arthur. **Outline of the Professional Association of Ontario,** by W. P. Dobson, Chief Testing Engineer, Hydro-Electric Power Commission.

June 29—Annual Meeting at the Golf and Country Club, Port Arthur. Reports and election of officers.

Sept. 29—Informal luncheon at the Prince Arthur Hotel, Port Arthur, in honour of H. W. McKiel, President of the Engineering Institute of Canada. Dinner meeting at the Royal Edward Hotel, Fort William, in honour of Mr. and Mrs. H. W. McKiel. Address by Dean McKiel on **The Engineer's Place in Modern Civilization.**

Oct. 31—Dinner Meeting at the Shuniah Club, Port Arthur. Guest of honour and speaker of the evening, L. Austin Wright, Secretary of The Engineering Institute of Canada.

Dec. 6—Meeting, City Council Chambers, Port Arthur. **Construction of the Dawson Road,** by S. E. Flook, City Engineer, Port Arthur.

LETHBRIDGE BRANCH

Since January 1, 1939, seven regular meetings with an average attendance of 40; two corporate members meetings with an average attendance of 15; and six executive meetings with an average attendance of 8 were held.

All regular meetings have been held in the Marquis Hotel preceded by a dinner during which numbers were rendered by George Brown's Instrumental Quartette, followed by vocal solos interspersed with community singing.

The list of speakers and subjects follows, attendance being given in brackets:

Jan. 7—**The Grande Coulee Project,** by H. R. Webb, Assistant Professor, Department of Civil Engineering, University of Alberta, Edmonton (39).

Jan. 21—Joint Meeting with the Association of Professional Engineers of Alberta. **Association Affairs,** by J. O. G. Sanderson, President of the Association (45).

Feb. 11—**The Development of Meteorological Science,** by C. Pickering, Meteorologist-in-Charge Weather Bureau, Kenyon Field, Lethbridge (30).

Feb. 25—**Corporation Law,** by R. R. Davidson, K.C. (20).

Mar. 11—Annual Meeting. **The Development of Coal Mining and its Relation to Civilization,** by A. G. Donaldson, Mine Superintendent, Standard Mine, Shaughnessy, Alberta. **The Photo Electric Cell and Vacuum Tube,** by J. S. Webster, Mine Electrician, Standard Mine, Shaughnessy, Alberta (21).

Oct. 16—Joint meeting with the Lethbridge Rotary Club. **The Work of the Engineer,** by Dean H. W. McKiel, President of the Engineering Institute of Canada (75). With President McKiel on his visit to the Lethbridge Branch, were L. Austin Wright, General Secretary of the E.I.C., and Mr. G. A. Gaherty, President of Montreal Engineering Co. and General Manager of the Calgary Power Co.

Oct. 28—Joint Meeting with the Association of Professional Engineers of Alberta. **The Need of Water Conservation,** by Major F. G. Cross, Superintendent Operation and Maintenance C.P.R., D.N.R., Lethbridge (45).

LONDON BRANCH

During the year 1939 the following meetings were held, attendance being given in brackets:

Jan. 25—Annual Meeting and election of officers held at Glen Allen Restaurant, London. **Diesel Engines as Applied to Modern Transportation,** by J. L. Busfield (58).

Feb. 22—Regular meeting held in the Normal School, London. **London's Bridges, Old and New—The Why and the Wherefore,** by J. R. Rostron (31).

Mar. 15—Regular meeting held in the Public Utilities Commission Board Room, London. **Preliminary Investigation of Pile Structures and Foundations, with Special Reference to Cast Piling,** by Jean P. Carriere (24).

May 12—Regular meeting held in the Public Utilities Commission Board Room, London. **Mechanical Equipment in the New Ontario Hospital, St. Thomas,** by H. H. Angus of Toronto (24).

May 30—Special dinner meeting held in the Hotel London. **The Future of the Engineer,** by President H. W. McKiel (33).

Oct. 18—Regular meeting held in the Public Utilities Commission Board Room, London. **Limestone and Lime Industry of the Thames River Valley,** by Stanley R. Frost, of the North American Cyanamid Ltd. (25).

Dec. 6—Regular meeting held in the Public Utilities Commission Board Room, London. **The Training and Welfare of the Young Engineer,** by Chairman H. F. Bennett (23).

Average attendance of all meetings—31.

In addition to the above, four Executive meetings were held with an average attendance of seven.

MONCTON BRANCH

The Executive Committee held five meetings. Five meetings of the Branch were held during the year 1939 at which addresses were given and business transacted as follows:

April 14—A meeting was held in the City Hall. **Liquid Air,** by D. G. MacGregor, M.A., Professor of Physics, Mount Allison University, Sackville. The address was accompanied by a practical demonstration. The meeting was also honoured by the presence of Dean H. W. McKiel, President of the Engineering Institute of Canada, who addressed the meeting on **Institute Policies.**

May 1—A joint meeting of Moncton Branch and the Mount Allison Engineering Society was held at Mount Allison University, Sackville. **An Investigation into the Causes of Damage to Brick Walls by Water Penetration,** by H. J. Crudge, Building Engineer, Canadian National Railways.

May 5—A meeting was held in the City Hall. **The Dial Telephone,** by A. A. Turnbull, Plant Engineer, New Brunswick Telephone Co., Saint John. A demonstration set illustrated the operation of the mechanism of the dial system. At this meeting nominations were made for branch officers for the year 1939-40.

May 31—Annual Meeting.

Dec. 15—A complimentary dinner was tendered Dean H. W. McKiel, President of the Engineering Institute of Canada. President McKiel spoke on the **Responsibilities and Future of the Engineering Profession.**

We regret to record the death of Branch Affiliate E. A. Cummings, which occurred on October 29, 1939.

Branches	Border Cities	Calgary	Cape Breton	Edmonton	Halifax	Hamilton	Kingston	Lakehead	Lethbridge	London
MEMBERSHIP										
Resident										
Hon. Members	..	..	..	..	..	..	1	..	..	..
Members	12	20	8	18	25	33	12	11	3	7
Assoc. Members	30	53	14	26	53	49	17	22	17	29
Juniors	8	12	3	16	13	17	3	2	2	8
Students	8	17	6	21	20	26	21	3	2	9
Affiliates	1	..	1	..	1	2	..	2	..	..
Total	59	102	32	81	112	127	54	40	22	53
Non-Resident										
Hon. Members	..	..	..	..	..	..	..	..	..	..
Members	7	3	3	..	7	6	1	4	1	3
Assoc. Members	10	11	14	5	16	13	6	9	7	2
Juniors	5	3	5	..	4	1	1	6	2	..
Students	9	4	6	4	10	2	3	..	7	2
Affiliates	..	..	..	..	..	..	..	..	..	..
Total	31	21	28	9	37	22	11	19	17	7
Grand Total December 31st, 1939	90	123	60	90	149	149	65	59	39	60
" December 31st, 1938	84	113	56	89	149	142	72	55	36	59
Branch Affiliates, December 31, 1939	..	13	..	..	..	18	..	1	21	1
FINANCIAL STATEMENTS										
Balance as of December 31, 1938	185.69	171.53	231.27	115.48	322.13	679.36	38.14	166.54	27.41	69.68
Income										
Rebates received during calendar year	166.83	207.70	103.38	147.30	238.51	274.58	109.58	120.65	100.00	107.70
Affiliate Dues	....	44.00	....	....	....	48.00	0.17	....	52.00	....
Interest	....	39.43	....	....	2.50	52.99	....	0.45	.09	....
Special Appeal	....	....	....	....	....	....	....	....	....	....
Miscellaneous	203.00	....	29.00	....	9.24	29.75	....	....	22.87	....
Total Income	369.83	291.13	132.38	147.30	250.25	405.32	109.75	121.10	174.96	107.70
Disbursements										
Printing, Notices, Postage①	82.90	73.94	14.05	32.57	38.82	79.53	10.65	18.41	2.53	23.05
General Meeting Expense②	218.35	35.00	81.57	21.48	....	192.55	7.56	100.64	69.50	9.50
Special Meeting Expense③	42.55	117.45	....	31.58	80.03	....	22.16	....	12.01	20.45
Honorarium for Secretary	....	25.00	....	50.00	50.00	....	25.00	10.00	25.00	....
Stenographic Services	10.00	10.00	13.20	1.00	29.54	50.00	....	....	1.60	5.00
Travelling Expenses④	....	6.50	....	11.80	....	60.00	....	....	9.00	....
Subscriptions to other organizations	....	....	....	....	....	....	⑤15.00	....	....	....
Subscriptions to The Journal	....	....	....	....	....	....	....	....	....	....
Special Expenses	21.25	....	25.03	10.00	....	⑥515.39	10.00	....	10.00	....
Miscellaneous	....	29.65	....	0.55	43.58	42.57	....	15.00	7.40	3.00
Total Disbursements	375.05	297.54	133.85	158.98	241.97	940.04	90.37	144.05	137.04	61.00
Surplus or *Deficit*	*5.22*	*6.41*	*1.47*	*11.68*	8.28	*534.72*	19.38	*22.95*	37.92	46.70
Balance as of December 31, 1939	180.47	165.12	229.80	103.80	330.41	144.41	57.52	143.59	65.33	116.38

①Includes general printing, meeting notices, postage, telegraph, telephone and stationery.
②Includes rental of rooms, lanterns, operators, lantern slides and other expenses.
③Includes dinners, entertainments, social functions, and so forth.
④Includes speakers, councillors or branch officers.

	Moncton	Montreal	Niagara Peninsula	Ottawa	Peterborough	Quebec	Saguenay	Saint John	St. Maurice Valley	Saskatchewan	Sault Ste. Marie	Toronto	Vancouver	Victoria	Winnipeg
	..	3	..	2	..	1	..	..	..	..	..	1	..	1	..
	4	226	18	85	9	19	5	12	3	35	9	141	64	24	31
	21	567	68	198	22	66	30	17	24	78	12	228	55	13	79
	2	87	4	23	10	11	10	7	16	8	7	62	9	7	22
	4	313	17	23	20	15	12	10	9	9	4	84	12	6	46
	..	16	..	2	..	..	3	..	..	..	..	5	1	..	4
	31	1212	107	333	61	112	60	46	52	130	32	521	141	51	182
	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..
	1	3	1	13	5	1	..	7	..	9	10	6	17	2	2
	6	39	3	36	16	12	3	14	5	38	35	6	31	7	13
	2	13	..	8	5	3	1	12	2	8	11	3	3	2	4
	9	31	1	13	5	2	1	14	3	10	17	7	6	1	6
	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	18	86	5	70	31	18	5	47	10	65	73	22	58	12	25
	49	1,298*	112	403	92	130	65	93	66	195	105	543	199	63	207
	43	1,165	100	404	95	127	63	98	54	150	101	489	195	59	198
	5	13	12	21	..	..	..	..	..	4	10	..	..	1	4

*For voting purposes only there should be added to Montreal Branch, an additional 333 members, 183 being resident in the United States, 111 in British Possessions and 39 in foreign countries.

	Moncton	Montreal	Niagara Peninsula	Ottawa	Peterborough	Quebec	Saguenay	Saint John	St. Maurice Valley	Saskatchewan	Sault Ste. Marie	Toronto	Vancouver	Victoria	Winnipeg
	182.61	1,220.97	280.89	531.35	199.88	88.76	229.71	240.28	43.55	64.01	475.00	512.26	147.21	64.08	52.23
	92.50	1,827.24	200.10	533.73	131.83	230.50	124.30	146.95	115.15	89.17	163.28	640.18	343.40	114.45	273.88
	20.00	50.85	14.70	39.00	23.00	....	....	....	....	....	30.00	....	....	3.00	15.00
	0.98	5.19	....	43.91	0.63	....	0.71	....	....	....	1.02	10.72	0.68	....	22.50
	....	....	....	....	....	....	....	....	....	....	10.32	5.00	....	....	....
	....	591.73	14.05	500.00	8.65	....	....	....	25.00	128⑦00	89.75	168.62	....	....	60.60
	113.48	2,466.81	228.85	1,116.64	164.11	230.50	125.01	146.95	140.15	217.17	294.37	824.52	344.08	117.45	371.98
	13.65	736.45	52.16	128.15	69.42	31.70	8.00	47.44	19.71	60.50	26.17	215.01	141.09	19.68	11.94
	3.06	96.00	38.32	722.05	36.80	4.00	1.25	16.65	22.40	....	117.65	12.50	64.75	3.10	137.58
	33.10	681.59	37.93	25.00	60.90	4.00	60.50	11.20	16.64	....	40.75	165.90	....	9.05	35.44
	25.00	300.00	75.00	....	....	100.00	....	25.00	....	....	25.00	100.00	50.00	25.00	....
	....	120.00	5.00	35.00	....	....	....	10.00	5.00	85.00	1.00	40.00	20.00	5.10	....
	6.72	....	25.00	....	8.25	....	2.75	....	....	....	....	56.51	....	....	....
	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	14.15	32.00	....	6.00	8.50	....	....	....	....	....	10.00	....	....	....	6.06
	10.13	50.00	25.00	264.40	....	51.70	15.00	20.00	15.00	....	15.00	30.00	....	10.00	95.00
	16.35	95.88	....	48.05	28.30	10.00	0.47	....	....	55.42	....	85.00	....	7.81	22.98
	122.16	2,091.92	258.41	1,228.65	212.17	201.40	87.97	130.29	78.75	200.92	235.57	704.92	275.84	79.74	309.00
	8.68	374.89	*29.56*	*112.01*	*48.06*	29.10	37.04	16.66	61.40	16.25	58.80	119.60	68.24	37.71	62.98
	173.93	1,595.86	251.33	419.34	151.82	117.86	266.75	256.94	104.95	80.26	533.80	631.86	215.45	101.79	115.21

⑤Chamber of Commerce.
⑥Purchase of Bond.
⑦From professional association.

MONTREAL BRANCH

Papers and Meetings Committee

The Papers and Meetings Committee of the Branch had the following personnel:

I. S. Patterson, *Chairman* — R. S. Eadie, *Vice-Chairman*

Civil Section

E. V. Gage — J. B. Stirling

Electrical Section

A. M. Crawford — E. R. Davis

Mechanical Section

A. B. Dove — A. L. Huber

Industrial and Management Section

J. E. Dion — C. A. Peachey

Radio and Communications Section

D. N. MacLeod — W. H. Moore

Municipal Section

J. Comeau — D. DesOrmeaux

Transportation Section

G. E. Shaw

Junior Section

P. E. Savage, *Chairman* — C. Craig, *Vice-Chairman*

The discussions following the meetings have been more extensive than usual and the average attendance of 106 is well up to that of past years.

This year the Committee co-operated with sister societies by having joint meetings with such organizations as the Institute of Radio Engineers and the Military Engineers Association of Canada.

The following is a list of the Papers delivered during the year, and the attendance is given in brackets:

Jan. 5—**Exploration and Mapping of the South Nahanni River, N.W.T., by the Harry Snyder Expedition of 1937,** by H. F. Lambart (60).
Jan. 12—**Annual Meeting of the Branch.** Also addresses by Pres. J. B. Challies, and Councillor Fred Newell (100).
Jan. 19—**Fire Prevention in Montreal,** by James McIsaac (50).
Jan. 26—**Visit to Montreal's New Postal Terminal.**
Feb. 2—**Branch Smoker.**
Feb. 9—**The Early Microphone and Recent Research,** by Dr. F. S. Goucher (175).
Feb. 16—**Recent Developments in Urban Transportation,** by S. B. Cooper (60).
Feb. 23—**Moving Pictures of a Trip Through Italy,** by R. E. Jamieson, (75).
Mar. 2—**Design and Construction of Dome of St. Joseph's Shrine,** by M. Cailloux (80).
Mar. 9—**Calcium Chloride in Construction,** by J. A. Knight (80).
Mar. 16—**Unit Substations,** by C. G. Levy (64).
Mar. 23—**The Cause and Remedy of Our Social-Economic Ills as Revealed by Engineering Research,** by P. Ackerman (125).
Mar. 30—**Business and Government,** by W. J. Batt (75).
April 6—**The Development of Modern Aids to Business Management,** by Wm. M. Vermilye (92).
April 13—**Engineering Education,** by R. E. Jamieson, F. C. Mechin and J. E. Armstrong (75).
April 20—Discussion of Mr. Ackerman's Paper—**Cause and Remedy of our Social-Economic Ills** (75).
Oct. 5—**Why Be Careless?**—a talk and moving picture on Traffic Control, by Howard M. Baker (100).
Oct. 12—**Streamlining,** by Dr. J. J. Green (110).
Oct. 19—**The Network Analyzer in System Planning,** by G. R. Hale (52).
Oct. 26—**Flame Hardening and Its Applications in Modern Industry,** by W. A. Duncan (86).
Nov. 2—**Modern Radio Range Equipment,** by F. A. A. Baily (135).
Nov. 9—**Operations of Trans-Canada Air Lines,** by Wing-Commander D. R. MacLaren (185).
Nov. 16—**Lions Gate Bridge,** by P. L. Pratley and D. B. Armstrong (185).
Nov. 23—**Annual Student Night**—reported in Junior Section list of meetings (165).
Nov. 30—**Industrial Electronics,** by J. T. Thwaites (94).
Dec. 7—**Recent Developments in Production Management,** by T. M. Moran (100).
Dec. 14—**Recent Developments in Military Engineering,** by Brigadier E. C. Schmidlin, M.C. (250).

Industrial and Management Section

From time to time we receive criticism that the Institute does not satisfactorily cover a certain branch of engineering, and the answer is that the fault lies with those members interested in that branch. The machinery is always there, for those who will avail themselves of it, to develop any particular interest. An outstanding example of this is the Industrial and Management Section. Organized a few years ago under the guidance of Mr. T. M. Moran, the Industrial and Management Section has been very active. In addition to the Chairman and Vice-Chairman, who act on the Papers and Meetings Committee, there are seven or eight active Committee men in this Section.

Besides the regular Thursday meetings arranged to cover its field, this Section has.interested itself in the formation of the Montreal Management Council, and the Branch has appointed one of its members as official Branch representative on that body.

Reception Committee

We feel that one of our most successful Smokers was held on February 2nd, under the Chairmanship of Mr. R. E. Heartz. The attendance was over 400, and a credit balance of $108.00 was shown. This year the Reception Committee under the Chairmanship of Mr. C. R. Lindsey is at work preparing a programme for the Smoker to be held February 1st, 1940. The Reception Committee during the year has also provided refreshments on certain special occasions, and helped in organizing the Courtesy Dinners to visiting speakers.

Publicity Committee

The Publicity Committee under the Chairmanship of L. Jehu, Jr., worked strenuously, and with marked success, to obtain publicity for the Institute in general, and for the Thursday night meetings in particular. Considerable apathy on the part of the Press is at times shown, as they claim engineering topics generally have no news interest. By continued effort, it is hoped that this attitude will gradually change.

Membership Committee

The Membership Committee under the Chairmanship of Mr. K. O. Whyte, was well organized, and their work is to be highly commended. They adopted a definite plan with the result that the total Membership of the Branch has increased.

We were very sorry to learn early last March, that Mr. J. B. D'Aeth was leaving Montreal, and felt that he should tender his resignation as one of our representatives on Council. On the recommendation of your Executive Committee, Council appointed Mr. H. J. Vennes to fill the vacancy for the balance of Mr. D'Aeth's term, which expired December 31st, 1939.

It is with sincere regret that we record the names of the following members deceased during the year.

Frederic Thomas Kaelin, M.E.I.C.
Norman Berford McLean, M.E.I.C.
Donald William Ross, M.E.I.C.
Julian Cleveland Smith, M.E.I.C.
Job Ivan Boulian, A.M.E.I.C.
Paul Emile Bourbonnais, A.M.E.I.C.
Joseph Philippe Baby Casgrain, A.M.E.I.C.
Bernard Harold Cripps, A.M.E.I.C.
George Esplin Cross, A.M.E.I.C.
Joseph Honoré Landry, A.M.E.I.C.
Thomas Herbert Nicholson, A.M.E.I.C.
John Charles Stadler, A.M.E.I.C.
Frank Percy Jones, Affil. E.I.C.

Junior Section

The Executive Committee for the Junior Section consisted of P. E. Savage, chairman; C. Craig, vice-chairman; R. N. Warnock, secretary; R. Boucher, A. Benoit, H. G. Seybold, J. E. Hurtubise, L. Jehu, Jr., L. Trudel.

The following is a list of the Junior Section meetings with the attendance given in brackets.

Jan. 9—Annual meeting. **The Art of Engineering,** by F. Newell. Refreshments (58).

Feb. 6—**Concerning the Cyclotron,** by Dr. H. G. I. Watson (48).

Feb. 27—**Photography in Engineering,** by R. A. Frigon (33).

Mar. 6—**The Metallurgy and Engineering Aspects of Aluminum,** by Dr. Andre Hone (72).

Mar. 20—**Telephone Traffic Engineering for the Montreal Exchange,** by A. J. Groleau (22).

Oct. 18—Opening Fall meeting. **The Institute,** by C. K. McLeod. Sound films, **Prelude to Flight** and **Wings over the Atlantic.** Refreshments (54).

Oct. 30—**Welding Electrodes,** by J. C. Newell (27).

Nov. 13—**Fundamentals of Lighting,** by M. LaFlamme (17).

Nov. 23—**Student Night.**
Speakers:—E. M. Cantwell (McGill).
A. Monti (Ecole Polytechnique).
M. R. Trudeau (Ecole Polytechnique).
W. G. Ward (McGill).
Cash prizes were awarded to the first and second papers. All four competitors were given Student Memberships for the year 1940.
Sound Film, **The Song the Map Sings.** Refreshments (165).

Dec. 11—**Prestressing of Suspension Bridge Cables,** by Maurice Dean.

New Secretary

Mr. E. R. Smallhorn, who has been branch Secretary for the past three years, asked to be relieved of his duties at the end of this year. He has filled the post with a great deal of energy and ability, and it was with sincere regret that his resignation was accepted. Our new Secretary, Mr. L. A. Duchastel de Montrouge, brings with him considerable experience in the administration of Branch activities.

NIAGARA PENINSULA BRANCH

The Executive held seven business meetings and one electoral meeting to conduct the affairs of the Branch.

The programme committee arranged the following professional meetings.

Feb. 3—Dinner meeting at the Welland Club, Welland. An illustrated talk on **The History of Steel Making in Ontario,** by B. Clarke Wales, Assistant General Manager of Algoma Steel Corporation.

Mar. 21—Dinner meeting, Leonard Hotel, St. Catharines, Ontario. An illustrated talk on **The Lion's Gate Bridge,** by Mr. Cushing, Chief Draughtsman of the Hamilton Bridge Co.

April 6—Dinner meeting, General Brock Hotel, Niagara Falls, Ontario. **Some Problems of a Research Laboratory,** by Dr. Saul Dushman, Assistant Director of Research Laboratory, General Electric Co., Schenectady, N.Y.

April 25—Luncheon meeting and Ladies' Night, Welland House, St. Catharines, Ontario. **Origin of the American Indians and their Constribution to Civilization,** by Diamond Jenness, M.A., F.R.S.C., Chief, Division of Anthropology, National Museum of Canada.

May 26—Annual Dinner meeting, Welland House, St. Catharines, Ontario. Presentation of Gzowski Medal by President H. W. McKiel. **The Engineer as Economist,** by Professor C. R. Young, Dept. of Civil Engineering, University of Toronto.

During the summer, meetings were held leading to the organization of the **Niagara District Technical Council** (NDTC), which organization made possible the cooperation of the activities of the

(1) Niagara District Chemical and Industrial Association.
(2) The American Institute of Electrical Engineers, Niagara District Discussion Group.
(3) The Engineering Institute of Canada, Niagara Peninsula Branch.

The following meetings have been held, sponsored by the N.D.T.C.

Oct. 12—Dinner meeting at Leonard Hotel, St. Catharines, Ontario. An illustrated address on **Large Welded Tanks of Cylindrical, Spherical and Spheroidal Shapes,** by H. C. Boardman, Research Engineer with the Chicago Bridge and Iron Co.

Nov. 7—Dinner meeting, Brock Hotel, Niagara Falls, Ontario. Inspection Trip conducted by Mr. Farmer to the Canadian Ohio Brass Company where the manufacture of high voltage insulators was observed and explained.

Nov. 14—Dinner meeting, Leonard Hotel, St. Catharines, Ontario. **Mines and Their Manufacture,** by Mr. DeChaunac of the T. G. Bright & Co., Wine Manufactures.

Dec. 7—Dinner meeting at Leonard Hotel, St. Catharines, Ontario. An illustrated talk on **Building Downward,** by Prof. R. F. Legget, Dept. of Civil Engineering, University of Toronto.

Dec. 12—Dinner meeting, Leonard Hotel, St. Catharines, Ontario. **Power Development in the Niagara District,** by Rob Roy McLeod of the Niagara Hudson Power Co.

OTTAWA BRANCH

During the year the Managing Committee held seven meetings for the transaction of general business.

The outstanding event of the year was the adjourned General Annual Meeting of the Institute which was held in Ottawa on February 14 and 15. There was a registration of 541 members, 230 of these being from out of town. The meeting was said to be one of the most successful ever held, and many complimentary remarks were passed to the committee responsible for its organization. Mr. J. L. Rannie, Chairman of the Ottawa Committee with Mr. H. V. Anderson, Assistant Chairman, adopted the policy of drawing upon the younger members of the Branch to form the committee and this policy proved a happy one.

It is with deep regret that we report the deaths of five of our members: Lt. Col. F. H. Emra, M. B. Bonnell, B. S. McKenzie, F. McDonnell, and G. S. Davis.

As in previous years the Branch donated two sets of draughting instruments to the Ottawa Technical School for presentation as prizes for proficiency in draughting. A copy of "Standard Handbook for Electrical Engineers" was presented to the Hull Technical School to be awarded to one of its students.

The following is a list of meetings held during the year 1939, with attendance figures in brackets. Unless otherwise stated meetings were luncheon meetings held at the Chateau Laurier.

Jan. 12—Evening meeting. Annual meeting Ottawa Branch, E.I.C. **Canada's National Memorial,** by Sydney March (71).

Jan. 26—**Metallurgical Testing and Research, and its Relation to the Development of Our Mining Industry,** by C. S. Parsons, Bureau of Mines, Ottawa (98).

Mar. 2—**Soil Mechanics, a New Science,** by J. W. Lucas, Department of Public Works, Ottawa (97).

Mar. 16—**Aviation Lighting,** by Harold Ainsworth, Department of Transport, Ottawa (84).

Mar. 30—**The Aesthetic Aspect of Bridge Building,** by William E. McHugh, Dominion Bridge Company, Ottawa (68).

April 13—**Modern Applications of Diesel Engines,** by J. L. Busfield, Montreal (74).

April 27—**Codes and Specifications,** by A. F. Gill, National Research Council, Ottawa (54).

June 15—**Experiences in the Sudan and Egypt,** by Sir William McLean, K.B.E. (115).

Oct. 2—**The Design and Construction of Concrete Thin Shell Domes of St. Joseph Basilica, Montreal,** by Maxime Cailloux, Montreal (60).

Nov. 2—**Defence of Trade on the High Seas,** by Captain L. W. Murray, R.C.N., Deputy Chief of the Naval Staff, Ottawa (126).

Dec. 7—**Canadian Defence Policy,** by Brigadier K. Stuart, D.S.O., M.C., Commandant, Royal Military College, Kingston (105).

Aeronautical Section

Three evening meetings were held, when technical papers dealing with aeronautical or related subjects were read and discussions held. The average attendance was sixty-three.

PETERBOROUGH BRANCH

The following meetings were held during the year 1939, with attendance in brackets:

Jan. 13—**Where Does the Engineer Fit into the Picture in a National Emergency.** An open discussion meeting (53).

Jan. 26—**Trends in Electrical Communication,** by J. L. Clarke, Bell Telephone Co., Montreal (47).

Feb. 9—**Lighting Protection for Transmission Systems,** by A. M. Doyle, Canadian General Electric Co., Toronto (31).

Feb. 23—**Metallurgy of Metallic Arc Welding,** by C. R. Whittemore, Dominion Bridge Co., Montreal (32).

Mar. 9—Annual Junior and Student Night. **Radio Fundamentals,** by B. K. Scarlett, Canadian General Electric Co., Peterborough. **Radio Aids to Aerial Navigation,** by J. R. Dunn, Canadian General Electric Co., Peterborough (29).

Mar. 23—**Uses of Aluminum in Industry,** by A. K. Jordan, Aluminum Company of Canada, Toronto (33).

April 22—**Aviation,** by Lt. Commander C. P. Edwards, O.B.E., Director, Civil Air Services, Dept. of Transport, Ottawa. Joint dinner meeting, Association of Professional Engineers of Ontario and E.I.C. Peterborough Branch (81).

May 3—Annual Meeting and election of Executive (39).

Oct. 4—**Vertical Shaft Generators,** by H. R. Sills, Canadian General Electric Co., Peterborough (49).

Oct. 25—Junior Night. **Steel Mill Drives,** by W. C. Moull, Canadian General Electric Co., Peterborough **Carrier Current Telephony,** by W. W. Rapsey, Canadian General Electric Co., Peterborough (31).

Nov. 20—Annual Dinner. Attended by the President, Dean H. W. McKiel (62).

Dec. 14—**Some Fundamental Ideas Concerning the Application and Heat Treatment of Tool Steels,** by H. B. Chambers, Metallurgical Engineer, Atlas Steels Ltd. (70).

Seven Executive Committee Meetings were held during year.

Special committees:—

Meetings and Papers Committee—I. F. McRae and A. R. Jones.

Branch News Editor—D. R. McGregor.

Social and Entertainment Committee—J. Cameron and O. J. Frisken.

Membership and Attendance Committee—G. C. Tollington.

Auditor—E. R. Shirley.

QUEBEC BRANCH

Three meetings of the Branch Executive Committee were held during the year, three Branch meetings, as follows:—

Mar. 15—Luncheon meeting at Kerhulu's to meet H. W. McKiel, President, The Engineering Institute of Canada.

Nov. 4—Annual meeting and election of officers at L'Ecole Technique of Quebec. An oyster party concluded the meeting.

Dec. 18—Evening meeting at L'Ecole Technique of Quebec. Films of excursions through **Science, Science of Seeing** and **Bumper Highway Guards.** The Canadian General Electric Co. sponsored these attractions.

It is with deep regret that we report the death of M. J. F. Guay, Life Member, who passed away during the course of the year.

A great honour has just reflected on the Quebec Branch through its Branch Honorary Member, Mgr. Alexandre Vachon. Former rector of Laval University, in Quebec, Mgr. Vachon is newly appointed Bishop Coadjutor of Ottawa with future succession.

SAGUENAY BRANCH

The Executive Committee held four meetings during the calendar year for the transaction of Branch business. In addition to these eight general meetings were held during the year 1939, as follows:

Feb. 3—**Operating Experiences with Electric Steam Generators,** by A. G. Joyce, Aluminum Co. of Canada Ltd., Arvida; R. A. Lane, Lake St. John Power and Paper Co. Ltd., Dolbeau; J. W. Gathercole, Price Brothers & Co., Kenogami; G. N. Kirby, Price Brothers & Co. Ltd., Riverbend; J. Foster, Price Brothers & Co. Ltd., Riverbend.

Mar. 10—**Electrical Maintenance in Industrial Plants,** by J. W. Ward, Aluminum Company of Canada Ltd., Arvida.

May 5—**The Hydrogenation of Coal,** by Dr. J. Edwards, Price Brothers & Company Limited, Kenogami.

June 9—Dinner and Annual meeting held at Arvida, Que. Dean H. W. McKiel, President, and F. Newell, Vice-President, were the guest speakers.

June 16—**Maintenance as affecting the Electrical Fire Loss Record** (illustrated), by G. S. Lawler, Electrical Engineer of the Associated Factory Mutual Fire Insurance Companies.

June 29—**Discussion and Demonstration of Flame Hardening and other Oxyacetylene Processes** (illustrated), by Mr. Anderson of the Dominion Oxygen Company.

Sept. 29—**The Development of Artillery** (illustrated), by G. F. Layne, Chief Engineer, Price Brothers & Company Ltd., Paper Division.

Oct. 12—**Recent Developments in Steam Generating Equipment,** by R. E. MacAfee of Babcock-Wilcox & Goldie McCulloch Ltd.

SAINT JOHN BRANCH

Six meetings of the Branch and six meetings of the Executive Committee were held in 1939.

Jan. 24—Annual joint dinner with the Association of Professional Engineers of New Brunswick. **Engineering Education,** by Dr. John Stephens, Dean of Engineering at the University of New Brunswick.

Feb. 14—Dinner dance at Admiral Beatty Hotel on St. Valentine's Day.

Mar. 2—Supper meeting at Admiral Beatty Hotel. **Marine Engineering,** by E. Ebdon, Chief Engineer of the Steamer Manchester City.

May 4—Annual dinner meeting and election of officers of the Branch. President H. W. McKiel paid his official visit to the Branch, presenting the Plummer Medal to H. I. Knowles, Chief Chemist of the Atlantic Sugar Refinery, for his paper **Building Invisible Edifices.** Following the President's address, J. S. Hoyt entertained the Branch with a programme of moving pictures.

Nov. 16—Supper meeting at Admiral Beatty Hotel. **European Trip, 1938,** by Geoffrey Stead, District Engineer, Department of Public Works.

Dec. 7—Supper meeting at Admiral Beatty Hotel. **The Engineer and Public Safety,** by Prof. E. O. Turner, head of the Department of Civil Engineering, University of New Brunswick. Dr. F. A. Gaby, President of the Institute in 1935, was a guest at this meeting.

ST. MAURICE VALLEY BRANCH

Four general meetings were held during the year, three in Shawinigan Falls and one in Grand'Mere. Three of the meetings were dinner meetings and one a plant visit. A summary of the meetings (with the number of people attending given in brackets) is as follows:

Feb. 23—A dinner meeting at Shawinigan Falls and the Annual Branch meeting with installation of new officers. Also a talk by H. O. Keay, Vice-President of the Institute, on the proceedings and a discussion of the Annual General and General Professional Meeting of the E.I.C. held in Ottawa, February 14th and 15th (26).

May 26—At the Belgo Division of the Consolidated Paper Corporation Limited, Shawinigan Falls. **Modern Trends in Boiler Design,** by R. E. MacAfee, and **Boiler Control,** by K. D. Sheldrick. After the meeting the party proceeded to the newly erected Boiler Plant (50).

June 8—A dinner meeting at Grand'Mere to welcome President H. W. McKiel. The party also included the General Secretary, L. Austin Wright. Dean McKiel spoke on **The Education of an Engineer** and **The Future of Engineering.** Mr. Wright spoke on the advantages of belonging to the Institute (55).

Dec. 14—A dinner meeting held jointly with the Shawinigan Falls Chemical Society, at Shawinigan Falls. **Magnesium,** by Dr. L. M. Pidgeon of the National Research Council, Ottawa (85).

SASKATCHEWAN BRANCH

There were six regular meetings of the Branch, each being preceded by a dinner, at which the average attendance was sixty-five. In addition, a general meeting was held during the month of February, under the auspices of The Association of Professional Engineers.

The system inaugurated late in 1937 with regard to the monthly meetings which are now being held jointly by The Engineering Institute of Canada, The Association of

Professional Engineers of Saskatchewan and The American Institute of Electrical Engineers has again proved to be of good general interest during the past year. A common committee, representing the three organizations, was again established, being known as a Papers and Meetings Committee. The Chairman of each Association again alternated monthly in charge of the meeting and all expenses were pooled. The identity of each organization is still retained with annual meetings being conducted as in the past.

The standing Committees of the Branch are as follows:
Papers and Library—D. D. Low, Convenor.
Nomination—C. J. McGavin, Convenor.
Membership—J. J. White, Convenor.

The programme for the year was as follows:

Jan. 20—**Babcock Integral Furnace Boilers,** by W. A. Osbourne.
Feb. 17—Branch Members met with The Association of Professional Engineers of Saskatchewan in Annual Meeting.
Mar. 24—Annual meeting of Branch. **Asphalt Technology,** by Dr. N. H. McLeod.
April 21—**Stream Control in Relation to Droughts and Floods,** by P. C. Perry.
Oct. 7—Address by the President of the Institute, Dean H. W. McKiel.
Nov. 27—**Prairie Farm Rehabilitation,** by George Spence.
Dec. 18—Devoted to general discussion by Junior Members on **The Education, Training and Experience of the Young Engineer.**

SAULT STE. MARIE BRANCH

The Executive Committee met on Jan. 9, 1939, and appointed standing committees. The Committees and the Chairmen are as follows:

Papers and Publicity—Hugh J. Leitch.
Entertainment—John L. Lang.
Membership—Carl Stenbol.
Legislation and Remuneration—W. S. Wilson.

The Executive Committee met seven times during the year to discuss and promote the activities of the Branch and Institute.

Six dinner meetings were held during the year. The average attendance at the meetings was twenty-six members and guests. The meetings were held at no set time during the month but were arranged for dates that suited the convenience of the speakers.

The Branch was honoured during the year by visits from the President of the Institute, Dean H. W. McKiel, and the General Secretary, L. Austin Wright. Dean McKiel was in Sault Ste. Marie in September and Mr. Wright in November.

Programmes of the meetings held were as follows:

Feb. 24—**Basic Open Hearth Process of the Algoma Steel Corporation,** by A. H. Meldrum. **Beneficiation of Iron Ore,** by Henry U. Ross.
Mar. 24—**Newest Refractories for the Steel Industry,** by J. W. Craig of the Canadian Refractories Limited.
May 25—**Highways,** by Hugh MacDougall, Divisional Engineer of Highways for Algoma.
Sept. 22—Visit of the President of the Institute, Dean H. W. McKiel.
Nov. 2—Visit of General Secretary L. Austin Wright of the Institute.
Dec. 22—Annual Meeting for 1939.

A feature of the current year was the Junior Night held on Feb. 24th under the Chairmanship of A. R. Clarkson. The Executive hopes that this feature will be continued.

The Executive of the branch wish to thank the Sault Daily Star for the courteous treatment afforded them during the current year.

The Executive regret the loss through a change of address of the following members:—Henry U. Ross, Jr.E.I.C., M. W. M. Conklin, S.E.I.C., Carl G. Kauth, Jr.E.I.C. We welcome into our Branch A. Mendelsohn, S.E.I.C. and John Callum, S.E.I.C.

Another outstanding feature of the year was the appeal made to the branch resident and non-resident members for a contribution to the Honorarium which was presented to Capt. R. J. Durley, Emeritus Secretary of the Institute. A generous response was received from the members.

TORONTO BRANCH

The Annual meeting of the Branch took place at the Canadian Military Institute on Wednesday, April 5, 1939.

The meeting was preceded by a dinner at 7 p.m. at which Dean S. C. Hollister, Dean of Engineering at Cornell University; Dean C. H. Mitchell, Prof. C. R. Young, Prof. R. W. Angus, J. R. Dunbar, Chairman of the Hamilton Branch; A. R. Hannaford, Secretary of the Hamilton Branch; C. G. Moon, Chairman of the Niagara Peninsula Branch; E. P. Muntz, Hamilton; J. A. Vance, Woodstock, were present.

During this past year the Executive Committee has held eleven meetings. Average attendance—nine.

Regular meetings held during the year are listed below with attendance given in brackets.

Jan. 14—Social evening held at the Engineers Club for members and their wives. Preceded by dinner and followed by entertainment, music, cards and billiards (125).
Jan. 19—Annual Students' night. **Diesel Electric Buses,** by R. N. Boyd. **Cavitation,** by A. D. Smith. **The Engineer in the Plant,** by F. C. Read. **Geared Turbine Drives for Marine Propulsion,** by M. D. Stewart. **Soil Stabilization,** by W. M. Walkinshaw. **Future of Pulp in Northern Ontario,** by G. T. Perry.
Feb. 2—**Highway Trends in Ontario,** by C. E. Robbins, District Engineer, Ontario Department of Highways (55).
Feb. 15—**The Forgotten Sparkplugs of Industry,** by Colonel Willard Chevalier, Vice-President, McGraw-Hill Publishing Company, New York. At this meeting an invitation was extended to all engineering and allied societies in Toronto (185).
Mar. 2—**Aerial Transportation Developments in Canada,** by J. A. Wilson, Controller of Civil Aviation, Department of Transport, Ottawa (100).
Mar. 16—**Engineering Experiences in China,** by A. T. Cairncross (75).
April 5—Annual Branch meeting (80).
May 18—Joint Dinner meeting—Affiliated Engineering and Allied Societies in Ontario. **Recent Developments in Aviation,** by Igor I. Sikorsky, Engineering Manager, Sikorsky Aircraft Division of United Aircraft Corporation (430).
Oct. 12—**Mining and Smelting of Nickel and Its Engineering Uses,** by K. H. J. Clarke, Sales Engineer, International Nickel Company (160).
Nov. 2—**The Low Voltage Network System of Distribution,** by C. E. Schwenger, Toronto Hydro-Electric System (70).
Nov. 17—**Engineering Education and Professional Responsibility,** by the President of the Institute, Dean H. W. McKiel. This was the occasion of the President's visit to the Branch (50).
Nov. 30—**Modern Applications of Diesel Engines,** by J. L. Busfield (50).
Dec. 7—**Airport Facilities at the Island and Malton,** by E. L. Cousins (70).

Previous to each regular meeting, dinners have been held in Hart House. These have been well attended and enjoyed by all who have availed themselves of the opportunity to attend.

The Branch Loan Fund established some seven years ago has a balance of $200.00. One application for a loan has been received during the year.

It is with deep regret that we record the death of the following members of the Branch during the year; J. F. Cassidy, A.M.E.I.C.; G. E. Evans, M.E.I.C.; E. T. Wilkie, M.E.I.C. Our sincere sympathy is extended to their families in their loss.

VANCOUVER BRANCH

Another year has passed for our Branch, and although there has been no happening of a spectacular or very unusual nature, the year has been marked by a steady progress of routine events which have taken place in an ordered sequence and harmonious manner. The activities of the Branch were briefly as follows:

Jan. 14—Inspection trip of Vancouver Iron Works plant to see fabrication of 48 in. electrically welded steel pipe manufactured by them for the Greater Vancouver Water District. Also inspection of 48 in. submerged section of 48 in. concrete main being assembled before launching at the Indian Reserve, False Creek.
Jan. 20—**Bullion Placer Gold Mine,** by Ray F. Sharpe, General Manager, Bullion Mines, Bullion, B.C.

Feb. 9—Exhibition of film made by Missouri State Highway Commission. **Tests on Various Highway Guard Rails,** by A. E. Foreman, Consulting Engineer.

Mar. 6—New Westminster Night. **The Development of the Fraser River Channel,** by K. W. Morton, District Engineer, Department of Public Works (Canada), New Westminster, B.C.

April 14—An illustrated lecture, **The Brothers of the Bridge,** by A. L. Carruthers, Department of Public Works, Victoria, B.C.

May 17—Inspection of Vancouver Airport (Sea Island) by courtesy of the Trans-Canada Airlines, Department of Transport and City of Vancouver Airport authority.

Oct. 19—Dinner in honour of Dean H. W. McKiel, President of the Institute, and L. Austin Wright, General Secretary.

The Branch also sponsored a lecture at the University of British Columbia last spring when an illustrated address on **Hydraulic Gates** originally prepared by Mr. Newell, Dominion Bridge Company, was presented to the Applied Science students.

The visit of our President, Dean H. W. McKiel and the General Secretary, Mr. L. Austin Wright, will not soon be forgotten by any of the members or guests who were present at the well attended dinner meeting on October 19th. The Presidential address was truly inspiring, stressing as it did the responsibility of the engineer, prior to the declaration of war, and the vitally important part he will take during and after the conflict. It was gratifying to observe the keen interest shown by our President in the importance of the young engineer in study and training, and we may rest assured that our representatives at Montreal are doing everything reasonably possible for the young members of the Institute.

The Chairman was invited by the General Secretary to attend the Regional Council meeting at Calgary on October 14th but was unfortunately unable to attend; however, the Branch was most ably represented by our Councillor, Mr. James Robertson.

The Executive meetings during the year were well attended and were marked by keen interest and the most friendly co-operation by all the members. We were unfortunate in losing the services of Air Commodore G. O. Johnston, due to the outbreak of the war.

There is little to report in the matter of co-operation and co-ordination between the Institute and the Association of Professional Engineers, but we believe that ideas are developing into a stage of crystallization which we hope will take definite and mutually satisfactory form at a future date.

Our Branch has maintained the best of relations with the University of British Columbia student body where we are most fortunate in having the valuable and ever-ready assistance of Dean Finlayson and our good friend and member of the Executive, Mr. Archie Peebles.

We regret to record the death of Mr. Thos. H. White, M.E.I.C., of honoured memory, on March 20, 1939, who was until his death the oldest member of the Institute.

The executive committee desires to express appreciation of the valued services of our efficient secretary, T. V. Berry, who has again proved his worth to the Institute in general and to our own Branch in particular.

VICTORIA BRANCH

During the year three general meetings of the Branch were held with an average attendance of twenty-five.

May 5—**Coast Defence,** by Lieut.-Col. R. L. Fortt, Officer Commanding Royal Canadian Artillery on the Pacific Coast.

Oct. 23—Branch received a visit from Dean H. W. McKiel, President of the Institute, accompanied by Mrs. McKiel and L. Austin Wright, General Secretary. A very successful dinner meeting was held when both the President and Mr. Wright addressed the members on Institute affairs.

Dec. 7—Luncheon meeting. **The Use of Aerial Photography for Mapping,** by F. C. Green, Surveyor-General of British Columbia.

Five meetings of the executive committee were held during the year when branch business was transacted, the average attendance of executive members being 70 per cent. Much of the business of the Branch throughout the year was delegated to the chairman and the secretary for attention.

Membership

The year just past saw considerable activity in the transfer of membership to and from this Branch and other branches of the Institute, much more so than in former years. This is largely accounted for in the proximity of the Branch to military and naval headquarters where many of our members are stationed.

In all ten transfers to the Branch were recorded and three new members were enrolled, two Students and one Junior. Five members of the Branch were transferred to other jurisdictions. The Branch had the misfortune to lose two of its Life Members by death during the year, W. S. Drewry, A.M.E.I.C., and Lieut.-Col. A. E. Hodgins, M.E.I.C., both being of advanced age at the time of their death.

Annual Meeting

The annual meeting of the Branch will be held early in the new year when the election of officers will take place. In conclusion this executive committee wishes to sincerely thank the General Secretary, and all his assistants at Headquarters for the ready assistance and unfailing courtesy received at all times throughout the year.

WINNIPEG BRANCH

During the year, the Branch Executive Committee held fourteen business meetings. In accordance with an agreement consummated in 1938, all general meetings except the Annual meeting, and the meeting of Oct. 3rd, were held under the joint auspices of the Winnipeg Branch and the Association of Professional Engineers of the Province of Manitoba. Papers presented at these meetings are listed below, the attendance for each meeting being shown in brackets.

Jan. 5—**Automatic Fire Extinguishing Systems,** by J. C. Davis, President, J. C. Davis Co. Ltd. (50).

Feb. 2—**Radio in Air Transportation,** by S. S. Stevens, Radio Engineer, Trans-Canada Airlines (90).

Feb. 16—Annual meeting (45).

Mar. 2—**Soils and Soil Conservation Problems,** by Prof. Ellis, Department of Soils, University of Manitoba (49).

Mar. 16—**Calcium Chloride in Engineering Construction,** by J. A. Knight, Manager of Highway Engineering Service, Brunner Mond Canada Ltd. (43).

April 6—**The Manitoba Power Commission,** by J. P. Fraser, General Superintendent, Manitoba Power Commission (65).

April 20—**Some Experiences with Residence Foundations,** by C. V. Antenbring, Designing Engineer, Cowin & Co. Ltd. (158).

Oct. 3—**Institute Affairs,** by President McKiel.

Oct. 19—**Foreign Exchange Control,** by Prof. W. J. Waines, Department of Political Economy, University of Manitoba (71).

Nov. 2—Visit to Engineering Laboratories, University of Manitoba (101).

Nov. 16—**Modern Trends in Primary Sewage Treatment,** by Douglas L. McLean, Superintendent, Greater Winnipeg Sanitary District (71).

Dec. 7—**Electric Boilers and their Application to Industry,** by C. P. Haltalin, Assistant Engineer, Winnipeg Electric Co. (52).

Abstracts of Current Literature

Contributed abstracts of articles appearing in the current technical periodicals

AMERICAN DIESEL PROGRESS

***Diesel Railway Traction*, November 24, 1939**

Abstracted by R. G. Gage, m.e.i.c.

The rate of progress maintained in the dieselization of American railways during the past two years or so shows, if anything, an increase within recent months, as witnessed by the following notes. The Chicago, Burlington & Quincy Railroad is to purchase four 2,000 b.h.p. streamlined stainless steel Diesel locomotives. Six of these units will be operated in pairs on the Exposition Flyer and Aristocrat trains, and the seventh will be held as spare for these two trains and for the Denver Zephyr and Twin Zephyr services. The original three-car Zephyr train was recently involved in a collision with a freight locomotive. The Chicago & North Western Railroad has been authorized to purchase two triple-unit 6,000 b.h.p. electro-motive Diesel locomotives for hauling two 14-car streamlined trains to run between Chicago and California. The Chicago, Rock Island & Pacific Railroad has been authorized to purchase ten 600 b.h.p. Diesel-electric switching locomotives at a cost of $625,000 and ten of 300 b.h.p. at a cost of $350,000. The Alabama & Florida Railroad is introducing light railcars on its local services, some of the vehicles being road-railers. Diesel engines of International manufacture are being used. The Illinois Central Railroad has ordered seven 600 b.h.p., one 1,000 b.h.p. and two 2,000 b.h.p. electric-motive Diesel switching and freight-transfer locomotives, the enquiries for which were noted in our issue of October 27. The Minneapolis, Northfield & Southern Railroad is proposing to purchase three Diesel-electric locomotives at a cost of $175,000 and the Ford Motor Company has ordered three 1,000 b.h.p. switching and freight transfer locomotives from the General Electric Company; each is to be powered by two 500 b.h.p. Cooper-Bessemer engines. Together with such recent introduction as the new Diesel-hauled 400's on the Chicago & North Western and the Denver Rockets on the C.R.I.P., and trains being built for the Atlantic Coast and Florida East Coast lines, the above orders give a good cross-section of Diesel traction activities in the U.S.A. The service given by the express Diesel locomotives in the States has been such that Mr. C. T. Ripley, chairman of the Railroad Division of the American Society of Mechanical Engineers, said recently that a radical change in the design of the steam locomotive would be necessary to make it capable of fully competing with the Diesel in high-speed service, even when the Diesel was working over territory mainly worked by steam locomotives. If a complete division was changed to Diesel traction there would be further major savings in the elimination of fueling and water facilities, and in intermediate section points.

THE ARTISAN CRISIS

***The Engineer*, October 13, 1939**

Handicraftsmanship as understood in the higher scale of artisan organization, with its professional qualifications entitling independent skilled workers to belong to the confraternity, has a bearing on the lighter branches of engineering production that should not be overlooked. An artisan of this class must be an artist in his trade and highly skilled, producing goods of individuality and quality, and appealing to buyers who are prepared to pay for goods of distinctive merit. He belongs to a middle class of producers between the big industry and the smaller artisans who are, for the most part, individual workers in association for relief from fiscal burdens that fall on industry generally. For many years the middle class artisan confraternity has been reorganized over most of the Continent on a social basis with international co-operation, and its aim has always been to attain the highest standard of quality of production. It is this ideal that stands out as a measure of achievement in all industries. A handicraftsman in art metal work, for example, sets a standard which the mass production manufacturer cannot hope to equal but is obliged to get as near to it as he can. The middle class artisan production can only find an outlet among buyers who will pay more for goods that are valued for professional initiative and taste, sound workmanship, and quality. A crisis has now arrived when that class of buyer has wholly disappeared. The situation of the artisan was already becoming difficult from the time that the financial stagnation and lessening incomes favoured the lower quality goods, and when armament manufacture was accelerated there were complaints from artisan associations that master craftsmen were going into factories in response to the demand for skilled workers. Since the outbreak of war the Federation of Syndicates of French Artisans sought to obtain work for its members by a participation in orders for national defence. This would necessitate an organization that does not appear yet to be feasible. For the moment, the situation of the artisan is critical. The general character of the crisis is seen in arrangements that are being made by the Government of the Swiss Confederation for the relief of artisans, who represent the greater part of the industrial population and contribute largely to the country's export trade. Alike in Switzerland and in France the artisan class will experience a difficult time during the war and all through its after-effects until the world settles down to a state of confident commercial collaboration. There can be no suppression of handicrafts in individualist countries, however much big industry may grow, and it is all to the good that handicraftsmanship should grow with it. On the other hand, the existence of the artisan is stated to be seriously threatened in Germany where, nevertheless, the movement which extended over the greater part of the Continent first took shape and exacted high qualifications from master craftsmen and imposed conditions of apprenticeship that were calculated to give increasing vitality to middle class industry. The collective system now adopted in Germany has much in common with that of the Soviets, so far as the submerging of individualism is concerned. A grouping of industrial and commercial effort under State control tends to the suppression of the artisan and the small trader. When a country becomes a vast State industrial machine it loses the human factor that means so much for progress, and this is recognized in the other totalitarian country where the artisan movement is fostered as necessary to the national welfare.

CANADA'S ECONOMY ON A WAR BASIS

Effect on Trade

***Trade and Engineering*, October 1939**

The change of Canada's economy to a war basis is being made rapidly and smoothly. New control boards have been set up which are functioning efficiently. The War Supply Board is being organized with powers which will extend considerably beyond the purchasing of supplies. The Wartime Prices and Trade Board has almost completed its organization, while the Foreign Exchange Control Board was set up with a speed which was surprising and even startling.

A ship licensing board has been created for the purpose of conserving and controlling shipping for essential service. Various measures are under consideration for ensuring supplies of needed materials without excessive price increases and include embargoes on exportation of some commodities and reductions in import duties in respect of others.

Industrial organizations also are making the necessary adjustments to the new conditions.

Control of Exchange

The Canadian regulations for control of foreign exchange will follow closely the British control system. They are designed to protect Canadian resources and prevent exportation of Canadian capital for other than necessary purposes. A gradual repatriation of Canadian investments abroad may be expected as Canadians dispose of United States securities, and the exchange obtained on their realization will be available to the foreign exchange control board on conversion into Canadian funds.

While one of the purposes of the exchange control system is to protect the Canadian dollar against too drastic decline and to maintain Canada's credit and purchasing power for necessary uses, the requirement of licenses for importations and the high premium undoubtedly will have an effect of far-reaching importance in discouraging imports, and incidentally, will provide further protection for Canadian industry in the home market. In addition, they will reduce Canadian spending on pleasure trips and even on business trips to the United States of America.

While many examples might be given of how the exchange situation will restrict imports to the advantage of Canadian producers, the situation as regards importations into Western Canada of United States crude oil for refining is of special interest. The increased cost in United States currency of Illinois crude oil provides the opportunity for a considerable extension throughout Western Canada from the Ontario-Manitoba border to the Rocky Mountains of sales of petrol produced from Turner Valley crude.

Turner Valley Oil

Although the control of imports which has been established by the British Government and the drop in the exchange value of the pound sterling will have a very marked effect on Canada's exports to the United Kingdom of products other than essential raw materials, food supplies, and munitions, the premium on United States funds is assisting Canadian producers to increase their sales in the United States.

Moreover, the war situation has lessened greatly European competition against Canadians in supplying wood pulp, newsprint, paper, and various other products to the American market. Under a provision of the trade agreement between Canada and the United States the treaty may be modified or terminated if the rate of exchange varies to such an extent as to prejudice the position of either country, but there is no expectation that the United States will avail itself of such right.

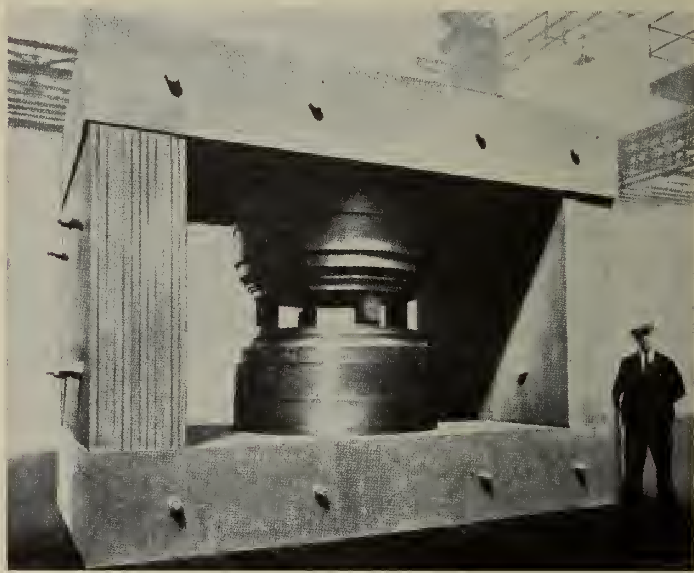
THE CYCLOTRON

***Colvilles Magazines*, September, 1939, and**
***The Engineer*, October 6, 1939**

We publish on this page an engraving of the mechanical portion of a large electro-magnet, recently constructed by Colvilles, Ltd., for the Department of Physics of the University of Birmingham, at the head of which is Professor M. L. Oliphant, F.R.S. When completed on the electrical side it will provide for the department an entirely new type of tool of immense power for physical and biological research, and a new means of investigating atomic structure which may well lead to discoveries having important and far-reaching results. The length over all is 15 ft. 7 in.; height, 12 ft. 3 in.; and breadth, 8 ft. The total overall weight is practically 230 tons. The base, side supports, and upper bridge pieces are of multiple plate construction and the area of 2 in. thick plates used for this purpose is sufficient to make a path 2 ft. wide and almost half a mile long.

All the material used in construction, i.e., steel plates, pole pieces, ties, suspension bolts, etc., were produced and roughed to shape at Dalzell Works, Motherwell, and it had been intended to complete the equipment in the workshop there as far as possible. However, the necessities of production requirements intervened so that the finished machining of the various pieces, together with the complete assembly, was undertaken at the Finnieston Works of Harland and Wolff, Ltd., where the photograph shown was taken in their workshop.

In a precision instrument of this nature, the machining of the components and particularly of the pole pieces required craftsmanship of a very high order. These pieces were required to have dead smooth surfaces, and also to be flat and parallel within a tolerance limit plus or minus two thousandths, and to achieve this high standard over areas of 6 ft. in diameter represents no mean achievement in precision machining and finish. Installation on site is now proceeding in Birmingham where elaborate precautionary measures are being taken in the accommodation provided to reduce the risk of accident and ensure the safety of the experimenters.



230-ton cyclotron.

In the efforts to produce high-speed atomic particles, the Cyclotron, or magnetic resonance accelerator, has so completely demonstrated its superiority in the matter of the energies which can be produced that laboratories all over the world are using them. Its popularity is easily understood in view of its effectiveness in producing the very energetic particles needed to disrupt the nuclei of the heavier elements. Direct methods of acceleration have failed as yet to give particles with energies exceeding about 2,000,000 volts, mainly because of the difficulty of getting an evacuated tube to stand the electrical strain of such high voltages. The Cyclotron, using no actual voltages above a few tens of thousands, has no such insulation difficulties, and so, relatively speaking, may be built cheaply and housed cheaply, yet it will deliver ion beams consisting of particles having many millions of volts energy.

RAILWAY TRAVEL IMPROVEMENTS IN FRANCE

***The Engineer*, October 13, 1939**

One month after the mobilization, the Minister of Public Works, Monsieur de Monzie, was able to give some idea of the achievement of the National Railway Company in maintaining a minimum service in the public interest while the railways were requisitioned for the abnormal requirements of military transport. During the first week 1,500 trains were run for the evacuation of populations from the frontier departments to the central regions of France, and the number of trains for public service was steadily increased until, at the beginning of October, it was possible to resume a limited number of express trains on all the main lines. From Paris there are expresses to Hendaye, Marseilles, Vintimille, Strasbourg, Cherbourg, and other important towns, as well as an acceleration of the Orient Express. Between Paris and Dieppe there is a daily express each way, the morning outward-bound train taking three hours 10 minutes for the journey and the evening train back three hours 18 minutes. Three express trains run each way daily between Paris and Havre, the outward time being three hours 37 minutes, and only two or three minutes more for the return. There are also three expresses each way between Paris and Calais which take five hours seven minutes for the journey, except the evening train from Paris, which reduces the time by seven minutes. Monsieur de Monzie affirms that the railway service is now about two-thirds of the normal, but it does not provide the same acceleration, and all expresses stop at some intermediate stations. The rapides have not been restored. Under present conditions the service is as good as can be expected, though still liable to be interfered with by military requirements. The public is invited to use the railways as little as possible, and Monsieur de Monzie complains of the way in which people evacuated from Paris are returning. Another interesting statement by the Minister is to the effect that the National Railway Company proposes to carry out certain reforms in the services and the trains, notably by providing more general comfort in travelling. Trains in France are still made up with three classes of coaches, but following upon the increases in fares, and the necessity for everyone to economize in view of rising prices, practically all passengers travel third class. Except for the big expresses there is hardly any train with more than two first and second class coaches, the first class generally sharing a coach with the second class. It may be presumed, therefore, that one of these classes will be suppressed, and that there will not be so wide a disparity in comfort between the two remaining classes as exists at present. Third class coaches badly need improvement in this respect, and it should be possible to provide adequate comfort now that the greater part of the rolling stock will have to be renewed.

PORTABLE SUCTION GAS PRODUCERS

The Engineer, November 24, 1939

The use of suction gas for road vehicles has become an essential factor in war time economy. There is no escaping the alternative of running privately-owned lorries and tractors on home-produced fuels or of laying them up during the period of hostilities. For this reason it is no longer a question of whether suction gas offers the same reliability, convenience, efficiency, and all-round economy as liquid fuels, but merely whether lorries can be run on it with the certainty that owners will be able to continue their business, which must be done if the country is to maintain a normal activity. In its present state of development the suction gas vehicle is doing sufficiently good work under favourable conditions. When there is no other source of energy available, apart from compressed coal gas and electricity, lorries with suitable suction gas equipments may be relied upon when placed in charge of men who know how to handle them. The problem has been the subject of long and patient research. It has been solved up to a point of practical utility, while failing to eliminate apparently inherent technical difficulties that at present stand in the way of a completely satisfactory realization. There has been a dispersal of effort in research and experiment, which may have been to the good in covering the ground so fully, and while failures are many there are practical successes and an accumulation of experience that now needs co-ordination with the object of achieving the continued development of the suction gas vehicle. A Comité National d'Entente des Carburants de Remplacement has been formed to effect such co-ordination so that a large war-time scheme can be put in hand for the equipment of lorries and other vehicles with producer plants. It represents all interests in the portable suction gas producer industry, and has appointed four commissions, each devoted to one of those interests. Firstly, the production of charcoal and composite fuels has its own problem of standardising a quality of fuel and stabilizing prices. Secondly, the distribution of fuel supplies throughout the country has a tendency to lag behind demand in the early stages because the demand is small and irregular, and if rapid progress is to be made consumers must be assured of being able to obtain supplies everywhere, and that, too, under conditions that do not involve undue variations in the standard price which may be expected from the cost of transporting charcoal and composite fuels over long distances. The question of the quality of fuel has disturbed many suppliers who had shared in a general belief that charcoal from any wood or waste would be suitable for portable suction gas plants. It is a matter that must be left to the third commission which deals with the construction of producers. While these offer interesting problems that may be solved in time, the commission can hardly do more at present than select the most suitable types of existing producers and arrange for their construction in sufficient numbers. Fourthly, of equal importance is the work of the commission which covers the whole practise of fitting suction gas equipments to vehicles. In the absence of engines designed especially to run on suction gas, exact information will have to be prepared concerning alterations to be made in engine bores, compressions, speeds, and changes in gears, as well as dimensions of induction pipes and other details that make all the difference in the running of suction gas lorries. This work is intended to make the best use of existing suitable plants in the hope of increasing the number of vehicles in use eventually to something like 30,000. At the same time, it may be assumed that with the importance given to suction gas road traction under present abnormal conditions, the new organization will be able to encourage a more active technical development in the direction of creating types of suction gas engines and simplifying the producer and general equipment in a manner to give some permanency to the industry.

ROT-PROOFING OF SAND-BAG REVETMENTS

Engineering, November 24, 1939

In a memorandum issued by the Ministry of Home Security, it is stated that, on the basis of present information, two types of preservative are considered to be suitable for application to sand-bag revetments. They are, respectively, a creosote or tar distillate, used as a water emulsion, and a solution of an organic copper salt in creosote, made up into an emulsion. The former is more widely available than the latter and is suitable for the treatment of revetments in position which had already deteriorated as the result of exposure to the weather for some time. The latter, although more potent, is also more expensive, and it is pointed out that its use will not generally be justified unless the bags are in good condition. Further, it is desirable to take down the whole revetment, treat all the bags, and then re-pile them. When a water emulsion of creosote or tar distillate is used, it should be applied in such quantity as to give, on the exposed portion of the bag, a coating of creosote not less than one-fifth of the normal dry weight of the fabric exposed. This is given approximately by a 25 per cent creosote emulsion when sprayed on the bags to give a thorough coating, completely satisfying the absorption of the fibres. The creosote should comply with British Standard Specification No. 144/1936, which deals with "Creosote for the Preservation of Timber." Any normal emulsifying agent may be used, and the composition below may be taken as a typical example. The latter three items constitute the emulsifying agent.

65	parts	creosote
35	"	water
1.2	"	oleic acid
0.8	"	casein
0.36	"	sodium hydroxide

The emulsifying agent is dissolved in water and the two fluids are mixed in a jet similar to that of a cream-making machine. An emulsion prepared in this manner, it is stated, should be stable and capable of being transported in drums or kegs. Before use, it should be diluted with water to a suitable consistency for spraying, bearing in mind, however, that the creosote content does not fall below 25 per cent.

When using the organic copper-salt emulsion, the salt should be dissolved in the creosote or tar distillate, the solution then being made up into an emulsion with water, by the use of a special type of emulsifying agent. The copper salt should be one of an organic fatty acid of high molecular weight, such as, for example, copper oleate. The organic copper salt should be added in the proportion of 16 per cent of the weight of the creosote, and the whole should be emulsified with water. When sprayed on the bags, it should be applied as a 20 per cent emulsion.

It is emphasized in the memorandum that the emulsion should be diluted with water immediately before use, as the diluted solutions do not keep. The emulsions should preferably be applied by means of a paint or horticultural spray, or even an A.R.P. stirrup pump, though brush application is permissible. Care should be taken to coat thoroughly any seams visible on the face of the pile, and to work the emulsion well into the seams. As is the case when handling creosote in the ordinary way, care is needed to avoid fire risks during application, and naked lights should not be allowed in the vicinity of the work nor should the men smoke while spraying. The freshly-creosoted revetments will have a strong odour characteristic of creosote, but this will decrease to an unobjectionable amount in a few days. As creosote may cause permanent stains, suitable measures should be taken to protect the surface of buildings against which the bags are placed, while spraying is in progress. In order to obtain the best possible penetration into the fabric of the bags, the preservatives should not be applied immediately after heavy rain, and, when wet, the bags should be given a reasonable time to dry. It is desirable to repeat the treatment and this should be done at intervals not exceeding three months.

HIGH-SPEED LIGHTWEIGHT PASSENGER TRAINS

By C. T. Ripley, Chief Engineer, Wrought Steel Wheel Industry, Chicago, Ill.

In a paper delivered on November 21 before the American Society of Mechanical Engineers at New York, Mr. Ripley stated that the streamlined high-speed, lightweight passenger train has been definitely successful on American railroads in recovery of traffic, financial return, and mechanical performance, and, consequently, the number of such trains in service should continue to increase.

In view of the current investigation of the safety of high-speed, light-weight trains by the Interstate Commerce Commission, Mr. Ripley offered the following statement: "Generally speaking, the new lightweight cars are being designed and built just as strong and safe as the older heavy types. Better engineering, stronger materials, and improved methods of fabrication make this weight reduction possible. New welding technique largely eliminates the human element and when properly applied should be preferable to the old riveting practice. In 1912 and 1938, specifications were written by the Railway Post Office Department so as to cover practically all types of construction with all types of materials. The major provisions o both the 1912 and 1938 specifications were, first, a minimum strength of centre-sill construction based on 400,000 lb. buffing static load and a factor of safety of two, and second, a minimum strength of end construction to protect against telescoping action. Cars built to meet these specifications have rendered excellent service with a remarkably good record in the protection of passengers under wreck conditions. As a consequence when lightweight construction was started in about 1931 these specifications were used as a minimum requirement, even though there were no rules of the American Railway Association or of the Government setting such limitation.

However, a feeling developed that because of the operation of lightweight cars between heavy cars in trains, it was necessary for the Association of American Railroads to set up more detailed specifications to cover the construction of all passenger-train cars built in the future, giving particular attention to prevention of damage from telescoping. A committee of the Association of American Railroads has recently developed these new specifications and they will probably govern all new construction of passenger cars. While these new specifications are generally based on the Railway Post Office specifications, they include some major changes. They provide for a centre-sill strength such that an 800,000-lb. load applied on line of draft will not produce any permanent deformation. The new specifications also include increased requirements for strength of couplers, carrier irons, and end construction, all of which mean some increase in weight, but which are apparently justified in view of the importance of maximum protection against telescoping of cars.

Several of the early trains were built of aluminum alloys but in recent years the majority of them have been built of stainless steel or low-alloy high-tensile steel. Inasmuch as no exactly similar cars have been built using the different types of steel or aluminum, it is not possible to make accurate weight comparisons. While it is true that the full use of the superior physical properties of stainless steel or the light weight of aluminum is limited to some degree by deflection requirements, it should be possible, by using these materials instead of low-alloy steel, to construct a lighter car of equal strength. A general comparison of the large number of cars of the various types which have been built indicates a weight advantage for stainless steel and aluminum of at least five per cent. It would be expected that the construction cost of cars built of these materials would be somewhat higher due to the high cost per pound of such materials, but competition between builders has resulted in about equal bid prices.

It is too early to evaluate fully the different types of light-weight car construction. Maintenance costs over a longer period and performance in accidents will ultimately provide the answer. It appears, however, that a weight of about 100,000 lb. for an 80-ft. coach is entirely practicable with full safety to passengers. If too much space for extra luxuries is provided, part of the advantage of lightweight construction is lost, as the important factor is the weight per passenger carried.

The Diesel-electric locomotive is more commonly used in these new high-speed streamlined trains than is the steam locomotive. It is claimed by some that this is chiefly due to the interest of the public in a new type of power, but the users apparently have good engineering arguments to support their choice. The advantages claimed for the Diesel are: first, high availability; second, rapid acceleration because of high tractive power at lower speeds; third, low maintenance costs; fourth, low fuel cost (usually less than half that of steam); fifth, lower rail stresses. The steam locomotive is less expensive, costing about $37 per hp. However, it is harder on track at high speeds due to the dynamic augment produced by overbalance in the driving wheels. It appears that radical change in the design of the steam locomotive is necessary to make it capable of fully competing with the Diesel in this service."

In conclusion, Mr. Ripley said, "Schedules faster than those now being made at 90 and 100 m.p.h. are possible and probable as soon as roadway conditions are further improved by curvature reduction and grade-crossing elimination."

GERMAN OIL RESOURCES—POPULAR GUESSING GAME

***Petroleum Times*, November 25th, 1939**

Abstracted by A. A. Swinnerton, A.M.E.I.C.

That popular guessing game of the moment—what are German oil resources—continues apace. An article in this issue by B. O. Lisle (New York) suggests that the German supplies may be greater than generally believed, and that by cutting down civilian consumption the annual output—quite apart from any reserves that may have been built up—may enable her to last much longer than her production and consumption figures might indicate.

Dr. A. J. V. Underwood, whose views on oil and cognate matters always carry the weight of sincere study, especially as regards German matters, comes to the same conclusion in an article in "The Industrial Chemist" for November.

He puts forward strongly the view that it is the prospective position towards the end of 1940, or early in 1941, that should be considered closer. In this light he arrives at the following table.

	Present rate of production	Production about end 1940
	Tons per year	
Synthetic production	2,000,000	3,000,000
Natural petroleum	700,000	1,000,000
Benzole	500,000	600,000
Producer gas from wood, charcoal, coke, anthracite	200,000	500,000
Brown-coal tars	200,000	400,000
Bituminous coal tar oils	250,000	400,000
Bottled gas	150,000	250,000
Ethyl alcohol	200,000	200,000
Methyl alcohol, isopropyl alcohol, n-butyl alcohol, isobutyl alcohol, acetone, methyl ethyl ketone	100,000	200,000
Total	4,300,000* (30,000,000 bbl.)	6,550,000* (45,000,000 bbl.)

Dr Underwood believes that even after the end of 1940 a further increase of production is, of course, possible and concludes his interesting survey thus:

"It therefore appears improbable that Germany will be rendered unable to carry on the war owing to a shortage of oil unless military activity on a greatly extended scale results in an extremely large increase in consumption or unless the present sources of oil imports into Germany are cut off through changes in the international situation or inability to meet payments required for vital imports, or unless Germany's productive facilities are seriously reduced through damages resulting from military operations."

On the other hand, in another article, C. R. Garfias and J. W. Ristori of the Cities Service Company are of the opinion that the Axis Powers are short of petroleum and that Roumanian oil is vital to Germany. They estimate that Germany with a domestic production of 25 million barrels as against estimated war time requirements of 90 million barrels is short 65 million barrels per year.

They estimate that Italy will have a production of about one million barrels against a war time demand of about 40 million barrels, leaving a deficit of 39 million barrels per year.

Russian production and consumption are about balanced at 240 million barrels per year and, even if Russia had any surplus for export, transportation difficulties would rule them out as a source of supply for Germany.

Rumanian production is estimated at 55 million barrels with a consumption of 20 million, leaving a surplus for export of 35 million barrels per year. But to transport this to Germany would require about 11,000 tank cars or 300 trains in continuous operation. Even if this feat could be accomplished it would still leave Germany 30 million barrels short of their requirements, as well as leaving nothing to take care of Italy's requirements (this may be one reason why Italy is staying neutral). Incidentally it should be noted that in peace time about 80% of Germany's imports and 60% of Italy's came from North and South America, so that Italy's entrance into the war as an ally of Germany would increase Germany's petroleum difficulties. The authors consider that one of the few ways in which Germany could avoid or lessen the dangers of a petroleum shortage would be to make peace or bring the war to a successful conclusion before she has exhausted her stored supply of petroleum products.

*(At rate of seven barrels to the ton.)

FLOOD PROTECTION IN THE LONDON TUBES

***The Engineer*, October 13, 1939**

An announcement issued by the Ministry of Information gives a short account of the work in progress on that section of the Northern Line between Kennington and Strand, which has been closed to traffic since Thursday, August 31. At this point of the line the tube tunnels run under the river and electrically-operated flood gates, which can be closed across the tunnels, are being installed at Waterloo and Strand on the Charing Cross branch of the railway, in order to enable these sections of the line to be isolated during an air raid, so as to prevent any possibility of flooding which might arise as a result of damage to the tunnels under the river. On the Bakerloo line, which also runs under the river, flood gates have been installed at Waterloo and Charing Cross. As a temporary precaution while the work of installation is in progress on the Northern Line, concrete bulkheads have been constructed in the tunnels at Charing Cross and Waterloo. These will be removed as soon as the flood gates are in position, and the normal train service will then be restored, the gates only being shut when an air raid warning is received. The gates, which are made of built-up steel, slide horizontally into position within a specially constructed framework and they are designed to be operated either electrically or by hand. For their power operation, which is controlled by a push-button, alternative supplies of electric current are available. The gates are designed to resist a force of 200 tons, which is far in excess of any pressure that might have to be borne. They can be closed within three minutes of the order to close them being received. The gates on the Bakerloo line have been closed during each of the recent air raid warnings, and their closing was accomplished well within this time limit. An interlocking device, which ensures that the gates cannot be closed while there is a train on any of the sections of the line isolated by the closing of the gates, is provided. A specially-trained staff is in continuous attendance at each of the gates, and the closing signal is acknowledged electrically from the operators' control cabins, in which are illuminated diagrams indicating whether the under-river sections of the line are clear of trains or not. The sections of the northern line between Moorgate and London Bridge are also temporarily sealed with concrete bulkheads, and the London Passenger Transport Board now awaits the decision of the Ministry of Transport as to whether flood gates should be installed.

Editorial Comment...

REVIEW

A study of the annual reports from committees and branches of the Institute is a large undertaking, but for those who are not privileged to visit every branch it is the only way to get a grasp of the breadth of the Institute's interests and activities. These reports are printed in this number of the Journal and are presented by Council for the consideration of the entire membership.

Finance

It has become common practice to gauge success in terms of dollars and cents. This is not a true standard, but at least it is convenient and concise. A perusal of the financial statement will show that from this angle 1939 has been a successful year. The surplus is substantially larger than has been declared for several years, although there has been a steady improvement over that period of time. If this acceleration can be maintained it will permit the Institute to render a greater service to the members, and will make possible a widening of the field of activities that will be of benefit to all.

An analysis of the figures shows that the surplus comes from an increase in both sources of revenue, i.e. fees and Journal advertising, and a general decrease in expenditures. The largest single decrease comes from the fact that our membership list was not printed in 1939, whereas in 1938 the entire number of the December Journal was given up to it. This is an expenditure which has to be faced over short periods of time, and doubtless before long will again appear in the financial statement.

The principal increase in revenue comes from the various membership fees. In the first place the collection of arrears was approximately a thousand dollars ahead of last year. By virtue of an increase in new memberships the income from admission fees is up as is also the collection of current fees. In all, revenue from fees is better than last year by almost twenty-two hundred dollars.

Membership

The membership roll of all grades now totals 4,813 which is an increase of 183 over 1938. The persistent work of membership committees, the interest of branch officers and the visits of presidents to branches, have steadily raised the membership figures until now it is the highest that it has been in fifteen years. It is gratifying to know that this accretion continues year after year with only occasional interruptions and without any modification or slackening in the qualifications for membership. It is proof of health and strength and justification of purpose.

Expenditures

Control of expenditures can be regulated only within comparatively moderate limits. Fortunately cost does not increase in proportion to increases in membership, which at least partially explains the improved showing for last year. Of equal significance is the fact that cost does not decrease proportionally with a reduction in membership—a fact which may be forced upon our attention before long, because of war conditions.

Council has already ruled that fees will be remitted upon request to members serving overseas. This is as it should be, but when it is recalled that almost a thousand members served in France in the last war, it becomes apparent that revenue is going to be affected without a corresponding reduction in expense. This makes more than ever necessary, the staunch support of members who are not on active service. The maintenance of membership, the prompt payment of fees, an increase in interest in branch activities will permit the Institute to carry on with unabated effort and success in spite of the reduction in income which is likely to develop. Under continued war conditions, opportunities for service will probably become greater. Only the genuine whole hearted support of the membership will make it possible for the Institute to meet these opportunities, and fulfil the obligations which are present at a time like this.

General

A further study of reports will show substantial progress in the development of co-operative arrangements with provincial professional associations; increased activity in international relationships; progress towards better serving the needs of the young engineer; plans for improving the library and many other items of general interest. The reports from branches indicate that an active year has been experienced and that finances are in excellent condition.

1940

It is encouraging to face the future with such a year of successful accomplishment in the immediate past. There is no use being blind to the possibilities of war and its adverse effect on Institute affairs, but neither is there anything to be gained by letting the black clouds of international disturbance entirely block the view of the future. The future will come and must be met, and in it will be found greater opportunities to serve that may permit the Institute to reach new levels of attainment, both for its members and for Canada.

A NEW ERA IS INAUGURATED

The Halifax engineers enjoy an enviable reputation for organizing "active" functions for the professional group. Certainly the dinner of January 25th came within that category, and as well as providing the background for the formal signing of the co-operative agreement between the Association and the Institute, afforded a happy reunion for two hundred members of the two organizations.

That the signing of the agreement was appreciated as an event of great importance was indicated by the formal ceremony that accompanied it. At a table set on a stage where all the audience could see it, the Presidents and Secretaries signed on behalf of their organizations, and prominent engineers who had been active over years of negotiation signed as witnesses. The applause that greeted the consummation of this new basis of operation was encouraging evidence that it met with the approval of all engineers in the province.

The agreement becomes effective from the first of the year. Its wording indicates that its principal objective is the establishment of a common membership and a common fee, but something of even greater significance is made possible, although it is not so clearly indicated in the phrasing of the document itself. This is that a common front and a common cause are now established, and that for the future unified efforts are available to advance the welfare of the profession, and for the further development of the interests of the public. Surely such objectives justify the patient efforts of those members of each society who have for several years given generously of their time and thought. This concluding ceremony in Halifax must have brought great satisfaction to them all.

During the banquet the President of the Institute traced the history of engineering organization in the province, giving the names of several who were active years ago, and whose careers are still fresh in the minds of many in the audience, although most of them have long since departed this life. A great debt is owed by the present generation to those pioneers in engineering and in engineering organization, whose efforts to establish the calling as a profession, and the profession as a unit, reached its highest peak with the signing of this co-operative agreement in Halifax.

The working of the agreement requires the establishment of certain new procedures which are now underway. A change in accounting methods, collections, rebates, administration and so on, become necessary, but they present no obstacles. Members will notice these changes and will be glad to facilitate the establishment of a new and better order, to the end that the profession may advance in the eyes of its own members as well as those of the public.

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF ONTARIO

The election of 1940 officers and council of the Association of Professional Engineers of Ontario was announced on January 27th at the general meeting of the association at the Royal York Hotel in Toronto. At this well attended gathering, the retiring President, W. P. Dobson, relinquished office in favour of his successor, J. W. Rawlins of Toronto. A specialist in mining engineering, Mr. Rawlins has served the International Nickel Company in a variety of technical capacities for 34 years.

The Vice-president is S. R. Frost, sales director of North American Cyanamid Limited, Toronto; the registrar, M. Barry Watson, consulting engineer, Toronto; and Walter McKay is secretary-treasurer.

The members of council, representing the various branches of the profession, are as follows:

Civil Engineers on Council:

W. E. P. Duncan, M.E.I.C., General Superintendent, Toronto Transportation Commission, Toronto.

J. Clark Keith, A.M.E.I.C., General Manager, Windsor Utilities Commission, Windsor.

Warren C. Miller, M.E.I.C., City Engineer and Treasurer, St. Thomas.

Chemical Engineers on Council:

R. M. Coleman, Smelter Superintendent, International Nickel Co., Copper Cliff.

R. A. Elliott, Assistant General Manager, Deloro Smelting and Refining Co. Ltd., Deloro.

E. T. Sterne, Manager, G. F. Sterne & Sons, Brantford.

Electrical Engineers on Council:

H. A. Cooch, M.E.I.C., Vice-President, Canadian Westinghouse Co., Hamilton.

Commander C. P. Edwards, A.M.E.I.C., O.B.E., Chief of Air Services, Dept. of Transport, Ottawa.

W. S. Ewens, Vice-President, Sangamo Co. Ltd., Toronto.

Mechanical Engineers on Council:

C. C. Cariss, Chief Engineer, Waterous Ltd., Brantford.

L. T. Rutledge, M.E.I.C., Associate Professor of Mechanical Engineering, Queen's University, Kingston.

K. R. Rybka, M.E.I.C., Associate W. J. Armstrong, Consulting Engineer, Toronto.

Mining Engineers on Council:

P. D. P. Hamilton, Associate Manager, General Engineering Co. (Canada) Ltd., Toronto.

G. A. Howes, Macassa Mines Ltd., Kirkland Lake.

D. G. Sinclair, Ass't. Deputy Minister, Dept. of Mines, Ontario.

The New President

Active in the interests of the profession for many years, Mr. Rawlins has been a member of the Association since 1923. For fourteen years he has been government representative on the chemical branch of the council and was chairman of the finance committee of the Association in 1939.

Born in Manchester, England, he came to Canada early in life and received his preliminary education in the schools of Perth, Ontario. At Queen's University he took the mining engineering course and graduated with the degree B.A. and B.Sc. In September, 1901, he joined the International Nickel Company (then the Canadian Copper Company).

For a number of years Mr. Rawlins was chief chemist at Copper Cliff and afterwards served the industry in a variety of posts. During the war he was assistant smelter superintendent and later metallurgist. In 1927 he became assistant general superintendent at the Port Colborne refinery and in 1931 returned to Copper Cliff as technical assistant

J. W. Rawlins

to the general manager, a post he retained until his retirement from active service in 1935.

His interest in civic affairs has led him to take an active interest in problems of employment and when the Committee for the Stimulation of Employment was formed at the instance of Dr. F. J. Conboy, he was appointed to the General Placement Committtee.

CANADIAN ENGINEERING STANDARDS ASSOCIATION SPECIFICATIONS

In connection with the war, the C.E.S.A. is acting as a medium for the submitting of proposals, on behalf of Canadian industry, through the British Standards Institution, to the British Army, Navy and Air Force, looking to the possible substitution of Canadian products for those specified to British Standards, which may be difficult to obtain under existing conditions.

In addition to its own Canadian Standards, the Association has on file the publications of all the principal national standardizing bodies.

C.E.S.A. Specifications may be obtained from the Association, National Research Building, Ottawa, at 50c. per copy (with a few exceptions for specially expensive publications) subject to discount on large orders.

In accordance with the regular practice of the Association, the following standards have been prepared with the co-operation and approval of producer and consumer interests, trade associations, educational institutions, the railways, insurance interests and interested departments of Dominion and Provincial governments.

During their preparation the appropriate committees made reference to analogous publications of the British Standards Institution, standardizing bodies of other British nations, the American Society for Testing Materials, the American Standards Association, the National Electrical Manufacturers' Association, Underwriters' Laboratories, Inc., etc.

A list of specifications, issued, and in progress is given on page 99 of this Journal. It indicates the wide range of the Association's activities as of December 1939. Fuller information will be found in its quarterly Bulletins.

CORRESPONDENCE

THE EDITOR,
THE ENGINEERING JOURNAL,

Dear Sir:

In the very excellent paper, "The Domes of St. Joseph's Basilica, Montreal," by M. Cailloux, which appeared in the October, 1939, issue of The Engineering Journal, reference is made to bolted clamps which were used in splicing the hoop steel. Since this is an unusual method, I suggest that Monsieur Cailloux be requested to supply, for publication in the Journal, a more detailed description of these clamps and the tests which were made on them.

Yours very truly,
C. F. MORRISON,
Assistant Professor of Civil Engineering,
University of Toronto.

21st December, 1939.

THE EDITOR,
THE ENGINEERING JOURNAL,

Dear Sir:

In reply to the request of Professor C. F. Morrison of the University of Toronto for a more detailed description of the clamps used in splicing the hoop steel in the domes of the Basilica of St. Joseph in Montreal, I am pleased to offer the following comments.

In planning the erection of the hoop steel for the domes of the Basilica of St. Joseph in Montreal, it was found that welding of the reinforcing bars was impracticable, and yet I wanted a perfect continuity in the bar stresses.

To obtain this I first hooked the ends of the bars and lapped them a sufficient distance to transfer the stress through the concrete, but I wanted absolute certainty that each hoop would work for itself and also that the bars would not get displaced and thus lose continuity.

Then I thought of splicing the bars with bolted clamps and my choice fell on ordinary standard pole line guy clamps; I then asked the Steel Company of Canada to furnish me with samples of these clamps, but not galvanized, as I wanted a perfect bond with the concrete.

In the Steel Company of Canada testing room, tests were made with different clamps on bars of different sizes and we obtained the following results:

Bar size	Type of guy clamps	Tension at first slipping
¼ in. round	One clamp with one bolt	2,925 lb.
⅜ in. round	One clamp with one bolt	3,440 lb.
½ in. round	One clamp with two bolts	5,500 lb.
⅝ in. round	One clamp with two bolts	6,215 lb.

During these tests we found that for ¼ in. and ⅜ in. bars two-bolt guy clamps were no better than the same clamp sawn in two, and with only one-bolt, so we adopted this new clamp and had the Steel Company manufacture this one-bolt clamp, not usually on the market, by simply shearing a two-bolt clamp in two.

As our bars ranged only in sizes from ¼ in. to ⅝ in. round, we tried black clamps with one, two and three bolts on bars of the above sizes and came to the conclusion, after numerous tests, that the above arrangements were giving us the best results, with tightening of the bolts not a very critical item. Of course, the bolts had to be sufficiently tightened but the use of extra long wrenches, with handles longer than ten inches, did not give us any greater tension at first slipping.

By studying the tensions at first slipping in the above table it was found that these tensions were greater than the permissible loads for the steel if stressed to 18,000 lb. per sq. in., so I came to the conclusion that the desired end had been attained.

In the main dome the quantity of clamps used was: 796 two-bolt clamps and 1,057 one-bolt clamps. The reinforcing bars used were about 60 ft. long for the ⅝ in. and

Bolted clamps in place.

½ in. bars, and about 40 ft. long for the ⅜ in. and ¼ in. bars, except on the very top where bars had to be shorter on account of the small diameter of the hoops.

Yours very truly,
MAXIME CAILLOUX, C.E.
Associated Engineers Limited.
Montreal, Que.

January 10, 1940.

ELECTIONS AND TRANSFERS

At the meeting of Council held on January 20th, 1940, the following elections and transfers were effected:

Members

Jones, Evan Stennett, district engineer, Dept. of Public Works of B.C., Cranbrook, B.C.
Potter, Russell Elmer, B.Sc. (Civil), (Univ. of Sask.), chief engr., city of New Westminster, B.C.
Wright, William James Turnbull, B.A.Sc., (Univ. of Toronto), associate professor of engineering drawing, University of Toronto, Toronto, Ont.

Associate Members

Baty, James Bernard, B.S. (Civil), (A. & M. Coll. of Texas), asst. professor, dept. of civil engineering, Queen's University, Kingston, Ont.
Cape, Gordon, B.Sc. (Civil), (McGill Univ.), chief inspector, Dominion Bridge Co. Ltd., Lachine, Que.

Juniors

Alton, William, B.Sc. (Physics), (Queen's Univ.), Lieut., R.C.C.S., C.A.S.F., Kingston, Ont.
Stiles, Douglas Duncan, B.A.Sc. (Civil), (Univ. of Toronto), gen. asst. to E. A. Cross, M.E.I.C., Toronto, Ont.

Affiliates

Farand, Laurent Charles, Quebec land surveyor, with J. M. O. Lachance, Montreal, Que.
Frederick, Stanley Edward, central office man, Maritime Telephone and Telegraph Co., Sydney, N.S.
Haltrecht, Arnold, Dipl. Ing. (Technical School, Darmstadt), proprietor, Electroradio Engineering Company, Montreal, Que.

Transferred from the class of Junior to that of Associate Member

Buchanan, Edward Trevor, B.Sc.. (Elec.), (McGill Univ.), asst. master mechanic, Consolidated Paper Corporation, Shawinigan Falls, Que.
Reid, Kenneth, B.Sc. (Elec.), (McGill Univ.), asst. elect'l. engr., City of Victoria, B.C.
Sandwell, Percy Ritchie, B.A.Sc. (Mech.), (Univ. of B.C.), asst. to the chief engr., paper machy. dept., Dominion Engineering Works, Ltd., Montreal, Que.

Transferred from the class of Student to that of Associate Member

Welsh, James Gordon, B.A.Sc. (Civil), (Univ. of Toronto), checking and design, Horton Steel Works Ltd., Fort Erie North, Ont.
Williams, David G., Flight-Lieut., M.Sc. (Elec.), (Univ. of Alta.), Signals Officer, Western Air Command, R.C.A.F., Vancouver, B.C.

Transferred from the class of Student to that of Junior

McKee, Gordon Hanford Whitehead, B.Eng., (McGill Univ.), M.Bus. Adm. (Harvard Univ.), instructor in business administration, University of Western Ontario, London, Ont.

Students Admitted

Armstrong, Howard Elgin, (Queen's Univ.), 557 Johnston St., Kingston, Ont.

Baker, Benjamin, (Univ. of Man.), 307 Princeton Apts., Winnipeg, Man.

Hughes, Gerald Francis George, (Univ. of N.B.), 7055 Bloomfield Avenue, Montreal, Que.

Hunter, Douglas David, (McGill Univ.), 156 24th Ave., Lachine, Que.

Lee, John Douglas, (Queen's Univ.), 45 Second Ave., Brantford, Ont.

Madill, Joseph Tindale, B.Sc. (Univ. of Alta.), The Graduate House, Mass. Inst. Tech., Cambridge, Mass.

Moull, William Crawford, B.A.Sc. (Elec.), (Univ. of Toronto), 313 Maitland Ave., Peterborough, Ont.

Newby, William Murray, (Queen's Univ.), 97 Light St., Woodstock, Ont.

Nicolson, Robert, B.Sc. (Civil), (Univ. of Alta), 1211 17th Ave. W., Calgary, Alta.

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

J. E. Armstrong, M.E.I.C., chief engineer of the Canadian Pacific Railway Company, was elected president of the Canadian Railway Club at the annual meeting held in Montreal last month.

W. Taylor-Bailey, M.E.I.C., vice-president and general manager of the Dominion Bridge Company, Limited, is the new treasurer of the Montreal Board of Trade.

Lt.-Col. M. M. Dillon, M.C., A.M.E.I.C., who had been since 1936, commanding officer of the Canadian Fusiliers (Machine Gun) of London, Ont., has recently been transferred to the staff of the machine gun training centre for western Canada at Saskatoon, Sask. Lt.-Col. Dillon has been active in the militia since 1915 when he was commissioned at the age of 20 as a lieutenant in the Norfolk Rifles. He went overseas in 1916 and in 1917 went to France with the Motor Machine Gun Corps. He returned to Canada with the rank of captain in May, 1919, when he was demobilized. Some years ago when the Canadian Machine Gun Association was formed, Col. Dillon took an active part in its organization and in November of last year he was elected president of the Infantry and Machine Gun Association of Canada.

Col. Dillon is well known as a structural engineer, having designed many important buildings in London, Ont., and outside.

Major S. W. Archibald, M.E.I.C., has been appointed to replace **Lt.-Col. Dillon,** A.M.E.I.C., in command of the Canadian Fusiliers (Machine Gun), of London, Ont. Major Archibald has had long military experience, having first enlisted as a private in the 119th Battalion, Canadian Expeditionary Forces, in 1916 at the age of 20. He was wounded at Cambrai in France and upon demobilization in 1918 he was a lieutenant in the Algonquin Rifles. He has been active in the non-permanent active militia service and in 1936 he received the appointment of Major in the Canadian Fusiliers.

Major Archibald is prominent in the municipal engineering field. He is a graduate of the University of Toronto with a degree of B.A.Sc. in civil engineering, and is an Ontario Land Surveyor. He was a demonstrator with the faculty of applied science with the University of Toronto in 1923 and instructor in charge of engineering drawing and mathematics at the Sault Ste. Marie Technical School. He engaged in municipal engineering practice in Seaforth from 1925 to 1931 when he came to London to carry on a similar practice.

C. A. Norris, A.M.E.I.C., has joined the staff of the *Engineering and Contract Record* in Toronto. He was graduated from the University of Toronto in 1923 with the degree of B.A.Sc. He has been for many years a construction engineer with Bremner Norris and Company, Ltd. of Montreal. For some time he was with G. R. Locker Company in Montreal.

H. J. Vennes, A.M.E.I.C., is the newly elected chairman of the Montreal Branch of the Institute for 1940.

Mr. Vennes has long been an active member of the Institute and on several occasions has delivered papers on various advanced subjects, some of which have been published in the Journal. Born in 1888, Mr. Vennes came from Norway to the United States in 1892. He graduated from the University of Minnesota in 1916 with a B.A. degree, and spent five years at the Bell Telephone Laboratories in New York. Coming to Canada from New York in 1921, when the first carrier current telephone systems were being installed here, he remained in this country ever since, be-

H. J. Vennes, A.M.E.I.C.

coming a Canadian citizen and highly regarded throughout the Dominion as an outstanding communications engineer. He has had much to do with the design and installation of the many carrier current telephone and telegraph systems, radio broadcasting stations, sound pictures and public address systems in this country since their introduction, and was largely responsible for the many allied developments of Northern Electric in this country, including the famous first radio "Peanut" tube and radio receivers in which it was used, and also other electrical devices now so generally used in communication systems, motion picture, aviation radio devices and the Hammond electric organ.

His term of office should mean a notable year for the Montreal Branch.

L. A. Duchastel, A.M.E.I.C., has been elected secretary-treasurer of the Montreal Branch of the Institute, replacing E. R. Smallhorn, A.M.E.I.C., who had filled this office for the last three years. Upon graduation from the Ecole Polytechnique of Montreal, where he received the degree of B.A.Sc. in 1927, Mr. Duchastel joined the Shawinigan Water & Power Company in Montreal. He was connected with the preliminary study and the design of the Company's hydro-electric developments on the upper St. Maurice river in the province of Quebec, particularly with the Rapide Blanc development. Later, he was engaged in a cost survey of all the Company's power houses. He is now a power sales engineer in the Commercial and Distribution Department of the Company. Mr. Duchastel has always taken an active interest in the Institute affairs, especially in the Junior Section of the Montreal Branch, having been chairman in 1936.

Major Edward T. Renouf, A.M.E.I.C., is commanding the 7th Medium Battery, Royal Canadian Artillery. He was educated at McGill University where he received the degree of Bachelor of Science in 1923. Upon graduation, he went with Chas. Walmsley Company of Canada, Limited and spent two years in shop work and draughting. From 1925 to 1927, he was engineer in charge of the layout of amiesite on highways in the province of Quebec, with the Société Générale des Ponts et Chaussées, Limitée. From 1927 to date, Major Renouf has been production manager and editor of technical and scientific books with the Renouf Publishing Company in Montreal.

James R. B. Milne. A.M.E.I.C., has accepted the position of assistant manager with the Northern Foundry and Machine Company, at Sault Ste. Marie, Ont. After having served five years, designing and erecting naval machinery at H.M. Dockyard, Rosyth, Scotland, he joined Price Brothers & Co., Limited, Kenogami, Que., where he was for twelve years, the last four of which he was mechanical superintendent. His last appointment was for three years as mechanical superintendent at Spruce Falls Power & Paper Company, Kapuskasing, Ont.

Donald Ross, A.M.E.I.C., has joined the staff of the Canadian Industries Limited, in Hamilton, Ont., where he is engaged in the construction of a new plant. A graduate in civil engineering from the University of New Brunswick in 1937, he was for a few months assistant engineer on the reconstruction of the harbour of Saint John, N.B. Later he entered Price Brothers Limited, at Riverbend, Que., where he was engaged in construction work. From May, 1938, until his recent appointment, he was engineer in charge of concrete and buildings on the construction of the Newfoundland Airport.

E. M. MacLeod, Jr.E.I.C., has accepted a position with the Shawinigan Water & Power Company, at La Tuque, Que. He was previously with the J. R. Booth Company, Limited, at Ottawa.

Pilot Officer J. Lalonde, S.E.I.C., is now stationed at Trenton, Ont. He joined the Royal Canadian Air Force upon graduation from the Ecole Polytechnique of Montreal in the spring of 1939.

D. P. MacNeil, Jr.E.I.C., is now in the mechanical department of the Steel Company of Canada Limited, in Montreal. Since graduation in mechanical engineering from the Nova Scotia Technical College in 1936, he had been with the Dominion Steel and Coal Corporation, Limited, at Glace Bay, N.S.

J. L. Paré, S.E.I.C., is at present at the Massachusetts Institute of Technology, Cambridge, Mass., doing post-graduate work. He was graduated in civil engineering from the Ecole Polytechnique in 1939 and has been since with the Société d'Entreprises Générales, Limitée, at Amos, Que.

T. S. McMillan, S.E.I.C., has joined the staff of the Canadian Industries Limited, at Brownsburg, Que. He is a graduate in civil engineering from the University of New Brunswick and had been, since graduation in 1937, engaged in road construction in New Brunswick.

H. J. Lemieux, S.E.I.C., has accepted a position as sales and service engineer with the Anti-Hydro of Canada, Limited, in Montreal. A graduate from the Ecole Polytechnique in 1939, he was previously with the Provincial Department of Public Works in Quebec.

E. R. Hyman, S.E.I.C., is now engaged in oil fields development with the Trinidad Leaseholds, Limited, in Trinidad, British West Indies. He was graduated as a Bachelor of Science from the University of Manitoba in 1934 and from the Royal Military College at Kingston in 1938. He obtained his M.Sc. degree in civil engineering from the Massachusetts Institute of Technology in 1939.

Obituaries

George Sanford Davis, M.E.I.C., died suddenly at his home in Ottawa on December 29th, 1939. He was born at Cincinnati, Ohio, on November 28th, 1874, and received his education in the local schools. He acquired his engineering training with various companies in the United States and came to Canada in 1905 to join the Canadian General Electric Company as construction superintendent. He was later district engineer in Ottawa and also in Montreal. In 1920, he entered consulting practice as electrical engineer with J. M. Robertson of Montreal. For the past two years Mr. Davis had been a resident of Ottawa where he was employed as electrical engineer for the Department of National Defence.

Mr. Davis had joined the Institute as an Associate Member in 1921 and he had been transferred to Member in 1928. He was also a Life Member of the American Institute of Electrical Engineers.

Edward Arthur Evans, M.E.I.C., died in Quebec City on January 22nd, 1940. He was born on February 26th, 1855, in England and received his education at the Royal Naval College, Portsmouth, and at King's College, London, England.

Mr. Evans began his career as an engineer in the offices of Joseph Phillips, civil engineer and contractor, Victoria, Westminster, London, in January, 1870. In 1884, after some years as a contractor's engineer on waterworks and railway construction in England he came to Canada and was engaged in surveys and construction of various branch lines now part of the Canadian Pacific Railway, in Ontario and Quebec. He made some of the preliminary surveys for the Quebec bridge and then was resident engineer in charge of the construction of the Quebec terminals of the Quebec and Lake St. John Railway, reballasting and general completion of the Chicoutimi branch. He was in charge of the final surveys of the Great Northern Railway of Canada, now part of the Canadian National Railways and also made the surveys and soundings for the Hawkesbury bridge of the same railway. In 1895 he became chief engineer of the Quebec, Montmorency and Charlevoix Railway, and built the electric street railway system in the city of Quebec, and in 1897 he was made general manager and chief engineer of the two systems and also the Montmorency Electric Power Company, all now forming part of the Quebec Power Compnay. In 1910 he resigned to go into private practice as a consulting engineer, being responsible for the construction of many engineering works in different parts of the province.

He was in active work for 68 years. In 1938 increasing years compelled his retirement.

He was one of the oldest surviving members of the Institute, having joined it as a Member in 1887 when it was founded as the Canadian Society of Civil Engineers.

Frank McDonnell, M.E.I.C., died at Ottawa on December 19th, 1939. He was born at Randalstown, Ireland, on October 18th, 1877. He received his education at the Royal Institute of Ireland and at the Technical Institute of Belfast. Upon his arrival in this country, he entered the Marine

Department of the Dominion Government as a mechanical engineer and six years later he became assistant to the chief of the steamship inspection service in the Department. Nine years later, he was made chairman of the Board of Steamship Inspection, a position which he still occupied at the time of his death.

Mr. McDonnell joined the Institute as a Member in 1921.

Lt.-Col. Duncan MacPherson, M.E.I.C., died at his home in Toronto on January 2nd, 1940. He was born near Bath, Ont., on February 2nd, 1858. He was a member of the first class to be graduated by the Royal Military College in 1880.

Upon graduation he joined the staff of the Canadian Pacific Railway as divisional engineer in Montreal. After twenty-five years there he joined the Canadian National Railways as assistant chief engineer at Ottawa.

In 1916 he offered his services to the government and was made second in command of the 21 camps for enemy aliens in Canada. He held this position until 1920. At that time he retired from both civil and military life.

Colonel MacPherson joined the Canadian Society of Civil Engineers as a Member upon its foundation in 1887. He was made a Life Member of the Institute in 1926.

VISITORS TO HEADQUARTERS

A. Babin, A.M.E.I.C., Resident Engineer, Quebec North Shore Paper Company, from Baie Comeau, Que., on January 2.

Lieut.-Cmdr. W. S. E. Morrison, A.M.E.I.C., Engineering Officer of Barracks, from Halifax, N.S., on January 2.

Gaston Dufour, S.E.I.C., Public Works Department of Canada, from Quebec, on January 3.

Paul Vincent, Jr.E.I.C., Department of Colonization of the Province of Quebec, from Quebec, on January 3.

A. G. Moore, A.M.E.I.C., Resident Engineer, Cie Immobilière de Ste-Marguerite, from Lake Masson, Que., on January 4.

G. E. Booker, A.M.E.I.C., from Uxbridge, Ont., on January 6.

Donald Ross, A.M.E.I.C., from Saint John, N.B., on January 8.

H. G. Cochrane, A.M.E.I.C., from Saint John, N.B., on January 8.

T. S. McMillan, S.E.I.C., from Jacquet River, N.B., on January 9.

Charles Miller, A.M.E.I.C., Hydraulic Engineer, Saguenay Power Company, Limited, from Arvida, Que., on January 16.

F. L. Lawton. M.E.I.C., Chief Engineer, Saguenay Power Company, Limited, from Arvida, Que., on January 17.

C. E. Garrett, M.E.I.C., President, Gorman's Limited, from Edmonton, Alta., on January 20.

Past-President G. J. Desbarats, C.M.G., Hon.M.E.I.C., from Ottawa, **E. Viens,** M.E.I.C., Director of the Laboratory for Testing Materials, Department of Public Works, from Ottawa, **E. B. Wardle,** M.E.I.C., Chief Engineer, Consolidated Paper Corporation, Limited, from Grand'Mère, Que., on January 20.

W. B. Cuthbertson, S.E.I.C., from Saint John, N.B., on January 22.

H. C. Fitz-James, A.M.E.I.C., Vice-President and Mgr., Pacific Coast Pipe Company, from Vancouver, B.C., on January 25.

J. L. Paré, S.E.I.C., of the Société d'Entreprises Générales, Limitée, from Amos, Que., on January 25.

J. R. Carter, A.M.E.I.C., from Kenora, Ont., on January 29.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

EDMONTON BRANCH

B. W. Pitfield, A.M.E.I.C. - *Secretary-Treasurer*
J. W. Porteous, Jr.E.I.C. - *Branch News Editor*

Professor E. A. Hardy, of the University of Saskatchewan, was the speaker at the January Meeting of the Edmonton Branch of the E.I.C. After a dinner at the Macdonald Hotel, Mr. Hardy entertained the members with a delightfully informal talk on **The Development of the Combustion Chamber of Internal Combustion Engines.** Using slides for illustration, the speaker traced the combustion chamber from earlier forms to those used in modern automobiles. Probably the most important factor in the design is to get away from detonation and at the same time to allow a high compression ratio and as much advance in timing as possible. The factors considered are the shape of the chamber and the position of the spark plug. One of the chief problems at the present time is to get a chamber which will function economically when the engine is throttled down to small fractions of its maximum power, since this is the condition under which automobile engines operate during a large percentage of the time.

After a number of questions were asked and a hearty vote of thanks given the meeting adjourned.

HAMILTON BRANCH

A. R. Hannaford, A.M.E.I.C., - *Secretary-Treasurer*
W. E. Brown, E.I.C., - - - *Branch News Editor.*

The annual business meeting and dinner of the Branch was held at the Rock Garden Lodge, on Friday, January 12, 1940. There were forty-six members and guests present and the visitors included Dr. A. E. Berry, Chairman of the Toronto Branch and A. W. F. McQueen, Chairman of the Niagara Peninsula Branch together with the Secretary-Treasurer, Mr. G. E. Griffiths. The meeting and dinner was presided over by John Dunbar, the retiring Chairman.

After the reading of the annual report of the Branch the election of officers for the year was approved and a Branch Nominating Committee elected. General business was discussed and various motions carried, of which the Institute will hear more later.

Following the business session the guest speaker of the evening, Mr. W. A. Aiken, B.A., gave an interesting and instructive talk, entitled **The Historians' Debt to the Engineer.** E. G. MacKay moved a vote of thanks to the speaker followed by a vote of thanks to the retiring Executive by W. Hollingworth.

Mr. McQueen had previously, in well chosen words, replied to the toast to the visitors. E. P. Muntz spoke briefly in his usual vein of encouragement to all those trying to put the profession where it belongs. W. L. McFaul spoke to the members requesting that every effort be made to attend and support the Annual General meeting in Toronto next month.

At this point Mr. Dunbar turned the chair over to Mr. Alec. Love, the new Chairman of the Branch for the year 1940, who closed the meeting after a brief address.

LETHBRIDGE BRANCH

E. A. Lawrence, s.e.i.c. - *Secretary-Treasurer*

The Lethbridge Branch held a dinner meeting on Saturday, January 6th, the occasion being Ladies' Night. During the dinner instrumental music was provided by the George Brown Orchestra. Mrs. Clarence Jackson sang Scottish songs, and a male quartette composed of Messrs Standen, Green, Brown and Pizzy gave a number of selections. Mr. Bob Lawrence led the gathering in community singing.

The guest speaker was Miss Hildur Sandquist, who gave an address on a trip she had made through Central Europe in the summer of 1939, just prior to the outbreak of hostilities. Miss Sandquist's trip took her from Sweden through the Baltic States and Poland to Danzig, where everything was in a ferment over the question of affiliation with Germany. On south, through Poland, there was little evidence of preparation for war, the peasantry seeming very unconcerned though the hotel-keepers were worried over the situation and tourist trade was almost at a standstill. In Slovakia, Hungary and Austria the same conditions prevailed, though in Vienna there were signs of disturbance, and no motor routes were open to the north on account of reported civil disturbances. This necessitated returning through Slovakia and Poland in order to enter Germany, and as the Polish frontier was left, thousands of German mechanized units were met speeding towards the boundary line. The German food was found to be scarce and of poor quality, and the air was electric with warlike preparations, so the motorists travelled quickly to the Baltic coast and managed to get back to Sweden before hostilities broke out.

MONCTON BRANCH

V. C. Blackett, a.m.e.i.c. - *Secretary-Treasurer*

On December 15th the Moncton Branch tendered a complimentary dinner to Dean H. W. McKiel, president of The Engineering Institute of Canada. The dinner was held in the Palm Room of the Brunswick Hotel. F. O. Condon presided, and at this meeting was elected chairman of the branch, succeeding Lt.-Col. F. L. West, who is retiring on account of active service with the Canadian Forces. There was a large attendance, including not only members of the Institute but also the Association of Professional Engineers of New Brunswick. After the toast to the King, a toast to the president was proposed by H. J. Crudge, past-president of the professional association.

Speaking in reply, President McKiel said his presidential year had been the most enjoyable of his life. The Institute to-day, he stated, is a tower of strength, definitely not on the downward path. It is the most vigorous organization in Canada and compares with any engineering body in the United States. His recent tour of the branches had shown him Canadian engineers are a unit, the same type of man everywhere you go. The engineer is looked upon by the public as a man who can be trusted. His integrity is recognized by all.

Tracing the growth in viewpoint, the speaker said the engineer of yesterday was concerned only with the technical excellence of his work. If his product was technically correct, he was satisfied. From this acceptance of his own task, the engineer was inevitably judged by his fellow citizen as merely a tradesman, perhaps a highly educated mechanic. To-day the engineer realized the same undeniable demand for accuracy, but his narrow viewpoint has advanced. He now asks unconsciously "Is this project necessary? Can the country afford it and absorb it?" This recognition of our debt to society, said the president, has accomplished an end that no legislation, no shifting of wage limits could do. Every age has been dominated by the particular group best fitted to assume leadership at the time. This is the age of technology, and one in which the engineer must play a leading part in the political and industrial life of the nation.

At the conclusion of the address G. L. Dickson, C. S. G. Rogers, and J. A. Godfrey spoke in appreciation of President McKiel.

MONTREAL BRANCH

L. A. Duchastel, a.m.e.i.c. - *Secretary-Treasurer*

The Branch held its Annual Student Night on November 23rd, 1939, at which the following papers were presented: **A Mine Assay Office** by E. M. Cantwell, **The Construction of a Six Inch Telescope** by A. Monti, s.e.i.c., **Lighting, A Social Science** by W. G. Ward and **The Fixed Point Method and Influence Lines** by M. R. Trudeau. Mr. Trudeau and Mr. Ward were awarded first and second prizes respectively for their papers. These cash prizes were awarded upon the decision of the judges, F. C. Mechin, J. A. Beauchemin and H. Massue. R. Fricker presided at the meeting.

Through the courtesy of the Ford Motor Company of Canada, a sound picture "The Song the Map Sings" was shown during the evening.

On November 30th, 1939 J. T. Thwaites, development engineer of the Canadian Westinghouse Company, Hamilton, Ont., presented a paper before the Branch, **Industrial Electronics.** This paper illustrated with lantern slides, was a most interesting one. Previous to the meeting a courtesy dinner was held at the Windsor Hotel. R. N. Coke was chairman of the meeting.

T. M. Moran spoke to the Branch December 7th on **Recent Developments in Production Management.** Mr. Moran, factory manager, mechanical and sundries division, Dominion Rubber Co. Ltd., Montreal, is chairman of the Industrial and Management Section of the Branch, which has been active this year. J. S. Cameron presided at the meeting.

On December 14th, 1939, a joint meeting with the Military Engineers' Association of Canada was held under the chairmanship of J. B. Stirling. Brigadier E. Schmidlin, m.c., Director of Engineering Services, Department of National Defence presented an interesting paper, **Recent Developments in Military Engineering,** describing the changes in the practice of military engineering that have taken place since the last war. A courtesy dinner at the Windsor Hotel was served prior to the meeting.

On January 11th, 1940, the Annual Meeting of the Branch was held. The retiring executive presented their report and financial statement, and the new officers were installed.

Mr. Smallhorn's resignation was accepted regretfully. He filled the office of secretary-treasurer admirably and has kindly consented to act in an ex-officio capacity on the executive for a year.

Television and Its Recent Developments, a paper presented by W. B. Morrison of the R.C.A.-Victor Company, Montreal, drew a large audience of Montreal Branch members and members of the Institute of Radio Engineers on January 18th, 1940. The lecture described a complete television system as used at present, and a demonstration of the system showed some of the practical problems involved in television transmission and reception. Mr. W. C. Fisher assisted Mr. Morrison in the demonstration.

Junior Section

On January 22nd the Junior Section met to elect officers for the 1940 term. Results of the ballot were: R. Boucher, chairman; A. P. Benoit, vice-chairman; J. Hurtubise, secretary; H. G. Seybold, G. Beaulieu, J. R. Johnson, W. W. Ingram, councillors.

L. A. Wright, General Secretary of the Institute, spoke on **The Young Engineer and the War** in a very interesting manner. He explained the work that had been done for the Government in surveying Canada with the object of securing a record of the academic qualifications and the experience of all technically trained men in the engineering profession so that a register could be set up at Ottawa for the use of industry and governmental departments.

OTTAWA BRANCH

R. K. Odell, A.M.E.I.C. - *Secretary-Treasurer*

The annual meeting of the Ottawa Branch was held on Thursday evening, January 11, 1940, in the auditorium of the National Research Council Building, Sussex Street. Reports for the past year were presented and officers elected for the ensuing year. J. H. Parkin, retiring chairman, presided.

The secretary-treasurer's report, presented by R. K. Odell, stated that the Branch was in sound financial condition and that the membership had been increased by fifteen during the past year. Feeling reference was made to the loss suffered through the death during the year of the following members: Lieut.-Colonel F. H. Emra, M. B. Bonnell, B. S. McKenzie, G. S. Davis, and Frank McDonnell.

W. L. Saunders reported for the membership committee and Wing-Commander A. L. Ferrier outlined the work of the Aeronautical Section. The report of the Proceedings Committee was presented by Norman Marr.

As a result of the elections, officers for the ensuing year were: Chairman, W. H. Munro; Secretary-Treasurer, R. K. Odell, who was re-elected; Members of the Managing Committee, J. H. Irvine and W. H. Norrish, newly elected to serve two years; and N. Marr, H. V. Anderson, and W. L. Saunders, who were elected at the 1939 annual meeting and have one remaining year to serve.

After the business of the annual meeting proper was concluded, Dr. R. W. Boyle, Director of Physics and Electrical Engineering of the National Research Council, addressed the meeting on **Some Pre-War Observations in Europe.** Dr. Boyle spent some time in Europe last year prior to the outbreak of war during which he visited Scandinavia, touched at Gdynia, Danzig and Finland. He spent two weeks in Russia, saw something of Roumania, Hungary and Poland and was in Warsaw during the six days immediately preceding the outbreak of hostilities.

Mr. L. Austin Wright of Montreal, General Secretary of the Institute, was present at the meeting and spoke briefly.

Light refreshments were served at the close of the meeting.

PETERBOROUGH BRANCH

A. L. Malby, Jr.E.I.C. - - *Secretary-Treasurer*
D. R. McGregor, S.E.I.C. - *Branch News Editor*

A largely attended meeting of the Branch was held on December 14th, with the Chairman, Mr. D. I. Burgess, presiding.

The speaker of the evening was Mr. H. B. Chambers, Metallurgical Engineer with Atlas Steels Ltd., of Welland. Mr. Chambers spoke on **Fundamental Ideas Concerning the Application and Heat Treatment of Tool Steels.**

Mr. Chambers pointed out that there are three properties which all tool steels possess to a greater or lesser degree; these are resistance to wear, resistance to impact, and ability to operate at elevated temperatures. The degrees to which a steel possesses each of these properties determines its application. For instance, a file requires a great deal of resistance to wear, but no great resistance to impact. At the other extreme a hammer requires a great deal of resistance to impact, but its resistance to wear is relatively unimportant, and it does not need to be capable of operating at any elevated temperature.

The degree to which a tool steel possesses each of these properties is determined by two things; the amount of carbon in the steel, and the heat treatment given the steel. Mr. Chambers discussed this in detail. Going on from this, he stated that although there seemed to be a multitude of tool steels on the market, all these can be classified into twelve main types or groups, according to the carbon content and the heat treatment given the steel; the entire range of tool steel applications can be covered by these twelve groups.

Mr. Chambers then went on to discuss the various factors which make a tool wear out too soon, or chip or break in service; he pointed out the factors which tend to make a tool warp or crack, or change size in hardening.

At the conclusion of the talk Mr. Sills moved a vote of thanks to the speaker which was heartily endorsed by the meeting.

At a meeting held on January 11th, Mr. H. Foster, Chairman of the Welding Committee at the Peterborough Works of the Canadian General Electric Committee, gave an address on **Fundamentals of Metallic Arc Welding.**

Mr. Foster first gave a brief history of the art of arc welding. The first patents on arc welding were taken out some fifty years ago, but industry was slow to accept this new tool; it is only during the last fifteen or twenty years that the use of welding has become widespread. Many important improvements in welding equipment and technique have been made during this latter period until to-day arc welding is an accredited method of joining steels together for practically every application.

The speaker pointed out that a comprehensive plan for the training of welders is something which every manufacturer using welding should have. This protects both the manufacturer and his customer. Every welder should be tested at fairly frequent intervals to ensure that his efficiency is being maintained.

Welds can be tested from a tensile, bending, and shock absorbing viewpoint. Tensile tests are made by cutting a test bar, and then pulling it apart. This test is of little value, since invariably the weld metal is stronger than the parent metal; fracture takes place in the parent metal, not in the weld. Bending tests—made by butt welding two pieces and then folding so that the crease occurs along the weld—and shock absorbing tests made by dropping a weight on the weld, while the bar is supported at each end—are of greater use, since they give an indication of the ability of the weld to survive under conditions which are more likely to be met in service. A quick test, for visual examination, can be made by nicking the bar at the weld and then breaking it.

Arc welding is now done with both alternating current and with direct current and equally satisfactory welds can be obtained with either current, providing the correct electrodes are used for each. Where very heavy currents are involved, alternating current has the advantage that no magnetic blow occurs. On direct current, magnetic blow sometimes makes the arc very difficult to control, especially around the corners.

Up until fairly recently, practically all welding was done using bare electrode. To-day, almost the reverse is true; covered electrodes have largely replaced bare electrodes. Mr. Foster discussed the composition of present day electrodes and the fluxes used to cover them, and he showed that feeding the electrode too fast or too slow resulted in a poor weld, due to lack of penetration, or slag inclusion.

Mr. Foster discussed carbon arc welding and atomic hydrogen welding briefly, pointing out the application and advantages of both, particularly in the welding of non-ferrous metals.

At the conclusion of the talk a vote of thanks to the speaker was moved by Mr. Ottewell.

ST. MAURICE VALLEY BRANCH

V. Jepsen, A.M.E.I.C., - *Secretary-Treasurer*

On Thursday, December 14th, a dinner meeting was held in Shawinigan Falls. This meeting was held in conjunction with the Shawinigan Falls Chemical Society. At the close of the dinner a humorous skit was presented by Dr. R. McIntosh and then the company adjourned to the ball room where the guest speaker of the evening, Dr. L. M. Pidgeon of the National Research Council, spoke on the subject of **Magnesium.** Dr. Pidgeon is an authority on the production and uses of this metal. His subject was listened to with great interest by both the chemists and engineers.

At the present time very little is known about magnesium, and it has been produced only in comparatively small quantities, but it threatens to become a rival to aluminum, when its production methods have become more simplified.

Dr. Pidgeon first showed numerous slides on the uses of magnesium in industry wherever reduction in weight in any equipment is a factor of prime importance, such as in airplane construction. He showed numerous applications of the metal, such as landing wheels, wing struts and members; in fact airplanes have been made entirely of magnesium. This metal can be welded in very thin sections whereas aluminum cannot.

The speaker then dealt with the best production methods and suggested new ones. In America all the magnesium at the present time is made by the Dow Chemical Co. at Midland, Mich., by electrolysis of the fused chloride. There are numerous disadvantages to this method and they undoubtedly keep the cost of the metal high. Dr. Pidgeon has done considerable work on the straight reduction of the oxide of magnesium, using 95 per cent silicon as the reducing agent. There are numerous problems which must be worked out in this process also, but on the whole it should produce the metal much more cheaply, especially in regions with a plentiful power supply.

The speaker showed that the country producing the most metallic magnesium is Germany. Great Britain comes next, followed by the United States. He also showed that the supply of ore necessary for making the metal is very widely distributed. Canada has a plentiful supply of dolomite, magnesite and brucite, the latter being the richest ore available at the present time, and occurring in the Ottawa Valley region in large quantities. Its production, however, entails the production of considerable calcium oxide.

Dr. Pidgeon predicts that there will be a distinct pick-up in the metallic magnesium industry in the near future.

The variety and extent of the discussion at the close of the paper was a tribute to its interest by all those attending the meeting.

Dr. Andre Hone, president of the Shawinigan Falls Chemical Association, was the chairman and called upon Mr. A. F. G. Cadenhead to introduce the speaker and then upon Mr. C. H. Champion, vice-chairman of the St. Maurice Valley Branch, to propose the vote of thanks.

The attendance at the dinner was 55 and at the meeting 85.

TORONTO BRANCH

J. J. Spence, a.m.e.i.c., - - *Secretary-Treasurer*

D. D. Whitson, a.m.e.i.c., - *Branch News Editor*

On Thursday, January 18th, the Toronto Branch held its Annual Students' Night. Six papers were presented and four prizes were awarded. The judges had rather a difficult task on their hands to select the winners since all of the papers were exceptionally well presented. These winners will receive a year's Student Membership and a year's subscription to the Journal.

The following are the prize papers:

Wind Bracing, by S. J. Simons.

The Rehabilitation of Flooded Generators, by D. R. B. McArthur.

Aerodrome Construction, by D. E. Kennedy.

Some Aspects of Depreciation, by E. E. Hart.

VICTORIA BRANCH

Kenneth Reid, Jr.E.I.C. - *Secretary-Treasurer*

The Annual Meeting of the Victoria Branch was held in Spencer's Dining Room, Victoria, on January 19th, 1940, and was preceded by a dinner which was attended by twenty-six members and guests among whom were a number of representatives from the local headquarters of the military, naval and air forces stationed here.

Following the dinner a business session was held when the reports for the year were received. These showed the branch to be in a healthy condition with a membership increase over the preceding year, a small financial surplus and a modest bank account. The election of officers for 1940 took place.

The feature of the evening, apart from the business of the annual meeting, was an address by Mr. A. L. Carruthers, Bridge Engineer of the Provincial Department of Public Works, on the subject, **Brothers of the Bridge,** a monastic Order of mediaeval engineers founded in southern France in the year 1154, under Pontifex Maximus as Abbot, which devoted its energies to the art of bridge building and other works of an engineering nature, and kept alive the science during the dark ages following the collapse of the Roman Empire. Many notable structures in western Europe owe their origin to this ancient Order, including old London Bridge in the City of London. The massiveness of their undertakings as well as the accuracy of their work and beauty of design is a source of wonderment to modern engineers.

Mr. Carruthers led up to the origin of this remarkable Order by tracing the development of engineering construction, and particularly bridge construction, through the ages from ancient times in Babylonian, Persian, Egyptian, Chinese, Greek and Roman, and showed the characteristics of each civilization and the architecture peculiar to each period. After the fall of the great Roman Empire barbarism held sway for a time destroying much which had been accomplished, until the feudal system, the only one possible for those times, brought more or less order out of chaos. It was during this period that these engineering monks quietly preserved the secrets of the trade and finally in 1154 banded themselves together in the unique Order, "Brothers of the Bridge". They formed many branches of the Order and their services were much in demand throughout southern France, Germany and England. Illustrating his address by slides, Mr. Carruthers showed many pictures of structures built by these men, a large number of which, although now mostly in ruins, may still be seen to-day.

Of particular note was old London Bridge, the same made famous by the well-known tune, "London Bridge is falling down", which was an example of the skill and enterprise of these engineers. The speaker traced the history of the old structure over a period of 300 years until it was finally demolished and replaced by a more modern structure early in the nineteenth century.

As a fitting sequel to a most interesting evening Mr. R. C. Farrow, of the Provincial Water Rights Branch, showed two reels of motion pictures of northern British Columbia, the bridge builders' paradise. These pictures were taken by Mr. Farrow himself while on a survey trip to a proposed power site on the upper reaches of the Kemano River at the head of Gardner Canal and showed the methods employed for transporting equipment and supplies into these hard-to-get-at places. Indians with 35-foot cedar dug-out canoes were employed for the river work. The beautiful scenery and rugged terrain made most interesting pictures.

At the conclusion of the evening hearty votes of thanks were passed to Mr. Carruthers and to Mr. Farrow for one of the most interesting and instructive evenings enjoyed by the branch.

Library Notes

Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

REVISED LIST OF C.E.S.A. SPECIFICATIONS

I—Standards Published or Ready for Issue

During the year new C.E.S.A. standards or revisions to existing standards have been completed as follows:

Section A—Civil Engineering

*A 5—Portland Cement (3rd edition).
*A57—High Early Strength Portland Cement.

Section B—Mechanical Engineering

B44-1938—Safety Code for Passenger and Freight Elevators.
B12-1939—Galvanized Steel Wire Strand (2nd edition).
B51-1939—Regulations for the Construction and Inspection of Boilers and Pressure Vessels.
B52-1939—Mechanical Refrigeration Code.
B53-1939—Code for the Identification of Piping Systems.

Section C—Electrical Engineering

C10-1938—Tungsten Incandescent Lamps (2nd edition)
C50T-1938—Insulating Oils.
C22.2 No. 7-1938—Portable Electric Displays and Incandescent Lamp Signs (2nd edition).
C22.2 No. 45-1938—Rigid Steel Conduit.
C22.2 No. 46-1938—Electric Air Heaters.
C22.2 No. 48-1938—Non-metallic Sheathed Cable.
C22.2 No. 50-1938—Knife Switches.
C22.2 No. 51-1938—Armoured Cable and Armoured Cord.
C22.2 No. 56-1938—Flexible Steel Conduit.

General Specifications

C14-1939—Reinforced Concrete Poles (2nd edition).
*C49- Hard Drawn Aluminum Wire, Aluminum Cable and Aluminum Cable (Steel Reinforced).
C58-1939—Design of C.E.S.A. Cast Lead-pin Thread for Insulator Pins of 1 in. and 1⅜ in.

C.E. Code, Part I—Inside Wiring Rules

C22.1-1939—Canadian Electrical Code, Part I (4th edition).

C.E. Code, Part II—Approvals Specifications

C22.2, No. 1(b)—-1939—Power-operated Radio Devices (Conductively-coupled Type).
*C22.2, No. 2- —Electric Signs (2nd edition).
C22.2, No. 31-1939—Switchboards, Construction and Test of
C22.2, No. 53-1939—Domestic Electric Clothes-washing Machines.
*C22.2, No. 58- —Isolating Switches (for High-potential "Disconnect" Use).
C22.2, No. 59-1939—Fuses (Both Plug and Cartridge Type).

C.E. Code, Part III—Outside Wiring Rules

*C22.3, No. 1(A)—Construction of Supply and Trolley Lines Crossing Railways.
*C22.3, No. 1(B)—Construction of Communication Lines Crossing Railways.

Section G—Ferrous Metals

G26 -1938—Commercial-quality Hot-rolled Bar Steels (3rd edition).
G27 -1938—Commercial Cold-finished Bar Steels and Cold-finished Shafting (3rd edition).
G30 -1938—Billet-steel Concrete Reinforcing Bars (3rd edition).
G31 -1938—Rail-steel Concrete Reinforcing Bars (3rd edition).
G32 -1938—Cold-drawn Steel Wire for Concrete Reinforcement (3rd edition).
G45 -1938—Fabricated Steel Bar or Rod mats for Concrete Reinforcement.
G46 -1938—Welded Steel Wire Fabric for Concrete Reinforcement.

Section S—Steel Construction

S 6 -1938—Steel Highway Bridges (3rd edition).
S47T-1938—Tentative Welding Qualification Code for Fabricators, Contractors, Supervisors and Welders.
S48T-1938—Tentative Electrode Specification for Electrode Manufacturers and Structural Steel Fabricators.

*Standards printed, but not actually published.

II—Standards Partially Completed

The following standards have been the subject of discussion by appropriate committees during the past year and such progress has been made that it is anticipated they will be published as new or revised C.E.S.A. standards during the coming year.

Section A—Civil Engineering

A 5-1927—Portland Cement (Revision).
A57- High Early Strength Portland Cement.
A23-1929—Concrete and Reinforced Concrete (Revision).
A16-1930—Steel Structures for Buildings (Revision).
(Note—A16 will be transferred to Section S—Steel struction—in the new edition).
A54- Procedure for Fire Tests for Building Construction and Materials.
A55- Procedure for Tests for Fire Resistance of Roof Coverings.
A56- Wood Piling and Pile Driving.

Section B—Mechanical Engineering

B51—Canadian Regulations for the Construction and Inspection of Boilers and Pressure Vessels.
B52—Mechanical Refrigeration Code.
B53—Colour Identification of Piping Systems.

Section C—Electrical Engineering

C49- —Aluminum Cable and Aluminum Cable Steel Reinforced.
C58- —Design of C.E.S.A. Cast Lead-Pin Thread for Insulator Pins of Nominal Diameters of 1 in. and 1⅜ in.
C14-1924—Reinforced Concrete Poles (Revision).
C22.1-1935—Canadian Electrical Code, Part I (Inside Wiring Rules), Fourth Edition (Revision).
C22.2—Canadian Electrical Code, Part II (Approvals Specifications).
1(b)—Power-operated Radio Devices (Conductively-coupled Type).
31 —Switchboards.
47 —Air-cooled Transformers.
53 —Washing Machines.
57 —Pull-off Plugs for Electro-thermal Appliances.
C22.3—Canadian Electrical Code, Part III (Outside Wiring Rules).
(a)—Regulations for Supply and Trolley Lines Crossing Railways.
(b)—Regulations for Communication Lines Crossing Railways.

New Subjects Under Development

Authorisation of the C.E.S.A. Executive Committee for the investigation and preparation of standards has been given for the following subjects. Appropriate committees, sub-committees or panels have been organised for the purpose.

Section A—Civil Engineering

Building Brick.	Lime.
Structural Hollow Tile.	Gypsum Blocks.
Vitrified Clay Sewer Pipe.	Concrete Blocks.

Section B—Mechanical Engineering

Nominal Sizes and Standard Dimensions for Wood Screws.

Copper and Brass Pipe.	Copper Tubing.
Cast Iron Pipe.	Steel Pipe.

Section C—Electrical Engineering

Oil Circuit-breakers; Paper-insulated Lead-covered Cable; Regulations for Communication Lines Crossing Supply and Trolley Lines; and the following Approvals Specifications: Motors in Hazardous Locations (Classes I, II, III and IV); Capacitors; Motors in Non-hazardous Locations; Bell-ringing, Signalling and Small Power Specialty Transformers; Motor-operated Appliances (Portable Type with Fractional h.p. Motors); Porcelain Insulating Devices; Service-entrance Cable; Snap Switches; Electric Ranges; Cooking and Liquid Heating Appliances; Solderless Wire Connectors (Pressure Type); and revisions to Specifications No. 3—Electrical Equipment for Oil-burning Apparatus; No. 9—Electric Fixtures; No. 14—Industrial Control Equipment in Ordinary (Non-hazardous) Locations; No. 16—Insulated Conductors for Power-operated Radio Devices; No. 25—Enclosures (Other than Explosion-proof) for Use in Hazardous Locations; No. 28—Asbestos-covered Wires; No. 42—Receptacles, Plugs and Similar Wiring Devices.

Section S—Steel Construction

Specification for Metallic Arc Welding (Bridges and Buildings).
Specification for Protective Eye Screens for Welders.

BOOK REVIEW

Public Works in Canada Under the Department of Public Works

By K. M. Cameron, M.E.I.C., Chief Engineer, Department of Public Works, Ottawa. The King's Printer, 1939, 84 pp., 6½ by 9¾ in., paper.

The progress of a newly settled country is necessarily dependent upon the growth of its means of communication and its public works, particularly the provision of harbours and aids to navigation in inland and coastal waters, and the construction of buildings and other works for the government service. The present Chief Engineer of the Dominion Department of Public Works has given us an admirable account of the way in which these and other indispensable aids to the country's development have been furnished in Canada. His story will be read with interest by all who wish to learn something of the origins of Canada's present system of public works and transportation, and of the men who have been responsible for supplying so satisfactorily the country's needs in these respects.

Mr. Cameron's survey covers the period beginning in 1841, when the draft of vessels between Quebec and Montreal was limited to ten feet, and the provinces of Upper and Lower Canada had just entered into union. The combined population of these provinces and the Maritimes colonies was then about one and a half millions. Just after confederation, there were three and a half million people. To supply the needs of this rapidly growing community, whose number reached the ten million mark sixty years later, has been no light task.

The public works required were of many kinds. At first slides and booms for the timber trade, roads and bridges for the movement of settlers, lighthouses, harbours and drydocks were among the chief undertakings. Later the development of the west established entirely new requirements. During the present century the growth of the grain export trade has led to harbour and canal construction in the St. Lawrence basin on an impressive scale. The utilization of Canada's fishing grounds, covering some two hundred thousand square miles of salt water and seventy thousand square miles on the Great Lakes, has called for extensive development of fishing harbours, often under very difficult local conditions and with severe limitations as to cost. In connection with these and other activities, important survey work had to be done and precise levels established. The Dominion Government was called upon to provide telegraph facilities around the Gulf of St. Lawrence and in the Northwest Territories, involving some eleven thousand miles of line. Add to these the many public buildings needed for the government services in Ottawa, and in all the principal cities and towns of the Dominion, and one obtains some idea of the responsibilities which have been carried by the officers of the Department of Public Works and its predecessors, the Commissioners of Public Works of the United Provinces.

But Mr. Cameron does not confine himself to the statistical and technical aspects of his subject. He notes the achievements and sterling character of the many engineers who have been engaged in Public Works in Canada from 1779 onwards. Many of these men were drawn at first from the Royal Engineers, later a number of distinguished civilians took up the work. The names of many of them will be found on the early lists of members of the Canadian Society of Civil Engineers. Such men as Colonel By, Admiral Bayfield, and Sir Casimir Gzowski were followed by a succession of equally devoted and professionally competent engineers. Canada has indeed been fortunate in the high professional standing of the officers of her government departments dealing with engineering and scientific matters. It is gratifying to have so eminent a public servant as Mr. Cameron set forth so clearly the achievements of his predecessors and fellow-workers.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

AIRCRAFT RADIO AND ELECTRICAL EQUIPMENT

By H. K. Morgan. New York and Chicago, Pitman Publishing Corp., 1939. 374 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.50.

The fundamentals of electricity and electrical equipment are presented, present-day equipment is described, and the topics of radio waves, static, direction finding, ultra-high frequencies, inspection and maintenance are discussed. There are numerous schematic diagrams, questions follow each chapter, and the answers are grouped in an appendix.

AMERICA'S TREASURE

By W. M. Reed; edited by C. Croneis. New York, Harcourt, Brace & Co., 1939. 395 pp., illus., 9½ x 6½ in., cloth, $3.00.

The story of the mineral wealth of the United States is told in simple language, with emphasis on the geological background of the deposits of metals, petroleum and building stone. The later chapters deal with a variety of subjects: erosion, production and power statistics, inventions, athletic prowess, slum clearance, and the future of America.

AUTOMATIC DESIGN OF CONTINUOUS FRAMES IN STEEL AND REINFORCED CONCRETE

By L. E. Grinter. New York, Macmillan Co., 1939. 141 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.00.

The design process explained and advocated is based on the method of balancing moments, and consists of a series of successive corrections in which the crudity or refinement of the analyses approximates that of the respective preliminary designs. Much of the author's previously published material has here been reorganized, together with additional information, to enable the designer to apply automatic design methods to continuous structures.

COMBATING CORROSION IN INDUSTRIAL PROCESS PIPING

By L. G. Vande Bogart. Chicago, Ill., Crane Co., May, 1939. 103 pp., illus., charts, tables, 11 x 8 in., paper, $3.00.

Corrosion theory is discussed, both for direct chemical corrosion, such as oxidation, and for electrochemical corrosion; the behavior of common piping materials, both metallic and non-metallic, in contact with typical corrosive solutions is considered; and the practical problem of corrosion is treated under classified groups of corrosive liquids. There is a bibliography and a list of recommendations of materials, arranged alphabetically by corrosive agents.

CONCRETE PIPE IN AMERICAN SEWERAGE PRACTICE. Bulletin No. 17, prepared and edited by M. W. Loving.

Chicago, American Concrete Pipe Association, 1938. 96 pp., also Supplements, illus., diagrs., charts, tables, 9 x 6 in., lea., apply.

A brief history of sanitary engineering, technical data on sewerage systems and concrete sewer-pipe, and illustrative examples of modern sewerage improvements are presented, mainly reprinted from other sources. Several A.S.T.M. specifications and American Concrete Pipe Association bulletins are also included.

THE ELECTRIC POWER ENGINEERS' HANDBOOK

By W. S. Ibbetson. New York, Chemical Pub. Co.; London, E. & F. N. Spon., 1939. 241 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $5.00.

Intended as a practical manual for the efficient control and care of all kinds of electrical machinery, this book presents basic theory, description, and directions for the proper operation and maintenance of motors, generators, converters and rectifiers. There are two chapters on faults, breakdowns and testing.

FOUNDATIONS AND EARTH PRESSURES

By C. H. Wollaston. London, Hutchinson's Scientific and Technical Publications, 1939. 295 pp., diagrs., charts, tables, 9 x 6 in., cloth, 21s.

The opening section describes subsoil classification, soil-mechanics theory, the testing of subsoils, foundation types and methods, and shear and bond stresses. In part II earth pressure calculations, including cohesion and distribution effects, are considered, together with retaining walls. Practical design, with calculations for specific cases, appears in part III.

GENERAL CARTOGRAPHY

By E. Raisz. New York and London McGraw-Hill Book Co., 1938. 370 pp., illus., diagrs., charts, maps, tables, 9½ x 6 in., cloth, $4.00.

Map making in all its phases is presented, beginning with historical information. The remainder of the first section deals with scales and projections, representation of earth features, lettering, composition and drafting of maps. The second section discusses maps for special purposes, including graphical and statistical maps, cartograms, science maps, etc. Globes, models, field sketching and cataloging are also considered. The work is said to be the first American text on its subject.

GREAT BRITAIN. Dept. of Scientific and Industrial Research. Methods for the Detection of Toxic Gases in Industry. Leaflet No. 6. CARBON BISULPHIDE VAPOUR.

London, His Majesty's Stationery Office, 1939. 8 pp., diagrs., tables, 10 x 6 in., paper (obtainable from British Library of Information, 50 Rockefeller Plaza, New York, $0.10).

The properties, occurrence, poisonous effects and first aid treatment are briefly mentioned, in addition to the description of the methods and equipment for carrying out the test for carbon bisulphide vapor.

LAND DRAINAGE AND RECLAMATION

By Q. C. Ayres and D. Scoates. 2 ed. New York and London, McGraw-Hill Book Co., 1939. 496 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $4.00.

The purpose of this text is to cover the problems of drainage, reclamation and surveying that arise on the average farm and which the farmer himself can be expected to handle. After a discussion of the broad aspects of land reclamation, the text deals with land surveying, surface drainage, clearing of land, sub-surface drainage, and erosion control. Problems and references accompany some chapters.

MACHINE SHOP WORK

By F. W. Turner and O. E. Perrigo, revised by A. Bertrand. Chicago, American Technical Society, 1940. 361 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $2.75.

This comprehensive treatise on approved shop methods includes the construction and use of tools and machines, details of their efficient operation and a discussion of modern production methods. Descriptive illustrations and diagrams are used extensively and there is a final chapter explaining typical slide-rule calculations.

THE MATHEMATICAL THEORY OF HUYGENS' PRINCIPLE

By B. B. Baker and E. T. Copson. Oxford, England, Clarendon Press; New York, Oxford University Press, 1939. 155 pp., diagrs., tables, 10 x 7 in., cloth, $4.25.

This book deals with the mathematical theory of Huygens' principle in the propagation of light and of sound waves of small amplitude. It is concerned with the general theory of the solution of the partial differential equations governing these phenomena, detailed application of the theory to the solution of special diffraction problems being discussed only as an illustrative example.

ORGANIZATION AND MANAGEMENT OF PRODUCTION

By W. N. Mitchell. New York and London, McGraw-Hill Book Co., 1939. 417 pp., diagrs., charts, tables, 9½ x 6 in., cloth, $4.00.

In this text the author presents the outgrowth of his attempts to develop an introductory course in production management for business students in colleges. The book deals concisely with those factors in the economic, technological and geographical environment of production that determine the general forms of organization of production activities, and also covers the more important problems encountered by production executives in administration work. Reference lists, questions and exercises are appended.

POWER ECONOMICS FOR ENGINEERING STUDENTS

By R. C. Gorham. Pittsburgh, Pa., Pittsburgh Co., 1939. 310 pp., diagrs., charts, tables, 9½ x 6 in., cloth, $3.25.

The necessity for engineering economy is stressed in part A, which presents fundamental concepts and factual information, with general principles which are applicable to engineering practices for best overall economy. Part B furnishes the opportunity for the application of the preceding principles, largely through the use of examples from public utility practice. There are lists of references and many problems.

PRACTICAL ELECTRICAL WIRING

By H. P. Richter. New York and London, McGraw-Hill Book Co., 1939. 503 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $3.00.

Practical methods of electrical wiring are explained in plain language for the man who does it. All kinds of light and power wiring for home, farm and factory are described, and the fundamental principles are clearly presented. All material is based on the National Electrical Code, and selected tables of data from the code are included.

PRINCIPLES OF INDUSTRIAL ORGANIZATION

By D. S. Kimball and D. S. Kimball, Jr. 5th ed., New York and London, McGraw-Hill Book Co., 1939. 478 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

The internal organization and procedures of industrial enterprises are comprehensively covered, and industrialism is considered from the broader points of view of economic organization in general. New material treating of the effect of recent Federal legislation upon industry has been included in this new edition, and all statistical data have been revised.

PRODUCTION MANAGEMENT

By A. M. Simons, reviewed by H. P. Dutton. Chicago, American Technical Society, 1940. 588 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.50.

The efficient control of present-day mass production is possible only through the standardization of the many procedures which contribute to it. The intention of this book is to provide a practical approach to the problems of plant location, factory layout, work routing, task fixing, office organization, etc., and to the many phases of hiring, training and handling of the personnel.

PUBLIC SPEAKING FOR TECHNICAL MEN

By S. M. Tucker. New York and London, McGraw-Hill Book Co., 1939. 397 pp., 8 x 6 in., cloth, $3.00.

The proper presentation of speeches, lectures, etc., is comprehensively covered. Virtues and defects in speaking are brought out through narrative treatment, and working principles to be drawn from these examples are conveniently summarized at the end of chapters. The subject matter covers not only diction, organization of material, and platform technique, but also important helps for the technical speaker on using charts, answering questions, etc.

THE RADIO AMATEUR'S HANDBOOK, 17th ed., 1940.

West Hartford, Conn., American Radio Relay League, 1939. 575 pp., illus., diagrs., charts, tables, 10 x 7 in., paper, $1.00 in U.S.A., $1.25 in foreign countries; bound, $2.50.

This well-known manual covers comprehensively the amateur short-wave field. The fundamental principles and the design, construction and operation of transmitting and receiving apparatus are described in detail, including ultra-high frequency, emergency, and portable equipment. In addition to revision and new illustrations the subject matter in this edition has been divided into major sections with more extensive subdivision than before.

SEMI-CONDUCTORS AND METALS

By A. H. Wilson. Cambridge, England, University Press; New York, The Macmillan Co., 1939. 119 pp., diagrs., charts, tables, 9 x 6 in., paer, $2.00.

The purpose of this book is to provide a simplified authoritative account of some of the main achievements of the theory of metals in the past ten years, and thus to form an up-to-date supplement to the various treatises on the subject. The presentation aims to make clear the physical principles on which the theory is based and to derive the results wherever possible by simplified arguments. Brief bibliographies of recent publications are included.

SYMPOSIUM ON THERMAL INSULATING MATERIALS

Columbus Regional Meeting, March 8, 1939. Philadelphia, American Society for Testing Materials, 1939. 123 pp., illus., diagrs., charts, tables, 9 x 6 in., paper, $1.25; cloth, $1.50.

Four papers constitute this symposium, as follows: Factors influencing the thermal conductivity of non-metallic materials; Test methods for determining physical properties of thermal insulations; One consumer's problems in selecting heat insulation; Effect of solar radiation on the heat transmission through walls. Discussion of the papers is included.

TURBINES À VAPEUR

By Pio-Oulsky; translated by R. Demchenko and E. Kisselev, preface by C. Monteil. Paris, Dunod, 1939. 403 pp., illus., diagrs., charts, tables, 11 x 8 in., paper, 185 frs.; bound, 210 frs.

This text, translated from the Servian language, represents the course in steam turbines given at Belgrade University. The first section, after a classification by types, discusses in detail the products of the fifteen large European manufacturers. Following this the parts and auxiliaries of steam turbines are discussed from the designers' point of view, and a chapter is devoted to turbine regulation. The final chapter discusses the problem of high-speed shafts and their critical speeds. The book is illustrated with excellent drawings.

STATIC AND DYNAMIC ELECTRICITY

By W. R. Smythe. New York and London, McGraw-Hill Book Co., 1939. 560 pp., diagrs., charts, tables, 9½ x 6 in., cloth, $6.00.

This book formulates the basic laws of electrostatics, magnetostatics, and electromagnetic theory, by concise vector methods, from the underlying experimental facts. It gives an extended treatment of the mathematical technique for applying these laws to specific problems. Although the theory is completely developed from basic experimental facts, the emphasis is on problems, of which there are several hundred. References are given for additional study.

Employment Service Bureau

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

SITUATIONS VACANT

ELECTRICAL ENGINEERS AND DRAFTSMEN—Junior, 25-40 years of age. At least two years experience in substation work. State qualifications, age, length of experience and present location. Apply to Box No. 1985-V.

MAN with science degree, chemistry, engineering and practical knowledge of steam boiler plant operation. Strong personality and progressive nature are required to sell the technical service and product of this company. Apply to Box No. 2003-V.

MECHANICAL ENGINEER, for large Canadian industrial corporation. Sales experience in the engineering field necessary. Age between twenty-five and thirty. Bilingual essential. Apply Box No. 2012-V.

CHEMICAL ENGINEER OR CHEMIST who has majored in Organic Chemistry with a few years experience in Laboratory or Factory in connection with developing rubber compounds: knowledge of, or experience in, allied synthetics desirable, In applying please state age, details of educational background and experience, salary desired and availability. Box No. 2013-V.

NATIONAL RESEARCH COUNCIL VACANCIES

Because of losses from the staff of the Radio Laboratories in the Division of Physics and Electrical Engineering and of new war work, there are now vacancies as named below. All the work involved is of important war nature and it is essential that applicants should have radio experience.

(a) 1 Professional—Assistant Research Physicist, $2820-3300 per annum; (b) 1 Professional—Junior Research Physicist, $2100-2700 per annum; (c) 1 Subprofessional—Senior Laboratory Assistant (Replacement), $1440-1740 per annum; (d) 3 Subprofessional—Laboratory Assistant (2 New; 1 Replacement), $1140-1380; (e) 1 Subprofessional—Laboratory Helper (Replacement), $720-1020.

BRITISH ADMIRALTY VACANCIES

In consequence of an offer by the Canadian Government to the British Admiralty of a certain number of technically qualified men for a special technical war service, the National Research Council has offered to assist in finding, selecting and listing of men suitably qualified. Therefore, the Council would be pleased to receive the names, addresses, and credentials concerning or relating to education, experience, and personal qualifications of British subjects in Canada who may be included in the following category and who would wish to serve:—

GROUP I.

Engineer–Physicists with experience of radio frequency technique, especially of very short waves. Half of these men are required for Experimental Development work in the laboratory and half for Design, i.e. turning the experimental model into production.

It is essential that all men in this group should have suitable practical experience and it is considered unlikely that anyone under the age of 25 could have obtained the experience necessary. All the men of this group are to be employed in *civilian capacity in Experimental Establishments.*

Two (2) men of each sub-group here indicated may be placed in the Senior Experimental Officer Grade, with salaries £680 per annum; the remainder of each subgroup will be placed in the Experimental Officer Grade at salaries between £350 and £550 per annum depending on age and experience.

(We have no details of the possible application of the Income Tax Act of Great Britain to the above stipends.)

GROUP II.

Men of the Engineer-Physicist type for executive and maintenance duties in connection with a special war service. These men should have a good fundamental training in Physics or Engineering, with special knowledge of radio and considerable practical ability; and they should be capable of being trained rapidly to understand, operate and control the special apparatus of this service. They must be medically fit, of the officer type, and either possess or be capable of acquiring rapidly the power to command. These men would be given commissions as Lieutenants or Sub-Lieutenants, R.N.V.R. (Special Branch), and would be required to serve either afloat or ashore. Rates of pay for these officers are as follows: £463:5:0 for married officers over 30; £435:17:6 for married officers under 30 (plus children allowances); £381:2:6 for single officers.

(We have no information of a possible allowance for officer's uniform with the above rates of pay, nor have we details of the possible application of the Income Tax Act of Great Britain.)

GROUP III.

Engineers with mechanical knowledge and good practical experience of high frequency electrical or of radio installations. It is desirable that they should have Engineering or equivalent degrees, but high research qualifications are not necessary. They must be medically fit, of the officer type, and capable of serving on maintenance duty. Men in this group would be entered as Probationary Temporary Sub-Lieutenants, R.N.V.R. (Special Branch), in the first instance. Rates of pay for these officers are as follows:

Married officers: £333:15:0 per annum, plus children's allowance; Single officers: £279:0:0 per annum.

(We have no information of a possible allowance for officer's uniform with the above rates of pay, nor have we details of the possible application of the Income Tax Act of Great Britain.)

Applications from or suggestions concerning eligible men should be addressed to the Secretary-Treasurer, National Research Council, Ottawa.

When applying refer to Overseas Appointment, Group I, II or III as the case may be.

SITUATIONS WANTED

CIVIL ENGINEER, grad. '29, eleven months on construction, three months on road location, five months in draughting office, desires position on construction or would like to enter draughting office with possibilities in steel and reinforced concrete design. At present employed. Apply to Box No. 352-W.

CIVIL ENGINEER, M.A. (Cantab.). A.M.Inst. C.E., A.M.E.I.C. Age 35. Married. Experienced general construction, reinforced concrete, roads, hydroelectric design and construction, surveys. Apply to Box No. 751-W.

ELECTRICAL ENGINEER, B.A.Sc. General Electric test course, induction motor and D.C. machine design. Now employed in minor executive capacity. Has also had experience as instrumentman on highway construction. Wants opportunity to serve where technical training can be used to better advantage. Apply to Box No. 993-W.

MECHANICAL ENGINEER, B.A.Sc., A.M.E.I.C. Eight years experience in shop practices, field erection, draughting, design and estimating. Advanced training in Industrial Management. Would like to work with an industrial engineering firm or act as an assistant to a manufacturing executive to gain further training n industrial leadership. Married. Age 32. Apply to Box No. 1543-W.

REFINERY ENGINEER, B.Sc. (E.E.), Man. '37. Experienced in supervising operations and maintenance of small refinery. Registered provincial 3rd class steam engineer. Executive background. Also experience in sales and road construction. Consider any location and reasonable offer. Available on short notice. Apply to Box No. 1703-W.

CIVIL ENGINEER, B.Sc., S.E.I.C. Married. Six months surveying; mill site; water supply, power line location, earthwork, drainage, topographic. Has given field instruction in surveying. Three months bridge maintenance, asphalt paving inspection in two provinces. Five months draughting. Excellent references. Speaks some French and Spanish. Will go anywhere. Available on two weeks notice. Apply to Box No. 1860-W.

MECHANICAL ENGINEER, A.M.E.I.C. Age 37. Married. 1st Class B.O.T. Certif. 1st Class Ontario Stat. Engr's Certif. Thorough technical and practical training. Specialist in maintenance and general plant supervision, refrigeration, power plant. Available on short notice. Box No. 1963-W.

ELECTRICAL ENGINEER, B.Sc. (Alta. '36) S.E.I.C. Age 25. Single. Two years experience in engineering sales as power apparatus specialist and in special products sales for leading electrical manufacturing firm in Canada. Experience in promotion and sale of power line hardware equipment as well as in public address and radio broadcast equipment. References. Location immaterial. Will go anywhere on short notice. Apply to Box No. 2011-W.

ELECTRICAL ENGINEER, B.Sc. (Manitoba '34) A.M.E.I.C. Married, Canadian. Experience includes year and half with British electrical firm in England on apprenticeship course and erection work. Three years as sales engineer of wide range of electrical apparatus. Work included draughting and outside erection of diesel driven generating equipment, etc., also draughting and layout design. Experienced in office routine and correspondence and can meet public. References are available and will consider any location. Box No. 2022-W.

CIVIL ENGINEER, B.A.Sc. (Tor. '34). Age 27. Single. Two years experience with well known firm of consulting engineers in surveying, waterworks and sewer design and construction and municipal engineering. Three and one half years experience in the design of mining machinery of all kinds including sales engineering work in the mining districts of Northern Ontario and Quebec. Well experienced in structural and mechanical detailing. References. Apply to Box No. 2041-W.

SALES ENGINEER, fifteen years experience in sales and sales management, oil burners, heating, industrial heavy oil burners and air conditioning equipment. McGill graduate. Apply Box No. 2046-W.

CIVIL ENGINEER, graduate N.S. Tech. College (Civil '38)—13 months experience with Geodetic Survey in field, 6 months taking inventory of electrical distribution system for utility evaluation, 2 months office appraisal for same, 8 months hydroelectric design, including drafting plans for dam, spillway, tail race and power house of reinforced concrete, 4 months general maintenance work including drawing plans for warehouses and repair jobs. Would accept position anywhere in Canada. Age 23. Good health. Jr.E.I.C. Single, British Nationality. Box No. 2069-W.

ELECTRICAL ENGINEER, B.Sc. (Alta. '36), S.E.I.C. Canadian, age 25, single. Six months general surveying, including plane table, level and transit work. Experience in large western industrial plant includes six months as shift engineer, one year as electrician, eighteen months as assistant plant engineer. Work included draughting, design, estimates and specifications for plant layouts, conveying equipment, etc. Also some experience with production work. Desires permanent position with future. Good references available and will consider any location. Box No. 2071-W.

PHYSICAL METALLURGIST, M.S., Jr.E.I.C., A.S.M. Age 24, single, presently employed. Wide experience with large steel company in all types of metallographic testing, investigation of complaints, commercial heat treatment. Familiar with steel mill operation and production, of automotive, alloy forging, rail and structural steels. Box No. 2080-W

ELECTRICAL ENGINEER, B.E. (N.S.T.C. '36), S.E.I.C. Age 25. Married, no children. One year's experience electrical installation, operation and maintenance of power house, motors, generators, alternators, transformers, switching gear, underground cables, airport field lighting, conduit wiring, house wiring and lighting at Newfoundland Airport. One and a half year's experience in manufacturing plant in responsible position including about six months in official capacity. References. Location immaterial. Available on about two weeks notice. Box No.2085-W.

PRELIMINARY NOTICE

of Application for Admission and for Transfer

January 27th, 1940

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

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

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

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

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

The Council will consider the applications herein described in March, 1940.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

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

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

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

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

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

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

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

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment 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

CULLEN—JOHN TAYLOR, of 200 Elgin St., Ottawa, Ont. Born at Houghton-le-Spring, England, June 20th, 1917; Educ.: 1929 30, Sunderland Technical School. Private study; 1937-39, ap'tice engr., Price Bros. & Co. Ltd., Kenogami, Que.; Sept., 1939 to date, dftsman., Deputy Postmaster General's Branch, Civil Service Commission, Ottawa.

References: A. Cunningham, G. F. Layne, J. Shanly, N. D. Paine, W. P. C. LeBoutillier.

DONALDSON—DAVID RENNIE, of New Westminster, B.C. Born at New Westminster, May 2nd, 1916; Educ.: B.A.Sc. (Civil), Univ. of B.C., 1939; 1937-38 (summers), student asst., Topogl. Survey, Dept. of Mines, Ottawa; May, 1939 to date, inspector of aircraft, Boeing Aircraft Company, Vancouver, B.C.

References: J. N. Finlayson, A. Peebles, E. Smith, A. S. Wootton, T. V. Berry.

DOUGLAS—RALPH LOUIS, of Montreal, Que. Born at Morell, P.E.I., March 29th, 1911; Educ.: B.Sc. (Mech.), Queen's Univ., 1937; 1936 (summer), engrg. dept., Enamel & Heating Products Ltd., Sackville, N.B.; Upon graduation entered the employ of the Trane Company of Canada Ltd.; spent five months at the Trane School at Lacrosse, Wis.; in Feb., 1938, was transferred to Montreal to take over the coil and air conditioning dept. of the Montreal Office, since then in charge of that dept. in the Quebec territory.

References: L. T. Rutledge, H. W. McKiel, G. L. Wiggs, L. M. Arkley, W. W. Timmins.

GILL—J. EMILE, of 5353 Monkland Ave., Montreal, Que. Born at Pierreville, Que., March 19th, 1885; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1908; R.P.E. of Que.; 1909-10, sewer and paving work; 1911-12, topog'l. work and surveying; 1912-17, private practice, sewers, roads and waterworks; 1918-22, technical service, and 1922-28, road dept., City of Montreal; 1929 to date, asst. engr., Quebec Streams Commission.

References: O. O. Lefebvre, S. F. Rutherford, A. Duperron, H. Massue, J. A. Lalonde.

HARRINGTON—CONRAD DAWSON, of 24 Ramezay Road, Westmount, Que. Born at Montreal, Nov. 17th, 1884; Educ.: 1902-05, R.M.C., B.Sc., McGill Univ., 1907. R.P.E. of Que.; on graduation joined firm of Byers and Anglin as engr. in charge of concrete work. Spent two years in U.S. gaining experience on outside work. When this firm dissolved, went into new firm of Anglin's Limited as vice-president. When this firm took over Canadian end of Norcross Brothers, became vice-president and general manager of newly formed firm of Anglin-Norcross Corporation Ltd., and has occupied this position to the present time. Also president of Anglin-Norcross Quebec Ltd.. and Anglin-Norcross Ontario Ltd.

References: J. M R. Fairbairn F .P Shearwood O. O. Lefebvre, A. Surveyer, J. B. Challies.

HILLMAN—WILLIAM ANGUS, of Kenora, Ont. Born at Clachan, Ont., Feb. 16th, 1888; Educ.: Corres. Course, A.T.S., Chicago; 1905-08, chainman, 1908-10, rodman, 1910-11, instr'man., 1912-13, res. engr., C.P.R.; 1915-17, res. engr., H.B. Rly.; 1918, res. engr. on constrn. of Winnipeg aqueduct; 1919-20, field engr., water supply surveys, C.P.R.; 1921-24, and 1926-27, layout engr. on bldg. constrn., Carter Halls Aldinger Co.; 1924-25, office manager for same company at Minneapolis; 1927-28, res. engr., C.N.R. water service; 1928-29, supervn. of quarry layout and constrn. of crushing plant, and 1929-30, engr. and asst. supt., crushing plant, Grenville Crushed Rock Co.; 1931-33, layout engr. and supt. of crushing and mixing plant, Abitibi Canyon hydro plant constrn.; 1933-36, quarry and crushing plant mtce., 1936-37, engr. and asst. supt. crushing plant, Grenville Crushed Rock Co.; 1937-39, supt. on road constrn., Rayner Construction Co. (A.M.E.I.C. 1921-29).

References:J. W. Porter, G. Mitchell, T. C. Main, R. L. Hearn, H. E. Barnett.

KING—CAMERON NORCOTT, of Fredericton, N.B. Born at Plaster Rock, N.B., March 21st, 1915; Educ.: B.Sc. (Civil), Univ. of N.B., 1936; 1937-39, instr'-man., highway divn., Dept. of Public Works of New Brunswick.

References: A. F. Baird, J. Stephens, E. O. Turner, W. J. Lawson, C. G. Grant

MOHURY—BIPRA DAS, of Calcutta, India. Born at Darjeeling, August 16th, 1912; Educ.: Diploma in Civil Engineering, Anderson Engineering & Technical Institute, Calcutta; Incorporated Building Surveyor (London); Assoc. Member, Ins. Assn. of Architects and Surveyors (London); Assoc. Member, Inst. Highway Engrs., London; 1930-31, railway probationer surveyor, Bengal Nagpur Rly.; 1932-34, asst. res. engr., Indo Burma Engineering Syndicate, Vizag, Madras; 1935-37, engr. executing works in the Public Works Dept. of the Govt. of Bihar and Orissa (responsible for the constrn. of several bridges and bldgs.); at present, asst. district engr., Concrete Association of India, Calcutta District (engr. in charge of the city of Calcutta and other provinces—responsible for design and details and constrn. of reinforced concrete structures). (By special ruling of Council references from members of British Institutions have been accepted.)

References: A. Stewart-Lewis, U. S. Jayaswal, S. C. Das Gupta, I. N. Ghosh, K. C. Gupta.

NEILSON—JAMES EDWARD, of Montreal, Que. Born at Lyn, Ont., Feb. 3rd, 1907; Educ.: B.Sc., Queen's Univ., 1928. R.P.E. of Que.; 1928, shift fireman, Swifts, Toronto; with the Riley Engineering and Supply Co. Ltd., Toronto, as follows: 1929 (1 mos.), dftsman., then joined field service and erection dept., moved to Montreal in charge of field service and erection for eastern territory, incl. Ottawa and Kingston to Maritime provinces; Sept., 1930, moved back to Toronto for course in furnace design, estimating and engrg. application of equipment; 1931, moved to Montreal, and from 1932-34, in charge of Montreal office, selling and servicing equipment; 1934 to date, sales engr. with Foster Wheeler Limited, who acquired the rights from the Riley Stoker Corporation in the United States for the manufacture and sale of their equipment. Since that time selling, by engrg. application, in addition to above equipment, other equipment manufactured by Foster Wheeler, incl. cooling towers, heat exchangers, oil refinery apparatus, boilers of all types, superheaters, economizers, condensers, evaporators, etc.

References: F. A. Combe, P. E. Poitras, H. C. Karn, C. K. McLeod, E. A. Ryan, J. T. Farmer, J. F. Plow, E. A. Goodwin, D. F. Grahame, J. B. Stirling, J. L. Bieler.

POLLOCK—ALLAN, of Schumacher, Ont. Born at Glasgow, Scotland, May 1st, 1910; Educ.: 1930-32, Queen's Univ.: 1928-29, 1930, Shawinigan chemical plant, Shawinigan Falls; 1932-36, independent dfting. work; 1936 to date, with the McIntyre Porcupine Mines, mining, sampling and surveying.

References: A. Jackson, R. A. Low, H. Idsardi..

STAPLEY—WILFRED HENRY, of Halifax, N.S. Born at Saskatoon, Sask.; Nov. 30th, 1914; Educ.: B.Eng. (Mech.), Univ. of Sask., 1937. 1935-36 (summers), attached to R.C.C.S., as 2nd Lieut.; 1937, attached to R.C.A.F. for training as a pilot. Qualified as pilot, May, 1938; promoted to Flying Officer, July, 1938; at present, Flying Officer, No. 5 (B.R.) Squadron, Halifax, N.S.

References: C. J. Mackenzie, I. M. Fraser, D. Ross.

THOMPSON—JAMES IRVING, of Lynden, Ont. Born at Lynden, June 2nd, 1918; Educ.: B.A.Sc. Univ. of Toronto, 1939; 1936-37 (summers), rodman, chainman, Ontario Dept. of Highways; June, 1939 to date, hydrographer (temporary), Hydrographic Service, Dom. Govt., Ottawa, Ont.

References: C. R. Young, R. F. Legget, W. J. Smither, J. L. Foreman, R. E. Hanson.

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

ARMSTRONG—JOHN EDWIN, of Montreal, Que. Born at Peoria, Ill., Sept. 29th, 1886; Educ.: C.E., Cornell Univ., 1908; 1908-12, asst. on engrg. corps., Pennsylvania lines west of Pittsburgh; 1912-28, asst. engr., chief engr's. office; 1928-38, asst. chief engr., and 1939 to date, chief engr., C.P.R., Montreal, Que. (A.M. 1917).

References: J. M. R. Fairbairn, P. B. Motley, A. R. Ketterson, R. B. Jones, F. Newell, L. A. Wright.

FOR TRANSFER FROM THE CLASS OF STUDENT

DESCOTEAUX—PAUL R., of Cap de la Madeleine, Que. Born at Montreal, Aug. 18th, 1912; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1934. R.P.E. of Que.; 1932-34 (summers), mining surveys; 1934 (Oct.-Dec.), road survey; 1935-37, town engr., Rouyn, Que.; 1937-38, asst. divn. engr., and 1938 to date, divn. engr., Quebec Roads Department. (St. 1934).

References: P. G. Gauthier, A. Frigon, S. A. Baulne, A. O. Dufresne, F. J. Leduc, E. Gohier, J. P. Chapleau.

DUNCAN—JOHN DANIEL, of Milton, Ont. Born at Aberdeen, Scotland, August 20th, 1906: Educ.: B.A.Sc., Univ. of B.C., 1928. R.P.E. of Ont.; 1924-25, electrician, Granby Cons. Mining & Smelting Co. Ltd.; 1928-29, test dept., and 1929-39, application of engrg, motors and control, material handling equipment, mine hoists, etc., preparation of estimates, apparatus sales dept., Can. Gen. Elec. Co. Ltd., Toronto; at present Lieut., 1st Corps Signals, R. C. Signals, C.A.S.F. (St. 1928).

References: W. E. Ross, D. L. McLaren, A. B. Gates, W. L. Laurie.

ELLIOTT—JOHN COURTENAY, of Leamington, Ont. Born at Shawville, Que., May 18th, 1910; Educ.: B.Sc., Queen's Univ., 1934; 1934-35, junior engr., and 1935 to date, new business representative, responsible for approval of design—sale and installn. of natural gas domestic heating, The Dominion Natural Gas Co. Ltd. (St. 1934).

References: A. Macphail, W. P. Wilgar, R. A. Low, D. S. Ellis, L. M. Arkley.

HAWKEY—BERTRAM JACKSON, of Fernie, B.C. Born at Calgary, Alta., Jan. 31st, 1906; Educ.: B.Sc. (Elec.), Univ. of Alta., 1936; 1926-35, electrn. with East Kootenay Power Co. Ltd., Fernie, B.C.; 1936-37, test course, C.G.E., Peterborough and Toronto; 1937 to date, private practice as consltg. engr., work incl. design and constrn. of an air conditioning system for theatre in Fernie; also designed and remodelled the interior and front of the same theatre, incl. an up to date lighting system. (St. 1936).

References: M. L. Wade, G. E. Elkington, H. J. MacLeod, W. E. Cornish, W. M. Cruthers.

HOLLAND—TREVOR, of 575 Walpole Ave., Town of Mount Royal, Que., Born at Montreal, Oct. 27th, 1908; Educ.: B.Eng., McGill Univ., 1932; 1929-30-31 (summers), Flying Training Course, R.C.A.F., Camp Borden; with Brandram-Henderson Ltd., Montreal, as follows: 1933-38, plant engr., and 1938 to date, vice-president in charge of all mechanical detail, plants, and operations for all divisions. (St. 1929).

References: D. G. Anglin, G. M. Wynn, F. A. Combe, C. M. McKergow, R. DeL. French, E. Brown.

MacGIBBON—JAMES ALEXANDER, of 3671 Jeanne Mance St., Montreal, Que. Born at Brownsburg, Que., Nov. 3rd, 1910; Educ.: B.Eng. (Mech.), McGill Univ., 1937; with Canadian Industries Limited as follows: 1928-30, asst., metallurgical lab., 1932-34, asst., "Bedaux" piece work rate system, 1931, 1935-36, experimental work in metallurgical and ballistic labs., June, 1937, to date, dftsman., engrg. dept., Montreal. (St. 1937).

References: E. B. Jubien, H. B. Hanna, M. S. Macgillivray, I. R. Tait, A. B. McEwen.

POULIOT—PAUL LOUIS, of 128 St. Ann St., Quebec, Que. Born at Arthabaska, Que., Oct. 2nd, 1912; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1937; 1938 to date, ap'tice, Shawinigan Water & Power Company, 6 mos., meter shop, Montreal, 1 year, Shawinigan Falls power house, 1 year, engrg. dept., Quebec Power Co., (St. 1936).

References: R. B. McDunnough, E. D. Gray-Donald, R. Dupuis, J. Saint Jacques, G. H. Cartwright, C. B. Reid.

ROSS—THOMAS W., of Dalhousie, N.B. Born at Hawkesbury, Ont., Mar. 2nd, 1911; Educ.: B.Eng. (Mech.), McGill Univ., 1935; 1931-32, lab. asst., G. J. Manson, Hawkesbury; 1932-33, lab. asst., Forest Products Labs. of Canada, Montreal; 1936 to date, dftsman., New Brunswick International Paper Co., Dalhousie, N.B. (St. 1935).

References: L. Sterns, A. H. Chisholm, C. H. Champion, K. S. LeBaron, C. M. McKergow, A. R. Roberts.

SCHOFIELD—ROBERT JOHN GRAHAM, of 5 Rockwood Place, Hamilton, Ont. Born at Winnipeg, Man., May 25th, 1912; Educ.: B.Eng. (Chem.), McGill Univ., 1935; 1935-36, operator, Brunner Mond Canada, Amherstburg, Ont.; 1936-38, chemist, Canadian Cottons Ltd., Milltown, N.B., at present, chemist and asst. dyer, Canadian Cottons Ltd., Hamilton, Ont. (St. 1935).

References: W. A. T. Gilmour, A. R. Hannaford, J. R. Dunbar, H. A. Lumsden, A. Love.

NATIONAL RESEARCH COUNCIL ADAPTS ITS PROGRAMME TO WAR NEEDS

The National Research Council is on a war footing. It is working in close co-operation with the Department of National Defence and the War Supply Board. During the absence of General McNaughton on military service, Dean C. J. Mackenzie of the University of Saskatchewan is Acting President. The Council has received offers of laboratory facilities and staff for war work from most of the universities and from several large industrial laboratories. It is the purpose of the Council, in the prosecution of war research referred to it, to make the greatest possible use of existing facilities in various centres throughout the Dominion and to utilize the services of organized teams of research workers wherever possible.

Many investigations bearing on war problems are in progress in the laboratories. Tests are being made on textiles of all kinds for military purposes; studies are being directed towards the development of paints for the detection of poison gases; gas mask equipment is being examined; the value of proposed inventions is being appraised, and in practically every laboratory at least some of the work has a bearing on the war.

For convenience, this review of the Council's work in 1939 is restricted to notes on work in the mechanical engineering and the physics and electrical engineering divisions.

Division of Mechanical Engineering

Wind tunnel tests to determine the effectiveness of wing flaps installed on certain aircraft have indicated that the landing speeds would be decreased by the use of the flaps on land planes and to a greater extent on seaplanes.

With the advent in Canada of high speed military aircraft which may have to be operated on skis during the winter months a new ski has been produced which is suitable for use on all types of civil and military aircraft, and supersedes the earlier streamlined ski developed in the laboratories.

Research on the snow performance of aircraft skis was continued at Sioux Lookout, Ontario, where the temperatures in winter are lower and the snow conditions different from those at Ottawa. From data obtained in these tests aircraft skis have been designed which have low sliding resistance, low tendency to "freeze in" and high resistance to wear.

A model of the proposed horizontal wind tunnel for the new Aerodynamic Laboratory was built and tested with a view to improvements in design. This model was built large enough to be of use as a small wind tunnel.

Investigations into the possibility of explosions in automobile service stations through the ignition of oil mist produced by spring-spraying operations showed that the minimum concentration of spring-spraying oil needed to produce an explosion was much in excess of the maximum concentration of oil measured in the mist produced by actual spring-spraying operations.

A new flume has been designed and constructed for use in hydraulic structure design. It is intended to contain models of dam spillways, sluice gates and similar structures, of a size sufficient to render the results free from scale effect. A new basin is being designed for ship model work. It will be 600 feet long, 25 feet wide and 10 feet deep and will have separate towing equipment for high speed work.

Safety and regularity are the watchwords of modern air transport. The National Research Council maintains a laboratory for testing aircraft dashboard instruments.

Division of Physics and Electrical Engineering

In the Division of Physics and Electrical Engineering work includes investigations on general physics problems and in such specialized fields as acoustics, electrical engineering, heat, metrology, optics, radium and X-rays, and ultrasonics.

Defrosting of aircraft propellers is very important when aircraft are flying in moist air at freezing temperatures. Experiments are in hand on the heating electrically of the leading edge of propeller blades. Equipment has also been developed to study vibrations in aircraft while in flight.

Studies have been carried out in the attenuation of sound in lined ducts, and to check predictions based on new theories. The internal state of metals has been studied to determine the progress of fatigue.

The Council has installed a one-half million volt transformer, a one-million volt impulse generator to simulate the effects of natural lightning, and a cathode ray oscillograph to study high speed transients, such as those caused by lightning discharges. Development of a voltage regulator of the electronic type which would be cheaper in first cost than those heretofore on the market and which would give a closer voltage regulation has been undertaken.

The thermal conductivity of some Canadian limestones and dolomites has been measured at temperatures ranging from 250° F. to 600° F.

Some work has been done on a laboratory model to gain information in regard to heating of refrigerator cars by the several systems of piping used in connection with underslung heaters.

An extensive series of tests has been made on heat transfer through fabrics worn by women indoors in order to get a comparison of these with those worn by men. The results indicate that wearing a dress made of jersey material (knitted dress) along with certain other clothing a woman can be just as warmly clothed as a man. A "heavy" silk stocking is found to give extremely little protection against cold and contrasts severely with the trouser leg and air space which surrounds a man's calf. Some experiments have been made on the heat transfer through blankets in connection with studies of ground-sheets for troops.

Diffusion coefficients of various types of building papers are being determined and shortly will be made available.

A new projector for the transfer of data from air photographs to maps has been designed. An auxiliary camera has been built for use with the present standard aircraft instrument camera to record instrument readings on film. The new camera is quite small and can be placed in any convenient location in the aircraft.

To certify gauges for checking tools, optical methods are employed. With the advent of the war, this work became especially valuable, as one of the first and most important requirements in munitions supply is the provision of accurate standard gauges.

An artificial source of light which is constant in colour and intensity has been developed and a small room has been equipped in the optics laboratory with this correct form of artificial illumination for grading by colour.

Numerous castings, welds, and forgings have been inspected by X-ray and radium gamma ray methods. The laboratories have also assisted the aircraft industry by the development of uniform methods for the X-ray inspection of aircraft castings and in organizing such inspection in Canada. The equipment used for the testing of clinical X-ray dosemeters is being extended to meet requirements resulting from the recent adoption of higher electrical potentials for the operation of therapeutic X-ray apparatus in some of the Canadian cancer institutions.

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 23 | MARCH 1940 | NUMBER 3

PUBLISHED MONTHLY BY
THE ENGINEERING INSTITUTE OF CANADA
2050 MANSFIELD STREET - MONTREAL

Price 50 cents a copy, $3.00 a year, in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

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Past-Presidents' Prize	$100 cash	For a paper on a topic selected by Council.
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Gzowski Prize	Gold medal	For a paper contributing to the literature of the profession of civil engineering.
Plummer Prize	Gold medal	For a paper on chemical and metallurgical subjects.
Leonard Prize	Gold medal	For a paper on a mining subject, open to members of the Canadian Institute of Mining and Metallurgy as well as The Engineering Institute.
Students and Juniors	Books to the value of $25 (5 prizes)	For papers on any subject presented by Student or Junior members.
University Students	$25 in cash (11 prizes)	For the third year student in each college, making the best showing in college work and activities in student or local branch of engineering society.

THE ENGINEERING JOURNAL

VOLUME 23 | MARCH 1940 | NUMBER 3

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

OUR RESPONSIBILITIES

I AM FULLY conscious of the magnitude of the responsibilities which fall upon me as President of The Engineering Institute of Canada. Some of these responsibilities I must carry to the best of my ability, some I can delegate to others, but the paramount responsibility of guiding the efforts of the Institute in making its best contribution towards the successful prosecution of the war, I must share with every member.

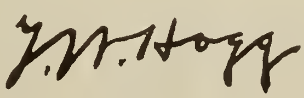
Canada is facing a very critical year. Her best and unstinted contribution to this war for the preservation of democracy is essential. Any failure on her part might mean calamity. I, therefore, bespeak the fullest support from every Institute member—both in his individual war effort and in the co-operative effort he can contribute for the common good.

Nicholas Murray Butler once said that "The future of the world is bound up with the hope of a true democracy that builds itself upon liberty . . . False democracy shouts, 'Every man down to the level of the average.' True democracy cries, 'All men up to the heights of their fullest capacity for service and achievement.'" Let us all remember, therefore, that while we are fighting for democracy we should also endeavour to build a true democracy in this Dominion.

Many of us, busy in our daily labours, may give little thought to our higher responsibilities as engineers. But we would all do well to recall the obligation we undertook in the ceremony of the ring—The Ritual of the Calling of an Engineer:

"MY TIME I will not refuse; MY THOUGHT I will not grudge; MY CARE I will not deny towards the honour, use, stability and perfection of any works to which I may be called to set my hand."

Our responsibilities as engineers and subjects of a nation which is founded upon the principles of a true democracy, are not only technical, but moral. Our technical training in accuracy and logic well equips us to make a great contribution to society; to offer that impersonal, unprejudiced viewpoint and judgement so essential to-day for strengthening our democratic economic structure. Because of this responsibility, therefore, let us all endeavour to apply our technical training to our moral life—and take great care in the accuracy of our spoken and written word.



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CANADIAN HIGHWAY CONTROL AND SAFETY

ANGUS D. CAMPBELL, M.E.I.C.

Manager, Omega Gold Mines Limited, Larder Lake, Ont., Safety Engineer, McIntyre Porcupine Mines Limited, Schumacher, Ont.

Paper presented before the General Professional Meeting of The Engineering Institute of Canada at Toronto, Ont., February 9th, 1940

Motor vehicle accidents in Canada in 1939 killed some 1,500 people and maimed probably 100,000 others. This is over twice the fatality toll of occupational accidents in Canada. The social and humanitarian aspects of this record have shocked all classes of the community. Premiers and cabinet ministers, various public officials, prominent citizens, the pulpit and the press, have all deplored highway accidents and warned against them. Despite all this, the slaughter and its accompanying economic loss goes on.

Engineering Concern with Highway Safety

Highway safety is really an engineering problem. It is thus a proper subject for The Engineering Institute of Canada. One of the proudest boasts of the engineering profession has been that its work is designed and executed for stability and safety. One of the chief claims for legal protection of the engineering profession is the safety of the public. Nevertheless, although highways and motor vehicle transportation are major engineering tasks, there is not yet safety on the highways of Canada. Somewhere and somehow, the engineers of Canada are falling down on this big job. This statement is not an indictment of provincial and municipal highway engineers. Each Canadian engineer must share some part of the responsibility since "of him to whom much has been given, much is expected." Every Canadian engineer can help to make our highways safe, and the Engineering Institute can lead in this important work.

CANADA—MOTOR VEHICLE STATISTICS—1938

Province	Accidents	Deaths	Reported Injuries	Property Damage	Department and Official Reporting
British Columbia	5,073	102	2,464	$525,654.58	The Commissioner, Provincial Police, Motor Vehicle Branch
Alberta	..	70 (Estimate)	..	...	Statistics not kept by Public Works
Saskatchewan	1,200	45	859	189,875.00	Provincial Taxation Commission, Director of Motor Vehicle and Gasoline Revenue
Manitoba	2,892	78	1,587	167,868.00	Department of Labour, The Accident Prevention Branch
Ontario	13,715	640	11,683	1,747,875.00	Department of Highways, Motor Vehicles Branch Accident and Statistical Division
Quebec	9,568	402	5,764	...	Bureau of Provincial Revenue, Bureau of Statistics
New Brunswick	1,040	55	578	...	Department of Public Works, Motor Vehicle Registrar and Gasoline Tax Auditor
Nova Scotia	2,204	75	1,088	154,565.00	Department of Highways, Registrar of Motor Vehicles
Prince Edward Isl'd	..	..	..	...	Royal Canadian Mounted Police

Human and Money Costs of Highway Accidents

Before considering how engineers can make Canada's highways safer, let us review why these highways should be made safer. The preceding statistics of accidents, fatalities, and personal injuries, in our various provinces for the year 1938 are enough to give anyone thought.

The foregoing statistics show only the number of comparatively serious injuries reported. If the same proportion of approximately 100 disabling injuries to one fatal holds good in highway accidents as in industry, then at least 150,000 persons were injured on Canadian highways in 1938. Even if the bald record of approximately 1,500 killed and 150,000 injured on our highways in one year fails to move us, the personal knowledge of individual highway accidents with the resultant deaths, the suffering, temporary or permanent, the shocks to the victims, as well as the anxiety and sorrow of relatives, dependents and friends, must surely convince each of us that highways should be operated more safely.

If, on the other hand, the humanitarian aspects of the problem are disregarded, and the engineering, economic side alone is considered, even a brief review will convince any engineer or other economist that Canadian highways must be made safer. The full cost of highway accidents cannot be known. The official provincial estimates of motor vehicle property damage alone, are over $3,000,000 per year. If the money costs of the human injuries are calculated on the same basis as compensation for industrial accidents they reach a staggering sum. Under the Ontario Workmen's Compensation system, which is similar to that of other Canadian provinces, it costs $30,000 for the industrial accidents which occur for every fatal accident. On this basis, in 1938 the 1,500 Canadian motor vehicle deaths and their accompanying permanent and non-permanent injuries, would require for medical aid and compensation, the sum of $45,000,000. Enormous as such compensation and medical costs would be, if paid, they are not the biggest item in accident expense, since the indirect and uninsurable costs are calculated[7] to be three or four times as large as the direct costs of compensation and medical treatment.

Probably the greatest loss, but an incalculable one, is the loss of use of Canadian highways due to the real and justifiable fear of highway accidents. This becomes a larger and more definite loss as Canada makes yearly increasing highway expenditures, largely to attract tourists. These expenditures, such as the $44,000,000 spent by Ontario for the year ending March 31st, 1938, can only be justified by increased revenue from tourists. As far back as 1930 it was estimated[12] that United States citizens spent one billion dollars a year in touring on this continent. Located as Canada is, with Ontario as a wedge into the most populous States, Canadian highways are travelled by millions of United States tourists, and Canadian revenue from tourists is estimated at $300,000,000 per year.

This year, with European travel impossible, with Canadian money at a discount, and with the newer cars and highways of the past two years revolutionizing the comfort and cost of highway travel, our highways should be more attractive than ever to United States tourists. This is fortunate, since never was tourist revenue so vital to the economic life of Canada as in her present war-effort. Now is the time to reach out for tourist traffic and revenue.

But until our highways are more safely controlled, the full amount of possible tourist revenue and its important accompanying international good-will cannot be obtained, since tourists and those Canadians who hope that their days may be long will continue to hesitate in making full use of the open roads of this Dominion. On the other hand, safe Canadian highways would not only bring peace of mind and happiness to Canadian citizens, but their advertising value would be worth millions of dollars in increased tourist revenue.

The greatest present need in obtaining safe Canadian highways is more of engineering approach and analysis and direct engineering action.

Engineers and Highway Safety

Engineering is already doing much for highway safety and has been chiefly responsible for checking motor vehicle fatalities in Canada. Without the results of engineering work, the appalling rise in highway fatalities up to the year 1937 would not have been checked (and even reduced in some of the provinces) as it has been.

Automotive engineering has made continuous improvements in motor vehicles, which now perform reliably and efficiently and are marvels of safety. In sound body construction, improved tires, shatter-proof glass, improved lighting, the elimination of projecting killing parts, and in the general ability of motor cars to protect their occupants, the automotive engineers have made wonderful contributions to highway safety.

In highway engineering proper, that is, in the design, construction, and maintenance of streets and highways, Canadian engineers are definitely working towards safety. This is in spite of having one of the most widespread highway systems in the world, and our great difficulties of terrain and climate.

Little has been written about this for the Institute. Although there are many references to highway safety in the published proceedings of the Canadian Good Roads Conventions[1] and of the Road Superintendents' and Engineers' Conferences of Ontario[2], it is found, upon enquiry, that the only papers on safety printed in the Engineering Journal in recent years are "Safety in Industry"[3]; "Engineering Efficiency into the Highways"[4]; and "Engineering the Highways for Safety"[5].

There was, too, a striking lack of definite reference to safety in the Semicentennial Number of the Institute's Journal of June, 1937, although the reviews of Canadian engineering in that number do stress by inference the fundamental safety of Canadian engineering design and construction.

One reference to highway safety in that number is noteworthy[6]. Professor C. R. Young says in his article on "Bridge Building" that by the use of splash panels on bridges built by the late A. B. Crealock at Belleville and Galt, it was possible to prevent the splashing of pedestrians and make it impossible for children to dart out on the roadway from behind the hangers. This is a tribute to the practical interest in safety of our departed friend, who did so much in so many ways for engineering in Canada.

The theme of "Engineering the Highways for Safety" was followed up in a splendid paper[5] by Mr. C. A. Robbins, who describes the modern idea in highway construction as exemplified by the four-lane highway being built east and west from Toronto. This particular example of safety being built into highways is one of the best in the world. Despite this and smaller examples throughout Canada, we must conclude with the author that "irrespective of the length to which the engineer may go in designing the highway from a safety standpoint, the final factor of safety rests with the driver of the motor vehicle, and while engineers who are constructing highways are faced with many difficult problems, those who have the responsibility for motor vehicle control are perhaps faced with problems more difficult to solve."

The main problem of highway safety is stated there. Highway design and construction for safety simply cannot keep up to the growth of motor traffic. A pioneer Scotch road-building engineer, John Loudon MacAdam, is said to have enunciated the theory that "roads should be built to suit the traffic and not traffic to suit the roads." As a theory it is sound, but in this large Canada of ours, the traffic must suit the roads for many years yet. This involves highway control and operating safety, but who has the responsibility for highway control?

Engineers would appear to control the operating of our highways. We have well organized Provincial Highway Engineering Departments. The completeness of these,—with chief engineers, assistants, specialty, district and division engineers covering all districts and the whole supplemented by road superintendents and engineers in our cities, towns, counties and townships—will be an agreeable surprise to investigating members of this Institute. The complete engineering personnel of these departments and municipalities is detailed in the February 22nd, 1939, issue of the "Engineering and Contract Record." These engineers are doing a marvellous work for Canada.

We have, however, extremes in highway control jurisdiction, with trans-Canada highways, provincial highways, county, township, town and city roads, and many roads that, like Topsy, have merely "growed up." Somewhere in the maze of jurisdiction, engineering control is lost.

Despite the admirable work they are doing for Canada in highway transportation, engineers in Canada do not have the responsibility for the safe operating control of the highways which they design, construct, and maintain. This operating control is left chiefly to the police and the coroners.

Examining the mechanics of actual highway control, we find that those chiefly concerned with highway operation of motor vehicles and highway safety are the Provincial Registrars, who issue driving licenses and motor vehicle permits, and who in some provinces are the gasoline tax auditors. Only in New Brunswick, Nova Scotia and Ontario, are these officers in the Highways or Works Departments. Actual administration of the Highway Act, and by inference of road operation, is in the hands of the police who are under the Attorney-General's Department.

Accidents on highways, if the cause of personal injury or property damage amounting to $50, must in most provinces be reported to police officers who are supposed to investigate and to send copies of their reports to the Provincial Registrar of Motor Vehicles. In addition, coroners must send reports of inquests on highway accident victims to the Registrar, who can then *compile accident statistics.* The divisional or other highway engineers in most provinces do not learn officially of accidents on their roads until they are ancient history. Certainly they do not make it their business to investigate these accidents. Responsibility and authority in highway control are divided between the highway and the Attorney-General's Departments and engineering seems to keep out of it. The statistical branches of the Registrars of motor vehicles and gasoline revenue collectors, and in Manitoba of an Accident Prevention Branch of the Department of Labour, record in their reports earnest attempts at highway accident prevention. For example, the report of the Ontario Vehicles Branch for 1937 records: "The year 1937 saw a tragic toll recorded with the number of accidents and victims reaching a new high; a result which might have been foreseen, perhaps, in view of the heavy increases in traffic volume. To meet the alarming situation, an advertising campaign using a 'horror' or 'fear' approach was employed with gratifying results indicated during the last few months of the year."

In the author's opinion, this kind of approach reaches only the habitant's warning conclusion, "You'll not get drowned on Lac St. Pierre so long you stay on shore." So you'll not get killed on the highways so long as you are afraid to use them. Ontario's "horror" or "fear" campaign was a desperate remedy for desperate circumstances. It is now being followed up there and in other provinces by other educational methods.

We engineers appear to accept very literally what are called the "three E's of highway safety", namely,—engineering, education, and enforcement, and stop at a very narrow definition of the first "E". Such a casting off of responsibility can only be done at a great loss of status to the engineering profession and at a great loss to safety. The effective approach to the safety problem is, in its entirety, the engineering one, with engineering recognizing the interdependence of the human and mechanical elements.

Engineers, having as they do, "a responsibility and opportunity not given to the average man"[3] surely cannot subscribe to the doctrine that it is sufficient for engineers to do everything possible to raise the standard of highway design to a point where, if accidents do happen, our consciences are clear.

We know that "the final factor of safety rests with the driver of the motor vehicle and that a road can be well designed for safety and volume and yet can be made a veritable death trap by the (uncontrolled) reckless or careless driver."[10]. Yet we cannot get clear of the highway control and safety problem like the Irishman who threw the axe into the fight and said, "Thank God my hands are clear of it."

The writer strongly advocates, then, changes in our remote dual control of highway operation. District, county and municipal engineers must be allowed and encouraged to get right to first-hand grips with the causes and details of road accidents occurring in their areas. This would insure:

First—A reasoned analysis of the safety problem with continuous factual evaluation of the real causes of accidents and their remedies.

Second—A continuous dealing with the mechanical or physical elements of the car and the highway, and above all, *action*—the prompt application of sound engineering principles to the control of the human element, since as Huxley so truly said, "the great end of life is not knowledge but *action.*"

All of the many agencies now working for highway safety need and would welcome the aid of engineers. This would be especially true of the police, who have a definite place in engineering highway control for safety. If the police are not soon given this engineering co-operation, Provincial and Municipal Police Engineering Departments will have to be set up.

Overburdened as some Provincial Police are with all kinds of law enforcement, they often have to use their own cars on highway patrol. Of such a patrol in one province, a recent newspaper dispatch says: "It has been announced by the attorney-general that it is proposed to separate the Liquor Commission Police from the Provincial Police. It was also stated that the custom of releasing most of the provincial officers during the winter will be reverted to. Under the previous administration, provincial traffic constables were employed twelve months a year at a salary of $100 a month. They will likely now be employed as under an administration before, for eight months a year at $125 a month."[8]

Engineers may well ask themselves how highway safety can be obtained under "the three E system" where

Engineering stops at design and construction;

Education is the function of miscellaneous agencies and secures its chief gains through the "fear" motive so successfully used in the *Toronto Star* articles of December, 1939;

Enforcement is the starved child of revenue departments that begrudge salaries of even $125 per month for twelve months a year.

Industrial Safety Engineering

In industry, safety engineering has had marvellous results in accident prevention. Industrial management engineers, assisted often by engineers definitely assigned to safety, and often successfully by those without formal engineering training, have cut the number of disabling accidents and fatalities, and consequently have secured uninterrupted production and profitable operation. Some instances of this are:—In Canadian mining, considered a very dangerous occupation, the number of fatal accidents per thousand men employed in 1929 had been cut in half by 1939; one northern Ontario mine with 800 men in 1926 had 430 lost-time accidents, of which 200 resulted in lost-time of over seven days each, the compensation term; in 1938, the same mine, with 1,400 men employed, had only 81 lost-time accidents, of which just 40 were compensation cases. Last year 53 great DuPont factories went through the entire year without a lost-time accident. "A reduction in accidents from 65 per cent to 85 per cent when a safety programme is installed in a factory is not unusual"[13].

Highway Construction Engineering

As in industrial accident prevention, an engineering approach is being made to actual safe highway operation and accident prevention in an important field where industry and government road operation join. That is in road construction. In Ontario, road contractors on this work pay $6 per $100 of payroll for workmen's compensation for accidents. This is, of course, a cost of highways. That rate, fixed by the actual cost of accidents on road construction, is three times as high as that paid in the supposedly dangerous work of mining. The members of the Ontario Road Builders' Association are going to do something about this, and have formed a Workmen's Compensation Accident Prevention Association in their Class 21[14]. It is a reasonable assumption that they will cut their compensation rate by a third, which will still leave it twice the mining rate. This will save directly in compensation $150,000 a year, and expenditures for safety on highway construction will be abundantly justified. This will definitely affect safety on the highways.

There appears no reason why governments and municipalities themselves should not take up organized road construction and operating safety as a similar direct means of saving the tax-payers' money [15]. There is no question but that the humanitarian and social results would also repay in votes.

Engineering Highway Control

Can engineers bring highway control safety efforts, similar to those of industry, into the complex field of government and police jurisdiction, and can the engineers survive there? The author believes they would thrive on it and suggest that each Department of Highways appoint one of its engineers as Director of Highway Safety under the chief engineer of the department. This director would have under him engineers assigned to safety work in each Highway Division, who would work in close co-operation with the divisional engineers. In addition, the employment of safety engineers by large municipalities would be stimulated. These highway safety engineers should be men trained, or who will take the training[11], in operating and management problems rather than the type who specialize in "cause work," since the latter tend to emphasize the emotional side at the expense of sound economics. There is an abundant literature on highway safety available to teach these men[12], and such safety engineers would earn their salaries from the first day in facilitating safety work amongst the Highway Department's own employees, and would in a short time pay handsome dividends to their provinces in increased highway safety.

This is not too ambitious a highway safety programme, yet it will not be obtained unless engineers go after it. It is a programme, however, which may be obtained piecemeal. It is literally true that any municipality, county, provincial division or province, can to a large extent determine its own highway accident rate. Safety is purchaseable. Of this the City of Toronto is becoming an example. Despite increasing traffic, the number of motor vehicle deaths in 1939 shows a decided drop as compared with the past several years, as:

1934	88
1935	74
1936	80
1937	—
1938	80
1939	61

These results place Toronto high in the list of safe cities in North America. While no one organization can take credit for this, it is significant that one of our fellow engineers, Mr. Tracy leMay, is in action in Toronto as traffic engineer in an advisory position to the Council on safe Traffic Control.

If any branch of this Institute, or any group of engineers similar to the well-known Brantford group, will seriously take up highway safety in their area, even though they may have set-backs, good results are bound to be obtained. The adventure is recommended to engineers.

Finally, engineering action for highway safety is needed even before the expected influx of tourists in the coming season. A start on it can be made through the only public enquiries that are held into highway accidents, that is, through coroners' inquests. It should be necessary for the municipal or provincial divisional engineers or their engineer representatives, to attend such inquests to give expert and explanatory evidence as to how the fatal accident occurred on the highway of which they had charge. There would then be fewer alibis offered by the public on the state of the road. After the first few inquests, the engineers-in-charge would make it their business to know what was happening on their highways. Arrangements would very quickly be made by which the engineers would learn at once, by wire or 'phone, of highway accidents, and they or their assistants would be right on the job to investigate. The engineering approach having thus been started with the facts for presentation at the coroners' inquests, engineering analysis would point the way to the needed or effective remedy, whether local improvement in the highway, supervision of signs, the removal of an obstruction, or better enforcement of the Traffic Act. Very soon highway safety engineering would become the basis of, and dovetail into, all the legal enforcement and educational phases of highway accident prevention.

There are few departments of human activity in which the engineering approach is not effective. Engineering, if directly applied to highway control, can solve the problem of highway safety. Safe Canadian highways may well become highways of happiness for the Canadian people and their friendly United States neighbours.

Safe Canadian highways can be a large factor in solving Canada's war-time economic problems.

The "Sons of Martha" are called on to make our highways "safer than the known way."

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The luncheon, Annual Meeting, on Thursday, February 8th

THE ECONOMIC IMPACT OF THE WAR

DR. F. CYRIL JAMES
Principal and Vice-Chancellor of McGill University

Address delivered at the Annual Banquet of The Engineering Institute of Canada, Toronto, Ont., February 8th, 1940

Much has been said and written regarding the economic impact upon the Dominion of Canada of the struggle in which we are now engaged, but many of the statements are contradictory. If you will permit me to do so, I think that it may be appropriate before an audience of engineers and technical experts to discuss in rather elementary fashion some of the fundamental problems that are involved. It is comparatively easy when one ascends into the higher realms of finance, and makes the picture still more complex by efforts at prognostication, to lose all reality in a world of nebulous imaginings. I shall not, therefore, apologize if I begin with facts which, although they are supposed to be self-evident, are none the less worthy of considerable emphasis.

From the viewpoint of the economist, the most important aspect of any war is that it is expensive. When armies are mobilized, millions of men are withdrawn from industrial and agricultural occupations. Some of them are drafted for actual fighting; others are required to man administrative offices and supply services that are essential to the welfare and efficiency of a modern army. But whatever these men may do, it is apparent that for the duration of the war they are no longer engaged in productive activity. The country is poorer because they no longer produce those goods and services which they might have been expected to contribute towards the national income if they had been permitted to follow their normal peace-time activities.

This, however, is not the only drain upon the national income that war imposes. Troops must be fed and clothed, and although the admission constitutes a sardonic commentary upon some aspects of our civilization, it is often true that a man is better fed and clothed as a soldier than he had been as a civilian. Moreover, the activities of armies involve considerable expenditure of munitions. Bullets and shells are, from the economic sense, compounded of copper, lead and steel that might have been used for the fabrication of articles of domestic convenience if there had been no war, while the materials out of which explosives are manufactured might have provided cotton shirts and silk stockings for a substantial portion of the population. It would be interesting to calculate the quantity of peace-time consumer goods that might have been created out of the physical materials that are expended in one day's serious fighting!

And, in the third place, war is expensive because it involves destruction of property. Newspaper headlines remind us of the bombardment of cathedrals in Finland and of the sinking within a few hours, or even minutes, of ships that it would take us months to build. There are also automobiles and tanks which are lost in the mêlée of fighting and we must not forget all of the accumulated loss that comes from depreciation of productive equipment, a depreciation resulting from continuous use at a time when it is difficult or impossible to provide for adequate replacement.

No man has calculated with any degree of accuracy the aggregate costs which result from the addition of these three elements, and I would remind you that my analysis, being purely economic, fails to consider the additional losses in terms of human life and of the intangible values that cluster under the names of culture and spiritual comfort. Even on the lowest material level, the costs of war are enormous, and it follows that the most serious economic tasks that a belligerent must face are, first to encourage, by all means in its power, the maximum increase in the physical volume of production, and, second, to obtain from that production quantities of goods and services that are adequate to meet its own war-time needs.

Let us consider these two problems separately. Although we occasionally read in the newspapers extended accounts of the manner in which the Russian and German governments encourage increased production by shooting a few of the people who do not produce enough, we have not resorted to such stringent methods within the democracies. (As a matter of fact, those of us who have given any attention to the study of scientific management will probably have serious doubts as to the ultimate value of executions considered as an incentive.)

Fundamentally, the government of a democracy relies upon that spirit which is called patriotism to inspire its people toward greater and more persistent effort in the production of essential goods and services. Kipling has written of the intense determination of a machinist whose husband had been killed at the front, and each of us remembers the extent to which workers in munition factories were willing to expend their energies during the dark days of that winter when 1916 passed over into 1917. Spiritual enthusiasm of that kind is a factor of immeasurable importance in expanding the production of those goods and services that are essential to modern warfare. In the long run, I am inclined to think it is the only factor of outstanding importance, but there are two others which must be mentioned for their contributory significance.

Nothing is more apt to destroy the effect of spiritual enthusiasm than petty friction and the feeling that somebody else is getting greater reward in return for no more sacrifice. To avoid both of these handicaps, co-ordination of economic activity is vitally essential in time of war. There must be sincere co-operation between employer and worker in order to avoid the frictions of open industrial strife and of unobtrusive restriction of output, a co-operation that is sincere and whole-hearted on both sides of the table so that there is no lingering suspicion on either hand that the other is getting the best of the bargain. There must also be full co-ordination of the operations of enterprises that would normally be competitive, a co-ordination that deliberately sets out to eliminate waste and to encourage maximum utilization of available facilities.

Mention should also be made of monetary policies which, in previous wars, have provided an inflationary stimulus during the early uncertain days of the struggle. Nobody has any illusions as to the long-run effects of monetary policies that involve a steady inflationary rise of the general price level. We have seen too much of the anarchy that they produce. But if we consider the matter objectively, we are compelled to admit that, during 1914 and '15 for instance, rising prices provided an incentive which encouraged employers to work as hard as possible and permitted them to increase the wages which they paid to their workers.

These three, patriotism, co-ordination and mild inflation, constitute the trinity of forces that democratic powers have relied upon to expand the physical volume of production in time of war. It must be admitted, in the light of history, that they were successful forces. When we consider the burden of debt that comes down to us as a legacy from the last world war, we are apt to forget that the physical economic wealth of the world, its houses and factories and machines, actually increased during the war period. According to the statistics compiled by the League of Nations, the physical volume of world production was six per cent higher at the bottom of the 1923 depression than it had been during the comparative prosperity of 1913.

Naturally, this figure, being an average, covers a wide divergence between different countries. The production of eastern Europe in 1923 was only 80 per cent of what it had been ten years earlier, while that of North America was 27 per cent greater. In countries like France, in which the devastation of war had seriously handicapped agriculture and industry, it was natural to expect a considerable decline in annual income, while countries like the United States, which felt extraordinarily little of the physical ravages that war entails, experienced the greatest enrichment.

Unfortunately, I have not been able to obtain satisfactory statistics for the Dominion of Canada, but at the expense of slight repetition I should like to give you a few more figures which emphasize the extent to which physical productivity increased during the last war. You know well how greatly the United Kingdom suffered and what tremendous sacrifices it made during four years of hostilities, yet in the depressed year of 1924 its national income (after making all allowances for changes in prices) was two per cent higher than it had been in 1913. In the United States, the national income was fully 25 per cent greater in 1923 than it had been a decade before, while the aggregate wealth of that great country was 85 per cent above the pre-war figure. Even after all allowance is made for the increase in debts, both public and private, Doane estimates the increase in wealth at not less than 70 per cent. These figures offer high testimony to the ability of great democracies to expand their productive capacity and their physical output during the years of war, and I emphasize them for the purpose of disproving the prophecies of those who foretell unlimited impoverishment.

Turning to our second major problem, I have suggested that the government of a belligerent nation must find ways in which it can acquire quantities of goods and services adequate to meet its war-time needs. This is an entirely separate problem, a problem of administration and economic distribution.

In theory there are four ways in which it can be accomplished. In a completely autocratic country, where government controls all natural resources and directs all economic activity, the problem can be handled by an elaborate scheme of rationing. Russia tried something like this under the second Five Year Plan that was developed when Ossinsky was Chairman of the Soviet Planning Commission. Goods were allocated to productive or consumptive uses, to the armies or to the civil population by governmental edicts that were an integral part of a comprehensive scheme, but no other country has, to my knowledge, tried the experiment in modern times. Although there have from time to time been suggestions for the conscription of business on a national scale, we have been too conscious of the complex problems involved to accept any such omnipotent schemes. After all, omnipotence, if it is to be wisely used, implies as well the quality of omniscience, and we have not yet discovered the latter virtue in any statesman or business leader no matter how much we may admire him.

If we exclude, then, this first alternative, the remaining three operate through the monetary system. They recognize the fact that men and women receive their incomes in the form of money, that the demand for goods and services is a demand expressed in money and that a government which wishes to acquire a larger portion of the total national output must increase its own buying power in terms of dollars and diminish the buying power of other members of the community. The most obvious way to do this is by increased taxation. The government takes an increasing portion of each individual's income, thus forcing the individual to restrict his consumption and releasing a considerable quantity of goods and services which the government can purchase with its tax income. Great Britain, during the last war, made considerable use of this method and, during the present struggle, the level of taxation in England has risen to a figure that would be considered dangerously burdensome in any other democracy. But neither Great Britain or any other country has ever been able to finance a major war by taxation alone. Whether or not they are justified I do not know, but governments have always been reluctant to squeeze the last penny out of their complaining tax-payers lest high taxation should dampen the spirit of patriotic enthusiasm to which I have already referred. Moreover, it is extraordinarily difficult to develop any system of severe taxation which is entirely equitable as between one person and another.

For both of these reasons, governments customarily borrow a portion of the funds that they require. By selling securities to individuals with savings or buying power beyond immediate consumption needs, the government is able to mop up funds that might have been used to finance consumption. The demand of the population for goods and services is reduced by this method just as effectively as it would have been by higher taxation and the government is equally able to attain that command over industrial and agricultural output which the needs of war require. In this case, however, there remains at the end of the war a legacy of debt. The actual cost of the war is not postponed and placed on the shoulders of a later generation, since that cost must be borne, in terms of real goods and services, from day to day, but there does remain a problem of financial distribution of income which complicates the post-war reconstruction.

All of these methods involve a conscious and deliberate sacrifice on the part of all people within the community throughout the duration of the war. For that reason, some governments have resorted to inflationary finance in an ill-advised effort to anaesthetize the public. Immediate governmental needs are financed in this case either by the printing of paper money or by the selling of bonds to commercial banks which pay for them by newly created deposits. Individual incomes are not reduced in terms of dollars but prices rise as a result of the inflation so that a given income buys fewer goods and services. Once again private consumption is restricted and the government is enabled to acquire its goods and services, but, as I have already suggested, the ultimate results of any such attempts to finance a war painlessly involve a degree of economic anarchy that may (and in fact has) proved even more dangerous than the war itself.

The Dominion of Canada, during the present war, has steadfastly set its face against such inflationary policies and is using plans that combine some of the elements of the first three methods suggested above. The level of taxation has been raised to provide larger revenues and bonds have been sold for the purpose of absorbing a portion of the available savings of the community. Both of these plans have succeeded admirably and they have been supplemented by the creation of various governmental agencies which are designed to co-ordinate business activity in such a way that competition will be restrained and costs maintained at a reasonably low level.

These regulatory agencies are of considerable importance. In the case of the Canadian Shipping Board, operating in conjunction with the British Ministry of Shipping, a comprehensive scheme has been developed to ensure the most efficient utilization of the available pool of tonnage. Less thoroughgoing, but equally significant, are the activities of the War Supply Board which is intended "to mobilize, conserve and co-ordinate economic and industrial facilities," while the War-Time Prices and Trade Board has assumed responsibility for general supervision of purchasing and marketing. Alongside of these, the Foreign Exchange Control Board has been charged with responsibilities which, in view of Canada's national economic interests, go far to develop a unified policy throughout the money market of the Dominion.

In the few minutes that remain I shall not attempt any elaborate discussion of the activities of these bodies. Indeed I imagine that several of you are more intimately acquainted with the detail of their operation than I am. I should, however, like to emphasize their tremendous importance to the successful prosecution of Canada's war effort and to suggest that engineers and business administrators can render significant contributions by working with them and for them.

These governmental agencies represent a thoroughgoing effort to attain that co-ordination of economic activity which I have already described as essential if we are to reap a full measure of benefit from the spirit of patriotism. They represent an attempt to dispense, for the time-being, with the normal activities of the market and to eliminate the normal effect of prices as a criterion of business operations. In a sense, they are charged with the development of policies that facilitate the maximum physical utilization of our resources, a problem of engineering and of business administration. If they succeed in that task, they will have contributed much to the winning of the war and also to the reduction of the costs that war involves, but their success depends fundamentally on the willingness of every business man and every engineer to co-operate wholeheartedly and intelligently in the work that is being done. There is no such thing as partial co-operation. Either there must be full co-operation or none at all.

May I add one word in conclusion, a word that is again addressed particularly to engineers and others responsible for administering the business affairs of the Dominion. If we wish to preserve a liberal democracy in Canada it will be necessary at the end of the war to provide for the orderly disbanding of regulatory agencies as well as for the demobilization of armies. The problems of that reconstruction will not be small and it is important, at this stage, that you should be considering the way in which business life is to be restored to pre-war freedom. If that reconstruction be handled efficiently and smoothly, Canada may, during the post-war years, reap the fruits of the expansion that its economic life has undergone during the war. If the task is botched, Canada will face an acute economic crisis as every belligerent country did in 1920. Let us hope that we may learn from our mistakes not only to mobilize efficiently for the war itself but to plan the economic framework of the post-war world in a fashion that will permit enduring peace and high prosperity.

Abstracts of Current Literature

Contributed abstracts of articles appearing in the current technical periodicals

THE PLANNING OF STREET LIGHTING

By J. Bertram, B.Sc.

***Journal of The Institution of Electrical Engineers,* November, 1939**

Introduction

During the last decade there has been a revolution in street lighting all over our country. From a business which local councils tended to regard as a side issue, it has grown to one of the first order of technical and commercial importance. Along with its development there has grown a more thorough appreciation of the principles involved in this creation of artificial visibility, and this had led to more and more investigational work.

The need for safety on the roads is focussing a critical public interest on the lighting of our streets and highways, and the final recognition of the need for development in this line was the appointment by the Ministry of Transport of a Departmental Committee on Street Lighting. Nowadays practically every borough electrical engineer and his assistants are finding that they have to face the problem of lighting their streets satisfactorily—a problem with many baffling complexities.

The subject of street lighting is so vast that it can only be touched on in one paper. This paper, therefore, will give a very brief summary of the technical aspect of the street-lighting problem, and will collect together the various factors which control the planning of a good installation.

Type of Unit

There are prevalent to-day two main types of electric light source:—

(*a*) Electric filament lamps.
(*b*) Electric discharge lamps.

It can be said with a considerable amount of truth that the arrival of the discharge lamp was the biggest incentive to the rise in technical importance of street-lighting problems.

The change in the type of unit used is probably least noticeable with filament lamps, although striking advances can be found in America, where the introduction of a bi-post filament lamp has brought out the Reid Channon stepped reflector lantern.

Consideration of the polar distribution of a standard 400-watt mercury discharge lamp shows that for efficient illumination, whether the lamp is operated horizontally or vertically, more than half the light output from the lamp will have to be re-directed. There are only two effective methods of re-directing light, viz. reflection and refraction. Lanterns for discharge lamps employ some combination or other of these two methods. A modern design is shown in Fig. 1.

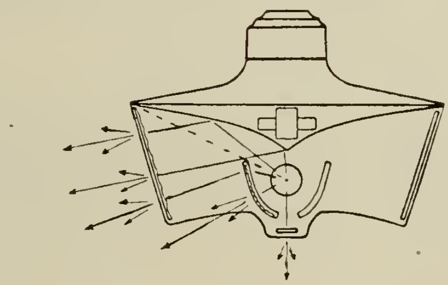


Fig. 1

With the vertical lamps the source has its greatest dimensions in the plane of major re-direction. For accurate re-direction of light the source should have the smallest possible dimensions, and the disadvantage of vertically-operated discharge lamps is evident. Accurate control can only be obtained by a considerable sacrifice in efficiency.

If, however, the discharge lamp is operated horizontally, the smallest dimension of the source (which is the cross-section of the luminous arc) lies in the plane of major re-direction, and accurate control can therefore be obtained by using an optical system of normal size and shape. Also the horizontally burning lamp gives roughly the required rectangular distribution in the horizontal plane, so that very little re-direction will be necessary.

The efficacy of horizontal operation, first advocated in 1934, has now been proved by the general trend in street-lighting practice.

Visibility

This is the quality of being seen clearly by the eye. To fulfil its requirements it is necessary to illuminate the road surface so that the darkest object can be seen upon it at a considerable distance. This is generally obtained by making use of the fact that road surfaces have a high specular reflectivity value at glancing angles of incidence and, therefore, do not need to be flooded with excessive quantities of light. The problem is entirely different from that of lighting a room or a factory area.

The whole problem was never seriously investigated until the Ministry of Transport set up a Departmental Committee to consider it. The main theme of their report discusses in turn each of the essential points. Their recommendations for main-road lighting have been briefly summarized as follows:

Mounting Height.—25 ft.

Spacing.—120–150 ft. with permissible maximum of 180 ft. It is noted that at bends, road junctions, etc., this spacing may need to be appreciably lower.

Overhang.—The maximum should be 6 ft. The maximum distance between two rows of sources should be 30 ft. With roads wider than 40 ft. lanterns should be kerb-mounted, and additional sources should be placed centrally at intervals not exceeding 35 ft. in length.

Siting.—This is obtained by limiting the angle subtended at the observer by sources which appear to be adjacent. Angular limits will vary to some extent with the nature of the road surface. The Committee do not make any rigid rules concerning siting, but give a number of very useful recommendations.

Lantern Power.—Broadly speaking, this is the output from the lantern. The Committee suggest 3,000 to 8,000 lumens per 100-ft. run. With 150-ft. spacing this means a lantern output of 9,500 to 12,000 lumens.

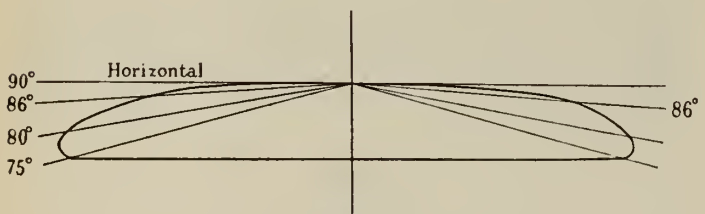


Fig. 2

Distribution and Glare.—The Committee make no definite recommendations.

At the present time there are three distinct types of distribution in use:—

(1) Non-cut-off.

(2) Controlled cut-off.

(3) Full cut-off.

Controlled cut-off is a recent innovation. The concentration of high candle-power near to the horizontal to effect high road brightness results in heavy glare from all the lanterns visible ahead of the observer. This glare can be reduced by taking advantage of the rapidly increasing road reflectivity by cutting down the candle-power as the horizontal is approached. The polar curve of such a lantern for 150-ft. spacings will have its maximum at 75 deg. to 80 deg., maintaining a fairly high level up to 86 deg. and then rapidly decreasing towards 90 deg. Such a curve is shown in Fig. 2. The author feels that this controlled cut-off gives the vital compromise necessary between road brightness and glare.

REVIVAL OF THE GAS PRODUCER

***Civil Engineering and Public Works Review,* December, 1939**

In an interesting and topical lecturette delivered before the Junior Institution of Engineers at the end of last month, Mr. K. W. Willans, M.I.Mech.E., suggested that the cause of the decline of the gas producer was bad design and lack of systematic research, coupled with the advent of the solid injection oil engine supported by effective research work and propaganda. Reference was made to the influence of transport requirements on the latter type of engine, and also to the fact that these same influences have largely led to the revival and interest in the small capacity gas producer.

Mr. Willans sketched three broad divisions into which the gas producer might be divided, as follows:

1. Producers gasifying tar free fuels, e.g., anthracite, charcoal, and cokes by combustion.

2. Producers gasifying waste vegetable matter, such as wood, sawdust, peat, mealie cobs, etc., by combustion.

3. Producers gasifying vegetable matter by methods other than those in divisions 1 and 2.

Dealing with the first class of producer, the lecturer pointed out that many of the troubles with the earlier designs were due to uncontrolled steam admission to the fire, and that by introducing a simple control of this factor, most of the troubles vanished.

The lecturer dealt with the broader aspect of the fuel problem. He pointed out that workable coal seams must eventually become exhausted, and suggested that after making use of water to the utmost for power production the balance be obtained by growing fuel as a crop. He calculated, from experimental work, that 60 acres of poor land, planted with hazel bushes, would produce continually sufficient gas to generate 100 Bhp.

This led to the waste wood gas producer, using fuels ranging from sawdust to peat and lignite. These fuels all produce tar which is very much easier to remove from gas than is tar from bituminous coal. Such producers are constructed on up draft, down draft and cross draft plants, but as wood is practically free from clinker-forming ash, the lecturer favoured the up draft producer. The advantages of the down draft type in burning the tar produced, and its constructional simplicity, are out-weighed by the fact that it will not consume sawdust and small wood pieces. This type of fuel can be dealt with in the up draft producer, provided the moisture content does not exceed about 15 per cent.

Mr. Willans then proceeded to deal with the well-known producer associated with the name of Charles Whitfield, pointing out the early contact with the hot gas with water, not only for rapid cooling, but—even more important—for wetting both the gas and the metal surfaces so that the building up of tar is prevented. Dealing with centrifugal tar extractors, the author pointed out that to obtain the speed necessary for efficient tar extraction, the power absorbed in driving this unit may be as much as 10 per cent of the engine output derived from the gas produced. He felt that research in the direction of high pressure water sprays would be well repaid.

Dealing with the effluent water, and the corrosive acids produced, particularly when using hard woods such as elm, the employment of acid-resisting metals was advocated, and also circulation of the effluent water with steel scrap in the cooling tanks, to assist in neutralizing acidity.

In summing up, the lecturer considered that the gasification of wood presented no fundamental difficulty and that the snags encountered could be overcome by the application of common sense. He also touched briefly upon the possibilities of fuel digesters producing gas by chemical reactions by other means than combustion.

BENTONITE

***Civil Engineering and Public Works Review,* December, 1939**

Bentonite is a clay material containing 75 per cent or more of the crystalline minerals, montmorillonite, (Mg. Ca)

O.Al_2O_3 .5SiO_2, nH_2O, or beidellite, Al_2O_3 .3SiO_2 .nH_2O, and is derived from volcanic ash. Typical bentonites carry only about 16 per cent Al_2O_3, more than 60 per cent SiO_2, four per cent or more of MgO and CaO, and almost four per cent iron oxides, together with seemingly significant amounts (around two per cent) of alkali metal oxides, chiefly Na_2O.

Physical properties are commercially more important than chemical composition. Standard bentonites may swell to as much as 10 or 15 times their original volume when in contact with water, whereas type two bentonites (or "sub-bentonites") swell no more than ordinary plastic clays.

The principal uses of bentonite are as a bonding agent in foundry moulding sands; oil-well drilling mud; for bleaching petroleum products; in the manufacture of cement products, ceramic products, soaps, refractory materials, paper, cosmetics, water softeners, sealing agents, paints, medicinal emulsions, and roofing; for de-inking newsprint and clarifying dry-cleaner fluids; as the core of earth-fill dams; and as lining for irrigation ditches. This list is not exhaustive, and new uses for bentonite are being found every year. The base price of processed bentonite at present in the U.S.A. is $10.50 a ton, F.O.B. Wyoming mills.

The commercial value of a bentonite deposit depends upon (1) the type or class of bentonite, (2) the thickness of the seam, (3) dip of the seam, (4) amount of over-burden, and (5) transportation costs.

ADMIRALTY CONTROL OF MERCHANT SHIPBUILDING

***Engineering*, February 9, 1940**

The expected announcement, that the Admiralty would assume control of all shipbuilding for mercantile as well as naval account in British yards, was made by the Prime Minister in the House of Commons on January 31. The decision of the Government, Mr. Chamberlain stated, embraced also the responsibility for repairs, and would come into force on the following day, Thursday, February 1. Sir James Lithgow, Bt., chairman of Messrs. The Fairfield Shipbuilding and Engineering Company, Limited, of Messrs. Lithgows, Limited, and of Messrs. William Hamilton and Company, Limited, becomes a member of the Board of Admiralty, with the title of Controller of Merchant Shipbuilding and Repairs, and Sir Amos Ayre, hitherto Director of the Merchant Shipbuilding and Repairs Division of the Ministry of Shipping, is transferred to the Admiralty, where he will continue to exercise the same functions. In response to a question, Mr. Chamberlain explained that all the merchant ships built would be constructed to the order of the Admiralty, and when completed would be the property of the Government. He asked for notice of a question regarding the means by which the building programme would be financed.

Thus does history repeat itself; though with the important difference that, in this war, the Government is taking action after the expiry of only five months, which, in the last war, was delayed for nearly two and a half years, by which time more than 2,000,000 tons of British ocean-going shipping had been sunk as a result of enemy action. Since the outbreak of the present war, the gross British losses, including coastal shipping, amount to little more than a quarter of this total, and the net loss, after allowance has been made for captured enemy vessels and for foreign tonnage acquired by purchase, is very considerably less. The early introduction of the convoy system is largely responsible for this improved position; and for this reason, together with the greater efficacy of modern methods of countering submarines, mines and the operations of hostile aircraft, it may be expected that the relative advantage will be maintained.

It is important, nevertheless, that the shipbuilding resources of the country should be employed to the fullest possible extent, if only to lessen the dependence upon neutral shipping.

The possibility of some such action as the Government has now taken had been envisaged by those in and about the shipping industry who remembered the course of events in the last war; and, despite sundry significant differences between the circumstances then and now, most of the arguments for and against this policy, which were current 23 years ago, are likely to be resurrected. It may be assumed that past experience will prevent any repetition of the costly and completely unproductive experiment of the national shipyards; there is sufficient potential building capacity in the redundant yards which were closed by the National Shipyard Security organization to absorb all the labour available, and more. According to the Parliamentary correspondent of The Times, however, a revival of the principle of the "standard ship" is to be anticipated in the near future, on a basis of five of six types. There has been no official hint of any intention to re-introduce the straight-frame type of cargo steamer which was evolved in 1917-18 in order that the bridge-building and structural-engineering firms might employ their existing plant to supplement the output of the regular shipyards. The result, it will be recalled, was the addition to the British mercantile marine of a number of ships which, however serviceable in such an emergency as that of 1917-18, were among the most strange-looking examples of naval architecture that even the Great War produced. Indeed, it may be conjectured that the name, War Climax, given to the first vessel of the type, possibly represented the orthodox shipbuilder's instinctive reaction to her appearance on the stocks. In the primary purpose of turning out cargo tonnage rapidly with the minimum of material and a definite scarcity of skilled labour, however, the policy of standardization was not discredited by the results achieved, although the end of the war came before its full momentum was attained.

STRATOSPHERE COMMERCIAL AIRCRAFT

***The Engineer*, December 1, 1939**

A month after the event, under circumstances of strict secrecy, it was officially announced that, on the 13th of October, a stratosphere flight had been made from Paris to Rio-de-Janeiro with halts at Dakar and Natal, in Brazil. The application of stratosphere in this implies an altitude of between 7,500 m. and 9,000 m. The machine used was the land-plane "Camille-Flammarion" weighing about 25 tons and belonging to Air France-Transatlantique, which was created by Air France and the Compagnie Générale Transatlantique mainly for air services across the North Atlantic. It was piloted by Codos and Guillaumet, accompanied by a wireless operator and a mechanic. Built in one of the national aircraft factories the machine bears indications of its being a Farman design. For a long while the Farman works, which are not nationalized, endeavoured to produce a type of commercial machine that would fly at very high speeds in a rarefied atmosphere that, to distinguish it from normal conditions, was called the stratosphere, but when the first machine was tested it came to grief and nothing more was heard of commercial flights at high altitudes until the laconic official announcement of the successful journey to South America. The South Atlantic was crossed from Dakar to Natal, in Brazil, in twelve hours at an average speed of 167 m.p.h., and the flight from Natal to Rio-de-Janeiro was accomplished in ten hours. The idea of the so-called stratosphere flight for commercial services is to reach an altitude where atmospheric conditions are supposed to be constantly favourable, although there is still much to be learned about temperatures, humidity, and ice formation. A good deal of practical experience will have to be acquired, and complete security in passenger and navigation cabins ensured, before commercial air services can be undertaken in a rarefied atmosphere.

THE FIFTY-FOURTH ANNUAL GENERAL MEETING

Convened at Headquarters, Montreal, on January 25th, 1940, and adjourned to the Royal York Hotel, Toronto, Ontario, on February 8th, 1940

The Fifty-Fourth Annual General Meeting of The Engineering Institute of Canada was convened at Headquarters on Thursday, January twenty-fifth, nineteen hundred and forty, at eight-thirty p.m., with Councillor A. Duperron, M.E.I.C., in the chair.

The Assistant to the General Secretary having read the notice convening the meeting, the minutes of the Fifty-Third Annual General Meeting were submitted, and on the motion of R. H. Findlay, M.E.I.C., seconded by C. K. McLeod, A.M.E.I.C., were taken as read and confirmed.

Appointment of Scrutineers

On motion of Huet Massue, M.E.I.C., seconded by E. Nenniger, A.M.E.I.C., Messrs. J. Comeau, A.M.E.I.C., J. M. Crawford, A.M.E.I.C., and J. B. Stirling, M.E.I.C., were appointed scrutineers to canvass the Officers' Ballot and report the result.

There being no other formal business, it was resolved, on the motion of W. G. Hunt, M.E.I.C., seconded by J. G. Hall, M.E.I.C., that the meeting do adjourn to reconvene at the Royal York Hotel, Toronto, Ontario, at ten o'clock a.m., on the eighth day of February, nineteen hundred and forty.

ADJOURNED GENERAL MEETING AT THE ROYAL YORK HOTEL, TORONTO, ONT.

The adjourned meeting convened at ten-thirty a.m., on Thursday, February 8th, 1940, with President H. W. McKiel in the chair.

The General Secretary announced the membership of the Nominating Committee of the Institute for the year 1940 as follows:

Nominating Committee—1940

Chairman: E. V. Buchanan, M.E.I.C.

Branch	*Representative*
Border Cities	C. G. R. Armstrong
Calgary	R. S. Trowsdale
Cape Breton	M. F. Cossitt
Edmonton	W. E. Cornish
Halifax	H. S. Johnston
Hamilton	W. J. W. Reid
Kingston	D. S. Ellis
Lakehead	E. L. Goodall
Lethbridge	R. F. P. Bowman
London	F. C. Ball
Moncton	G. L. Dickson
Montreal	Walter Hunt
Niagara Peninsula	W. Jackson
Ottawa	E. Viens
Peterborough	W. M. Cruthers
Quebec	A. O. Dufresne
Saguenay	G. F. Layne
Saint John	G. Stead
St. Maurice Valley	A. C. Abbott
Saskatchewan	S. Young
Sault Ste. Marie	J. S. Macleod
Toronto	A. H. Harkness
Vancouver	W. H. Powell
Victoria	K. Moodie
Winnipeg	V. Michie

Awards of Medals and Prizes

The General Secretary announced the awards of the various medals and prizes of the Institute as follows, stating that the formal presentation of these distinctions would be made by His Honour the Lieutenant Governor of Ontario at the Annual Dinner of the Institute that evening.

Gzowski Medal (two awards) to E. A. Hodgson, M.E.I.C., for his paper, "The Structure of the Earth as Revealed by Seismology," and to G. A. Gaherty, M.E.I.C., for his paper, "Drought, a National Problem."

Duggan Medal and Prize (two awards) to D. B. Armstrong, A.M.E.I.C., for his paper, "The Island of Orléans Suspension Bridge," and to C. R. Whittemore, A.M.E.I.C., for his paper, "Welded Steel Pipe for the City of Toronto Water Works Extension."

Leonard Medal to Charles G. Kemsley, M.C.I.M.M., co-author of the paper, "The Internal Shaft at Dome Mines."

Students and Juniors Prizes

John Galbraith Prize (Province of Ontario) to J. R. Dunn, S.E.I.C., for his paper, "Radio Aids to Aerial Navigation."

Phelps Johnson Prize (Province of Quebec, English) to C. B. Charlewood, JR.E.I.C., for his paper, "Steam Superheaters for Water Type Boilers."

Martin Murphy Prize (Maritime Provinces) to D. L. Mackinnon, S.E.I.C., for his paper, "Soil Mechanics."

Report of Council

On the motion of Dean Ernest Brown, seconded by C. K. McLeod, it was *Resolved* that the report of Council for the year 1939, as published in the February, 1940, Journal, be taken as read and accepted.

Treasurer's Report and Report of Finance Committee

It was moved by J. A. McCrory, and seconded by deGaspé Beaubien, that the Treasurer's report, and the report of the Finance Committee, as published in the February, 1940, Journal, be taken as read and accepted.

D. S. Laidlaw asked for an explanation of the reduction of nearly $3,000 which had been made in the expense of the Journal, partially offset by a decrease in Journal revenue. In the unavoidable absence of the chairman of the Finance Committee, Mr. McCrory explained that there had been a saving due to a reduction of about $1,500 in printing costs because no list of members had been published in 1939. Further, this year there had been a change in the method of stating expenditures and receipts on Journal account. These, in the 1939 statement, are shown as net amounts, thus differing from the figures of 1938, when a certain proportion of the expense of obtaining advertising had been charged direct to the Institute instead of being deducted from revenue. The system now adopted would be continued in future statements.

On being put to the meeting the motion was carried unanimously.

Reports of Committees

On the motion of H. A. Lumsden, seconded by Fraser S. Keith, it was *Resolved* that the reports of the following committees be taken as read and accepted: Legislation; Publication; Library and House; Papers; Training and Welfare of the Young Engineer; Professional Interests; Membership; Board of Examiners and Education; International Relations; Radio Broadcasting; Deterioration of Concrete Structures; Employment Service.

The President referred in complimentary terms to the work of the Committee on International Relations under the chairmanship of Dr. J. B. Challies, particularly in respect to the work which they had done in connection with the British-American Engineering Congress which was to have been held in New York in September, and which had to be cancelled at the last moment due to the imminence of war. He also commented on the work of the other committees all of which had been carried out with a high degree of efficiency.

AUTHORS OF PAPERS

O. W. Ellis

E. M. MacGill, A.M.E.I.C.

C. M. Goodrich, M.E.I.C.

International Press Ltd.

A. D. Campbell, M.E.I.C.

G. A. Gaherty, M.E.I.C.

W. P. Dobson, M.E.I.C.

R. C. McMordie, A.M.E.I.C.

A. W. F. McQueen, M.E.I.C.

J. J. Spence, secretary-treasurer of the Toronto Branch

Past-President Challies introduces Elizabeth MacGill to her audience. Dean Brown presides

P. L. Pratley and C. R. Young talk about "Limit Design"

N. A. M. MacKenzie at luncheon speaks on International Law

Always a welcome guest, Geo. T. Seabury, Secretary A.S.C.E.

R. J. Magor was the luncheon speaker on the first day

O. W. Ellis talks about alloys with C. R. Young

Dr. Dugald Jackson of M.I.T. speaks at the president's dinner

Whatever it is, C. E. Sisson, Col. Smythe and General Mitchell are certainly interested

The Lieutenant-Governor presents the John Galbraith Prize to J. R. Dunn

A luncheon party—left to right—Wills Maclachlan, B. R. Perry, W. P. Dobson, W. R. McCaffrey and Norman Eager

Branch Reports

On the motion of H. F. Bennett, seconded by W. R. Manock, it was *Resolved* that the reports of the various branches of the Institute be taken as read and accepted.

Amendments to the By-Laws

In accordance with Sections 74 and 75 of the By-laws, Council presented for the consideration of corporate members certain proposals for the amendment of Sections 2, 3, 4, 7, 32, 34 and 39. These changes were prepared in order to give effect to a resolution passed at the Annual General Meeting on February 14th, 1939, approving a proposal to abolish the class of Associate Member. The amendments now proposed by Council for this purpose had been published in the December Journal, and were not submitted for discussion.

On the motion of C. K. McLeod, seconded by R. F. Legget, it was unanimously *Resolved* that these proposed amendments to the by-laws be approved, and that they be sent out to the members for letter ballot.

The President then introduced another group of proposed amendments, affecting Sections 12, 13, 64 and 67, which had been put forward by members of the Ontario branches to provide that in future those branches shall be represented by two vice-presidents instead of one as at present, these proposals having also been published in the December Journal, and communicated to the meeting by printed copies, J. R. Dunbar moved that they be approved and submitted to the members for letter ballot, and the motion was seconded by C. G. Moon.

R. L. Dobbin asked for an explanation as to the reason for the change now proposed. In reply Mr. Dunbar explained that in Ontario there were over fifteen hundred members in ten branches and they were represented by only one vice-president, while in Quebec and the Maritime provinces the proportion of members to vice-presidents was much lower. In view of the large membership and considerable number of branches in Ontario, it was felt that the Ontario members did not get adequate vice-presidential representation, particularly since it is very difficult for one vice-president to visit all the Ontario branches. Further, with only one vice-president in Ontario, it was inevitable that there should be many branches which have never had vice-presidential representation.

Mr. Dobbin felt that as this proposal would increase the number of councillors it was open to some objection. For some time the desire of the membership had been rather to reduce the number of councillors than to add to it.

Mr. Bennett expressed satisfaction with the present arrangements. The difficulty of branch representation could be overcome if the larger branches would refrain from making nominations so as to give the smaller branches a chance, a policy which had been successfully carried out in the Maritime provinces.

After further discussion the motion was carried.

L. A. Duchastel had noted that while the list of sections to be changed to give effect to the abolition of the class of Associate Member had mentioned Section 39, the changed wording of Section 39 had not been shown on the printed leaflet distributed at the meeting. Should this section not be included in the number approved for ballot on Mr. McLeod's resolution ?

The President agreed that the reference to Associate Members would have to be deleted from the present Section 39, which deals with the compounding of fees, and it was resolved, on the motion of F. W. Paulin, seconded by J. R. Dunbar, that the necessary change in the wording of Section 39 should be included in the amendments to be sent out to ballot, this to apply also to any other section found to require change to agree with the spirit of these amendments as proposed.

New Business

R. F. Legget offered a motion deprecating the issue of any announcement of a meeting of the Institute in conjunction with trade advertising of any kind. He was supported by D. S. Laidlaw.

After discussion, and an explanation given by the General Secretary, it was resolved, on the motion of J. R. Dunbar, seconded by E. V. Buchanan, that Mr. Legget's motion be laid on the table.

Alex. Love, as chairman of the Hamilton Branch, wished to take the opportunity of inviting the Institute to hold the 1941 Annual General Meeting in Hamilton. This invitation was seconded by W. L. McFaul, the councillor-elect from the Hamilton branch.

The President stated that this invitation had been presented to Council at its meeting on the previous day, and that Council had greatly appreciated the action of the Hamilton Branch. It was felt, however, that the incoming Council would be the proper body to deal with such an invitation, and accordingly it had been referred to them for appropriate action.

C. G. Moon observed that while the three immediate past-presidents had seats on the Council as honorary councillors, other past-presidents had no official status on Council. He wished to suggest that the past-presidents as a body should be constituted an advisory committee which might with advantage discuss important problems, such as the long term continued policy of the Institute, and advise Council thereon.

The President remarked that he had found the past-presidents to be most active and helpful in regard to any Institute matters referred to them, and many of them were serving on committees, particularly, for example, on the Committee on International Relations.

P. E. Doncaster heartily agreed with Mr. Moon, and thought the suggestion an excellent one, and well worth investigation on the part of the Council. He then moved that this annual meeting suggest to the incoming Council the advisability of considering the formation of a committee composed of all past-presidents to act in an advisory capacity on matters of policy. The motion, having been seconded by C. G. Moon, was put to the meeting and carried unanimously.

Election of Officers

At the request of the President, the General Secretary read the report of the scrutineers appointed by Council to canvass the officers' ballot for 1940, as follows:

President	T. H. Hogg
Vice-Presidents:	
Zone B (Province of Ontario)	J. Clark Keith
Zone C (Province of Quebec	McNeely DuBose
Zone D (Maritime Provinces)	W. S. Wilson
Councillors:	
Victoria Branch	A. L. Carruthers
Lethbridge Branch	J. M. Campbell
Calgary Branch	G. P. F. Boese
Winnipeg Branch	A. J. Taunton
Sault Ste. Marie Branch	J. L. Lang
Niagara Peninsula Branch	W. R. Manock
Hamilton Branch	W. L. McFaul
Toronto Branch	C. E. Sisson
Peterborough Branch	A. B. Gates
Ottawa Branch	J. H. Parkin
Montreal Branch	J. G. Hall C. K. McLeod
Quebec Branch	A. Larivière
Moncton Branch	G. E. Smith
Cape Breton Branch	I. W. Buckley

On the motion of E. P. Muntz, seconded by O. O. Lefebvre, it was *Resolved* that the report of the scrutineers be adopted, that a vote of thanks be tendered to them for their services in preparing the report, and that the ballot papers be destroyed.

The President then delivered his address on "The Engineer as a Citizen," which will be found on page 129

Dr. F. Cyril James, recently appointed vice-chancellor and principal of McGill University, was the guest speaker at the banquet

of this issue of the Journal. At its conclusion, on behalf of all members of the Institute, he expressed appreciation of the efficient services rendered during the past year by the General Secretary, his assistant, and the other members of the Institute staff.

On the motion of C. S. G. Rogers, seconded by P. L. Pratley, a hearty vote of thanks was extended to the Toronto Branch in recognition of their hospitality and activity in connection with the holding of the Fifty-Fourth Annual General Meeting.

J. Clark Keith, the newly elected vice-president from Ontario, moved a vote of thanks to the retiring President and members of Council. In seconding Mr. Keith's motion, Dr. Challies mentioned that a resolution of thanks to the President had been passed at a recent Council meeting, which not only expressed appreciation of the President's work, but also congratulated him on the excellent results which had followed his visits to the various branches. That resolution also asked the President to convey to Mrs. McKiel the Council's appreciation of the part she had taken so graciously in the activities of the Institute. Dr. Challies felt that the members present would desire to associate themselves with these expressions of appreciation. The motion was carried by acclamation.

As chairman of the Committee on International Relations, Dr. Challies reminded members that the distinction of honorary membership in the American Society of Civil Engineers had recently been conferred on Past-President J. M. R. Fairbairn. He also drew attention to the presence at the meeting of Colonel John P. Hogan, the President, and George T. Seabury, the Secretary of that great society. Members would also note that Mr. W. H. McBryde, the President of the American Society of Mechanical Engineers, had honoured the Institute by attendance at the Annual Meeting. There was also present Mr. B. L. Thorne, President of the Canadian Institute of Mining and Metallurgy, and Dr. Challies asked President McKiel to present these gentlemen to the members assembled.

In doing so, President McKiel expressed the Institute's cordial welcome to these distinguished visitors, which they were good enough to acknowledge in brief and timely addresses.

There being no further business the meeting adjourned at twelve forty-five p.m.

Council Meeting

In holding a Council meeting on the day before the Annual General Meeting, the precedent recently established was followed this year, and with very satisfactory results. As in the case of the similar event last year, the councillors-elect were invited, and the interest of the gathering was increased by the presence of a number of prominent guests who had accepted the invitation of the President to attend and participate in the discussions. These visitors included the President-Elect and two vice-presidents elect, several branch chairmen and a number of former members of Council; a sprinkling of deans and professors in engineering schools; members and chairmen of several important Institute committees; the presidents of two of the great American engineering societies, the presidents of two of the Canadian provincial associations of professional engineers and the president of a sister Canadian engineering institute.

This policy of inviting such a list of interested and distinguished guests is an excellent one. With an attendance of fifty-five a great breadth was given to the discussions, and it will be helpful to Council over a long period of time to have the opinions of these informed people on the several problems that came up for consideration at this meeting, and which will be dealt with from time to time throughout the year.

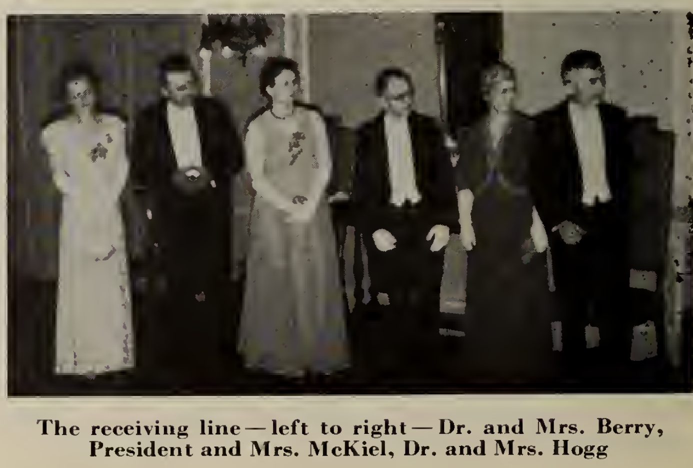
It is usual for the agenda of this meeting which closes the year's work to be very broad in its scope, and to include items of such importance that the consideration of them is left until this occasion. This year was no exception. Discussions of great value on the important topic of "The Training and Welfare of the Young Engineer" were contributed by guests well qualified to speak on that important subject The committee which has the matter in hand will be helped greatly by the co-operation of these educators and employers. The meeting, which assembled at 10.00 a.m., was not adjourned until 5.45 p.m., except for the luncheon period.

Technical Sessions

The subject with which the first professional session opened on Thursday afternoon was sufficiently controversial to attract a large audience and led to very active discussion. The chairman was R. L. Dunsmore. The author, G. A. Gaherty, remarked that his views on **The Economic Front** were open to argument and were subject to modification, but he felt that if such questions were not attacked and discussed by bodies like the Institute, no progress would be made. After hearing his stimulating paper, speakers in discussion agreed in welcoming this definite attempt to put forward the engineers' point of view on vital economic problems, although several of them were unable to endorse all the author's conclusions.

Attendance at the morning session on Friday, under the chairmanship of Dean Brown, was so large that it had to be held in the Ball Room. There was a full programme of important papers on three entirely different topics.

The first, by A. W. F. McQueen and R. C. McMordie, dealt with the manner in which the principles of the new art or science of soil mechanics have been applied on the construction of a large earthen dam at Shand, Ontario, which forms part of an extensive conservation scheme in



The receiving line — left to right — Dr. and Mrs. Berry, President and Mrs. McKiel, Dr. and Mrs. Hogg

the Grand river valley. The paper and the discussion which followed threw light on many of the debatable points in soil-mechanics technique which still need elucidation, and on construction methods which have to be developed on the site in view of the results of soil tests.

Many members besides those specially interested in aviation gathered to welcome the author of the next paper, Elizabeth MacGill, one of the small but increasing number of women who have achieved distinction in engineering design. Her paper on Flight Test Reporting was appreciated as a thorough and concise presentation of a difficult subject. As the results of flight tests necessarily depend somewhat upon the views of pilots, who are individualists, it is not always easy to assess the weight of their personal opinions. Miss MacGill was thanked and complimented upon her contribution to Canada's activities in aeroplane construction. There was an active and very technical discussion.

The concluding paper of the morning session, on **Highway Control and Safety**, by A. D. Campbell, gave a forceful account of the present situation as regards highway safety in Canada, with constructive suggestions for its improvement. The author took the point of view of an engineer who is deeply concerned but is not himself engaged in highway work. In discussion it was pointed out that in the United States a greater measure of highway safety has been attained than in Canada. It was urged that in addition to placing some responsibility upon the highway engineer

G. A. Gaherty presents his paper with R. L. Dunsmore in the chair

as regards safety, education and enforcement should be further stressed.

The programme at the afternoon sessions, over which C. S. G. Rogers presided, was as varied and informative as that of the morning.

A stimulating paper by C. M. Goodrich on **Limit Design** presented the ideas of a structural engineer whose knowledge of the classical methods of stress-calculation has been widened by long experience of the behaviour of structures as loaded in daily use. The newer procedure sketched by the author is an expression of the art of structural design which takes into consideration the ductility of the material, avoids some intricate mathematics, and embodies lessons drawn from failures under load.

A branch of safety practice of great importance to the general public, as well as to electrical engineers, formed the topic of W. P. Dobson's paper on **Grounding Practice.** Representatives of power companies and government departments agreed with the author as to the difficulty of covering all possible cases by hard and fast rules, and the discussion was worthy of the authoritative paper.

The paper on **Recent Developments in Alloys** which concluded the session was an example of the assistance which specialists can give to engineers in branches of technology which are advancing from day to day. Dr. Ellis' resumé of pertinent information was welcomed as a valuable compendium of data on the uses and properties of the

The annual meeting—left to right—H. J. Vennes, J. A. McCrory, Dean Ernest Brown and C. K. McLeod

newer alloys, presented by an acknowledged authority on the subject.

Professor C. R. Young and his committee are certainly to be congratulated on the quality and interest of the papers and the discussions to which they gave rise.

The following is a complete list of the papers presented:

The Economic Front, by G. A. Gaherty, M.E.I.C.

Soil Mechanics at the Shand Dam, by A. W. F. McQueen, M.E.I.C., and R C. McMordie, A.M.E.I.C.

Practicable Forms for Flight Test Reporting, by Elizabeth MacGill, A.M.E.I.C.

Highway Control and Safety, by Angus D. Campbell, M.E.I.C.

Limit Design, by C. M. Goodrich, M.E.I.C.

The Present Status of Grounding Practice with Particular Reference to Protection against Shock, by W. P. Dobson, M.E.I.C.

Developments in Alloys During the Last Twenty Years, by O. W. Ellis.

The Luncheons

The luncheons at the Annual Meetings are no mere formalities. They do much to bring together old friends whose paths may have been separated for years, and to aid in the formation of new acquaintanceships. This year they were exceptionally effective in these respects.

A. E. Berry, chairman of the Toronto Branch, presided at the luncheon on Thursday. A civic welcome was extended by J. D. McNish, K.C., on behalf of the City of Toronto, and then Mr R. J. Magor, chairman and president of the National Steel Car Corporation, told the story of his preliminary investigations into "The War Potential of Canadian Industry." Having taken a leading part in the visits of Canadian industrialists to Britain before the war, he was able to describe the steps taken to ascertain the lines along which the efforts of Canadian industries could most usefully be directed in order to build up war potential.

Montreal engineers take it seriously—from left to right—B. R. Perry, J. E. Armstrong, R. E. Jamieson

C. M. Goodrich's paper on "Limit Design" brought forth unusually good discussion. C. S. G. Rogers was the chairman

During these journeys a great deal of spade work was done which is now resulting in the effective mobilization of Canadian industry for war work.

At the luncheon on the following day, retiring Vice-President E. V. Buchanan, the chairman, was in happy vein. His humorous introduction soon put the meeting in the proper mood to appreciate the remarks of the speakers.

Following this an address was given by Prof. N. A. M. Mackenzie, Professor of International Law at the University of Toronto. He was introduced by Professor C. R. Young, and spoke all too briefly on a subject which he has made his own—**The Status of International Law in the Present War.** The close attention of his audience bore witness to the importance attached by everyone present to the questions of international law which have been so prominent of late.

The Banquet

Always a leading feature of the annual meeting, the Banquet this year was noteworthy because its chairman was the retiring instead of the incoming President. This departure from the previous custom of the Institute has been made to permit the induction of the new President at the close of the dinner, thus conforming with the practice of nearly all leading engineering societies in having the new President assume office at the close of the annual business meeting.

President McKiel has thus had the distinction of presiding at two annual banquets of the Institute, a responsibility for which he was thoroughly qualified.

The principal guests at the head table were His Honour the Lieutenant Governor of Ontario and Mrs. Albert Matthews, the former honouring the Institute by consenting to present the prizes and medals to the fortunate recipients. President McKiel, with Mrs. McKiel, was also supported at the head table by the speaker of the evening, Dr. F. Cyril James, the recently appointed principal and vice-chancellor of McGill University, the incoming president, Dr. T. H. Hogg and Mrs. Hogg, Warren H. McBryde, president of the American Society of Mechanical Engineers, and Mrs. McBryde, of San Francisco, Colonel John P. Hogan, president, and George T. Seabury, secretary, of the American Society of Civil Engineers, of New York, B. L. Thorne, president of the Canadian Institute of Mining and Metallurgy, of Calgary, Dean C. J. Mackenzie, president, National Research Council, and Mrs. Mackenzie, of Ottawa, Professor R. E. Jamieson, president, Corporation of Professional Engineers of Quebec, Professor N. A. M. Mackenzie and Mrs. Mackenzie, R. J. Magor, president, National Steel Car Corporation, of Montreal, and Colonel Waters, A.D.C. to the Lieutenant Governor.

Dr. James' address on **The Economic Impact of the War,** was a forceful presentation of the complex economic and sociological problems arising from the war. The audience was impressed, not only by his knowledge of the many ramifications of his subject, but also—and to a marked degree—by the clarity of his views and the practical nature of the conclusions he drew.

Prior to the dance which followed the banquet, members and guests were received by the President and Mrs. Hogg, immediate Past-President H. W. McKiel and Mrs. McKiel, and the chairman of the Toronto Branch, Dr. A. E. Berry and Mrs. Berry.

The President's Dinner

A delightful preliminary to the serious business of the meeting was provided by President McKiel who entertained councillors, officers, past officers of the Institute and some distinguished guests at dinner at the Engineers' Club, on Wednesday evening. There were sixty-eight present.

The head table guests were Dr. Dugald Jackson, the speaker, Professor Emeritus of Massachusetts Institute of Technology, President-elect T. H. Hogg, Warren H. McBryde of San Francisco, President, American Society of Mechanical Engineers, Colonel John Hogan of New York, President, American Society of Civil Engineers, Professor R. E. Jamieson, President, of the Corporation of Professional Engineers of Quebec, J. W. Rawlins, President, the Association of Professional Engineers of Ontario, Dr. W. H. Martin, President, Canadian Institute of Chemistry, Dr. A. Frigon, Assistant General Manager, Canadian Broadcasting Corporation.

Dr. Jackson spoke of his interest and work on engineering curricula with some reference to the survey which he had just completed at the Faculty of Applied Science and Engineering of the University of Toronto.

Dr. Hogg, who was introduced by Dean Mitchell, expressed his appreciation of the honour which had been done him by selecting him as the next President of the Institute. He asked for the co-operation of all members to the end that the Institute would continue to progress throughout him term of office.

Colonel Hogan and Mr. McBryde also spoke. They conveyed to the meeting the good wishes of their societies, and each expressed regret that Canada had become involved in war, but hoped that success would attend the allied effort within a short time.

After dinner, adjournment was made to the lounge, where conversations were continued to a late hour. The success of the function was readily proved by the disinclination of the guests to depart.

The Ladies

On Wednesday evening the wives of officers and councillors gathered in the Toronto suite where Mrs. McKiel and Mrs. Hogg presided over the social activities, while the husbands attended the President's dinner at the Engineers' Club.

On Thursday afternoon a delightful tea was held in the library of the hotel where fifty ladies gathered. Thursday night, of course, was very well occupied with the banquet and dance.

Friday's programme was made up of a special tour of Eaton's store, with luncheon in the Georgian Room. A theatre party took up the afternoon, and rounded out a programme that provided just the right amount of "arranged" entertainment so that one still had time to visit with friends in the hotel.

The members of the ladies committee deserve special mention, and the thanks of the entire out of town delegation is gladly accorded them.

Dr. Frigon tells about the Canadian Broadcasting Corporation, while Professor Jamieson fills his pipe and Colonel Hogan explores his coffee

R. J. Magor *International Press Ltd.*

Dr. F. Cyril James

Professor Norman Mackenzie

Colonel J. P. Hogan, president, A.S.C.E., speaks at president's dinner, much to the amusement of Professor Jamieson

Dr. Hogg speaks at the president's dinner. Left to right—President McKiel, W. H. McBryde, president, A.S.M.E., and J. W. Rawlins, president, Association of Professional Engineers of Ontario

T. R. Loudon discusses Miss MacGill's paper

W. P. Dobson presents his paper: Chairman E. P. Muntz is in the background

A. D. Campbell speaks on highway safety

Mrs. Hogg and Mrs. McKiel lunch with ladies of the Committee

Left to right—Professor R. W. Angus, E. V. Buchanan, R. L. Dunsmore and W. P. Dobson

Hon. M.E.I.C.

"Then said he, 'I am going to my Father's; and though with great difficulty I am got hither, yet now I do not repent me of all the trouble I have been at to arrive where I am. My sword I give to him that shall succeed me in my pilgrimage, and my courage and skill to him that can get it. My marks and scars I carry with me, to be a witness for me that I have fought His battles who now will be my rewarder.'

"So he passed over, and all the trumpets sounded for him on the other side."

The closing paragraph of John Buchan's "Mr. Standfast" —a quotation from "Pilgrim's Progress".

CORPORATE MEMBERSHIP CLASSIFICATION

Shortly a ballot will be submitted to members to provide for one class of corporate membership, that of MEMBER—M.E.I.C. This ballot, which will be sponsored by Council, provides for a change in membership classification that was approved *without a single dissenting vote* at the annual general meeting held at Ottawa in 1939 and at Toronto in 1940. If the ballot receives the necessary two-thirds affirmative vote, the present Associate Membership class will disappear, and all Associate Members will automatically become Members.

The basic reasons for the proposed change are two-fold. First, a desire for clarification and simplification of the Institute's corporate membership designations, and second, a conviction that such clarification and simplification will permit closer co-operation with the provincial professional associations.

Council believes these advantages will justify the proposal. It is hoped that a substantial and favourable ballot will be recorded.

DISCUSSIONS OF ANNUAL MEETING PAPERS

An unusual number of discussions have been received dealing with the papers presented at the Annual and Professional Meeting, which was held in Toronto on February 8th and 9th. However, several additional members have indicated a desire to submit discussions and therefore further time is being made available.

In order to give time to arrange and edit all these, it is necessary to set a closing date. Therefore all discussions which are received at Headquarters prior to April 1st will be eligible to appear in subsequent numbers of the Journal.

REPORT OF COMMITTEE ON WESTERN WATER PROBLEMS

Owing to the absence of the chairman, the report of this committee was not presented in time to be published with the other reports. It was presented to and accepted by Council on February 7th, 1940.

The President and Council:

Your Committee has been keeping closely in touch with all matters relating to "Western Water Problems" and is very much exercised over the situation developing in regard to the international waters of the St. Mary's and Milk Rivers. In the symposium of papers presented at the last annual meeting attention was drawn to Canada's precarious position but no active steps have as yet been taken to retrieve it, while on the American side of the boundary works are nearing completion that will enable the Americans to put to beneficial use not only their own share of the water but also a substantial portion of ours. As our right to the water is contingent upon our putting it to beneficial use, we are likely to lose it forever unless prompt action is taken. This means that the existing irrigation users on the Canadian side will suffer a deficiency in water supply in perpetuity and that a tract of several hundred thousand acres south and east of Lethbridge that could be made highly productive under irrigation will remain permanently waste land.

The implications of the question are such that we have to be sure of our ground. To this end your Committee is nominating a local sub-committee to prepare a detailed report setting out the facts insofar as they can be ascertained regarding:

(a) The international aspects of the problem.

(b) The portion of Canada's share of the waters of each stream the United States could put to beneficial use now or upon completion of the works under construction.

(c) How much storage would be required to provide the existing Canadian users with an adequate water supply.

(d) How much suitable land is available that it would be feasible to irrigate from these rivers and what water supply would be required.

(e) What storage and other works would be necessary to make the requisite amount of water available or such portion of it as is economically feasible.

(f) The engineering problems likely to be encountered in the design and construction of the necessary works with particular regard to the foundation and unwatering conditions at the sites of any major dams.

(g) Estimates of cost, suitability of land for irrigation, number of families that could be supported thereon, the value of the crops that could be raised and any other information bearing on the economic feasibility of the undertaking as a whole.

With this report in hand, the main committee would be in a position to make its recommendations to Council as to what action, if any, the Engineering Institute should take.

Respectfully submitted,

G. A. Gaherty, M.E.I.C.

THE "FIRST ENGINEER" IN HALIFAX

At noon of the same day on which Dean McKiel signed the co-operative agreement with the Association of Professional Engineers of Nova Scotia, he spoke to the members of the Commercial Club of Halifax at the Halifax Hotel. The meeting was held under the chairmanship of Harold S. Johnston, M.E.I.C., and in honour of the guest speaker, several other members of the Institute were invited guests.

It was interesting to read a special dissertation on the Institute emblem—the beaver, which appeared on the printed programme. It is reprinted here in part so that other members, as well as those in Halifax may enjoy it.

"**The First Engineer** was the beaver. He was also the first lumberman, hydro-electrical engineer, civil engineer, tunneller, and trench digger. He cut down the forest, made dams, storage ponds, bridges, and houses with compartments where he could conserve and preserve his food. He co-operated with his fellows and established the first telegraphic communication system in the world. This he did by wagging his tail, thereby instituting for the first time the Wig Wag System. He also established the first co-operative with regard to the storage and supplying of food materials. For his defence he became the builder of the first Maginot Line, and he has preserved his identity down through the ages. What advances the present day engineers have made on the system established by this industrial animal you will probably hear sometime during the day. From him the present day generation can learn co-operation in the face of a common enemy. If the democratic nations of this world would adopt the habits and customs of the beaver instead of the monkey, we could wipe Hitlerism from the face of the earth forever."

DISCUSSION ON THE 18-FOOT DIAMETER STEEL PIPE LINE AT OUTARDES FALLS, QUE.

Erratum

One of the contributors to this discussion, Mr. H. C. Boardman, of the Chicago Bridge and Iron Company, Chicago, Ill., calls our attention to a typographical error which occurred in the publication of his comments in the January, 1940, issue of the Journal, p. 12.

The equations I, II, III and IV, p. 12, column two, are incomplete since in each one the entire expression following the first term to the right should be between brackets, as follows:

$$\text{I.}\quad M1_T = \frac{KQR}{2\pi}\left\{ A \cos u + \sin \triangle\,(u \sin u) - (\pi - \triangle)\left(1 + \frac{a}{R}\right)\right\}$$

$$\text{II.}\quad M2_T = \frac{KQR}{2\pi}\left\{ B \cos u - \sin \triangle\,(\pi - u) \sin u + \triangle \left(1 + \frac{a}{R}\right)\right\}$$

$$\text{III.}\quad M1_R = \frac{kQR}{2\pi}\left(1 + \cos \triangle\,(u \sin u) + C \cos u\right)$$

$$\text{IV.}\quad M2_R = \frac{kQR}{2\pi}\left(1 - \cos \triangle\,(\pi - u) \sin u + D \cos u\right)$$

DR. THOMAS H. HOGG, C.E., D.Eng., M.E.I.C.

PRESIDENT OF THE ENGINEERING INSTITUTE OF CANADA, 1940

One of the best known names in the engineering profession in Canada is that of the new president of The Engineering Institute of Canada. This is due to the personality and accomplishments of the man himself, and to the importance and prominence of the position he occupies. At the annual banquet, on the evening of Thursday, February 8th, Thomas H. Hogg was conducted to the presidential chair by the out-going president, Dean H. W. McKiel, and was received with great applause by the audience of four hundred people.

After thirty-six years of membership in this society Dr. Hogg has attained to the greatest honour that lies within the power of the Institute to give. He is a worthy successor to the long line of distinguished engineers who have headed the Institute in the fifty-three years of its existence. The welfare of the organization, as well as its traditions are in safe hands, and beyond a doubt the year 1940 will see a continuation of the healthy progress that has been so apparent over a great period of time.

Dr. Thomas H. Hogg, C.E., D.Eng., M.E.I.C.

It is surely appropriate that Dr. Hogg should have been born at Chippawa, Ontario, the subsequent centre of such great hydro-electric activity and power development. It is almost as though the circumstances of his career were born with him. The story of Chippawa—the story of the Hydro-Electric Power Commission of Ontario, and the story of the man who now heads that great organization, all run parallel.

He was graduated from the School of Practical Science in 1907 and from the University of Toronto with the degree of B.A.Sc. in 1908. His professional degree of C.E. was won in 1912, and the degree D.Eng. (honoris causa) in 1927. After a term spent as demonstrator in applied mechanics at the University of Toronto he joined the Ontario Power Company, Niagara Falls, in 1909, and was engaged in draughting, designing, surveying and construction work with this Company until 1911, when he became managing editor of the Canadian Engineer in Toronto. After eighteen months at the editor's desk he joined the staff of The Hydro-Electric Power Commission of Ontario as assistant hydraulic engineer in 1913, became chief hydraulic engineer in 1924, chief engineer Hydraulic and Operating in 1934, and later chief engineer. In 1937 he was appointed to the position he now holds, namely, chairman and chief engineer of The Hydro-Electric Power Commission of Ontario.

Dr. Hogg has an international reputation as an hydraulic engineer and has been largely responsible for the design of many of the Commission's power plants. He has served also as consulting engineer to the governments of the Dominion of Canada, to the Provinces of Ontario and Manitoba, to the Nova Scotia Hydro-Electric Power Commission, and in connection with numerous other power projects throughout Canada. He represented the Ontario Government in the preparation of the report on the St. Lawrence Waterways Project by the conference of Canadian Engineers and in the recent international negotiations in connection with the St. Lawrence Waterways. He is a member of the Lake of the Woods Control Board.

He has actively participated in meetings of the World Power Conferences, and presented a paper on "Recent Trends of Water Power Development in Canada" before the Second Conference in Berlin in 1926. At the Third World Power Conference at Washington in 1936 he was a member of the Canadian National Committee and also an official Canadian delegate.

Dr. Hogg is a Member of the Institution of Civil Engineers of Great Britain, a Member of the American Society of Civil Engineers, a Fellow of the American Institute of Electrical Engineers, and a Member of the Association of Professional Engineers of the Province of Ontario. He joined The Engineering Institute of Canada (Canadian Society of Civil Engineers) as a Student in 1904, was transferred to Associate Member in 1912, and to Member in 1922.

ADDRESS OF THE RETIRING PRESIDENT

DEAN H. W. McKIEL, M.E.I.C.

Delivered before the Fifty-Fourth Annual General Meeting of The Engineering Institute of Canada, Toronto, Ont., February 8th, 1940

The programme of an annual meeting usually provides for an address by the retiring President; in fact this particular programme calls for a Presidential Address. That, however, is much too dignified a title for what I intend to say.

Before beginning the topic which I have chosen, may I again say what a pleasure it has been to be your President during the past year and how greatly I appreciate the support accorded me by the vice-presidents and councillors. I also wish to compliment the Treasurer, our Secretary, and his staff for the capable and efficient way in which they have performed their duties. The work of all committees has been most satisfactory, and the thanks of our membership are due their chairmen and members. I would especially like to refer to the improving financial condition of the Institute, the improvement in our headquarters building and its furnishings, and the activities of three particular committees, whose work I believe will have far-reaching results. The first of these is the Committee on Professional Interests, which, under the chairmanship of Vice-President Newell, last year brought about the co-operative agreement in Saskatchewan, followed this year by a similar agreement in Nova Scotia. The second is the Committee on International Relations, under the chairmanship of Past-President Challies, who did such effective work in connection with the proposed international meeting in New York. We all deeply regret that circumstances involving the declaration of war compelled the cancellation of this meeting. The third committee to which I wish to call attention is that which, under the chairmanship of Mr. H. F. Bennett, is considering the welfare of the young engineer. This committee has already amassed a considerable amount of information and is well started on its work. In any consideration of the work of the year, the registration of technical men for voluntary service, in which the Institute participated, should certainly have a place. In closing this short discussion of Institute matters, may I refer to my tour of the branches, and to the great inspiration and increased understanding of Institute affairs which it brought me. I feel that this tour should be undertaken by every President, when possible, and that preferably it should be made in the early part of his term of office.

After considerable thought I have chosen as my subject for this afternoon, "The Engineer as a Citizen." While realizing my own inadequacy to deal with such a topic, its importance at the present time is an ample excuse for my temerity in introducing it. With the outbreak of war and Canada's assumption of her responsibilities as a member of the British Commonwealth of Nations, the engineers of Canada have rushed to enlist, and where this privilege has been denied them they have insistently demanded to know how else they can be of service. We all realize the value and privileges of a democratic form of government, and when such is threatened from without, we also recognize the responsibility which democracy lays upon us individually. We demand the right to defend it, no matter what the cost. The engineer is second to none in this demand as the events of the last war and the present situation abundantly demonstrate.

This raised the question in my mind, "Is the engineer equally willing to recognize his responsibility to a democratic government in time of peace?" If there be such a responsibility in ordinary times, how should it be met? The strength and weaknesses of dictatorships are evident; they depend only on the will of one man, or at the most, of a small group. But the strength of a democracy depends on the active and earnest co-operation of many individuals working together for the common good. Its weakness lies in the failure of many of these individuals to recognize this condition and to assume their responsibility contingent upon it. Do engineers as individuals and as a profession recognize this obligation, except in time of stress?

Democracy must necessarily be served by intelligent citizens who are prepared to study the many questions confronting it and to bring to bear on these questions the analytical power of trained minds. Who is better qualified to do this than the engineer or scientist, whose whole training in mathematics and natural science is designed to develop such critical and impartial analysis? Who is more accustomed to securing data, carefully weighing all evidence and then making a definite pronouncement, with the full expectation that his finding will only be accepted after it has been tested and proved by other independent investigations? Who, then, but the engineer and scientist should be in the forefront of those dealing with the many problems bewildering democracy today? This happy condition, however, has not yet been realized, largely, I think, because the very habit of mind which the engineer's training and practice have developed makes him reluctant to deal with problems of the type involved. The engineering mind concerns itself only with exactness and with plans based on determinate and predictable factors. As a result engineers have as yet been little interested in the field of national economics, and have done very little to aid those who are dealing with the problems involved in this field.

In spite of their present lack of interest, however, I believe that the future of democracy lies in the hands of men with the training of the engineer, but with a greater breadth of view. May I quote from an address by Henry A. Wallace,* United States Secretary of Agriculture, who has said: "There is something about engineering that tends to lay emphasis on logical, cold, hard, lifeless facts. Nearly all engineers have suffered the remorseless discipline of higher mathematics, physics and mechanics . . . As a result the engineer sometimes imputes a value to precise mathematical reasoning that it does not always have. There is such a thing as life, and the mathematics of life is as far beyond the calculus as the calculus is beyond arithmetic . . . It seems to me that the emphasis of both engineering and science in the future must be shifted more and more toward the sympathetic understanding of the complexities of life, as contrasted with the simple, mathematical, mechanical, understanding of material production." The engineer, then, while retaining his habits of critical analysis and cold logic must adapt his reasoning to the conditions found in the social sciences where the number of variables is legion and many of the factors are but slightly predictable. He must lose his scorn of the sociologist and economist, and recognize that while his own field of investigation has the authority of long tradition, that of political and social science has had but a short life outside the realm of philosophical speculation; that the methods of this field are but poorly developed as yet, and that the exactness of natural science will never be possible. In short, the engineer must recognize that the type of investigation most urgently needed now in the social field is the very type to which he has been accustomed, but with some modifications suitable to the different conditions encountered. Again quoting from Secretary Wallace: "I would be the last to suggest that the engineer abandon the precision of his thinking and his

*An address before the American Association for the Advancement of Science, Boston, December 29, 1933.

honesty in facing facts. I am merely asking that the same qualities be brought to bear, in so far as possible, on the more complex situations which have to do with living organisms and our social life. In brief, then, we wish a wider and better controlled use of engineering and science."

The engineer with the broadened attitude thus suggested would note the change which has come over industry in the past quarter century. He would see that our prosperity is a function of an expanding industry; that during the last century this expansion was largely due to an expanding national frontier; but that with the coming of this century the limit of this material type of expansion was reached, and that future expansion must be of a different kind. Professor Allan Fisher of the Royal Institute of International Affairs, London, in his book, "The Clash of Progress and Security" divides industry into three parts: the primary industries, concerned with the production of food stuffs and raw materials; the secondary industries, whose function it is to modify the form and thus enhance the usefulness of these simpler physical products; and the tertiary industries, which cater to the whims and luxury desires of man, and whose output consists largely of personal services. He finds that industrial development has been successively centred in these divisions and that with the coming of the present century American industry entered the third part. This, if it be so, would mean that industrial expansion of the future must lie in this third field and is only attainable by continually raising the standard of living. In such a condition President Wickenden foresees a greater development of planned economics; not those as enforced by dictatorships in which past experience is disregarded, but those based on a sound understanding of the social structures.* Hence the engineer of the future will find himself in a field which requires close acquaintance with more than the laws of mathematics and the natural sciences.

The engineer should also recognize that some of our most pressing problems today, if not actually due to his activities, are associated directly with them. For example, unemployment, in many cases the result of technological advances, should receive his attention. While it is perfectly true that in the long run technical improvement in industrial processes provides more jobs than it destroys, yet this gives scant comfort to those thrown out of employment during the period of adjustment to the new conditions. Again many of our housing difficulties and slum conditions arise from centralization of industry, a process in which engineering has played a major part. One might cite many similar problems with an engineering background toward the solution of which we might individually and collectively do a great deal.

Certain national problems might well be discussed in engineering bodies, where an impartial but searching analysis could be assured. We find medical groups discussing various phases of national health, legal men in their meetings dealing with types of national legislation. Why should not we deal with engineering questions of a national character ? We can find precedent for this, for an outstanding study of the Canadian railroad problem has been written by a member of this Institute, as have several analyses of the deep waterways question. We have also devoted at least two annual meetings to the discussion of problems of national importance. This practice should be encouraged and extended.

Another field in which the engineer should be able to contribute materially to the national welfare is in regard to the relations between capital and labour. Himself usually an employee, yet by virtue of the work in which he engages a representative of capital, he should be able to explain the aims and objectives of each to the other so that many causes of friction would disappear. With his help and by wise planning, dislocations attendant upon major changes in industrial processes and machinery may be greatly reduced or even eliminated. This is not mere theory, for such an experiment has been recently tried in the textile mills of the south. Here by the introduction of multiple looms a considerable saving in labour was effected. An investigation of the results of this policy was made by Prof. E. D. Smith of Yale University*, who found that in those mills where, before the change was made, labour and management were brought together to discuss the probable results, adjustments were made which resulted in the almost total avoidance of friction, but where the change was simply put into effect without previous preparation, opposition at once developed. Here then is another opportunity for the engineer.

Hitherto the engineer has been engrossed with his technologic and scientific problems and has made enormous advances in these fields. He has paid but little attention, however, to the social results of this progress. He has consistently left the application of his advances to others, sure in his belief that they must prove of great advantage to all. We are told that the scientific advances of the past century are as nothing in comparison with those to come in the next, and we have today clear proof of the dislocation of our social and economic structure produced by the advances and methods of the past. Is it not time, then, that the engineer concerned himself more directly with the economic results of his labours instead of leaving that enquiry to others ?

With future conditions uncertain, the complications introduced by post war adjustments will aggravate the situation. Those best competent to judge, believe that we shall see an enlargement of governmental supervision of business and industry rather than a reduction. Thus it becomes imperative that careful study be given to national and industrial matters if democracy is to survive. This, I feel, should be a challenge to the engineer, and especially to the young engineer, to take a broader view than he has in the past. When the individual engineer and the profession recognize the responsibility of citizenship, as no doubt they will, then we shall have gone a long way toward curing the ills of our day. Furthermore I believe that such action will benefit for the profession as well, not only in the esteem in which it is held by the public, but also in a material way.

Lest my attitude be misunderstood, let me make it plain that I do not advocate socialism, communism or any of the other panaceas for our ills which are being advanced today, nor do I support any move to adopt trade union policies in engineering relations. It is rather my hope that through a broadening of the engineer's attitude toward social problems, such pitfalls may be avoided, since difficulties courageously faced are already half overcome.

There is not time for a discussion of the way in which this public consciousness on the part of the engineer may be awakened, though I think the beginning must be made in his period of training. This opinion is shared by President Roosevelt, who recently addressed an open letter to the engineering educators of the United States in which he questioned the suitability of engineering training, as presently constituted, to meet the changing conditions of the present and future. Many educators, themselves, had already expressed doubts in this connection, so we find the matter under earnest consideration by many bodies on this continent today, including our own Committee on the Welfare of the Young Engineer.

Many believe, however, that unless the engineers of the future, and others with similar training, give more attention to the social and political structure of our country, then democracy will experience hard and perhaps even desperate days. The responsibility is ours. Shall we measure up to it ?

*The Young Engineer Facing To-Morrow—Mechanical Engineering, May, 1939.

*Technology and Labour—E. D. Smith.

MEETINGS OF COUNCIL

A meeting of the Council was held at the Royal York Hotel, Toronto, Ontario, on Wednesday, February 7th, 1940, at ten o'clock a.m.

There were present: President H. W. McKiel in the chair; Past-Presidents G. J. Desbarats, A. J. Grant, O. O. Lefebvre and C. H. Mitchell; Vice-Presidents E. V. Buchanan (Province of Ontario), and R. L. Dunsmore (Maritime Provinces); Councillors B. E. Bayne (Moncton), J. L. Busfield (Montreal), P. E. Doncaster (Lakehead), R. H. Findlay (Montreal), A. B. Gates (Peterborough), O. Holden (Toronto), T. H. Jenkins (Border Cities), A. Larivière (Quebec), H. A. Lumsden (Hamilton), W. R. Manock (Niagara Peninsula), B. R. Perry (Montreal), A. U. Sanderson (Toronto), J. A. Vance (London), H. J. Vennes (Montreal), and E. Viens (Ottawa); Treasurer deGaspe Beaubien, Secretary Emeritus R. J. Durley, General Secretary L. Austin Wright, and Louis Trudel, Assistant to the General Secretary; President-elect T. H. Hogg; Vice-Presidents Elect McNeely DuBose (Province of Quebec), and J. Clark Keith (Province of Ontario); Councillors-Elect J. G. Hall (Montreal), W. L. McFaul (Hamilton), C. K. McLeod (Montreal), J. H. Parkin (Ottawa), and C. E. Sisson (Toronto). The following were also present by invitation: Colonel J. P. Hogan, President, and Mr. George T. Seabury, Secretary, of the American Society of Civil Engineers; Mr. W. H. McBryde, President, American Society of Mechanical Engineers; Dr. W. L. Malcolm, Dean of Engineering, Cornell University; Ernest Brown, Dean of the Faculty of Engineering, McGill University; J. W. Rawlins, President, and W. P. Dobson, Past-President of the Association of Professional Engineers of Ontario; Professor R. E. Jamieson, President of the Corporation of Professional Engineers of Quebec; K. M. Cameron, Chief Engineer, Department of Public Works of Canada; Colonel R. E. Smythe, Director of the Technical Service Council; G. A. Gaherty, chairman of the Committee on Western Water Problems; H. F. Bennett, chairman, and R. E. Heartz and R. F. Legget, members of the Committee on the Training and Welfare of the Young Engineer; Fraser S. Keith, J. A. McCrory and Geoffrey Stead, former members of Council; J. J. Spence, Secretary-Treasurer of the Toronto Branch; and the following branch chairmen: J. R. Dunbar (Hamilton), A. W. F. McQueen (Niagara Peninsula), and A. E. Pickering (Sault Ste. Marie). All councillors and guests were welcomed by President McKiel.

A report was presented from the Committee on Western Water Problems stating that they had appointed a local committee to make a study of the situation developing in regard to the international waters of the St. Mary's and Milk Rivers. This report was accepted with appreciation.

In regard to the rearrangement and rewording of the Institute by-laws, the Secretary Emeritus was requested to complete a draft which he had prepared, embodying in it the results of the forthcoming ballots for amendments and then submit it to the Council for further consideration.

A letter was presented from the Hamilton Branch extending a cordial invitation to the President and Council to hold the 1941 Annual General Meeting of the Institute in the City of Hamilton.

After some discussion, and an expression of appreciation of the Hamilton invitation, the Secretary was directed to present the invitation to the first meeting of the new Council following the Annual General Meeting.

Approval was given to a proposed amendment to paragraph 3 of Section 5 of the Toronto Branch by-laws.

A number of applications were considered, and the following elections and transfers were effected:

Elections

Members	2
Juniors	2
Students Admitted	11

Transfers

Junior to Associate Member	1
Student to Associate Member	4
Student to Junior	3

Mr. Perry drew attention to the recent incorporation, under Dominion charter, of a society apparently concerned with the activities of "engineers," and felt that some attempt should be made to discourage the further granting of charters to such bodies in Canada.

Professor Jamieson pointed out that this matter was also of interest to the professional associations, who had taken steps to prevent the issuance of letters patent to such bodies under provincial legislatures, but the provincial associations could take no action on Federal applications. The continued issuance of such letters patent was a matter of importance to the Institute. Members present agreed with Professor Jamieson, and on the suggestion of the President it was decided to bring the matter up for further consideration at the next meeting of Council.

The meeting adjourned at one o'clock and reconvened at two-thirty p.m. with President McKiel in the chair.

In presenting the report of the Committee on the Training and Welfare of the Young Engineer, Mr. Bennett stated that his committee would suggest to Council that a definite programme of student guidance should be undertaken with a view of enabling the young engineer, during his university course, to realise more fully his professional status. The committee hoped to prepare a booklet giving the Canadian point of view in this matter.

President McKiel spoke of his interest in the work of this committee, as he had been responsible for its establishment. In his contacts with the branches he had found that the membership generally was greatly concerned in this committee's work as being vital to the interests of the engineering profession. He complimented Mr. Bennett and his committee on the work which they had already accomplished.

Dean Brown thought that university authorities could benefit greatly by receiving the opinion of engineers active in the profession. He did not believe that a five-year engineering course after honour matriculation was possible. It had not been practicable to establish it at McGill. The university course should be of a fundamental nature, and should include, if possible, instruction in public speaking, English, business administration, engineering law and economics. Such things, however, should be introduced only into the latter years of the course.

Mr. McQueen thought that there was little use of including such subjects as a side line. They should be made a regular requirement.

Dr. Malcolm stated that the entrance requirements for Canadian engineering schools, so far as he knew them, were greatly superior to the entrance requirements of corresponding institutions in the United States, and in his opinion the basic training in Canadian engineering schools was better than that given in the United States. This was of great importance. Students should be thoroughly grounded in mathematics, physics and chemistry.

Professor Jamieson agreed with Dr. Malcolm, but pointed out the difficulties in teaching fundamental subjects in a broad scale, and at the same time equipping the student to meet the specific needs of industry. To crowd all this into a four-year course was almost impossible. Most professors had considerable contact with professional practice, but in every instance the faculties would be glad of suggestions of a constructive nature rather than indefinite suggestions to the effect that the student should be given "more of this and more of that." The difficulties of the engineering schools in the apportionment of the available time were formidable.

Speaking as a man who engages engineers, Mr. Parkin felt that unless engineering courses can be extended beyond four years it would seem that engineers are not prepared to pay the price of having their calling regarded as a profession. Possibly the same effect could be obtained if the length of the academic year could be increased by shortening the vacation periods. The final year or years should be given over to post graduate study.

Dean Mitchell explained that at Toronto the five-year course had been under consideration for a long time and had been proposed on several occasions, but had not been found practicable.

Mr. Rawlins was of the opinion that if the training period could not be increased, more attention should be given to preliminary training in high schools.

Mr. Dunsmore, as an employer of engineers, thought that the man with sound fundamental training was best suited to enter the industrial field. He preferred the graduate who had a broad understanding of the essentials, and was thus prepared to accept specialized training in the industry. He thought it might be possible for industry to advise the universities on the branches of engineering in which there was likely to be the most substantial demand.

Colonel Smythe drew attention to the position of the young graduate in relationship to the engineering societies. So many organizations were available to the young man as to confuse him. Organizations like the Engineering Institute should simplify the situation. Industry might well provide suitable work for undergraduates. Work of this kind had been well done by the Hydro-Electric Power Commission of Ontario.

Dr. Lefebvre, a member of the Board of Administration of the Ecole Polytechnique, remarked that this school from the very first had adopted general courses in engineering. He was entirely in favour of the recommendations made by Mr. Bennett's committee.

Colonel Hogan agreed with Dr. Malcolm that in the United States one of the greatest difficulties was the lack of proper preliminary training. Excellent work had been done by the American Society of Civil Engineers in establishing Junior Chapters in the colleges.

Mr. McBryde thought that a general college course was more applicable than a specialized one, largely because it is almost impossible for a student to know which branch of engineering he is likely to follow.

Mr. Cameron expressed the opinion that vocational guidance after college years was extremely valuable.

After further discussion it was decided to recommend to the incoming Council that Mr. Bennett and his committee be asked to continue their investigations.

Colonel Smythe, who was present by invitation, submitted a proposal for co-ordination of the various engineering employment agencies throughout Canada. After outlining the history of the Technical Service Council, he stated that he had communicated with the university authorities and with the Engineering Institute, suggesting the desirability of merging the considerable number of agencies which are at present operating such employment services. In his opinion a national technical employment service should be carried on through the universities, with some central organization co-ordinating and directing the work. He hoped that The Engineering Institute, along with other bodies, would aid in financing such a co-operative effort.

The General Secretary remarked that he had frequently discussed this matter with Colonel Smythe during the past two years. There were many difficulties in arriving at a satisfactory solution, some of which he mentioned. The employment department of the Institute was of great value to its members, but anything that could be done to improve such service on a national basis was something in which the Institute should be vitally interested. Mr. Wright would suggest that a committee be appointed to investigate the matter further and to reach some definite conclusion as soon as possible. After further discussion it was decided to recommend to the incoming Council the appointment of such a committee to consider the situation in consultation with Colonel Smythe.

President McKiel, in closing the meeting, expressed appreciation of the co-operation he had received from all members of Council throughout the year.

The Council rose at five forty-five p.m.

A meeting of the new Council was held at the Royal York Hotel, Toronto, Ontario, on Friday, February 9th, 1940, at two forty-five p.m., with President T. H. Hogg in the chair. There were also present: Past-Presidents J. B. Challies, G. J. Desbarats and H. W. McKiel; Vice-President McNeely DuBose; Councillors J. L. Busfield, P. E. Doncaster, R. H. Findlay, J. G. Hall, W. R. Manock, W. L. McFaul, C. K. McLeod, J. H. Parkin, A. U. Sanderson and J. A. Vance; Past Vice-President E. V. Buchanan; Past-Councillors B. E. Bayne, O. Holden, H. J. Vennes and E. Viens; Messrs. G. A. Gaherty, H. F. Bennett and R. L. Dobbin; Secretary-Emeritus R. J. Durley, General Secretary L. Austin Wright, and Louis Trudel, Assistant to the General Secretary.

Formal appointments were made of L. Austin Wright as General Secretary, and deGaspé Beaubien as Treasurer. The Finance Committee and the Committee on Professional Interests were appointed as follows:

Finance Committee	F. Newell, *Chairman*
	J. E. Armstrong
	deG. Beaubien
	G. A. Gaherty
	J. A. McCrory
Professional Interests	J. B. Challies, *Chairman*
	O. O. Lefebvre, *Vice-Chairman*
	G. A. Gaherty
	H. W. McKiel
	F. Newell
	C. E. Sisson

Other committee appointments were made as follows, with a request that the various chairmen submit the names of the other members of their committees for approval at the next meeting of Council.

Papers Committee	J. A. Vance, *Chairman*
Library and House	B. R. Perry, *Chairman*
Publication	C. K. McLeod, *Chairman*
	R. DeL. French, *Vice-Chairman*
Board of Examiners	R. A. Spencer, *Chairman*
	I. M. Fraser
	W. E. Lovell, with power to add
International Relations	J. M. R. Fairbairn, *Chairman*
	J. B. Challies, *Vice-Chairman*
Western Water Problems	G. A. Gaherty, *Chairman*
Deterioration of Concrete Structures	R. B. Young, *Chairman*
Membership	K. O. Whyte, *Chairman*
Radio Broadcasting	G. McL. Pitts, *Chairman*
The Young Engineer	H. F. Bennett, *Chairman*
Past-Presidents' Prize	R. DeL. French, *Chairman*
Duggan Medal and Prize	F. P. Shearwood, *Chairman*
Plummer Medal	F. Gordon Green, *Chairman*
Representative on the Canadian Chamber of Commerce	de Gaspé Beaubien

An invitation from the Hamilton Branch to hold the 1941 Annual General Meeting in Hamilton was considered, together with a verbal invitation from Mr. Doncaster that the meeting be held in Winnipeg or in that vicinity so that more members from that area might be able to attend. It was felt that it was a little early in the year to reach a decision, and it was decided to postpone consideration until a later meeting of Council.

Past-President Challies suggested that it might be advisable to review all the Institute honours and awards so their relative importance might be preserved, their real purposes properly co-ordinated, and continuity of policy be guaranteed. Council favoured the suggestion, and asked that definite recommendation be made by Dr. Challies and other past-presidents.

Past-President McKiel said he would like to take this opportunity to express in the form of a motion his appreciation to the Toronto Branch for the very efficient manner in which the Annual Meeting had been conducted. The motion was seconded by Mr. Findlay and carried unanimously.

The Council rose at four forty-five p.m.

NEWLY ELECTED OFFICERS OF THE INSTITUTE

McNeely DuBose, M.E.I.C., is the newly elected vice-president for the province of Quebec. Mr. DuBose was born in North Carolina, U.S.A., and was educated at the North Carolina State College, Raleigh, where he received the degree of Bachelor of Engineering in 1912. He was with various power companies in the United States and in 1919 became superintendent of the Talassee Power Company. He came to Canada in 1925 as superintendent of the Aluminum Company of Canada, Limited. In 1926 he was made general superintendent of the Saguenay Power Company Limited, at Arvida, Que. He is at present general manager of the company. Mr. DuBose is also president of the Saguenay Electric Company and director of the Saguenay Transmission Company, Limited, and of the Alma and Jonquière Railway Company.

J. Clark Keith, A.M.E.I.C., general manager of the Windsor Utilities Commission is the newly elected vice-president for Ontario. Born at Smiths Falls, Ont., he was educated at the University of Toronto where he obtained his degree of Bachelor of Applied Sciences, with honours in 1911. From 1912 to 1920, he was municipal engineer with the city of Moose Jaw, Sask. In 1920 he was appointed deputy chief engineer of the Essex Border Utilities Commission, Windsor, Ont., and the following year was made chief engineer. In 1932, Mr. Keith became business administrator of the Metropolitan General Hospital in addition to his other duties and in 1934, he was made chief executive officer of the commission. In 1935, he was appointed finance comptroller of the new city of Windsor which included Windsor, Walkerville, Sandwich and East Windsor. With the merging of the four municipalities, the functions of the Essex Border Utilities Commission were assumed by the Windsor Utilities Commission of which Mr. Keith is now general manager.

W. S. Wilson, A.M.E.I.C., the newly elected vice-president for the Maritime Provinces, was born in Lincolnshire, England, and educated at Middlesborough Technical College. After several years engineering experience in England, he came to Canada in 1917 as an assistant chief draughtsman with the Dominion Iron and Steel Company, Limited, at Sydney, N.S. A year later, Mr. Wilson became technical engineer of the company. In 1928 he was appointed assistant chief engineer and in 1931 chief engineer. Since 1936, he has been chief engineer of the Dominion Steel and Coal Corporation, Limited, at Sydney, N.S.

G. P. F. Boese, A.M.E.I.C., Department of Natural Resources, Canadian Pacific Railway, Calgary, is the newly elected councillor for the Calgary Branch. He was born in Worcestershire, England, where he was educated. Coming to Canada in 1907 he entered the Engineering Department of the Canadian Pacific Railway at Ottawa the same year and his services with the company, except for approximately two years during the Great War when engaged in munitions and military work, have been continuous. As instrumentman in 1909, resident engineer in 1912, he was engaged on maintenance, location and construction work in Eastern Canada and on the Lake Superior Division. In 1917 he became assistant engineer in connection with the operation of the Canadian Pacific Railway irrigation systems in Alberta and has held his present position as assistant to the chief engineer of the Department of Natural Resources most of that time. He was secretary for the Western Professional meeting of the Institute held at Banff in 1925 and was chairman of Calgary Branch in 1934-35.

I. W. Buckley, A.M.E.I.C., the newly elected councillor for the Cape Breton Branch, was born at Manchester, England, where he was educated. After several years with Messrs. Gallway's Limited, at Manchester in mechanical and construction work, he joined the British Westinghouse Company and remained with them until 1907 when he came to Canada as a maintenance and operating engineer in steel rolling mills of the Dominion Iron and Steel Company, at Sydney, N.S. From 1922 until 1932, he was sales and operating engineer with the Iona Gypsum Products Limited at Sydney. Later he was with the Canadian Fairbanks Morse Company, erecting Diesel engines and pumping equipment. At the present time he is in charge of the operation of the limestone dust mill of the Dominion Coal Company at Glace Bay, N.S.

I. M. Campbell, A.M.E.I.C., the newly appointed councillor for the Lethbridge Branch, was born in Scotland where he was also educated. He came to Canada in 1907 and entered the Canadian Pacific Railway as a chainman at Souris, Man. In 1913, he was resident engineer at Kenora, Ont., He went overseas with the Canadian Railway Troops and upon his return to Canada in 1919 he went back with the Canadian Pacific Railway as roadmaster at Dryden, Ont. In 1920 he was appointed division engineer at Winnipeg and in 1923 was transferred to Moose Jaw, Sask., in the same capacity. Since 1933, Mr. Campbell has been division engineer at Lethbridge, Alta.

A. L. Carruthers, M.E.I.C., has been elected councillor for the Victoria Branch. He was born in Sarnia Township, Ont., and received his education at the University of Toronto. In 1904, he joined the Canadian Northern Railway and was employed as bridge inspector, resident engineer and division engineer until 1917 when he was appointed district

McNeely DuBose, M.E.I.C.

J. Clark Keith, A.M.E.I.C.

W. S. Wilson, A.M.E.I.C.

engineer at Prince Rupert for the Department of Public Works of the province of British Columbia. In 1923, he became bridge engineer with the Department at Victoria, B.C., a position which he still holds.

J. H. Hall, M.E.I.C., a newly elected councillor for the Montreal Branch, was born at Cornwall, Ont. Following graduation from McGill University in 1921 with the degree of B.Sc., Mr. Hall was engineer and assistant superintendent of the Back River Power Company until 1924 when he joined the staff of the Combustion Engineering Corporatoin as manager of the Winnipeg office which position he held until 1927 when he was transferred to Montreal to take over the appointment of vice-president and general manager of the company. In 1934, he became general manager and director of the same company.

W. L. McFaul, M.E.I.C., is the newly appointed councillor of the Hamilton Branch. He was born at Owen Sound, Ont., and was educated at the University of Toronto where he received the degree of B.A.Sc. in 1913. After one year spent as assistant engineer with the city of Port Arthur, Ont., he became assistant city engineer with the city of Sault Ste. Marie, Ont., in 1914. He was appointed city engineer in 1916 and remained in that post until 1921 except for the period from 1917 to 1919 when he was overseas with the Royal Canadian Engineers. In 1921 he received the appointment of deputy city engineer of the city of Hamilton, Ont., and in 1923 he became city engineer and manager of the water works, a position which he still holds.

C. K. McLeod, A.M.E.I.C., a newly elected councillor for the Montreal Branch, was born in Montreal. He was graduated from McGill University with the degree of B.Sc. in chemical engineering in 1913, and immediately following graduation became plant chemist with that organization for the next three years. From 1916 to 1919 he was engaged on the inspection of explosives with the Imperial Ministry of Munitions. In May, 1919, Mr. McLeod was appointed chief chemist for the Dominion Glass Company, and a year later became superintendent with the Consumers Glass Company. In May, 1921, Mr. McLeod was with the Phoenix Bridge and Iron Works on design and sales of structural steel work. When this firm was taken over in October, 1923, by Canadian Vickers Limited, he occupied a similar position with the new organization. Since 1925 Mr. McLeod has represented the Permutit Company, Walter Kidde and Company and the American Hard Rubber Company in Eastern Canada, first as manager of the Chemical Engineering Equipment Company, then as a principal of Busfield McLeod Limited and in 1934 he entered into business under his own name representing the same interests.

Mr. McLeod is very well known to the membership of the Institute as a past secretary-treasurer of the Montreal Branch, which office he held for ten years and also as chairman of the Branch. He is a son of the late C. H. McLeod who for twenty-five years was secretary of the Institute. He is an alderman for the city of Westmount, Que.

J. H. Parkin, M.E.I.C., is the newly elected councillor for the Ottawa Branch. He was born in Toronto and was graduated from the University of Toronto in 1912. From 1914, he was lecturer in mechanical engineering and then assistant professor of mechanical engineering. In 1926 Mr. Parkin was appointed associate professor of mechanical engineering, which position he held until 1929. In addition to his work at the University of Toronto, he was in 1916-1919 assistant to the engineer in chief, British Acetones, Toronto; in 1917-1929 in charge of aeronautical research and instruction at the University of Toronto, and in 1920-29 as consultant on machine and aeronautical questions. In 1929 he was appointed assistant director of the department of physics and engineering physics in charge of aeronautical research with the National Research Council, Ottawa, Ont. Since 1937 he has been director, division of mechanical engineering with the National Research Council.

C. E. Sisson, M.E.I.C., is the newly appointed councillor for the Toronto Branch. He was born at Cavan, Ont., and educated at the University of Toronto where he obtained his degree of B.A.Sc. in 1905. Mr. Sisson has been with the Canadian General Electric ever since graduation. He is at present works engineer at the Davenport Works of the company in Toronto.

G. E. Smith, A.M.E.I.C., is the newly elected councillor for the Moncton Branch. He was born at Fredericton, N.B., and received his education at the University of New Brunswick where he was graduated in 1912. For two years after graduation, he was on the construction of the St. John and Quebec Railway and later with the Fraser Lumber Company. From 1916 to 1919, he was overseas in active service. Upon his return to Canada, he entered the Canadian National Railways as a draughtsman. At present he is in the city engineer's office at Moncton, N.B.

ANNUAL FEES

Members are reminded that a reduction of one dollar is allowed on their annual fees if paid on or before March 31st of the current year. The date of mailing, as shown by the postmark on the envelope, is taken as the date of payment. This gives equal opportunity to all members wherever they are residing.

INSTITUTE PRIZE WINNERS

G. A. Gaherty, M.E.I.C., is one of the recipients of the *Gzowski Medal* for 1939, for his paper, "Drought, a National Problem," presented at the Annual Meeting in Ottawa last year. Upon graduation from Dalhousie University, Halifax, in 1909, he entered the Western Power Company of Canada as designing engineer and remained there until 1914 when he joined the Canadian Garrison Artillery at Halifax and later went to France. Upon his return to Canada in 1919, he spent a year making surveys and designs for the Keely Silver Mines Limited. In 1920, he joined the Montreal Engineering Company Limited, as water power engineer and director. He later became chief engineer, then vice-president and at the present time holds the position of president. In 1923, he accepted the position of chief engineer and general manager of the Calgary Power Company Limited, in addition to his duties in the Montreal Engineering Company. In 1928 he became president of the company.

Ernest A. Hodgson, M.E.I.C., was also awarded the *Gzowski Medal* for 1939, for his paper entitled "The Structure of the Earth as Revealed by Seismology," published in the September, 1938, issue of the Journal. Mr. Hodgson was educated at the Hamilton Collegiate and at the University of Toronto where he obtained the degree of Master of Arts in 1912. He entered the Dominion Observatory at Ottawa as a seismologist in 1914 and in 1918 he became chief of the Division of Seismology at the Observatory, a position which he still occupies. In 1932, he obtained the degree of Doctor of Philosophy at Saint Louis University, Missouri. Dr. Hodgson's reputation as a seismologist extends far beyond Canada.

D. B. Armstrong, A.M.E.I.C., received the *Duggan Medal and Prize* for 1939, for his paper entitled "The Island of Orléans Suspension Bridge—Prestressing and Erection." He was educated at McGill University and entered the Dominion Bridge Company Limited at Lachine, Que., in 1919 as a draughtsman. He successively held the positions of designer, erection engineer and engineer in charge of special projects. In 1937, he became designing engineer of the company. He was closely associated with the design and erection of the Jacques Cartier bridge, Montreal, and later occupied the position of engineer in charge of the Island of Orléans suspension bridge. Mr. Armstrong's paper was published in the July, 1938, issue of the Journal.

C. R. Whittemore, A.M.E.I.C., has also been awarded the *Duggan Medal and Prize* for 1939, for his paper, "Welded Steel Pipe for the City of Toronto Water Works Extension." He received the degree of Master of Science in Metallurgy in 1924. Upon graduation, he went with the McArthur Irwin Paint Company of Montreal as a research chemist. In 1925 he joined the Consolidated Mining and Smelting

G. A. Gaherty, M.E.I.C.

E. A. Hodgson, M.E.I.C.

C. R. Whittemore, A.M.E.I.C.

D. B. Armstrong, A.M.E.I.C.

C. G. Kemsley

Company at Trail, B.C., where he was in charge of the Technical Service Department. Later he became technical engineer. In 1929, he returned to the McArthur Irwin Company in Montreal. In 1931, he joined the Dominion Bridge Company Limited at Montreal later becoming metallurgist. Since June, 1939, Mr. Whittemore has been Research Metallurgist with the Deloro Smelting and Refinery Company, at Deloro, Ont. In 1936 he was the recipient of the Plummer Medal of the Institute. He is the Chairman of the Montreal Chapter of the American Society for Metals. Mr. Whittemore's paper appeared in the July, 1939, issue of The Engineering Journal.

C. G. Kemsley is the recipient of the *Leonard Medal*, **1939**, for his paper written in co-operation with Mr. A. D. Robinson on "The Internal Shaft at Dome Mines." He was educated in Hobart, Tasmania. He came to Canada in 1907 and devoted himself for several years to prospecting in the Cobalt field. The mechanical phase of mining became, however, his forte. He served as master mechanic at the Hollinger mine. Finally he became mechanical superintendent for Dome Mines, Limited, which post he has now occupied for nearly seven years. He is the Chairman of the Purcupine Branch of the Canadian Institute of Mining and Metallurgy.

D. L. Mackinnon, S.E.I.C.
Winner of the Martin Murphy Prize

C. B. Charlewood, Jr.E.I.C.
Winner of the Phelps Johnson Prize

J. R. Dunn, S.E.I.C.
Winner of the John Galbraith Prize

ELECTIONS AND TRANSFERS

At the meeting of Council held on February 7th, 1940, the following elections and transfers were effected:

Members

Cariss, Carington C., chief engr., Waterous Limited, Brantford, Ont.

Stirrett, Gordon P. (Univ. of Toronto). inspecting engr. for B.C. War Supply Board, Vancouver, B.C.

Juniors

Adlam, Arthur Edwin, B.Sc. (Univ. of Sask.), asst. mining engr., Canadian Johns Manville Company, Asbestos, Que.

Rogers, John H., B.A.Sc. (Univ. of Toronto), asst. to city engr., St. Catharines, Ont.

Transferred from the class of Junior to that of Associate Member

Tapley, Donald Gordon, B.Sc. (N.S. Tech. Coll.), sales engr., Canadian General Electric Co. Ltd., Calgary, Alta.

Transferred from the class of Student to that of Associate Member

Korcheski, William Bruno, B.Sc. (Civil), (Univ. of Man.), C. D. Howe Co. Ltd., Port Arthur, Ont.

MacKay, Ian Norton, B.Eng. (McGill Univ.), asst. engr., Diesel engine dept., Dominion Engineering Works Ltd., Montreal, Que.

Martin, Henri Milton, Jr., B.Eng. (McGill Univ.), asst. works mgr., Dominion Tar & Chemical Co. Ltd., Sault Ste. Marie, Ont.

Watson, Howard Dalton, B.A.Sc. (Univ. of B.C.), branch manager, Linde Canadian Refrigeration Co. Ltd., Toronto, Ont.

Transferred from the class of Student to that of Junior

Eagles, Norman B., B.Sc. (Elec.), (Univ. of N.B.), asst. city elect'l. engr., Moncton, N.B.

Gunning, Merle Percy, B.Eng. (McGill Univ.), elect'l. engr., Montreal Light Heat & Power Cons., Montreal, Que.

Scheen, Marcel, B.A.Sc., C.E. (Ecole Polytechnique, Montreal), dftsman., R. A. Rankin & Co., Montreal, Que.

Students Admitted

Brown, Graham Edward, (Queen's Univ.), 262 Coltrin Road, Rockcliffe, Ottawa, Ont.

Cote, Joseph Leon, B.A. (Laval Univ.), student, engrg. dept., Quebec Power Company, Quebec, Que.

Deslauriers, Charles Edouard, (Ecole Polytechnique, Montreal), 45 Napoleon St., Quebec, Que.

deTonnancour, L. Charles G., (McGill Univ.), 19 Sunset Ave., Outremont, Que.

Geary, Bertram Harman, (Univ. of N.B.), 550 Charlotte St., Fredericton, N.B.

Jones, Edward Donald, junior dftsman., Northern Electric Co. Ltd., Montreal, Que.

Russell, Harold George, (McGill Univ.), 2358 Grand Blvd., Montreal, Que.

Taylor, Charles Gray, B.Sc. (Queen's Univ.), 112 William St., Arnprior, Ont.

Thomas, Jack Arthur, (Queen's Univ.), Kingston, Ont.

Valiquette, Francis, (Ecole Polytechnique), Grand'Mere, Que.

Venables, William Norman, (Univ. of Man.), P.O. Box 42, The Pas, Man.

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

Denis Stairs, M.E.I.C., is serving as Director of Engineering Projects with the War Supply Board at Ottawa. A graduate from Dalhousie University in the class of 1909, Mr. Stairs has been connected with the construction of many large projects. Since 1922, he has been with Montreal Engineering Company Limited, of which he is now a director. He is also supervisor of the northern properties of the company.

Geoffrey Stead, M.E.I.C., of Saint John is one of the most familiar figures at annual meetings of the Institute. On his way back from the Toronto meeting, he visited his daughter and son-in-law, Mr. and Mrs. C. A. Peachey, in Montreal, which gave him an opportunity to visit Headquarters.

Here is an example for all members of the Institute. He is a great believer in the value of annual meetings, and since 1907 has attended twenty-four such meetings of this society. It is doubtful if any other member can equal this record. Mr. Stead says that if a member wants to see the real value of the Institute, he should attend these annual professional gatherings.

For thirty-nine years he has been employed in the Department of Public Works, and for thirty-five of these years he has been in charge of a department. He served under sixteen different Ministers of Public Works. He has surely earned the rest that has come with his retirement.

Gordon McL. Pitts, M.E.I.C., was appointed honorary treasurer of the Royal Architectural Institute of Canada, at the annual meeting held in Toronto last month. Mr. Pitts is a member of the firm of Maxwell and Pitts, architects, Montreal, and is the chairman of the Institute's Radio Broadcasting Commiltee.

L. J. Belnap, M.E.I.C., president of the Consolidated Paper Corporation, Limited, has recently been elected a director of the Royal Trust Company, Montreal.

Ernest Gohier, M.E.I.C., director-general of the roads Department of the Province of Quebec, has been appointed chief engineer of the same department, succeeding A. Paradis, who has recently resigned.

Col. W. M. Miller, A.M.E.I.C., is now Chief Signal Officer, British Troops in Egypt, Cairo, Egypt. Born in Montreal in 1891, he was graduated from the Royal Military College, Kingston, in 1912. During the last war, he was Officer Commanding the 32nd Divisional Signal Company, Royal Engineers, in France. He came back to Canada, and was Senior Engineer Officer, Military District No. 1. He went back to England as a Captain in the Royal Corps of Signallers, stationed at Mansfield Park, Uckfield, Sussex, England. Col. Miller has also been stationed, for some time, at Trimulgherry, Deccan, India. In 1931, he was appointed Chief Signal Officer in Burma. He was then responsible for all the telegraph, telephone and radio arrangements for the troops engaged in quelling the Burma rebellion.

Antonio Roberge, A.M.E.I.C., has accepted the position of city engineer of Drummondville, Que. Upon graduation from the Ecole Polytechnique of Montreal, in 1926, he went with the Canadian Celanese Limited in Drummondville. In 1929 he was with Z. Langlais, consulting engineer, Quebec City, and in 1932, he accepted a position with the City of Quebec, as resident engineer on construction of the Battlefield's reservoir. Later, he was appointed assistant waterworks engineer with the City of Quebec.

W. F. Campbell, A.M.E.I.C., has received the temporary appointment of roads superintendent and county engineer for the County of Haldimand, Ont., during the absence, overseas, of Major A. L. S. Nash. Mr. Campbell had been assistant to Major Nash since 1934.

O. A. Barwick, A.M.E.I.C., has resigned from his position in the Engineer Services Branch of the Department of National Defence, Ottawa, to accept the appointment of metallurgist with the Dominion Bridge Company, Limited, Montreal. A graduate in architecture from McGill University, in the class of 1914, he was engaged during the last war on the inspection of munitions, with particular reference to the testing of metals. During the last twenty years, he has been engaged in the design and construction of many architectural projects. Previous to going to Ottawa, with the Department of National Defence, Mr. Barwick was carrying on a private practice as an architect, in Montreal.

Past-President J. M. R. Fairbairn, M.E.I.C. (third from left), was one of the recipients of an Honorary Membership in the American Society of Civil Engineers, at the Annual Meeting in New York, on January 17th. President D. H. Sawyer presented the certificates.

J. R. Hango, A.M.E.I.C., has been promoted to the position of superintendent of distribution for the Saguenay Power Company, Limited, and the Saguenay Transmission Company, Limited, Arvida, Que. A graduate in electrical engineering from the University of Alberta, in 1929, he was, for a few months, with the Canadian Westinghouse Company, in Hamilton, Ont. In the fall of 1929, he joined the Saguenay Power Company, Limited, as an engineering assistant. Later, he was appointed assistant electrical engineer. In 1937, he became power engineer of the company.

M. D. Stewart, S.E.I.C., is in the engineering department of Babcock, Wilcox and Goldie McCulloch, Limited, at Galt, Ont. Mr. Stewart was graduated in mechanical engineering, last spring, from the University of Toronto.

J. H. P. Matheson, S.E.I.C., has accepted a position in the engineering department of Canadian Industries Limited, in Montreal. A graduate from McGill University in 1930, he had been, since, with the Shawinigan Chemicals, Limited, in Shawinigan Falls, Que.

A. R. Bonnell, Jr.E.I.C., is now in charge of the roads section, in the Plant Construction Department of Trinidad Leaseholds, Limited, Pointe-à-Pierre, Trinidad, B.W.I. A graduate in civil engineering from the University of New Brunswick, in 1935, he had been with the Highway Division of the New Brunswick Department of Public Works until last summer, when he went to Trinidad with the Carib Construction Company, Limited, at Port-of-Spain.

A. A. Ferguson, A.M.E.I.C., has resigned from his position with Reed, Shaw and McNaught, Montreal, to become associated with his brother in the Pictou Foundry and Machine Company, Limited. He will be engaged in mechanical engineering and marine repair work and will reside in Pictou, N.S.

Raymond Boucher, Jr.E.I.C.

Raymond Boucher, Jr.E.I.C., is the newly elected chairman of the Junior Section of the Montreal Branch of the Institute. He was graduated from the Ecole Polytechnique of Montreal in 1933 with the degree of bachelor of applied sciences. In 1934, he received his degree of master of science from the Massachusetts Institute of Technology. He joined the teaching staff of the Ecole Polytechnique and is now professor of hydraulics.

G. A. Campbell, S.E.I.C., has accepted a position with the United British Oilfields of Trinidad, Pointe Fortin, B.W.I. He was graduated in civil engineering from the University of New Brunswick, in 1938, and was engaged, for some time, in survey work with the New Brunswick Electric Power Commission. He went to work with the Carib Construction Company in Trinidad, in August, 1939.

VISITORS TO HEADQUARTERS

D. L. Mackinnon, S.E.I.C., Diamond Construction Company, Limited, from Fredericton, N.B., on February 5th.

E. M. Nason, S.E.I.C., from Moncton, N.B., on February 13th.

Geoffrey Stead, M.E.I.C., from Saint John, N.B., on February 14th.

R. L. Dunsmore, M.E.I.C., superintendent Halifax Refinery, Imperial Oil Limited, from Dartmouth, N.S., on February 17th.

Sir Gerald Campbell, K.C.M.G., High Commissioner for the United Kingdom, Ottawa, Ont., on February 20th.

P. C. Hamilton, Jr.E.I.C., from Halifax, N.S., on February 21st.

I. B. Crosby, Affil.E.I.C., consulting geologist, from Boston, Mass., on February 21st.

R. C. P. Webster, A.M.E.I.C., manager, Maitland Charts, from Maitland, Ont., on February 22nd.

P. G. Gauthier, M.E.I.C., townsite engineer, Quebec North Shore Paper Company, from Baie Comeau, Que., on February 23rd.

F. L. Lawton, M.E.I.C., chief engineer, Saguenay Power Company, Limited, from Arvida, Que., on February 23rd.
G. T. Perry, S.E.I.C., Department of Mechanical Engineering, National Research Council, from Ottawa, on February 23rd.

Obituaries

David Mussen Bright, A.M.E.I.C., died in the hospital at London, Ont., on February 8th, after a lengthy illness. He was born at Portadown, North Ireland, on June 18th, 1875. He was graduated from the Belfast Institute of Technology, and in 1897 joined the Royal Engineers in Chatham, England. He served in China at the relief of Peking, during his seven years with the unit. He came to Canada in 1912, as a resident mechanical engineer with the Middle West Boving Company of Canada, at Lindsay, Ont. In 1913 and 1914, he was designing and superintending engineer with the Canadian British Engineering Company at Winnipeg, Man., on municipal power plants. He served overseas with the Royal Canadian Engineers from 1914 to 1919 and was appointed staff captain in charge of design and layout of workshops and on tests for light railways and aerial ropeways, etc. Following the war, Major Bright returned to the west, where he was, for some time, mechanical engineer with the Manitoba Power Commission at Winnipeg. Later, he was mechanical engineer with the Chicago Automatic Electric Boiler Company. In 1928, he came to London, Ont., where he engaged in a consulting practice as mechanical engineer. At the time of his death, he was president of the D. M. Bright Company, consulting engineers, of London, Ont.

Major Bright joined the Institute as an Associate Member in 1921.

Samuel Ebenezer McColl, A.M.E.I.C., died in the hospital at Winnipeg, Man., on January 26th. He was born in Winnipeg on July 17th, 1886. and was educated at the University of Manitoba. He was commissioned a Manitoba land surveyor in 1909, a Dominion surveyor in 1911, and a Saskatchewan surveyor in 1920. He was in private practice with his brother, Gilbert B. McColl, from 1912 until 1930. His surveys included the right-of-way of the Greater Winnipeg water district line, the power transmission lines of the Winnipeg Electric Company, and various railway, road and drainage surveys. In 1930, he was appointed director of surveys of the province of Manitoba. Under Mr. McColl's direction the department of natural resources made surveys and prepared accurate maps which assisted materially in promoting mining and developing various resources of the province. During the last war, Mr. McColl served overseas as lieutenant with the Royal Canadian Engineers.

Mr. McColl joined the Canadian Society of Civil Engineers as a Junior in 1916, and in 1919 he was transferred to Associate Member of the Institute.

George Wyman Shearer, A.M.E.I.C., died at his home in Montreal, on February 7th. He was born in Montreal on June 12th, 1886. He received his education at McGill University, where he was graduated with the degree of Bachelor of Science in Electrical Engineering, in 1907, and with the degree of Master of Science, in 1908. Upon graduation, he entered the Canadian Westinghouse Company and was engaged in installation on various electrical works. In 1912, he became mechanical superintendent with Ross & Macfarlane, of Montreal. He went overseas in 1915 and returned in 1919 as a major. In 1920, he became vice-president of the James Shearer Company, and in 1930 he was president of the James Shearer Construction Company of Montreal.

Mr. Shearer joined the Canadian Society of Civil Engineers, as a Student, in 1907, and he was transferred to Associate Member in 1912.

Lieut.-Col. Charles Nicholas Monsarrat, M.E.I.C., of the firm Monsarrat and Pratley, Consulting Engineers, Montreal, died on March 1st at his home. An obituary of Colonel Monsarrat will appear in the April issue of the Journal.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

BORDER CITIES BRANCH

H. L. Johnston, A.M.E.I.C. - *Secretary-Treasurer*
A. H. Pask, Jr.E.I.C. - - - *Branch News Editor*

A joint meeting of the Border Cities Branch of the Engineering Institute of Canada and the Detroit section of the American Society of Mechanical Engineers was held on January 12, 1940.

The programme began at 3.30 p.m., when members and ladies were guests of Hiram Walker and Sons, Ltd., in an inspection tour of the Walkerville distillery. This is the original plant of the firm which now owns plants in other parts of the world, including the world's largest distillery at Peoria, Ill.

At 5.30 p.m., at the Prince Edward Hotel, a motion picture of the new Peoria plant was shown as a description of modern distillery practice.

A dinner was held in the ballroom of the Prince Edward Hotel at 6.30 p.m. Of members and guests present, 50 were from the American and about 80 from the Canadian organization.

Following the dinner, the chairman, Mr. J. F. Bridge introduced Mr. L. Austin Wright, General Secretary, of the Institute, who expressed his appreciation to the American Society of Mechanical Engineers for past courtesies.

The Vice-President for Zone B, Mr. E. V. Buchanan, was then introduced who welcomed the members of the American Society of Mechanical Engineers to the meeting.

Mr. B. W. Beyer, Chairman of the Detroit Section of the American Society of Mechanical Engineers, replied for that society and then introduced the speaker of the evening, Mr. Henry G. Weaver, Director of General Motors Customer Research Division, who spoke on Sampling Public Opinion.

The speaker began by stressing the human side of customer research. He pointed out the growing popularity and interest in determining public reaction by the various polls now in use. He quoted a formula for business success by Kenneth Good, "Find what people like and do more of that. Find what people do not like and do less of that." He also questioned the truth of the old business motto, "The customer is always right."

The Customer Research Division of General Motors seeks to determine the desires of some 4,300,000 people. Its aim is to be the artificial substitute for the connection between consumer and producer that should naturally exist in a small business. The information it gains is carefully compiled and analysed. Often data from between the lines is of as great or greater importance than the other.

In illustrating the human side of the work, the speaker gave several humorous examples of the replies sometimes received. He pointed out that the information these gave could not be covered by cold statistics. Various tests of public reaction were described such as noting the effect on people of a purposely placed cover design or going through the wastebaskets of dealers. From these and similar tests, general laws are sometimes found. For example, more replies were received from questionnaires suggesting no reply and not enclosing stamped envelope than from those begging a reply and addressed envelope. Similarly, the enclosure of a leaflet telling why people should not answer questionnaires increased replies 20 per cent.

The speaker closed with thought that we have made much progress in sciences but world progress would be much greater if the technique of science could be applied to human understanding.

After a discussion period, a vote of thanks was moved by Mr. J. Clark Keith and seconded by Mr. Boyd Candlish. Coffee was then served.

HALIFAX BRANCH

L. C. Young, A.M.E.I.C. - *Secretary-Treasurer*
A. G. Mahon, A.M.E.I.C. - *Branch News Editor*

The Halifax Branch of The Engineering Institute of Canada, and the Association of Professional Engineers of Nova Scotia, held their annual joint banquet at the Lord Nelson Hotel, Halifax, January 25th. Features of the evening were the signing of an agreement linking the two bodies together into closer co-operation, and an address by J. A. Hanway, K.C., on the subject, "A Lawyer Looks at the Engineers."

The agreement between the two bodies, arrived at after some years of negotiations, was signed in a symbolic ceremony by Dean H. W. McKiel, president, and L. Austin Wright, general secretary for the national organization, and by S. W. Gray, president, and W. P. Morrison, secretary, for the provincial body.

S. W. Gray, A.M.E.I.C.
Retiring President of the A.P.E.N.S.

The signatures were witnessed by Col. F. W. W. Doane, dean of the engineering profession in Nova Scotia, and R. L. Dunsmore, for the E.I.C. and by Harold Johnston and R. W. McColough, for the A.P.E.N.S.

Prof. H. W. McKiel, retiring president of the E.I.C., proposed the toast to the co-operative agreement. Responding to the toast, S. W. Gray, the immediate past-president of the A.P.E.N.S., deplored the fact that trade unionism was gaining an entrance into the ranks of the engineering profession, and stated that this movement could not be effectively combated by the individual or local organization, but that it is a national matter, and assured the national president that any steps which might be taken by the E.I.C. to combat this movement would receive the co-operation of the Nova Scotian association.

Mr. Gray was joint chairman in the absence of R. B. Stewart, president-elect of the provincial organization, who was unable to attend on account of illness. Representing the Halifax Branch of the E.I.C. as joint chairman was Charles Scrymgeour.

Always one of the big social events of the year, the joint banquet was attended by approximately two hundred engineers from all over the province of Nova Scotia. Guest speaker was J. A. Hanway, K.C., chairman of the Board of Commissioners of Public Utilities, who concluded a witty address with a note of serious advice to his listeners, "to always maintain the high ideals of your profession." Other speakers and guests at the head table were Hon. J.

H. MacQuarrie, deputy mayor W. E. Donovan, L. Austin Wright, Col. F. W. W. Doane, and Michael Dwyer, former Minister of Mines for Nova Scotia.

Entertainment of high calibre, under the direction of K. L. Dawson, consisting of singing and dancing, was presented at intervals throughout the evening.

The members of the committee responsible for this very successful function are as follows: G. F. Bennett, chairman; J. J. Sears, Elmer Ball, B. H. Zwicker, R. W. McColough, L. MacC. Allison, W. H. Noonan, R. D. McKay, S. W. Gray, K. L. Dawson, I. P. McNab.

HAMILTON BRANCH

A. R. Hannaford, a.m.e.i.c. - *Secretary-Treasurer*
W. E. Brown, Jr.e.i.c. - - *Branch News Editor*

At the monthly professional meeting held on February 19th, at McMaster University, Dr. A. E. Berry addressed Members and visitors on the subject entitled, **Engineering in Public Health Activities.**

W. L. McFaul introduced the speaker and pointed out that in addition to Dr. Berry being Director, Division of Sanitary Engineering, Ontario Department of Health, he is Chairman of the Toronto Branch, E.I.C.

The speaker set forth two objectives for engineering in public health; first, the control of disease and secondly the raising of the standard of living. Reviewing the history of public health we saw that sanitation is an old problem, the children of Moses, the Greeks and the Romans all dealt with this work. The Greeks raised personal hygiene to a standard higher than had been reached before their time and perhaps since. The Romans carried out vast projects for the supply of water and other branches of sanitation. A period was reached in Europe and England when all these matters of health were discarded and then plague and disease became rampant. The discovery of vaccine for small pox in the year 1796 and later the findings of Pasteur in the relation of bacteria to disease gave new impetus to public health work. A milestone was reached in the publication in 1874 of the first report of the Health of Towns Commission, in England and the Public Health Act followed in 1875, which has served as a model for public health legislation all over the world. It is noteworthy that an engineer served on the first Provincial Board of Health, namely, Dean Galbraith of the Faculty of Applied Science, University of Toronto.

Dr. Berry deplored the lack of interest taken by engineers in connection with the supply and control of milk, which he stated is very definitely an engineering matter. Since compulsory pasteurization had been in force it was a fact that the number of cases of typhoid fever had been reduced by 50 per cent.

The field of sanitary engineering is primarily concerned with the control of disease, meeting the problems of water supply, sewage disposal, stream pollution, collection and disposal of refuse, recreational sanitation and the problems of milk control.

Speaking of water supply the speaker said we were apt to refer to the "good old days" when people lived longer, but this was not the case, for at one time the death rate was 80 persons per year for one thousand persons, later reduced to forty, and at the present time the rate is about 10 per 1,000. (In Hamilton the rate is actually 9.3.) Smells do not spread disease as often supposed and to be clean does not always mean sanitary; to be sanitary is to be in such condition that disease cannot be encouraged.

This very instructive address was illustrated with lantern slides, and the meeting enjoyed the company of Mr. Bennett from London and Mr. Sisson, Councillor of the Toronto Branch, also Mr. Spence, Secretary of the Toronto Branch. A vote of thanks to the speaker was moved by A. R. Hannaford. At the close of the meeting, Chairman Alex Love spoke briefly on our affection for the late Lord Tweedsmuir and the loss that the Institute and the Dominion of Canada feels at this time.

After the meeting the assembly adjourned for the usual coffee and period of mixing.

KINGSTON BRANCH

J. B. Baty, a.m.e.i.c. - *Secretary-Treasurer*

A regular dinner meeting of the Branch was held at Queen's Students' Memorial Union on Thursday evening, January 18th. More than the usual number of members and student members were in attendance. The attraction was an illustrated lecture on **Finland and International Politics** by Dr. E. L. Bruce, Miller Memorial Research Professor in Geology at Queen's University and Vice-President of The Geological Society of America. Dr. Bruce spent much time in Finland last summer and spoke with first hand information, illustrating his splendid talk with a number of lantern slides of pictures which he had taken. In addition to the general topic of his talk, Dr. Bruce told many interesting things concerning the customs of the people in Finland, mixing in a few humorous incidents which he had experienced. A short account of his speech follows.

Finland was a part of the Russian Empire from 1809 to 1917. During much of that time it had a large measure of self-government and remained a separate unit. The greater part of the population of Finland is Finnish. People of Swedish descent make up about 11 per cent. Lapps form a small group in the north and there are some Slavs in eastern Finland.

Most of the Finns are small farmers, but the produce of the land is barely sufficient for the agricultural population. Forest products form the largest export commodity. Russia has no present need of additional forest resources. Mining has been a small industry. The Outokumpu copper mine in central Finland produces about twelve thousand tons of copper per year. The most important mineral despoits known in Finland are those of nickel at Petsamo. These should have begun to produce this year had the Russian invasion not occurred. The nickel deposits would aid materially in the Russian industrial expansion and in the building up of the Murmansk area.

A second ice-free port on the Arctic would be of considerable advantage. Power developments at Imatra in southeastern Finland would be valuable as a source of energy for the Leningrad area.

The acquisition of Finland by Russia could be of no material assistance to Germany in the present war. Finland can produce no surplus of food stuffs. It is likely that the plant and mines at Petsamo have been so severely damaged that production of nickel will be delayed for at least three or four years. The copper from Outokumpu has always gone to Germany. It seems likely that should Russia gain control of that area, any copper produced would be diverted from Germany to meet the import demands of Russia, which are much in excess of the Finnish production.

A powerful factor in deciding the Russian policy may have been the ambition of those in power to regain all of the territory once part of the old empire. Successful invasion of Finland could be acclaimed as a great step toward the world revolution that the more extreme communistic group has urged. Stalin may have found it expedient to take some action to satisfy that demand.

LONDON BRANCH

D. S. Scrymgeour, a.m.e.i.c. - *Secretary-Treasurer*
Jno. R. Rostron, a.m.e.i.c. - *Branch News Editor*

The annual dinner meeting and election of officers was held on the 26th January, 1940, at the Grange Tea Room, the speaker being Mr. R. F. Legget, Assistant Professor of Civil Engineering, University of Toronto, and his subject, **Building Downwards.**

The chair was occupied by Mr. Harry F. Bennett who called on Mr. J. A. Vance for his account of the meeting at Ottawa. Mr. Vance said that he proposed to read a short synopsis of notes of the meeting, which was done. He was acclaimed for his record.

Mr. Bennett then called on Mr. Legget who, he said, was the author of a book on Geology and Engineering, who would, no doubt, use excerpts and lantern slides to illustrate his address.

Mr. Legget said that civil engineering included something more than merely building upward. Although foundations were seen and thought of very little they were really an important part of the work. He then described the various types of foundations to be found in some of modern engineering's most recent achievements including Boulder and Grand Coulee dams, the Panama Canal, mountain highways and tunnels.

Sixty years ago French and British engineers made a study of the possibility of building a huge vehicular tunnel connecting England with Europe, he said. "From the theory viewpoint of engineering the task was feasible but the social and economic factors discouraged further investigation." Such a tunnel would be by far the greatest ever attempted. Such an engineering feat could be accomplished but experts did not believe it would be built for many years to come.

In closing, Professor Legget gave a graphic description of the gigantic toll soil erosion is inflicting on Canada and the United States annually. This was an important problem that very little was being done about, although its control now meant much to the welfare of future generations.

This was listened to by 60 engineers and friends.

MONTREAL BRANCH

L. A. Duchastel, a.m.e.i.c. - *Secretary-Treasurer*

On January 25th, Mr. J. K. Sexton presented a paper illustrated by slides on **Hydro-Electric Work in Bolivia.** Having resided for almost three years in Bolivia, the speaker gave a very vivid description of the construction of hydro plants under very peculiar conditions. Through the courtesy of Mr. Krug a motion picture taken in Bolivia was also shown.

The Annual Branch Smoker was held on February 1st and was a pronounced success, over 400 members attending. The reception committee, under the chairmanship of C. R. Lindsey, provided a very interesting and entertaining programme.

Mr. M. S. Layton spoke to the branch on February 8th on **Welding Rods and Their Coatings,** describing the earlier types of welding wire and its evolution, discussing the various types now in use, the mechanism of coatings and their effect.

On February 15th the branch was fortunate in hearing an address by Mr. W. F. Hosford, vice-president of the Western Electric Co., Ltd. on **Some Problems and Responsibilities of Industrial Management.** The speaker referred to the modern methods of management adopted by his company and gave the audience food for thought which was amply demonstrated by the ensuing discussion.

Mr. Paul Sise, president of the Northern Electric Co. Ltd., presided at the meeting.

The subject of Co-axial Cable Systems was treated on Feb. 20th by Mr. M. E. Strieby of the American Telephone and Telegraph Company under the chairmanship of H. J. Vennes. The speaker gave an illustrated talk on **Co-axial Cables** and their merits for broad band transmission, touching upon the problem of television transmission. Previous to the meeting a courtesy dinner was given at the restaurant of the Bell Telephone Company.

Junior Section

Gilbert Coupienne, a student of the Ecole Polytechnique, presented a paper on **Gravel Road Surface Stabilization** before the Junior Section on February 5th. This paper, dealing with principles and practice of road surface treatment, was illustrated by moving pictures supplied by the Brunner Mond Canada, Ltd.

On February 19th the Junior Section heard two addresses by students, **Architecture in Engineering** by Stuart McNab and **Examination of Welded Structures** by Fernand Marchand. Both of these papers were very interesting and well presented.

NIAGARA PENINSULA BRANCH

Geo. E. Griffiths, a.m.e.i.c. - *Secretary-Treasurer*
J. G. Welsh, a.m.e.i.c. - - - *Branch News Editor*

On the evening of January 31st, the Niagara Peninsula Branch held a dinner meeting at the General Brock Hotel, Niagara Falls, Ont. Following the dinner, Chairman A. W. F. McQueen conducted a brief business session during which a nominating committee for the new executive was appointed, consisting of Mr. C. G. Moon, Mr. L. C. McMurtry, Mr. G. H. Wood, Mr. W. R. Manock and Mr. Paul Buss.

Mr. H. G. Acres introduced the speaker of the evening, Wing Commander D. G. Joy. Mr. E. L. Cousins, General Manager of the Toronto Harbour Commission, was scheduled to give an illustrated talk on **Airports,** but due to illness was unable to attend. However, Mr. Cousins was good enough to send his slides and motion pictures and Wing Commander D. G. Joy, District Inspector of Civil Aviation, delivered the address.

Briefly outlining the problems in airport construction, Wing Commander Joy pointed out that by careful study of topographical maps suitable sites were chosen, convenient as possible to the municipality, and such that a minimum of grading would be required. After a site was definitely determined, came the problem of grading a large soil area. The thin cuts or fills and large amounts of dirt to be moved have been a real test for contractors and designers of grading machinery. For drainage a very rapid run-off is required, and since the maximum permissible gradient is very flat, a great amount of underdrainage is required. At Malton the header drain is fifty-four inches in diameter! Then there is the matter of surfacing. The runways should be hard surfaced, the construction being similar to highway work, but necessarily much wider. Traction is not quite so important, but it must not be slippery or glossy when wet or dry. Above all there must be no loose material to be thrown around. The remaining surface of the field must be level and preferably sodded. Finally, there is the matter of lighting. Floodlights have not been found very satisfactory due to shadows and glare. Runway markers prove to be the best but those flush with the ground are difficult to keep clear, and those elevated are dangerous.

With respect to Toronto, after a great deal of research work, and consideration of various sites, it was decided to have a field at the island for use in good weather, this being particularly convenient to the business section of the city, and a larger field at Malton for use in bad weather. This latter field is to be equipped with every known safety device and thus provide a safe terminal in any type of weather for that section of the province. It was worthy of note that due to low elevation and unobstructed exposed position of the island airport the snow does not pile up and melts very quickly. At Malton more trouble has been experienced with snow. Auxiliary runways of compacted snow, which have proved so satisfactory further north, were unsuccessful there, so efforts will be made to keep the runways scraped clear.

A large number of slides were shown of the construction work at Malton and at the island. In both cases the runways were made one hundred and fifty feet wide, with a crushed stone base, a thick layer of coarse aggregate asphalt and a surface layer of fine aggregate asphalt. White crushed marble was used for the central strip and a strip on either side similarly treated, the latter, however, was intermittent so that the pilot could easily distinguish the centre of the runway. The runways at the Island are at present three thousand feet long and by filling in on the lake side these will soon be lengthened. The bay provides excellent facilities for seaplanes.

Views of the hangars and administration buildings proved interesting. The administration buildings while small, are modernistic and attractive and will be ample for several years, at which time further needs will be better estimated.

Several reels of motion pictures of many of the major airports in the United States were very enlightening.

The keen interest taken in this subject was indicated by the number of questions asked Wing Commander Joy. At this time he pointed out that whereas once two hours was all that was expected of a motor without a complete overhaul, now they are guaranteed up to one thousand hours. Also that the average pilot experiences no difficulty, and no undue stresses are imposed on the plane in landing at angles of twenty degrees or more from a line directly into the wind.

Mr. C. G. Moon moved a hearty vote of thanks to Wing Commander Joy for his courtesy in filling in, and for his excellent talk.

OTTAWA BRANCH

R. K. Odell, a.m.e.i.c. - *Secretary-Treasurer*

At one of the most largely attended noon luncheons of the Ottawa branch held at the Chateau Laurier on February 1 the members and their friends listened to an account of progress made to date and future plans of the British Commonwealth Air Training Plan. W. H. Munro, newly-elected chairman of the branch, presided for the first time since his election and extended a welcome on behalf of the Institute to fourteen of the high ranking officers of the Royal Air Force now in Ottawa in connection with the plan, who attended the luncheon. Officers of the Royal Canadian Air Force were also present in considerable number.

The address, **Canada Spreads Her Wings,** was given by the press liaison officer of the R.C.A.F., Flying Officer Fergus Grant, who traced the course of the Force since its creation as the C.A.F. about twenty years ago, and referred to the various steps leading up to the commencement of the air training plan.

At the conclusion of the address Group Captain D. D. Banting, of the Royal Air Force party who attended, was called upon and expressed his appreciation on behalf of his brother officers of all that had been done for them by Canadians. The officers had previously been introduced individually to the gathering.

QUEBEC BRANCH

Paul Vincent, a.m.e.i.c. - *Secrétaire-Trésorier*

A l'ouverture de la saison 1939-40 la Section de Québec présentait une soirée de films parlants sur des sujets techniques variés. La réunion avait lieu à l'amphithéâtre de l'Ecole Technique de Québec le 18 décembre, et elle fut bien réussie.

Sous la rubrique **Excursions in Science,** les films de la Canadian General Electric Company renseignèrent l'auditoire sur la fabrication des lampes électriques, sur l'utilisation de la cellule photo-électrique pour le triage des matériaux et sur différentes applications de l'électricité.

C'est ainsi qu'il fut possible de voir comment la voix humaine peut actionner un train électrique, comment les courants électriques les plus faibles peuvent s'évaluer au moyen d'un tube super sensitif et comment l'épaisseur des couches de peinture peut se mesurer électriquement, permettant un travail plus économique et plus perfectionné.

Science of Seeing nous a démontré la grande importance de nos yeux. La perte d'un membre se remplace artificiellement sans trop d'inconvénients, les fausses dents ne nous empêchent pas de manger, mais avec un oeil artificiel, l'on ne voit pas.

On constate que 20 pour cent chez les enfants ont une vue défectueuse, 40 pour cent chez les adultes et 95 pour cent chez les vieux. La moyenne générale des vues défectueuses est donc de 50 pour cent par suite du manque de bonne illumination.

Comparativement, le soleil nous fournit 1,000 chandelles (foot-candles) à l'extérieur et 200 chandelles près d'une fenêtre à l'intérieur, tandis que le soir à la lumière artificielle d'une lampe électrique de 40 watts nous nous contentons de 5 chandelles seulement. C'est réellement un pauvre éclairage quand on constate que pour lire, l'illumination moyenne requise est supérieure à 100 chandelles. Suivant ces films, il faut assez de lumière, et éviter les contrastes et les reflets. Si nous désirons nous éclairer pour voir confortablement nous devons donc utiliser le nombre de lampes nécessaires pour conserver notre vue et non la détruire.

Pour terminer la soirée, les membres furent mis au courant d'un nouveau type de garde-fous pour nos routes, présentés par la V. S. Tuthell Spring & Convex Steel Highway Guards. Il y était démontré que ces gardes ont l'avantage d'être plus durables, plus flexibles, de réparation plus facile et plus rapide que le bois dans une proportion de 80 per cent. L'on pouvait voir une auto enfoncer les gardes en bois à une vitesse de 8 milles à l'heure, tandis que le système nouveau résistait à un véhicule frappant les gardes à une vitesse de 40 à 50 milles à l'heure sous des angles de 10 à 35 degrés.

On a aussi constaté que la carosserie en subit des avaries insignifiantes et que le conducteur ou les occupants s'en tirent avec de légères secousses, contrairement à ce qui arrive avec les gardes-fous ordinaires. Le président de la Section, Monsieur Méthé, présidait l'assemblée.

SAINT JOHN BRANCH

F. L. Black, Jr.e.i.c., *Secretary-Treasurer*

Over 60 members of the new Brunswick Association of Professional Engineers and the local branch of the Institute attended a joint dinner at the Admiral Beatty Hotel on January 18th, 1940. H. F. Morrisey, Chairman of the Saint John Branch, introduced President McKiel and thanked him heartily at the close of his address. Other speakers included John N. Flood, who proposed the toast to the Association of Professional Engineers; G. A. Vandervoort, President of the Association, who responded to this toast; and C. B. Crosdale, who proposed the toast to the Institute. Dean McKiel, who is the first Maritimer to hold the presidency of The Engineering Institute of Canada, responded to the toast to the Institute.

"We are prepared to accept the good things of democracy; are we as prepared to accept the responsibilities? If not, I see that the democracies are in for very black days." This was the keynote of President McKiel's address on the place of the engineer in national life.

Stressing the important part played by engineers in the national war effort, as well as in peace time, the speaker exhorted fellow engineers to recognize their responsibilities in the social and economic life of the country as well as in the material and professional spheres.

SASKATCHEWAN BRANCH

J. J. White, m.e.i.c., *Secretary-Treasurer*

On Monday, December 18th, 1939, the Saskatchewan Branch held its monthly meeting in the Kitchener Hotel, Regina, when fifty members assembled at 6.15 p.m. for dinner which preceded the meeting.

J. E. Thom, Jr. e.i.c., was the chairman of the meeting which was devoted to a general discussion of the **Education, Training and Experience of the Young Engineer.**

The discussion was led by several of the younger members of the organization and proved to be very instructive and interesting. This meeting was held as a result of the inspiration left by the President on his western trip, last fall.

There was a great deal of discussion by the older members following the talks prepared by the younger members of the organization.

On motion of Mr. H. S. Carpenter, a hearty vote of thanks was extended to the younger members for their effort in making the meeting the success it proved to be.

The first meeting of the 1940 schedule of the Saskatchewan Branch was held on Monday, January 22nd, in the Kitchener Hotel, Regina. The Chairman of the Papers and Meetings Committee, D. D. Low, had arranged a Ladies'

Night and approximately one hundred sat down to dinner, which preceded the meeting.

P. E. Kirkpatrick acted as Chairman and introduced S. G. Bard, Field Collector and Preparator of the Provincial Museum, as the speaker of the evening, his subject being **Nature Appreciation.**

Mr. Bard went on to discuss the value of birds from an economic and aesthetic point of view, tracing to evolution of birds from the toothed varieties, down to the present-day birds that have changed but little in the last million years. Migration routes were shown and examples of the various types of birds following these air lanes. It is interesting to note some of these migrants travel several thousand miles from their winter to summer homes.

Motion pictures were shown of a pair of barn swallows. These swallows were first trapped at Regina Beach, Saskatchewan, in 1937 and have come to this barn each summer since. To date they have raised twenty-five young and have travelled approximately sixty-three thousand miles.

Changes were also noted in the migration of birds, more especially water birds. The colonial nesters are migrating when the lakes have not seriously been affected by the drought. The true prairies in Saskatchewan no longer house the great colonies of Pelicans. The few seen during the summer floating about like small white sailboats are non-breeders. The breeding colonies are re-established on islands in our forest areas. Ducks for the past two seasons have travelled south along our provincial boundaries. These areas have experienced unusual rains during the past few seasons.

Sanctuaries were created years ago to help maintain our abundant waterfowl. The drought has seriously affected many of these and with co-operation of various bodies new ones will likely be established. Waterfowl has decreased through various agencies, perhaps the most serious are the drying up of nesting areas, lack of proper nesting cover has increased the damage done by predators and continued shooting.

The value of hawks and owls is seldom understood. The shooting of our slow flying hawks is one of the most serious mistakes. These rodent destroyers are among the most valuable agents we have. Object lessons could be learned from mistakes made in various parts of the world. Rodents destroy great quantities of vegetation and the gophers are very destructive where grain crops are concerned. It has been estimated our gopher eating hawks are worth ninety dollars to us here on the prairies.

The camera is serving as a conservationist in the fact that a number of sportsmen prefer to show pictures of "how it got away" rather than a "bag". There is no question that taking a picture of birds, animals, etc., requires more patience and skill than does shooting. Color photography has opened up an entirely new and fascintaing field.

The talk was illustrated with pictures taken by Mr. Bard in motion pictures, stills and color photography.

On motion of Col. A. C. Garner a hearty vote of thanks was extended to the speaker of the evening for his excellent discourse.

SAULT STE. MARIE BRANCH

O. A. Evans, Jr.E.I.C. - *Secretary-Treasurer*
N. C. Cowie, Jr.E.I.C. - *Branch News Editor*

The annual meeting for the year was held in the Windsor Hotel on Friday evening, December 22nd, 1939, when 27 members and guests sat down to supper at 7.15 p.m. The branch was honoured with the presence of Wm. Meldrum of Lethbridge, Alta., who later in the evening along with his son, A. H. Meldrum, delighted the branch with some piano selections. The branch was also honoured by a number of tap dances by two members of Miss Florence Pickering's dancing class. The business portion of the meeting began shortly after eight o'clock with the reading of the minutes of the previous meeting, which were adopted as read.

The accumulated bills and correspondence of the month were then dealt with. The preliminary business of the evening being over, the Chairman called for the reports of the year. The Secretary's report for the year 1939 was received and adopted. The Secretary reported a general increase both in membership and finance. W. S. Wilson and C. W. Holman were appointed auditors for the year 1939. The reports of the various committees were received. Wm. Seymour thanked J. L. Lang, the branch's permanent entertainment chairman, for his efforts on behalf of the branch. He also moved a vote of thanks to the entertainers of the evening.

C. Neufeld reported the results of the election of officers for the year 1940. Chairman A. E. Pickering then gave the chair to the new chairman, H. J. Leitch, who remarked that the branch should pay more attention to the topics of general interest. C. Stenbol moved that the meeting be adjourned. Later a social evening was held where items of general and local interest were discussed.

The first general meeting for the year 1940 got away to a flying start on Friday, January 26th, when 39 members and guests sat down to luncheon at 6.45 p.m. in the Windsor Grill Room.

The business portion of the meeting began at 8.00 p.m. The minutes of previous meeting were read and adopted on motion of A. H. Russell and R. S. McCormick. C. Senbol and K. G. Ross moved that the bills be paid. W. S. Wilson brought in the auditor's report for the year 1939. The books were found correct. The members then introduced their respective guests.

Chairman H. J. Leitch then introduced the speaker of the evening, Mr. George Ponsford, Director of the Ontario Provincial Air Service, who had as his topic, **Modern Aircraft Development.**

Mr. Ponsford stated that the aeroplane as a transport and a military weapon had come to stay; in fact it was one of the greatest defensive and offensive weapons in the world to-day. He paid tribute to the designers who have made the aeroplane what it is to-day and to the pilots who have died in the course of aeroplane development.

The modern aeroplane is becoming streamlined. One important item was flush riveting. It was found that rivet heads made a tremendous drag on the plane. Another important article was the retractable undercarriage, that is to say, the undercarriage or landing gear could be brought up into the plane after taking off; thus eliminating drag while in flight. Another factor which had made for stability in aircraft design was the wind tunnel. Models could be tested in it under conditions which approach actualities and faulty designs could be discarded. There has also been a tremendous development in engines. New alloys have been found which will stand a greater strain and are lighter. Thus a bigger power plant can be installed in a plane of the same wing spread. In the engine an interesting innovation was stellite faced valves which will stand greater heat and higher temperatures. Other new features are better fuels, superchargers, etc.

At first, he said, all planes had wooden propellers but it was impossible to change the pitch. Then the metal propeller came in with the pitch sets for the maximum r.p.m A further development was a propeller in which the pitch could be changed. It made for an easier take-off. A still later development was a constant speed propeller in which the pitch changes with the power need; however, it has a limited range of 16 to 17 deg. and at high diving speeds it acted as a brake.

One interesting development for the comfort of air passengers was the supercharged cabin which enabled the plane to fly at altitudes of 20,000 ft. with the air in the cabin at pressures which corresponds to lower altitudes of 8,000 ft. and so.

Mr. Ponsford illustrated his address with pictures of new planes and a constant speed propeller.

K. G. Ross moved a vote of thanks to Mr. Ponsford for his excellent address.

C. Stenbol moved the meeting be adjourned.

Library Notes

Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

Elements of Steam Power Engineering:
By J. B. O. Sneeden. Longmans, Green and Co. Toronto, 1939. 255 pp., illus., 5 by 7½ in., cloth, $1.50.

The Physical Examination of Metals; Vol. I. Optical Methods:
By Bruce Chalmers. Arnold, London, 1939. 181 pp., 5½ by 8¾ in., cloth, $4.20

U.S. Bureau of Reclamation:
Boulder Canyon Project: Bulletin Three, Model Tests of Boulder Dam; Bulletin Four, Stress Studies for Boulder Dam.

REPORTS

American Concrete Institute:
Reinforced concrete design handbook.

Aluminum Research Laboratories:
Tests of 28-foot span aluminun alloy trusses by R. L. Templin, E. C. Hartmann, H. N. Hill.

Bell Telephone System: High Definition Television; Improved Microtome Technique for Soft Metals; Dielectric Measurements in the Study of Dispersions in Rubber; Frequency-Modulation: Theory of the Feedback Receiving Circuit; Survey of Magnetic Materials and Applications in the Telephone System; Impedance Properties of Electron Streams; Plastic Materials in Telephone Use; Room Noise at Telephone Locations; The Self-diffusion of Copper; Simultaneous Ionosphere Observations; Cold-cathode Gas-filled Tubes as Circuit Elements; Inductive Co-ordination with Series Sodium Highway Lighting Circuits; Electron Diffraction Studies of Thin Films; The Automatic Synthesis of Speech.

Canada Department of Labour:
Labour organization in Canada (for the year 1938); Report for fiscal year ending March 31, 1939.

Canada Department of Mines and Resources, Bureau of Mines:
Inverness County Coalfield (Physical and chemical survey of coals from Canadian collieries). December, 1939, Milling Plants in Canada.

Canada Department of Public Works:
Report for the year ended March 31, 1939.

Canada Department of Trade and Commerce:
Canada, 1940, Official handbook of present conditions and recent progress. 25c.

Canada Department of Transport:
Annual report for year ended March 31, 1939.

Edison Electric Institute:
Combustion, 1939 (Report of the Combustion Subcommittee of the Prime Movers Committee); Electric metal-melting furnaces (Report of the Industrial Power and Heating Committee); Cable operation, 1938 (Report of the Transmission and Distribution Committee).

Engineers' Council for Professional Development:
Present status and trends of engineering education in the United States (a report prepared by Dugald C. Jackson).

Great Britain Department of Scientific and Industrial Research National Physical Laboratory:
Notes on screw gauges, 4th ed., 1938, 4s. 6d.

Smithsonian Institution:
Annual report for the year ended June 30, 1938.

New Jersey:
Road mileage survey.

U.S. Department of the Interior Geological Survey: Geology and Fuel Resources of the Southern Part of the Oklahoma Coal Field, Pt. 4. The Howe-Wilburton district, Latimer and Le Flore counties; Gravel and Sand Deposits of Eastern Maryland; Geology and Coal Resources of the Minot Region, North Dakota; Geophysical Abstracts 95; October-December, 1938; Transit Traverse in Missouri, Pt. 1, Southeastern Missouri, 1903-37; The Mineral Industry of Alaska in 1938. (Bulletins 874-D, 906-A, 906-B, 909-D, 916-A, 917-A). Water Levels and Artesian Pressure in Observation Wells in the United States in 1938; Surface Water Supply of the United States, 1938, Pt. 4, St. Lawrence River Basin; Pt. 10, the Great Basin, Pt. 11, Pacific Slope Basins in California, Pt. 13, Snake River Basin, Pt. 14, Pacific Slope Basins in Oregon and Lower Columbia River Basin. (Water-Supply Papers 845, 854, 860, 861, 863, 864.)

University of London:
Calendar, 1938-39.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

A.S.T.M. STANDARDS on ELECTRICAL INSULATING MATERIALS. Specifications, Methods of Testing.
Prepared by Committee D-9. Oct., 1939, Philadelphia, American Society for Testing Materials. 309 pp., illus., diagrs., charts, tables, 9 x 6 in., paper, $2.00 (A.S.T.M. members, $1.50).

In addition to the current report of the responsible committee, this pamphlet contains eleven standard and eighteen tentative methods of testing for electrical insulating materials, and also three specifications. In addition, there are ten specifications covering certain rubber and textile products and methods of testing shellac.

CAST METAL HANDBOOK, 1940 ed.
Chicago, Ill., American Foundrymen's Association, 1939. 532 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $5.00.

This revision of the 1935 handbook is intended, as before, to provide designers and users of castings with up-to-date, correct information on the properties and applications of cast metals. The first section consists of recommendations to designers of castings, the second of recommendations to buyers. Succeeding sections give information upon the properties and uses of cast iron, malleable cast iron, cast steel, and the principal nonferrous casting alloys.

The CONSTRUCTION of ROADS and PAVEMENTS
By T. R. Agg. 5 ed. McGraw-Hill Book Co., New York and London, 1940. 483 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $4.00.

This text is intended to be a "concise presentation of approved practice in the construction of roads and pavements and of the principles involved." Questions of administration, finance, plans, design and surfacing are covered comprehensively. The new edition is entirely rewritten and much new material introduced.

ELECTRICAL COMMUNICATION
By A. L. Albert. 2 ed. John Wiley & Sons, New York, 1940. 534 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $5.00.

This textbook covers the whole field of electrical communication by wire and wireless transmission of code and speech. The various divisions of telegraphy, telephony and radio are not treated as isolated subjects, but their interrelations in providing an adequate, economical communication service are presented. This edition has been revised and enlarged, and the bibliographies attached to the chapters have been brought up to date.

ELEMENTARY CALCULUS
By G. W. Caunt. Clarendon Press, Oxford (England); Oxford University Press, New York, 1939. 388 pp., diagrs., charts, tables, 8 x 5 in., cloth, $2.75.

Both differential and integral calculus, with their geometrical applications, are covered in this adaptation from the author's larger treatise. Polar co-ordinates, centroids, curvature and Taylor's theorem are included, but partial differentiation and differential equations are omitted. There are many examples to be worked, with the answers grouped at the back of the book.

ENGINEERING DRAWING, Practice and Theory
By I. N. Carter. Scranton, Pa., International Textbook Co., 1939. 264 pp., illus., diagrs., charts, tables, 11½ x 8½ in., cloth, $2.50.

This textbook presents the subject in a novel way, by combining descriptive geometry and engineering drawing in a single course of study which thus covers both theory and practice. Considerable saving of time by elimination of duplication of classroom work is claimed. The book covers the fundamental principles of machine, structural and topographic drafting, according to accepted drafting-room methods.

EXCURSIONS in SCIENCE
Edited by N. B. Reynolds and E. L. Manning. McGraw-Hill Book Co., Whittlesey House, New York, 1939. 307 pp., 8 x 6 in., cloth, $2.50.

Thirty scientists present, in simple language, stories of their respective sciences, from organic chemistry to atomic physics, from archeology to astronomy. The book is based on a series of radio programmes sponsored by the General Electric Company.

Employment Service Bureau

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

SITUATIONS VACANT

MAN with science degree, chemistry, engineering and practical knowledge of steam boiler plant operation. Strong personality and progressive nature are required to sell the technical service and product of this company. Apply to Box No. 2003-V.

CHEMICAL ENGINEER OR CHEMIST who has msjored in Organic Chemistry with a few years experience in Laboratory or Factory in connection with developing rubber compounds: knowledge of, or experience in, allied synthetics desirable, In applying please state age, details of educational background and experience, salary desired and availability. Box No. 2013-V.

EXPERIENCED SHOPMAN with technical training required for general shop supervision of metal working plant. Apply to Box No. 2038-V.

CIVIL SERVICE VACANCY

Competition No. 40-235.—Applications are invited from male residents of the Province of Nova Scotia, for the position of **Junior Engineer**, Department of Puhlic Works, Halifax, N.S.

Time Limit: Application forms, obtainable at the Post Offices in the cities and larger towns, the Offices of the Employment Service of Canada, or from the Civil Service Commission, Ottawa, properly filled out, must be filed with the Civil Service Commission, Ottawa, **not later than March 18, 1940.**

Salary: In the event of permanent appointment, the initial salary of $1,800 per annum may be increased upon recommendation for meritorious service and increased usefulness, at the rate of $120 per annum, until a maximum of $2,160 has been reached.

Duties: To inspect construction work in progress and lay out work according to plans; to supervise dredging operations and to make soundings; to make surveys; to calculate quantities and estimate cost of work; to prepare detail drawings, plans and specifications in accordance with instructions; and to perform other related work as required.

Qualifications Required: Graduation in engineering from a university of recognized standing, with one year of experience in engineering work, or graduation from the Royal Military College of Canada with two years of engineering experience; junior membership in The Engineering Institute of Canada or membership in a provincial Association of Professional Engineers, or professional qualifications which would permit of such membership; good judgment, and ability to deal with men.

Age Limit: Preference will be given to qualified applicants who are not more than approximately 35 years of age on the last day for the receipt of applications.

Nature of Examination: A rating on education and experience will be given from the sworn statements, supporting documents, and other evidence submitted by applicants on and with their application forms. Candidates must give full particulars regarding their technical training and experience, especially as they hear on the qualifications for and duties of this position. An oral examination may be given, if necessary in the opinion of the Commission. No examination fee is required.

Eligible List: An eligible list, valid for a period of one year, for temporary and permanent appointment, may be estahlished.

Note: Future vacancies in positions of Junior Engineer, Department of Public Works, in the Province of Nova Scotia, may he filled by assignment from the eligible list which will be established as a result of this competition.

EMPLOYERS!

The Institute's Employment Service has on file the records of many young men graduating this spring in all the branches of engineering. Most of these graduates have had some early engineering experience during their vacations.

In recent weeks the demand for engineers has risen to a point where a scarcity has developed; therefore, we strongly recommend that employers arrange now for any extra help that they may require permanently or for the summer.

SITUATIONS WANTED

INDUSTRIAL EXECUTIVE, technically trained, 16 years experience in engineering, purchasing, production, manufacturing, technical sales, merchandise, general administration, and industrial relations. Box No. 185-W.

ELECTRICAL AND CIVIL ENGINEER, B.sc. Elec. '29, B.sc. Civil '33, Jr.E.I.C. Age 33. Experience includes four months with Can. Gen. Elec. Co., approximately three years in engineering office of large electrical manufacturing company in Montreal, the last six months of which were spent as commercial engineer, also experience in surveying and about two years highway construction Year and a half employed in electrical repair. Best of references. Apply to Box No. 693-W.

CIVIL ENGINEER, M.A. (Cantab.). A.M.Inst. C.E., A.M.E.I.C. Age 35. Married. Experienced general construction, reinforced concrete, roads, hydroelectric design and construction, surveys. Apply to Box No. 751-W.

MECHANICAL ENGINEER, Jr.E.I.C., Technical graduate, married, two children. Thirteen years experience design of steam boiler plants, heating, ventilating, air conditioning, piping layouts, estimates, specifications, also sales and general engineering. Available on short notice. Box No. 850-W.

ELECTRICAL ENGINEER, B.A.Sc. General Electric test course, induction motor and D.C. machine design. Now employed in minor executive capacity. Has also had experience as instrumentman on highway construction. Wants opportunity to serve where technical training can be used to better advantage. Apply to Box No. 993-W.

MECHANICAL ENGINEER, B.A.Sc., A.M.E.I.C. Eight years experience in shop practices, field erection, draughting, design and estimating. Advanced training in Industrial Management. Would like to work with an industrial engineering firm or act as an assistant to a manufacturing executive to gain further training n industrial leadership. Married. Age 32. Apply to Box No. 1543-W.

CIVIL ENGINEER, B.Sc., S.E.I.C. Married. Six months surveying; mill site; water supply, power line location, earthwork, drainage, topographic. Has given field instruction in surveying. Three months hridge maintenance, asphalt paving inspection in two provinces. Five months draughting. Excellent references. Speaks some French and Spanish. Will go anywhere. Availahle on two weeks notice. Apply to Box No. 1860-W.

CIVIL ENGINEER, B.Sc. '25; A.M.E.I.C. Fifteen years extensive general experience now desires permanent industrial or municipal connection. Experience includes surveying and mapping; highway construction; construction, operation and maintenance of wharves, dredged channels, water supply and sewerage systems, miscellaneous plant buildings, reinforced concrete structures. Executive hackground with experience at purchasing and office management. Available at short notice. Box No. 1919-W.

ELECTRICAL ENGINEER, B.Sc. (Manitoba '34) A.M.E.I.C. Married, Canadian. Experience includes year and half with British electrical firm in England on apprenticeship course and erection work. Three years as sales engineer of wide range of electrical apparatus. Work included draughting and outside erection of diesel driven generating equipment, etc., also draughting and layout design. Experienced in office routine and correspondence and can meet public. References are available and will consider any location. Box No. 2022-W.

CIVIL ENGINEER, B.A.Sc. (Tor. '34). Age 27. Single. Two years experience with well known firm of consulting engineers in surveying, waterworks and sewer design and construction and municipal engineering. Three and one half years experience in the design of mining machinery of all kinds including sales engineering work in the mining districts of Northern Ontario and Quehec. Well experienced in structural and mechanical detailing. References. Apply to Box No. 2041-W.

SALES ENGINEER, fifteen years experience in sales and sales management, oil burners, heating, industrial heavy oil burners and air conditioning equipment. McGill graduate. Apply Box No. 2046-W.

CIVIL ENGINEER, graduate N.S. Tech. College (Civil '38)—13 months experience with Geodetic Survey in field, 6 months taking inventory of electrical distribution system for utility evaluation, 2 months office appraisal for same, 8 months hydroelectric design, including drafting plans for dam, spillway, tail race and power house of reinforced concrete, 4 months general maintenance work including drawing plans for warehouses and repair jobs. Would accept position anywhere in Canada. Age 23. Good health. Jr.E.I.C. Single, British Nationality. Box No. 2069-W.

ELECTRICAL ENGINEER, B.Sc. (Alta. '36), S.E.I.C. Canadian, age 25, single. Six months general surveying, including plane tahle, level and transit work. Experience in large western industrial plant includes six months as shift engineer, one year as electrician, eighteen months as assistant plant engineer. Work included draughting, design, estimates and specifications for plant layouts, conveying equipment, etc. Also some experience with production work. Desires permanent position with future. Good references available and will consider any location. Box No. 2071-W.

PHYSICAL METALLURGIST, M.S., Jr.E.I.C., A.S.M. Age 24, single, presently employed. Wide experience with large steel company in all types of metallographic testing, investigation of complaints, commercial heat treatment. Familiar with steel mill operation and production of automotive, alloy forging, rail and structural steels. Box No. 2080-W

MECHANICAL ENGINEER, B.Eng. Mech., N.S.T.C. '35, A.M.E.I.C. 8 mos. hwys. constr. One year surveying and mapping, one year lecturing in mathematics, 18 mos. engr. in charge of surveys and constr. Writing and speaking ability. Particularly interested in specializing. Single and at present employed. 2083-W.

ELECTRICAL ENGINEER, B.E. (N.S.T.C. '36), S.E.I.C. Age 25. Married, no children. One year's experience electrical installation, operation and maintenance of power house, motors, generators, alternators, transformers, switching gear, underground cables, airport field lighting, conduit wiring, house wiring and lighting at Newfoundland Airport. One and a half year's experience in manufacturing plant in responsible position including about six months in official capacity. References. Location immaterial. Available on about two weeks notice. Box No. 2085-W.

COST ENGINEER, B.A.Sc. Age 29. General experience covers drafting, surveying, estimating and accounting. Special training in costing and management with successful experience in this work for the last two years Wishes to contact construction or manufacturing company having good opportunities for a technically trained cost man. Apply Box No. 2087-W!

AERONAUTICAL ENGINEER, B.A.Sc., A.M.E.I.C. Age 37, married. Experienced in all phases of aircraft design and production. Desires position of responsibility where training can be used to better advantage. Apply Box 2126-W.

PRELIMINARY NOTICE

of Application for Admission and for Transfer

February 29th, 1940

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

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

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

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

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

The Council will consider the applications herein described in April, 1940.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

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

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

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

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

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

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

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

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment 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

ANGUS—HARRY HOLBORN, of 1221 Bay St., Toronto, Ont. Born at London, Ont., December, 1881; Educ.: B.A.Sc., Univ. of Toronto, 1904; R.P.E. of Ont., 1904-12; dftsman & designer with Canadian Ingersoll Rand., Westinghouse Machine Company, Western Electric Co., and Bethlehem Steel Co.; 1912-15, consltg. engr., Toronto; 1915-17, member of firm, MacMullen, Riley & Angus, New York & Toronto; 1919 to date, consltg. engr., Toronto, specializing on mechanical, electrical, ventilation, plumbing, and power plants for bldgs.

References: A. H. Harkness, M. B. Watson, C. S. L. Hertsberg, R. E. Smythe, E. A. Cross.

BARNARD—WILLIAM ALFRED CHARLES, of 40 Beachdale Ave., Toronto 13, Ont. Born at Strood, Kent, England, Jan. 3rd, 1905; Educ.: 3 evening terms at Central & Danforth Technical Schools, Toronto; 1919-26, ap'ticeship with Rolph, Stone, Clark Ltd., lithographers, learning all forms of lithographic art reproduction, and 1926-27, continued with same firm in similar work as journeyman dftsman. and artist; 1928 to date, asst. to the chief geographer, surveys branch, Dept. of Lands & Forests, Ontario Provincial Government, Toronto, Ont. (Applying for admission as an Affiliate).

References: J. L. Morris, W. J. Thomson, J. M. Gibson, A. Hay, R. M. Smith.

BONENFANT—EDMOND, of Duparquet, Que. Born at St. Bruno de Kamouraska, Dec. 25th, 1909; Educ.: 1926-29, Quebec Technical School—Diploma in Mechanics; 1939, I.C.S. Diploma in Inorganic Chemistry; 1928-30, and 1932-33, transitman on surveying party, M. Laberge, Montreal, and R. E. Joron, Chicoutimi; 1934 to date, asst. chemist & metallurgist, and at present, asst. metallurgist & refinery operator, Beattie Gold Mines Ltd., Duparquet, Que.

References P. Methe, A. V. Dumas, J. Dumont, R. E. Joron, A. Frigon.

BOUCHER—OMER JOSEPH ROGER, of 6572 Louis-Hebert St., Montreal, Que. Born at Montreal, Dec. 19th, 1914; Educ.: B.A.Sc., Ecole Polytechnique, Montreal, 1937; R.P.E. of Que. With the Provincial Govt. as follows: 1937-38, Dept. of Trade & Commerce, 1938-39, Roads Dept., Oct. 1939 to Jan. 1940, Public Works Dept.

References: A. Circe, T. J. Lafreniere, A. Duperron, S. A. Baulne, J. A. Lalonde, L. Trudel.

BREBNER—KENNETH ALEXANDER, of Riverbend, Que. Born at Kingston, Ont., April 21st, 1891; Educ.: B.Sc., Queen's Univ., 1914. R.P.E. of Ont.; 1914-16, inspecting shells, Imperial Munitions Board; 1916-27, dftsman., with the following companies, Dominion Bridge, Riordon Pulp, Canadian Bridge, Hay Foundry & Iron Works, Newark, N.J., Harris Structural Steel, New York; 1927-28, checker, Albert Smith's Sons, Irvington, N.J.; 1930-31, asst. engr., Good Roads Mach. Co., New York; 1928-29, struct'l. engr., Magor Car Co., Passaic, N.J.; 1937, designing engr., Bathurst Power & Paper Co., Bathurst, N.B.; 1937-38, chief dftsman., and Nov. 1938 to date, plant engr., Price Bros & Co. Ltd., Riverbend, Que.

References: G. F. Layne, S. J. Fisher, N. F. McCaghey, G. H. Kirby, A. Cunningham.

DONALDSON—ADAM GILLESPIE, of Shaughnessy, Alta. Born at Lethbridge, Alta., Mar. 8th, 1909; Educ.: B.Sc., Univ. of Alta., 1933; 1928-32 (summers), Federal Coal Company; 1933-35, Cadillac Coal Company, 1934-35, as mine overman; 1935 to date, mine supt., Lethbridge Collieries Ltd., Lethbridge, Alta.

References: C. S. Donaldson, J. M. Campbell, G. S. Brown, C. S. Clendening, W. Meldrum.

FORD—JOHN NORMAN, of Calgary, Alta. Born at Calgary, May 6th, 1909; Educ.: B.Sc. (Elec.), Univ. of Alta., 1934; 1934-35, mtce., 1935-36, local mgr., Prairie Power Co., Regina; 1936-40, student engr., and at present, junior engr., Calgary Power Co. Ltd., Calgary.

References: H. B. Le Bourveau, H. B. Sherman, J. McMillan, H. G. Thompson, H. J. McLean.

FRASER—ROBERT, of Grand Mere, Que. Born at Sydney, N.S., Sept. 26th, 1911; Educ.: B. Eng. (Mech.), N.S. Tech. Coll., 1935; 1932-33 (6 mos.), rodman, gen. engrg. work, City of Sydney engrg. dept.; 1935 (5 mos.), road inspr. in N.S. for Milton Hersey Co.; 1935 to date, with the Consolidated Paper Corporation, Laurentide Divn., Grand Mere, Que., as follows: 1935-36, beating & ventilating engr., 1936-37, gen. mtce. engrg., 1937-38, paper-mill operating, 1938-39, asst. mill engr., 1939 to date, operating engr. in paper mill.

References: H. O. Keay, E. B. Wardle, W. B. Scott, H. G. Timmis, V. Jepsen.

FRISCH—JOHN, of Riverbend, Que. Born at Oslo, Norway, Sept. 8th, 1886; Educ.: Diploma in Mech'l. Engrg., College of Horton, Norway, 1906; 1907-14, dftsman. on design of pulp & paper woodworking and hydraulic machy., 1914-17, chief dftsman., J. & A. Jensen and Dahl, Oslo; 1917-19, with Union Paper Mills of Norway, in consltg. capacity on mill plans in Russia; 1920-23, chief dftsman., P. B. Yates Mach. Co., Beloit, Wis. and Hamilton, Ont.; 1923-29, mill mgr., John Fenderson Co. Ltd.; 1929-39, mill engr., mech. supt., Can. International Paper Co. in complete charge of mtce. & constrn. work. At present, mech. supt., Price Bros. & Co Ltd., Riverbend, Que.

References: S. J. Fisher, N. F. McCaghey, G. H. Kirby, G. F. Layne, A. H. Chisholm, R. P. Freeman, C. Bang.

GALE—FREDERICK TYNER, of Calgary, Alta. Born at Macleod, Alta., Feb. 6th, 1908; Educ.: B.Sc. (Elec.), Univ. of Alta., 1934; 1929-33 (summers), misc. office & outside work on bldg. constrn.; 1934, surveying, dept. of public works; 1935 (6 mos.), df'ing. & engrg. sales, Wilkinson & McLean Ltd., Calgary; 1935-36, serviceman, Canadian Utilities Ltd., Raymond; 1936 to date, junior engr., Calgary Power Co. Ltd., Calgary.

References: G. H. Thompson, H. B. LeBourveau, J. McMillan, F. A. Brownie, B. W. Snyder.

GENT—WILLIAM JAMES, of Newfoundland Airport, Nfld. Born at Trinity, Nfld., Nov. 22nd, 1910; Educ.: B. Eng. (Elec.), N.S. Tech. Coll., 1935; 1935-36, surveying, Land Settlement Board, St. John's, Nfld.; 1936-38, field engr., Hans Lundberg Ltd., Toronto; 1938 to date, power plant operator, Newfoundland Airport.

References: F. C. Jewett, R. A. Bradley, K. R. Chestnut, D. Ross, G. H. Burchill.

GRANICH—JOSEPH EDWARD, of 529 Clifton St., Winnipeg, Man. Born at Winnipeg, Dec. 20th, 1905; Educ.: 1918-25, special courses, I.C.S.; 1925-30, special studies, telegraphy, etc.; 1918-23, clerk, 1923-25, operator, 1925-30, supervisor, multiplex dept., C.P.Communications; 1931-34, supervisor in charge grain quotation ticker plant, Winnipeg Grain Exchange; 1934 (7 mos.), with Northern Electric Co., C.P.R. and Teletype Corpn., engrs. re installn. of high speed quotation ticker system for Montreal Stock Exchange, also similar work in Vancouver. Also during 1934 i/c ticker installns. in various cities throughout Canada; 1934-37, supervisor, ticker plant, Winnipeg Grain Exchange. At present, supervisor, printer & ticker services, Western Lines, C.P.Communications. I/c of multiplex, teletype & ticker apparatus.

References: J. D. Peart, E. S. Braddell, V. C. Jones, F. S. Fisher, C. P. Haltalin.

GUNG—GEORGE, of Toronto, Ont. Born at Victoria, B.C., Sept. 27th, 1911; Educ.: B.A.Sc. (Mech.), 1937; M.A.Sc., Univ. of Toronto; 1935 (summer), Beatty Bros. Ltd.; 1937 (summer), Can. Gen. Elec. Co. Ltd., Toronto; 1937-38, part time, and 1938 (Oct.-Nov.), full time research asst., mech. dept., Univ. of Toronto; 1939 (Jan.-Mar.), Massey Harris Co. Ltd., Toronto. At present, junior testing engr., H.E.P.C. of Ontario, Toronto, Ont.

References: R. W. Angus, G. R. Lord, E. A. Allcut, W. D. Walcott, R. B. Young.

HAND—NORMAN C., of 130 Colbeck St., Toronto, Ont. Born at Philadelphia, Pa., Aug. 31st, 1886; Educ.: B.S., Central High School, Phila. 1906-09, Spring Garden Institute and Drexel Institute, Phila.; R.P.E. of Ont.; 1904-06, apprentice machinist, 1906-08, apprentice dftsman., 1908-10, dftsman., Dr. W. M. White, Milwaukee; 1910-13, turbine erector, 1913-16, asst. mech. engr., H. B. Taylor, Phila.; 1916-22, asst. supt. shops, Wm. Cramp & Sons, Phila.; 1922-24, mech. engr., I. P. Morris Co., and 1924-29, mgr., I. P. Morris Co. and De La Vergne Co., Phila.; 1929-35, mgr., and 1935 to date, vice-president & gen. mgr., S. Morgan Smith Inglis Co Ltd., Toronto, Ont.

References: T. H. Hogg, H. G. Acres, O. Holden, R. L. Hearn, McN. DuBose.

HOLLI—SULO A., of 2476 Lincoln Road, Windsor, Ont. Born at Tampere, Finland, Sept. 29th, 1918; 1932-36, Windsor Vocational School—Diploma in Technical Dept.; 1936-39, Detroit Institute of Technology—has earned sixty credit hours towards Bach. degree in Mech. Engrg. Continuing studies at night; 1936 to date, dfting engr., engrg. dept., Canadian Industries Ltd., Windsor, Ont.

References: J. F. Bridge, C. F. Davison, H. L. Johnston.

KINDERSLEY—ROBERT ERSKINE GORDON, of 37 Strathearn Road, Toronto, Ont. Born at Exeter, Devon, England, Nov. 2nd, 1906; Educ.: 1925-27 (2 years of three year engrg. course), Cambridge University; 1927-28, dftsman., and 1928-34, in various capacities in refinery process work, International Petroleum Co., Peru; 1934-40, process work, lab. work, and sales work, Imperial Oil Ltd., Canada. At present, statistician, at head office, Toronto.

References: K. D. McDonald, I. H. Nevitt, J. W. MacDonald, E. M. Salter, G. R. Conrod, T. Montgomery.

LAIRD—ROBERT G., of Calgary, Alta. Born at Crystal, North Dakota, Dec. 2nd, 1896; Educ.: B.Sc. (Min'ng), North Dakota Sch. of Mines, 1927; 1928-29, diamond drilling, Flin Flon area, Sudbury Diamond Drill Co.; 1929-30, surveying, diamond drill hole locations, etc., H. M. B. Inglis, and 1930, similar work with Frontier Development Co.; 1930-32, Imperial Oil Refineries, Calgary; 1932-38, Royalite Oil Company, Turner Valley; 1938 to date, i/c engrg. dept., Valley Pipe Line Co., Turner Valley, Alta.

References: S. G. Coultis, G. D. Phelps, H. L. Stevens-Guille, J. W. Young, R. W. Dunlop.

LEXIER—HERSCHEL LOUIS, of 19 Yale Apts., Winnipeg, Man. Born at Winnipeg, June 11th, 1915; Educ.: Bach. Mech. Engrg., Univ. of Minnesota, 1938; 1938-39, highway survey, for Sask. Govt.; 1939-40, asst. to mech. supt., Swift & Co., St. Boniface, Man.

References: N. M. Hall, C. P. Haltalin, J. W. Sanger, H. L. Briggs, G. L. Shanks.

MACLACHLAN—KELLOGG SINCLAIR, of 630 Clarke Ave., Westmount, Que. Born at Toronto, Jan. 27th, 1892; Educ.: B.A.Sc., Univ. of Toronto, 1913; 1910-12 (summers), apprentice work; 1913, chemist, 1913-15, supt., Metals Chemical Co., Welland; 1915-16, constrn. engr., National Synthetic Co., Perth Amboy, N.J.; 1916-18, supervisor, production & distribution of explosives, Imperial Munitions Board; 1918, Cadet, Can. Engrs., C.E.F.; 1919, asst. to director of technical education, Ontario; 1920-24, various minor positions, Lincoln Paper Mills, Ltd.; 1924-25, asst. to R. Home Smith, receiver and manager, Lincoln Mills, Ltd.; 1925-27, gen. mgr., Lincoln Pulp & Paper Co. Ltd.; 1927-30, managing director, Alliance Paper Mills Ltd.; 1930-32, gen. mgr., and 1932 to date, president and gen. mgr., Fraser Companies Limited; Sept. 1939 to date, Acting Deputy Minister, Dept. of National Defence, Ottawa, Ont.

References: L. A. Wright, C. D. Howe, C. J. Mackenzie, W. Maclachlan, W. H. Munro, C. P. Edwards, A. Ferrier.

McINTYRE—WALTER BAKER, of 173 Peter St., Port Arthur, Ont. Born at McCreary, Man., May 9th, 1904; Educ.: 1920-24, special night classes, Kelvin Technical School, Winnipeg; 1925-26, private tuition in engrg., as approved by Univ. of Man.; 1920-24, chainman, rodman, 1925-27, levelman, transitman, 1927-28, instr'man. Port Arthur Divn., 1920-30, res. engr. on constrn., and 1931 to date, field engr., Can. Nat. Rlys. Estimating, laying out and final constrn., culverts, bridges, drainage, water stations, coaling plants, gen. track constrn., mtce., location surveys to final constrn.

References: P. E. Doncaster, S. E. Flook, W. Walkden, H. Os, F. C. Graham, G. Eriksen.

MOTT—CHARLES ALLAN, of Belleville, Ont. Born at Belleville, Nov. 2nd, 1897; Educ.: 1923-24, I.C.S. course in municipal engrg. 1925, arch'l. course (corres.), Chicago Technical College; R.P.E. of Ont.; 1919-29, asst. to city engr., and 1929 to date, city engr., bldg. inspr. and supt. of public works, City of Belleville, Ont.

References: F. S. Lazier, W. L. Langlois, E. R. Logie, J. J. Macnab, H. L. Schermerhorn, R. H. Parsons, A. E. Berry, W. Storrie.

PITTIS—RALPH COLIN ALFRED, of 18 Balmy Ave., Toronto, Ont. Born at Toronto, May 20th, 1913; Educ.: B A Sc., Univ. of Toronto, 1938; 1935 (3 mos), reinforced concrete detailing; 1936 (Jan.-Aug.), air base constrn. & teaching, Frontier College; 1937-38, Baie Comeau development, Foundation Company; 1938 (4 mos), road constrn., Highway Paving Co.; 1938-39, office bldg. constrn., Foundation Company; 1939, oil refinery constrn., Canadian Kellog Co.; Oct. 1939 to date, service station and plant constrn., Imperial Oil Limited, Toronto, Ont.

References: R. E. Chadwick, L. Grime, C. R. Young, W. B. Dunbar, F. H. C. Sefton.

RABB—ARTHUR H., of Kenora, Ont. Born at Perth, Ont., Feb. 8th, 1906; Educ.: B.Sc. (Civil), Queen's Univ., 1931; R.P.E. of Ont.; 1929-30 (summers), paving inspr., Dept. of Highways, and grading & retaining wall constrn., City of St. Thomas. With Dept. of Highways of Ontario as follows: 1931-32, rodman, 1934-35, instr'man. i/c of grading contract, 1935-37, instr'man. i/c of constrn. of concrete pavements, 1937 to date, asst. i/c of paving operations and divn. mtce.

References: E. A. Kelly, W. F. Noonan, C. K. S. Macdonell, W. L. Saunders, W. P. Wilgar.

RITCHIE—CHRISTOPHER, of Calgary, Alta. Born at Edmonton, Alta., Jan. 5th, 1914; Educ.: B.Sc. (Elec.), Univ. of Alta., 1935; one year post graduate in radio engrg. at Univ. of Alta.; 1936-40, student engr., and at present junior engr., Calgary Power Co. Ltd., Calgary.

References: G. H. Thompson, H. J. McLean, H. B. LeBourveau, H. B. Sherman, J. McMillan.

SHAPCOTTE—REGINALD F., of Port Arthur, Ont. Born at Port Arthur, Feb. 26th, 1913; Educ.: 1928-33, Port Arthur Technical School, dfting and surveying diploma; 1934-36, surveyor's dftsman. & instr'man., Dept. of National Defence; 1936-37, dftsman., Thunder Bay Harbour Improvements Co.; 1937-38, cruising & mapping for Detroit Sulphite Pulp & Paper Co.; 1939, planning & supervising constrn., L. Y. McIntosh, Architect; at present, dftsman., Dept. of Public Works, Port Arthur, Ont.

References: H. Os, G. H. Burbidge, P. E. Doncaster, S. E. Flook, C. J. L. Sanderson.

WEBSTER—JAMES S., of Shaughnessy, Alta. Born at Windygates, Fifeshire, Scotland, Dec. 18th, 1903; Educ.: 1924-27, Heriot-Watt College (did not complete course); 2nd class mining cert. for Alta. 1st class elect'l.; 1918-23, ap'ticeship with Fife Coal Co., Scotland; 1923-29, electrn. with Wemyss Coal Co., Fife, Scotland; 1929-31, electrn., with Roy Electric, Lethbridge, Alta.; 1931 (6 mos), electrn. with Can. Gen. Elec. Co., Lethbridge; 1931-35, chief electrn., Cadillac Coal Co., Lethbridge, Alta.; 1935 to date, chief electrn., Lethbridge Collieries, Lethbridge, Alta.

References: C. S. Donaldson, J. T. Watson, J. M. Campbell, G. S. Brown, C. S. Clendening.

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

EAGER—NORMAN ALDWYN, of Hamilton, Ont. Born at Montreal, July 18th, 1900; Educ.: B.Sc., McGill Univ., 1922, M.C.E., Cornell Univ., 1923; R.P.E. of Que.; 1921, dftsman., Phoenix Bridge & Iron Works; 1922, dftsman., dept. of highways, Penna.; 1924, res. engr., dept. of highways, Illinois; 1924-25, designer and salesman, Canadian Vickers; 1925-26, bldg. supt., Church Ross Co.; 1926-40, designing engr. and power sales research engr., Shawinigan Water & Power Company, Montreal; at present, asst. sales mgr., Burlington Steel Company, Hamilton, Ont. (Jr. 1925, A.M. 1934).

References: J. A. McCrory, C. R. Lindsey, E. Brown, R. E. Jamieson, E A Ryan.

FOR TRANSFER FROM THE CLASS OF JUNIOR

COOPER—JOHN SIDNEY, of New Liskeard, Ont. Born at Toronto, Ont., Oct. 14th, 1912; Educ.: B.A.Sc., Univ. of Toronto, 1934; 1930-34, contractor's asst. on bldg. constrn. work; 1934-35, surveyor's asst., and 1935-36, instr'man. & engr. supervising constrn. of waterworks, sewers & town surveying, Sutcliffe Co. Ltd., New Liskeard, Ont. With the Wabi Iron Works Ltd., as follows: 1936-38, struct'l. & mech'l. dftsman., and 1938 to date, chief dftsman. in full charge of drawing office. Responsibility includes design of mine cars, man cages, ore skips, mill machy. & gen. castings. Part time on sales engrg. work covering mining areas of Ontario & Quebec, consltg. with engrs. on design of equipment for specific applications. (Jr. 1936).

References: H. W. Sutcliffe, E. A. Beman, C. R. Young, J. M. Gilchrist, W. J. Smither.

MacCARTHY—HENRY BLAIR, of 110 Lisgar St., Ottawa, Ont. Born at Ottawa, June 7th, 1906; Educ.: B.Sc. (Chem.), McGill Univ., 1928; 1926-27 (summers), steelman, Fraser Brace Co., operator, Shawinigan Chemicals; 1928-30, surveying, cost estimating, and designing for water power developments, Gatineau Power Company; 1936 to date, Dept. of National Defence, senior asst. engr. on design, estimates, and specifications for bldg. constrn., water supplies, and gen. military station development work. (Jr. 1930).

References: G. G. Gale, W. E. Blue, E. G. C. Chambers, H. E. Maple, R. H. Cooper, R. K. Odell.

ORR—WILLIAM WINSTON, of 683 Lake Shore Road, Toronto, Ont. Born at Ottawa, Ont., June 26th, 1901; Educ.: B.Sc., Queen's Univ., 1927. With the Can. Gen. Elec. Co. Ltd., as follows: 1927-28, students' test course, Peterborough; 1928-29, distribution transformer design engr., and 1929 to date, power transformer design engr., Toronto. (St. 1928, Jr. 1930).

References: C. E. Sisson, D. Norman, W. M. Cruthers, G. W. Painter, D. L. McLaren.

FOR TRANSFER FROM THE CLASS OF STUDENT

GUNTER—ALLAN NELSON, of Regina, Sask. Born at Edmonton, Alta., Feb. 25th, 1916; Educ.: B.Sc. (Chem.), Univ. of Alta., 1938. With Prairie Farm Rehabilitation Act as follows: 1936-37 (summers), rodman & field dftsman., 1938 (summer), instr'man., July 1939 to date, junior engr. (St. 1939).

References: H. R. Webb, R. M. Hardy, C. A. Robb, R. S. L. Wilson, C. M. Moore.

HANKIN—EDMUND A., of 5590 Bradford Place, Montreal, Que. Born at Montreal, Apr. 29th, 1912; Educ.: B. Eng., McGill Univ., 1934. 1 year at the Univ. of Grenoble, France. With Francis Hankin & Co. Ltd. as follows: 1931-32 (summers), design & estimating work; 1935-37, asst. air conditioning dept., and 1937 to date, engr. in charge of air conditioning dept. (St. 1934).

References: F. A. Combe, E. A. Ryan, J. A. Kearns, W. J. Armstrong, A. P. Shearwood.

HOOD—GEORGE LESLIE, of 158 McIntyre St. W., North Bay, Ont. Born at Minnedosa, Man., April 17th, 1910; Educ.: B.Sc., Univ. of Man., 1932; 1934-37, elect'l. mtce., Howey Gold Mine, Red Lake, Ont.; 1937-38, demonstrator, Univ. of Toronto: 1938 (2 mos.), dftsman., Malton Airport Lighting, Toronto; 1938 to date, junior asst. meter & relay engr., H.E.P.C. of Ontario, North Bay, Ont. (St. 1930).

References: E. P. Fetherstonhaugh, N. M. Hall, R. E. Smythe, H. Robertson.

HYMAN—ERNEST ROY, of Pointe a Pierre, Trinidad, B.W.I. Born at Winnipeg, Man., Aug. 7th, 1915; Educ.: B.Sc., Univ. of Man., 1934. Grad. R.M.C., 1938. S.M. (Civil), Mass. Inst. Tech., 1939; 1939, dftsman., Universal Oil Products Co., and Sargent & Lundy, Chicago; at present, asst. engr., Trinidad Leaseholds Ltd., Pointe a Pierre, Trinidad, B.W.I. (St. 1936).

References: W. M. Fife, R. W. Emery, L. F. Grant, H. H. Lawson, G. G. M. Carr-Harris.

McGINNIS—ARTHUR DAVID, of Kingston, Ont. Born at Phillipsburg, Que., Aug. 14th, 1917; Educ.: B.Sc., Queen's Univ., 1938. M.C.E , Cornell Univ., 1939; 1934-37 (summers), gen. work on highway constrn.; 1938, engr. i/c. of highway constrn., and 1939 to date, engr. i/c of constrn. work, etc., for McGinnis & O'Connor, contracting engrs., Kingston, Ont. (St. 1938).

References—D. S. Ellis, J. B. Baty, T. A. McGinnis, R. M. Smith, R. F. Legget.

ROGERS—CARL L., of Toronto, Ont. Born at Moncton, N.B., May 17th, 1912; Educ.: B. Eng. (Elec.), McGill Univ., 1934; 1934-36, office work & air conditioning layouts, 1936-37, preparing plans & specifications on industrial heating work, involving large electric furnaces for the heat treatment of ferrous and non-ferrous metals, 1937-38, engrg. sales of large industrial heating equipment, 1938-39, sales of general equipment such as transformers, panel boards, control, etc., Can. Gen. Elec. Co. Ltd.; 1939 to date, industrial engr., H.E.P.C. of Ontario, power surveys of industrial plants, recommendations on new electric equipment, etc. (St. 1931).

References: M. J. McHenry, E. C. Williams, J. L. Balleny. S. Hairsine, W. E. Ross, C. E. Sisson.

SMYTH—WILLIAM CHRISTOPHER, of Montreal, Que. Born at North Bay, Ont., Jan. 25th, 1914; Educ.: B. Eng. (Civil), McGill Univ., 1936. With H. J. O'Connell Ltd., Gen. Contractors, Montreal, as follows: 1936-37, asst. engr., 1937-39, engrg. supt., and at present, supt. engr., all of the above on highway work. (St. 1935).

References: A. J. Grant, O. J. McCulloch, E. S. Miles, G. J. Dodd, E. Brown.

THORSSEN—LeROY ALLAN, of Edmonton, Alta. Born at Grantsburg, Wis., Dec. 16th, 1916; Educ.: B.Sc. (Civil), Univ. of Alta., 1939; 1938-39 (summers), rodman, instr'man., etc., Civil Aviation Br., Dept. of Transport. 1939 to date, lecturer in civil engrg., University of Alberta, Edmonton, Alta. (St. 1937).

References: H. R. Webb, A. L. H. Somerville, R. S. L. Wilson, W. E. Cornish, C. A. Robb, R. W. Ross.

READ MACHINERY CO. INC., YORK, PA.

Read Machinery Co. Inc., York, Pa., have issued two interesting and well illustrated booklets, one dealing with their chemical and industrial equipment and the other with their bakery equipment. The former (bulletin No. 39304) contains sixteen pages and describes Readco vibrating sifters, weighing hoppers, material handling equipment, various types of mixers, fabricated vessels, shredders, acetylators, weigh tanks and meters. The bakery equipment bulletin (No. 39325) contains, within its twenty-eight pages, a number of reference tables in addition to descriptive and illustrative matter covering the company's flour handling equipment mixers, proofers, ovens and miscellaneous equipment.

ELECTED TO CANADA STEAMSHIP BOARD

Brig.-Gen. C. H. Mitchell, C.B., C.M.G., D.S.O., C.E., and Sidney T. Smith have recently been elected directors of Canada Steamship Lines Limited.

DOMINION RUBBER APPOINTMENTS

George B. Rutherford's appointment as assistant general manager, mechanical rubber goods and sundries sales, is announced by Dominion Rubber Company Limited. Mr. Rutherford was formerly manager of special products sales, at Montreal.

Most of Mr. Rutherford's service with the rubber company has been spent in its western division, connected with mechanical sales activities. Successively named assistant manager, special representative, and—in 1929—manager of mechanical goods sales in this division, he was transferred from Winnipeg to Dominion Rubber Company's head office in 1938, where he has since managed special products sales.

R. B. Marr has been appointed assistant general manager of manufacturing, mechanical rubber goods division, according to an announcement by Dominion Rubber Company Limited.

Mr. Marr, whose association with the rubber company extends over eighteen years, has for the past ten years occupied the post of director of development for mechanical rubber goods and footwear. He was originally engaged in technical and laboratory work at the Dominion Tire Factory at Kitchener, and some years later was moved to Montreal, where he was placed in charge of footwear development.

George B. Rutherford

SHAWINIGAN CHEMICALS APPOINTMENTS

The following appointments were recently announced by Shawinigan Chemicals Limited: James Wilson, chairman of the board; V. G. Bartram, president; R. A. Witherspoon, chairman of the executive; W. S. Hart, first vice-president; H. S. Reid, vice-president; H. W. Matheson, vice-president; J. A. Fuller, secretary-treasurer and director.

FREE-SWINGING GROUND WIRE BRACKET

Canadian Ohio Brass have introduced, through the columns of "C-O-B Hi-Tension News" a newly designed bracket known as the "Swing-link"—a ground wire bracket which provides a flexible support and at the same time develops high slip strength. Details of this bracket are contained in the January issue of "Hi-Tension News."

OUTDOOR BREAKERS

Canadian General Electric announces the extension of its line of outdoor oil circuit breakers to include the type FKRO-255. These breakers are available for a-c or d-c electrical operation and are rated 15,000 volts and 600, 800, 1,200, 1,600 and 2,000 amperes and in rupturing capacity ratings 250,000 and 500,000 kv-a. They utilize the arc control features employed in the parallel line of indoor breakers type FKR-255. Provision is made for the use of bushing current transformers (two per phase), and a removable tank lowering device, readily attached to the rear of framework, is available.

WAR PRODUCTION

The register of scientific and technical personnel is available to industrial firms engaged in the manufacture of war materials who may require the services of scientists, engineers, specialists or skilled tradesmen. Lists of names and qualifications for any specified line of work will be furnished on request to the Director, Technical Section, Voluntary Service Registration Bureau, Ottawa, Ont.

Dr. H. M. Tory,
Director.

Major G. H. McCallum,
Asst. Director.

MOORE STEAM TURBINE BECOMES DIVISION OF WORTHINGTON

The Worthington Pump and Machinery Corporation announces that, effective January 2nd, 1940, its subsidiary, the Moore Steam Turbine Corporation, of Wellsville, New York, will be conducted as the Moore Steam Turbine Division of the corporation.

FLANGE-JACKS

Garlock Packing Company of Canada, Limited, Montreal, have introduced a new tool "Flange-Jacks" for replacing gaskets in flanged pipe lines, which is described and illustrated in a four-page bulletin recently issued by the company.

INDUCTION MOTORS AND CONTROL

English Electric Company of Canada, Limited, St. Catharines, Ontario, have just issued a price-list covering polyphase protected type squirrel cage induction motors and control, which can be obtained from any of the company's offices or representatives throughout Canada.

ATLAS STEELS APPOINTMENTS

Arthur G. Lambert, whose appointment as manager, export division, is announced by Atlas Steels Limited, Welland, Ontario, is a graduate of Sheffield University in Metallurgy, and of the City and Guilds Institute in Iron and Steel.

Mr. Lambert spent several years with the Parkgate Iron and Steel Company, near Sheffield, England, becoming assistant to the manager of the Melting Department. In 1923, he joined the staff of the Jessop Steel Company of Washington, Pa., becoming Production and Works Manager, and his present appointment is due to the development of the export division of the Atlas Steels Limited.

John C. Dawson has been appointed assistant manager, export division, Atlas Steels Limited, Welland, Ontario. Mr. Dawson is a graduate of Sheffield University, where he specialized in chemistry and metallurgy, and his subsequent experience covers several years in England and India, including service with the British Government. He has also had extensive experience with the Jessop Steel Company and with Edgar T. Ward Sons Company.

Arthur G. Lambert

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 23 | APRIL 1940 | NUMBER 4

PUBLISHED MONTHLY BY
THE ENGINEERING INSTITUTE
OF CANADA
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GROUNDING PRACTICE IN ELECTRIC SYSTEMS

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Paper presented before the General Professional Meeting of The Engineering Institute of Canada, at Toronto, Ontario, on February 9th, 1940

Introduction

The primary aim in grounding electric power systems is to prevent damage to equipment and to protect workmen and the public against injury from shock. Its secondary function is to assist in system operation. These aims sometimes involve conflicting requirements, with the result that practices vary considerably depending on individual opinions and local conditions. There is probably no subject in the electrical field which has been productive of a greater variety of opinion and practice; while the general principles have been thoroughly understood for many years, it has not been possible to establish general rules not subject to exceptions, nor to apply principles without the exercise of judgment based upon experience.

A comprehensive review of practice is not possible within the bounds of a short discussion; consequently the scope of this paper will be limited largely to the status of grounding practice in Canada, with particular reference to protection from shock.

General

From the point of view of personal safety, current is of greater significance than voltage. In order to prevent fatalities from electric shock, it is necessary that the current through the human body does not exceed safe limits for a definite period of time. This current is fixed by the potential difference between the conducting parts with which two portions of the body may come in contact. Differences of potential may exist between parts of an electric circuit and metal objects in the vicinity or between metal objects and the ground, or between the circuit and the ground, and it is these values which constitute the lurking danger and are thus more important than the absolute potential of the circuit.

It is important to distinguish between two conditions which may produce a hazard. Differences of potential may exist between conductors insulated from one another, the values of which depend upon the charges on the conductors and the electrostatic capacity between them. Differences of potential may also exist between points of an electric system in which current is flowing. In this case the potential difference is determined from the current flow and the impedance between the points.

In order that an accident may occur, the following conditions must be satisfied:

(a) Exposed metal surfaces must be raised to a dangerous potential; this is usually caused by a failure in the insulation of the system or of equipment connected to it.

(b) A person must touch this exposed metal surface and at the same time make contact with the ground or with some other conducting surface at ground potential.

(c) The protective measures (fuses or circuit breakers) must have failed to function.

These conditions seldom occur simultaneously, and consequently the number of fatal accidents caused by electricity is extremely low having regard to the number of users of electricity.

In order to prevent fatal accidents, it is thus necessary that the conditions mentioned above do not occur simultaneously. To prevent this occurrence insulating materials on the system must be maintained in a good state of repair. They must be installed in such a manner that the chance of failure may be reduced to the minimum and the necessary protective measures must be taken to prevent the appearance of dangerous voltages on exposed metal surfaces. As a further safeguard means must be provided, should such voltages occur, for reducing the possibility that a current of dangerous magnitude can pass through the body of any person who may touch such an exposed surface.

A full discussion of the effect of electric shock on the human body would be impossible here for reasons of spatial economy alone, quite aside from the fact that it is an extremely hazardous field for a layman to enter. However, it may be of interest to quote some results obtained by investigators and to refer to values which have been incorporated in regulations. It will emphasize the great differences of opinion existing among authorities and illustrate the difficulties which face utilities in deciding upon practice, and electrical authorities in framing regulations which will protect the public without working hardship by unduly increasing the cost of installation.

The passage of electric current through the human body causes paralysis of the higher nerve centres resulting in cessation of breathing, preventing normal reflex response and causing lack of tone of the blood vessels. The heart may be thrown into ventricular fibrillation, which is a disruption of normal heart action in which the heart appears to quiver rather than to beat.

Many investigations have been made using both animals and human beings as test media, and there is a large body of opinion to the effect that currents 10 to 20 milliamperes in magnitude may be endured for short intervals (less than one second) by normal human beings without dangerous consequences. Individual opinions, however, set this value as low as 0.3 to 0.4 milliampere, while others estimate that the minimum current which can be perceived is approximately one milliampere. Other authorities have investigated the current required to cause ventricular fibrillation which they hold will always cause death claiming that normal heart action cannot be restored if fibrillation occurs. The threshold of fibrillation is given by these authorities as about 100 milliamperes.

The time of occurrence of shock is an important factor; it appears to be accepted that if this occurs during a certain portion of the heart cycle (occupying about 20 per cent of the total period) lower currents will be more dangerous than if contact is made at another instant in the heart cycle.

The frequency of the shock current is also claimed to have an important bearing. One authority states that the threshold of fibrillation at 25 cycles is 25 per cent higher than at 60 cycles and at direct current five times as great as at 60 cycles. For shocks of short duration (0.1 second or less) the effect of frequency is less marked.

It is important to note that the duration of the current, as well as its actual value, is an essential factor. This is recognized in the regulations of the National Electrical Safety Code respecting Electric Fences in which values of milliampere-seconds are incorporated. This Code limits the leakage current to eight milliamperes in fence controllers of the continuous type. In Germany the maximum leakage current permitted is 0.35 milliampere and in Switzerland 0.4 milliampere. The Canadian Electrical Code specification for a.c.-d.c. radio receivers sets a limit of 1.5 milliamperes for the leakage current from exposed metal parts to ground. (All these values apply to normal operating frequency). The Verband Deutscher Elektrotechniker rules (German) state that condensers for protection against shock must not permit leakage greater than 0.4 milliampere when installed during factory construction and 0.8 milliampere if added subsequently.

The setting of values is sometimes complicated by conflicting requirements of regulations, for example, those governing radio interference may conceivably permit leakage currents beyond the values which some authorities regard as dangerous.

It is thus apparent that much research is still necessary in this field, and in the meantime practice and regulations should follow conservative lines and provide adequate factors of safety.

System Grounding

The main purpose of grounding transmission systems is to protect equipment; the voltages are so high that they cannot be reduced to safe values by grounding and structures and circuits are usually out of reach of the public so that the danger of accidental contact is small. Primary distribution systems (so-called) in many cases are scarcely distinguishable from transmission systems since voltages are frequently as high as 12,000. However, since these extend along public highways, the danger to the public is greater than in transmission systems and grounding practice is directed towards the protection both of persons and of equipment. Secondary distribution systems extend to customers' premises and the primary object in grounding is here the protection of persons.

The trend in practice, at least in the United States and Canada, is towards grounded systems. While some transmission systems, and a few distribution systems, operate ungrounded the great majority employ star-connected transformers with the neutral grounded. The majority of these systems are 2,300/4,000 volt, four-wire. In Ontario, two other voltages are used, namely, 4,600/8,000, 6,900/-12,000 and all extensions in rural areas make use of one of these three voltage ranges.

A variation of the grounded neutral system is the so-called "Hood" system which had its birthplace in Toronto. In this the primary and secondary neutral points are connected to a common wire. This system is universally used in Ontario for extensions.

From the very nature of these networks grounding is essential. The present practice is to ground the neutral wire at all transformer and lightning arrester locations and at all services. There is considerable diversity in practice as far as the grounding of exposed metal parts is concerned and this will be discussed later in the paper.

In the grounding of low voltage distribution systems the practice is governed by safety code regulations in so far as customers' premises are concerned. The Canadian Electrical Code contains detailed rules on this subject and specifies the grounding of certain wires depending upon the type of network (single phase or polyphase) and the voltage of the system. In general, these rules require the grounding of the neutral conductor or the neutral point of the transformer secondary, or if no neutral is used the conductor which will establish the lowest maximum voltage to ground. The above applies to circuits having a maximum difference of potentials between conductors to be grounded and other portions of the circuit, of 150 volts. The Code also recommends strongly that all system neutrals be solidly interconnected throughout the system. (See Canadian Electrical Code, Fourth Edition, 1939, Rule 902 (a).) The neutrals of direct current, three-wire systems must also be grounded but this connection must be made at supply stations only and not on consumers' premises. The primary reason for this is that multiple grounds on direct current systems may aggravate troubles caused by electrolysis. Further, direct current systems are frequently run underground and in any case not exposed to public contact to the same extent as alternating current systems.

The Code also permits inspection authorities to waive ground requirements if it is impracticable to obtain the resistance to ground prescribed.

Grounding Non-current-carrying Metal Parts

The grounding of non-current-carrying metal parts presents many problems in which local conditions are of great importance. Practice which may be satisfactory in some cases may be hazardous in others and each case should be studied with this in mind. The difficulties consist in harmonizing operating with safety requirements. The result has been a wide diversity in details of practice depending upon the relative weight attached to these two factors. It is not implied here that the personal safety factor is neglected in any case, but there is often a sharp difference of opinion as to the extent of the hazard involved. Two essential factors which must be considered are the magnitude of the potentials and currents and the duration of exposure.

Non-current-carrying metal parts may acquire potentials in several ways, each of which is responsible for exposures of different durations:

1. Induction between circuits may be responsible for voltages of varying magnitudes which endure as long as the circuits are "alive" and are thus continuous hazards.
2. Leakage through insulation, probably the most common cause.
3. Lightning either by indirect stroke or direct stroke.
4. Flashover from energized circuits or contact with energized wires.

In considering grounding problems the potential gradient, as mentioned above, is most important and if not duly considered serious hazards may be introduced by ground connections apparently satisfactory. In all types of ground connections, the voltage gradient is higher near the connection than at distant points and accidents have been caused by contact with ground electrodes in which the difference of potential has been beyond safe limits. Bonding of neighbouring exposed non-current-carrying metal parts is often effective in reducing these potentials.

STATIONS

While this is beyond the scope of the paper, the value of station ground resistance is often of importance in reducing hazards in distant parts of the network. This, however, is usually taken care of adequately by utilities both for operating reasons and for the protection of workmen in stations.

OVERHEAD STRUCTURES

All overhead lines and structures are potential sources of hazard as the general public is exposed to many portions of overhead systems. The difficulty is increased because the location of these lines is governed by load demand rather than the possibility of obtaining ground connections of low resistance.

UNDERGROUND STRUCTURES

From the point of view of safety to workmen grounding should be an advantage because of the great opportunity of making good contact with ungrounded parts such as cable sheaths, etc., and the earth grounding is often supplemented by bonding where low resistances to ground are possible. On the other hand, it may, as mentioned above, increase electrolysis troubles.

POLE HARDWARE

There is considerable diversity of practice in the grounding of pole hardware. Some engineers favour the grounding of metal insulator pins, switch handles, transformer cases, braces, etc., to the neutral and to a common ground; others object to grounding certain hardware claiming that operating difficulties are introduced.

The bonding of metal parts on pole tops at transformer locations establishes a common potential for these parts but hazards to workmen may be introduced if adequate clearances are not maintained from live parts. The connection to ground is very important and reliance should not be placed on a single grounding conductor, at least two should extend down the pole and these should be guarded from mechanical injury so as to minimize the chance of a broken connection between the grounded metal and the earth.

CONSUMERS' PREMISES

The primary object here is to protect persons from shock by limiting the voltage to ground to safe values. Grounding regulations play a governing role and a review of these is necessary to lend clarity to the discussion.

It should be stated that the two codes in force in North America, namely, the National Electrical Code and the Canadian Electrical Code are not in complete agreement although in general principles they are in accord. The same may be said of codes in Great Britain, the Continent, New Zealand and Australia, and a perusal of these indicates the necessity of considering local conditions rather than applying general principles universally.

The definition of "grounded" given in the Canadian Electrical Code is a very clear and concise statement of the requirements applicable in this case and is quoted below:

> "Grounded: Connected effectually with the general mass of the earth through a grounding system having current-carrying capacity sufficient at all times, under the most severe conditions which are liable to arise in practice, to prevent any current in the grounding conductor from causing a harmful voltage to exist:
>
> 1. Between the grounded conductors and neighbouring exposed conducting surfaces which are in good contact with the earth, or
>
> 2. Between the grounded conductors and neighbouring surfaces of the earth itself."

The Canadian Electrical Code, in general, requires the grounding of all such parts operating at potentials greater than 150 volts to ground. Grounding is also required at any potential if conditions are "extraordinary." By this is meant where danger from mechanical injury, excessive moisture or extreme temperature is present in ordinary dwellings, offices, factories, etc., and where danger from corrosive, flammable or explosive atmosphere exists.

The Code also requires the grounding of the non-current-carrying metal parts of certain portable appliances, and in the last edition a list of about fifty is given which may be revised from time to time as necessitated by field experience or by new equipment appearing on the market. Portable appliances must be grounded by a flexible supply cord containing an extra grounding conductor. These requirements also include the exposed non-current-carrying metal parts of lamp holders, switches, plugs and receptacles installed in basements and in all damp places where danger from shock is likely to be present, also of non-portable cooking and heating appliances for all voltages.

The Code recognizes the impracticability of securing adequate grounding in certain cases and provides for alternatives, such as insulation, isolation and guarding, and operation at low voltage.

For example, metal guards of extension cord lamps, which are used frequently under "extraordinary" conditions need not be grounded if they are thoroughly insulated from live parts. It is recommended that portable lamps and portable tools used in conductive locations in industrial establishments be supplied at low voltage (not higher than 32 volts) through a transformer having a separate secondary winding, in which case grounding is not required.

It is difficult to ground domestic washing machines, and the Code provides for safety by requiring that the motor be guarded and mounted on supports which insulate it from the metal frame of the machine.

Isolation and guarding apply to equipment such as instruments, meters, relays, etc., in cases where the potential is between 150 and 750 volts and the metal parts are made inaccessible to unauthorized persons by elevation or other means. Further, instruments operating at 750 volts and over are required to be isolated and guarded in addition to having non-current-carrying metal parts grounded.

It may thus be said that while the Canadian Electrical Code stipulates grounding as the usual method to be employed to secure personal safety, it recognizes practical difficulties which may arise and provides reasonable alternatives.

The Canadian Electrical Code also discusses in detail methods of grounding. Metal frames on stationary equipment are usually conveniently grounded through the wiring system, as the rigid or flexible conduit or the armour of

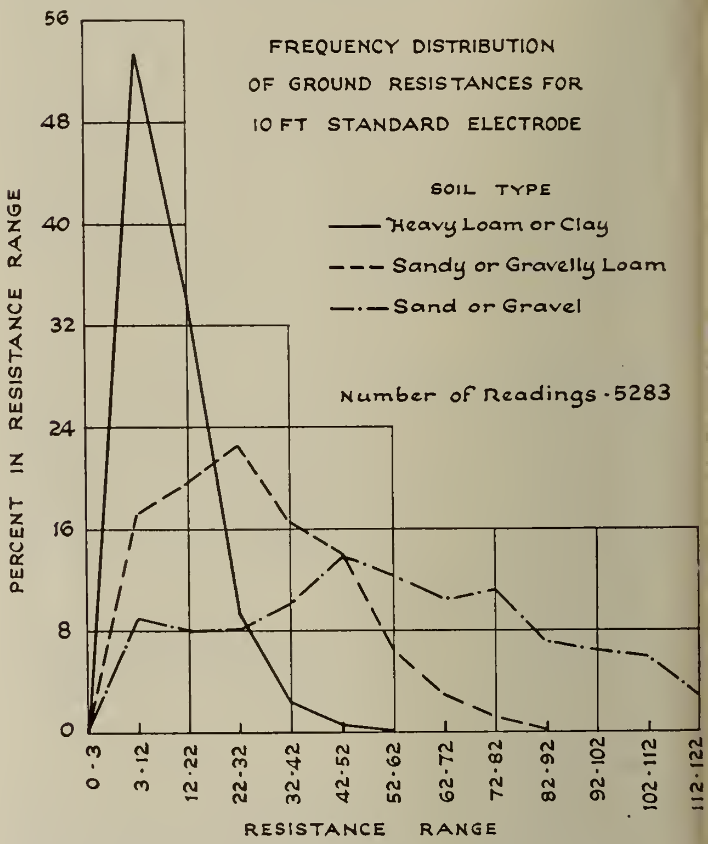

Fig. 1—Frequency distribution of ground resistances for 10 ft. x ¾ in. driven pipe electrode.

armoured cable afford a metallic path to ground. Non-metallic-sheathed cable now may have a grounding wire incorporated in it. For portable equipment, flexible supply cords are now available having a grounding conductor forming part of the cord assembly. Polarized receptacles are necessary to meet this requirement and this will no doubt present a problem particularly in the older installations.

Difficulties in the domestic field also arise, caused by the multiplicity of portable appliances such as electric razors, massage equipment, electro-therapy devices, etc., continually appearing on the market, which may be used where moisture is present and where grounded metal parts may readily be touched. It has not been deemed practicable to require the grounding of such devices. The Code, however, recognizes the bathroom as a location offering conditions conducive to accidents and attempts to remove the hazards by prohibiting the installation of receptacles there.

This rule was inserted in the 1930 edition, and it may be of interest to note that since then three fatalities in bath tubs have been reported in Ontario as compared with eight during eleven years previous to 1930. While these figures may not be correlated with the change in the rule, it is believed they have some significance. Attempts have been made to remove this rule but electrical inspection authorities having continually in their minds the ingenuity displayed by the public in the misuse of electrical appliances, have steadfastly opposed these attempts.

Perhaps the only electrical appliance in extensive use outside of certain prisons, designed for the sole purpose of giving electric shocks, is the electric fence. Its use in the United States has reached such proportions that administrative bodies in certain States, the Underwriters' Laboratories and the Bureau of Standards have prepared specifications governing its construction and test. This device by its nature relies for its effectiveness on the leakage current to ground. It is thus somewhat similar to devices equipped with means for radio-interference suppression—the leakage current must be sufficient to accomplish its purpose, but must not exceed safe values. At first sight it would appear to be a prolific source of accident, but although it has been responsible for fatalities, sufficient operating data have perhaps not been obtained to justify positive statements as to the hazards involved. The device is not recognized in the Canadian Electrical Code although the type operated by a battery is accepted in some provinces.

Ground Electrodes

The efficacy of grounding practice depends predominantly upon the characteristics of the ground electrode, i.e., the actual means of connection between the part to be grounded and the body of the earth. It is possible to destroy completely the protection desired if this factor be not adequately provided for. This is the chief stumbling block in the way of a thoroughly satisfactory solution of the problem and the particular difficulty resides in the variability of the electrical properties of the soil and the meagre knowledge available of ground characteristics. Experience has shown the great difficulties of designing a ground electrode which will meet all requirements under the conditions encountered.

A great deal of theoretical work has been done in the development of formulas for the resistance of many forms of electrode; these are undoubtedly of great help in securing satisfactory results. However, the uncertain factor is the resistivity of the ground, which varies so widely with type and condition of soil that extreme caution must be used in applying these formulas; calculations must be supplemented by tests which take local conditions into account. Much useful work has been done by H. B. Dwight[1] in developing formulas and practical methods of applying them. A collection of these formulas is given in a paper published in "Electrical Engineering," December, 1936.

TYPES OF ELECTRODES

The Canadian Electrical Code recognizes several types of electrode on the basis of their resistances. The most desirable is that referred to as a grounding system which has a resistance of six ohms or less. A metallic water piping system for public supply usually meets this requirement; this is used wherever practicable. Other recognized types of ground electrodes are: metallic water piping systems for private supply if at least 100 feet in length and buried in the soil, the metallic casings of artesian wells (if the casing is not less than three inches in diameter) and one or more ground rods (connected in parallel if more than one are used). Gas piping may, with certain restrictions, also be used for grounding the non-current-carrying metal parts of electrical equipment. Ground electrodes must be placed below the level of permanent moisture; the connection wires from the equipment to the electrode must be protected from mechanical injury. Special precautions must be taken in the connections between grounding conductors and electrodes; only clamps approved for the purpose may be used.

The Code strongly recommends that all grounds be tested at the time of installation and periodically (say, every five years) thereafter. In this respect more stringent regulations are in force in other countries—particularly in New Zealand where utilities are required to test grounds periodically or otherwise give proof that low resistances are being maintained. So far as the author is aware, no attempt is made in Canada to test ground electrode resistances periodically after installation.

The practice of using water supply systems for grounding has, within recent years, been the cause of difficulty between the water supply authorities and the electric utilities. About ten years ago the American Waterworks Association withdrew its approval of the practice of grounding electrical systems to water supply systems, alleging that the abuse of the privilege on the part of the utilities was resulting in the flow of excessive and destructive currents through the water pipes. The difficulty has been accentuated by recent attempts of the electrical utilities in the United States to introduce new methods of wiring in which a bare neutral conductor is incorporated.

Changes in water works practice, involving the introduction of mains of non-conducting material, has also increased the difficulty of obtaining low electrode resistance and may have a revolutionary effect on grounding practice particularly in urban centres.

A committee, known as the American Research Committee on Grounding, was formed a few years ago in the United States and is now investigating the subject in all its aspects.

ROD ELECTRODES

Rods or pipes driven vertically into the earth are almost universally used for grounding both consumers' circuits and equipment, and in many localities, distribution systems. These offer the advantages of low cost and ease of installation; under favourable soil conditions they may be driven to the permanent moisture level—an important feature in maintaining low electrode resistance.

From the point of view of resistance the material of the electrode is not important, since there is very little voltage drop in the electrode itself. In this district mild steel rods three-quarter inch in diameter, 10 feet long and ungalvanized have proved quite satisfactory. The corrosive effects of the soil and of chemicals used to treat the ground are negligible.

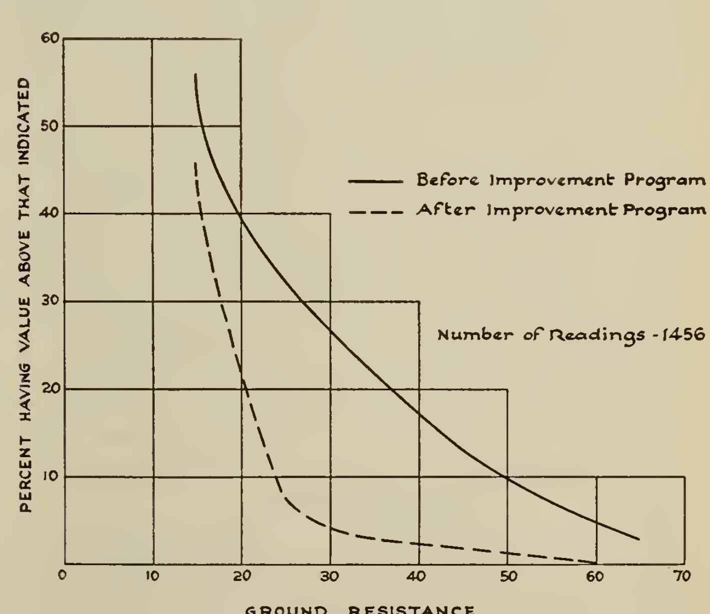

Fig. 2—Effect of ground treatment on resistance of driven pipe electrodes

The theoretical characteristics of rods may be calculated from the formulas of Dwight previously referred to. His paper also contains curves which facilitate calculations and have the great practical advantage that attainable ground resistances may be estimated in any case from measurements on a few temporary test grounds.

[1] *Professor of Electrical Machinery,* Massachusetts Institute of Technology, Cambridge, Mass., U.S.A.

TESTING OF ROD ELECTRODES

The practice of testing the resistance of transformer and consumers' ground electrodes at the time of installation is quite general in Canada. In Ontario, measures are taken to obtain, if practicable, resistances of 25 ohms or less in all transformer grounds; either by driving additional rods or by treating the ground with common salt. As a typical example of results achieved, 23,164 grounds were tested in 1934 of which 17,359 were reduced to 25 ohms or less by these methods. In some localities, it is impossible to obtain the desired resistance except at great cost, for example, where rock underlies sand or on gravel hill tops high above permanent moisture level. This condition may not be serious if the neutral is grounded at many points in multiple and has a low overall resistance to ground, this resistance being fairly uniform throughout the system. However, if the ground should be located at the end of a line so that it would be isolated if the neutral wire should break, a special effort is made to reduce the resistance to the minimum value.

The resistance of consumers' grounds is usually tested by the electrical inspector, since few wiring contractors are equipped with the necessary measuring instruments. In Ontario, resistances above 25 ohms as required by the regulations are reported to the supply authority, who is expected to reduce the transformer ground resistance to a lower value.

A study of the results of these resistance measurements made over a period of years in Ontario yields interesting information about the possibilities of obtaining low resistances in various types of soil. Figure 1 shows frequency curves for three types of soil from which it may be inferred that

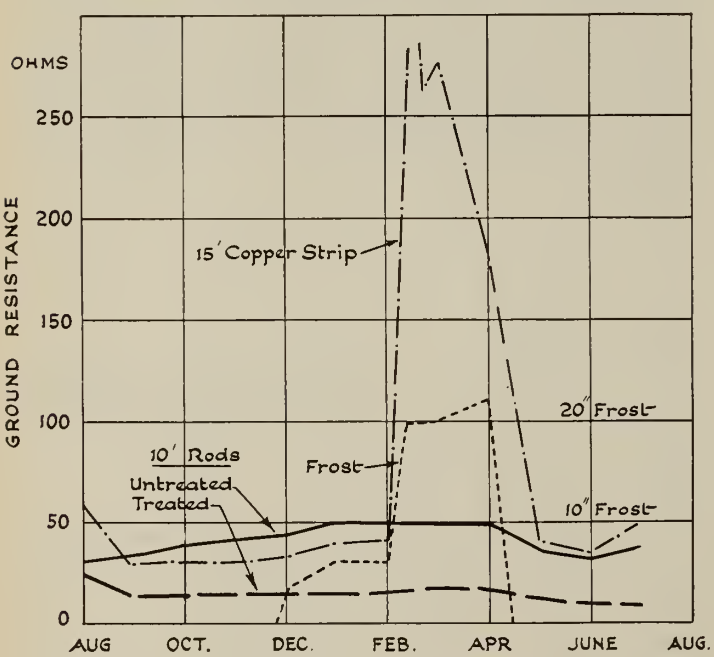

Fig. 3—Seasonal changes of resistance in copper strip and rod electrodes

in clay the most probable value of resistance is about ten ohms, in sandy loam about 30 and in gravel about 50. However, reliance should not be placed on such curves in designing electrodes; they are given merely to show the comparative results obtained in this part of the country. Figure 2 shows results plotted in a different way and indicates the benefits of ground treatment.

OTHER TYPES OF ELECTRODES

Investigations have been conducted by electrical utilities and others in order to compare the characteristics of various types of ground electrode. Such investigations were undertaken in Ontario in 1932, and while the results merely confirm in some respects those obtained elsewhere it is believed a summary may be of interest. They will be discussed in greater detail by E. F. Hinch in a future issue of *The Bulletin.*[2]

Eight test stations were installed in four different classes of soil, and measurements extended over a two-year period. The types of electrodes included:

- Wire mesh at various depths.
- Copper strips at various depths.
- Steel rods six feet to 20 feet long, three-quarter inch diameter, some of which were treated with salt.
- Perforated pipes, containing salt solutions.
- Several rods of T and star-shaped section.

The stations were located in clay, sand, gravel, and in soil underlain by rock at several depths, chosen as typical of conditions in Ontario.

Seasonal variations of as much as 2,700 per cent were found for some electrodes. Figure 3 shows typical results for driven rods.

Maximum values of resistance occurred in midwinter or midsummer, minimum in spring or fall. Precipitation was the most important single factor affecting the resistance.

In localities where a shallow layer of earth lies over rock, a strip electrode is better than a mesh. Frost destroys the effectiveness of an electrode. Soil treatment is valuable in reducing resistance; it is most effective in dense soils. It may often be more economical to treat single electrodes than to install additional rods.

A 10 ft. by ¾ in. steel rod would appear to have the best seasonal characteristics for use as an artificial ground. It is usually possible to lower greatly resistance values by driving rods in parallel. Where it is possible to drive longer rods this practice will be found, in many cases, more effective than driving additional rods in parallel.

CHARACTERISTICS OF ELECTRODES AT HIGH FREQUENCY

The effectiveness of a grounding system is determined by its impedance at the frequency of the disturbance. Consequently it is important to ascertain the effects of high frequencies and steep wave front discharges. Considerable research work is still necessary on this subject, but investigations, which have been conducted, show that impedance decreases with increasing frequency, and that in cases where multiple grounds are used the impedance of the interconnecting wires is frequently of great importance and the characteristics of the earth electrode relatively unimportant.

Discussion of Grounding Practice

It may possibly be inferred from this survey of grounding practice that the situation with respect to personal safety is not satisfactory, and that the many exceptions to grounding rules indicate the ineffectiveness of grounding as a means of protection. In this respect, judgement must be based upon the results as given in accident statistics and upon the potential hazards which may be deemed to exist, and which are not provided for at present.

Grounding is so intimately connected with the operation of electrical systems that there is no possibility of its being abandoned; the technical arguments in its favour are too weighty. The practice of grounding non-current-carrying metal parts, however, may be subject to modification, and it cannot be concluded that present methods will be continued indefinitely. However, based upon accident statistics, it would appear that the results, in general, are satisfactory. Figure 4 shows the number of industrial electric shock fatalities in Canada since 1926. It will be noted that since 1932, the ratio is approximately two per million in population. This is a very low value and compares favourably with statistics from other countries. W. Thorn of Melbourne, Australia, reports that in England an average for five years is 2.1; in Switzerland an average for ten years

[2] Published monthly by the Hydro-Electric Power Commission of Ontario, 620 University Ave., Toronto, Ont.

is 6.2, and in several other countries it varies from 4 to 6.7. The Metropolitan Life Insurance Company of the United States reported that from 1913 to 1935 the ratio for its policy holders was seven per million from electric shock. This was the lowest of six causes of accidents, automobiles being responsible for 40 per million.

From these figures it would appear that the measures taken to protect the public from injury in the use of electricity have resulted in a very satisfactory accident record for electricity as compared with other agencies.

It has been stated by advocates of alternative methods of protection that present methods have failed miserably. This sweeping statement is not borne out by evidence, at least in this country.

It must be apparent, however, that no general solution for the problem of grounding exists at present and that alternatives are necessary in certain cases.

The greatest defect in the present system is the difficulty of obtaining and maintaining low electrode resistance; this is particularly true in rural areas. In urban districts, large water supply piping systems offer a satisfactory solution, but, as mentioned previously, this may be affected by the introduction of non-conducting piping systems.

The second important difficulty rests in the construction of appliances and their manner of use by the public. Portable appliances, particularly, deteriorate more rapidly than any other item connected to electric systems. They are less carefully maintained in the hands of the public than equipment in industrial locations and on distribution systems. Carelessness in their use and home repairs are responsible for accidents. Further, certain portions of houses, particularly bathrooms, must be regarded as hazardous locations. The temptation is great to use appliances there, particularly heaters, electric razors, and many new devices rapidly appearing on the market. The provisions of the Canadian Electrical Code for these situations have already been discussed, namely, prohibition, as far as possible, in the use of portable appliances in these locations. This is as far as administrative control can go. Further steps must involve educational efforts to inform the public in the proper use of appliances and it may be said with some confidence that efforts in this direction have produced some results. The greatest possibilities of success lie in the training of school children, and this is a feature which should be emphasized more by educational authorities. In countries, such as Canada, where the use of electricity is so widespread, the primary and secondary school curricula should contain courses in the characteristics and use of electrical appliances.

Another objection which has been advanced against the practice of grounding is the possibility that breaks in conductors, particularly neutral conductors on consumers' premises may destroy protection. While this is true, it is also a fact that few cases of breaks in neutral wires have occurred. Only two fatalities have been reported in Ontario on overhead distribution systems caused by breakages in neutral conductors. So far as the author is aware none have been reported in domestic locations. The regulations, in general, prohibit the grounding of non-current-carrying metal parts to the neutral or identified wire in the consumers' circuit except at the service entrance. The reason for this rule is the fear of breaks in neutral conductors, but in the light of experience there are reasons for permitting this practice in domestic locations.

The chief difficulties in grounding practice are met with in the rural sphere where high ground resistance is most frequently encountered; this introduces a potential hazard which is not present elsewhere. The alternatives provided for in the regulations are not always applicable and other methods will have to be provided. At least two such methods have been proposed and one of them has been advanced to the stage of commercial application. This is called "earth leakage protection" and consists essentially of a circuit breaker connected to the exposed non-current-carrying metal parts of equipment in such a manner that the power supply will be interrupted if a dangerous voltage should appear on the exposed parts.

This method is recognized in the regulations of the Institution of Electrical Engineers of Great Britain. It was developed in Germany and is in use to some extent on the Continent and in Great Britain. In Australia many thousands of installations have been made particularly in the state of Victoria. Theoretically it would appear to offer complete protection irrespective of the value of ground resistance—an advantage not offered by other methods. However, it suffers the same disability as other methods of protection, since continuity of the grounding conductor is essential to its successful operation. Its non-selective characteristic is a further disadvantage. However, it is believed that this method warrants more study than has been devoted to it in this country.

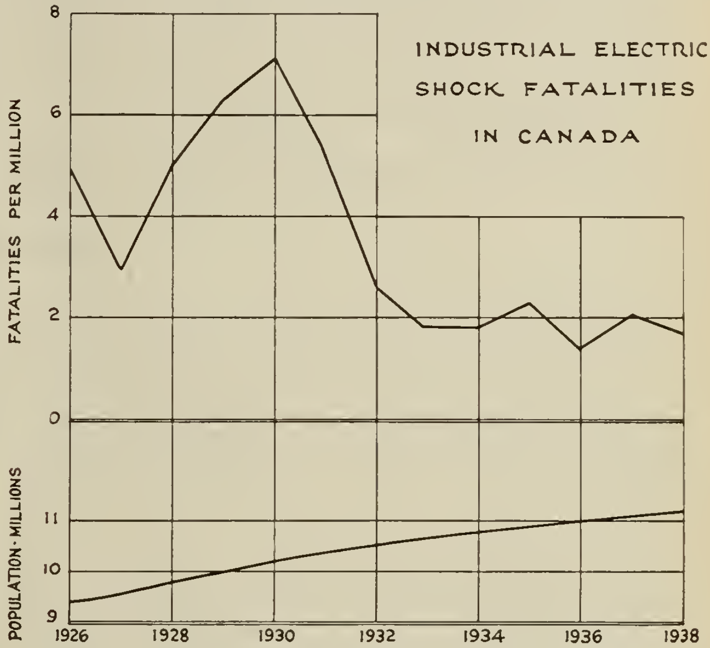

Fig. 4—Industrial electric shock fatalities in Canada 1926-1938

The other method referred to also disconnects the supply if voltage should appear on a metal part. It does not require additional conductors as does the earth leakage circuit breaker, but it does require that the consumers' circuits be isolated from other consumers and this will limit its application since a separate transformer would be required for each consumer.

While there is no reason for assuming an alarmist attitude concerning the defects in grounding practice, the situation, particularly as it applies to rural localities, should not be viewed with complacency. The potential hazards should not be overlooked since they may assume increasing importance as the use of electricity becomes more widespread. Economy should not be the governing factor in deciding upon protective measures. In fact it is difficult to ascertain whether unsatisfactory protection at low cost is the most economical solution. Accidents involving workmen's compensation are often expensive to electrical utilities and to industries, hence their interest in protection should not be determined solely by the initial cost of such protection.

While it may be impossible to reach finality in grounding practice, progress may be made by co-operative effort along several lines:

1. Further progress on an accelerated scale can be made in securing low ground resistance and efforts should be increased in this direction. The statement has been made that more is known about electrical phenomena in the

atmosphere than in the ground, and that earth characteristics vary far more widely than atmospheric characteristics. This points to the necessity for more research on ground characteristics, an effort which would be justified in view of the large amount now spent for grounding protection. Much can be done in this field to bridge the gap between theory and practice and to investigate the economic as well as the technical aspects of the design of ground electrodes. The correlation of ground resistance measurements made in different districts would be an important initial step and should lead to a better understanding of the economics of grounding practice and of the possibilities of securing grounds of low resistance.

2. Alternative methods of protection should be investigated and developed.

3. Standards for materials and regulations respecting installations should be maintained at a high level, as necessary supplements to grounding technique. There is little doubt that the improvements in wiring methods and in the construction of appliances and other equipment, brought about partly by installation and approvals regulations, have been contributing causes of the present fortunate position in Canada with respect to electrical accidents. The wholehearted co-operation of all branches of the electrical industry through the Canadian Engineering Standards Association, is responsible for an important and continuous contribution to public safety.

Acknowledgment

The author wishes to acknowledge the help given in the preparation of this paper by Mr. E. W. McLeod and Mr. J. R. Leslie of The Hydro-Electric Power Commission Laboratories.

DISCUSSION

Claude Gliddon, a.m.e.i.c.[3]

Grounding is not an exact science. The measurement of the actual ground resistance is not always easy, especially if the grounding system is extensive. The problem of protection against shocks cannot be covered by hard and fast rules. It is essential, therefore, in the introduction of regulations governing grounding, that room be left so that difficult cases may receive the treatment which gives the best protection.

There are many advantages in using a common neutral wire for grounding purposes. Where grounding on low voltage systems is employed for safety purposes, it is desirable to obtain as low a ground resistance as possible. It is often not feasible to get a low resistance ground, in a domestic customer's premises for instance. In this case, a neutral ground wire which extends along a distribution line and is connected to many low resistance grounds provides a satisfactory means of obtaining this low resistance ground, with its consequent protection against hazard to persons.

With reference to ground wires and grounded objects in the vicinity of wires carrying higher voltages, that is, where the safety of linemen and other electrical employees is concerned, it is important to regard *all* so called ground wires and objects as alive until the necessary steps are taken to determine that dangerous potentials will not be experienced by coming into contact with them.

The earth leakage circuit breaker may be found useful in this country in locations where it is not possible to obtain low ground resistance; it is understood that in Australia its use has been brought about largely by the introduction of non-metallic water piping systems. This device is used generally in countries where the voltage in residential supply is practically double that usual in this country, a condition which makes the need for such a device greater. In addition, the device in its present form is subject to testing difficulties and mechanical defects, as well as non-selectivity, and does not therefore appear suitable for use here.

Where it is not feasible to obtain low ground resistance, bonding of all exposed non-current-carrying metal parts may be the solution in many cases. As long as all conducting parts that a person may touch at one time are solidly bonded together, there is very little danger of receiving a shock. This bonding together of all parts also reduces the danger of radio interference.

W. B. Buchanan[4]

The author has discussed the problem of grounding from the point of view of codes and regulations. The writer's interest in the subject has been rather with the investigator's objective of determining the physical conditions involved, trouble-shooting, obtaining engineering data, etc., and the means wherewith to obtain such data, that is, instruments and measurements.

The author mentions the practice of grounding to water-pipes, also the proposed use of bare neutral wires. It should be realized that the various conducting bodies in earth frequently offer such a multiplicity of paths as to make the control of the ground current very difficult. It is highly important that the quantity of current and the manner of its distribution be under control and serious objections apply to indiscriminate attachment to earthed conductors.

The general principle of protection assumes that if, for any reason, the insulation on electrical apparatus be seriously impaired, such apparatus should be disconnected immediately from service. Proposals to accomplish this have involved the use of sufficiently low resistance to blow a fuse or circuit breaker, or to obtain similar operation by the use of an earth-leakage trip-coil. Such action is necessary in modern systems because failure of insulation may cause failure at some other location which may conceivably be in some other consumer's premises.

Occasionally operators find such enforced interruption quite irksome and prefer to continue operation of the feeder even with faulty insulation. Hence, we have had in the past, advocates of a non-grounded system, also, a history of grief of various types. One case on record tells of a 500 hp. motor fed from a 2,200 volt three-phase ungrounded circuit, which operated apparently quite satisfactorily until another motor of the same capacity on the same circuit developed a similar fault on another phase; then both motors promptly blew up. The damage could have been held to much less amount had a ground indicator been in service. The tendency of modern recommendations is that if a section of a circuit is liable to become grounded, it should be isolated electrically from all other electrical connections. Typical examples are the secondaries of welding and bell-ringing transformers.

The author has kindly invited the writer to supplement his paper by a review of earth-testing methods and instruments that may be used. Such a review must necessarily be condensed, but it is hoped that the comments following will be helpful, even if not complete.

The method of testing to be adopted depends on the type of information required and the purposes for which it may be used. The test may involve a single earthed electrode as a safety ground or a complex solidly-connected system of ground-wires as in a large electrical station with many tentacles in various directions. The results may be obtained in the form of a single value as the result of a few minutes' work, or as a potential survey under heavy current test, requiring hours or even days to complete the tests.

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[4] *Testing Engineer*, The Hydro-Electric Power Commission of Ontario, Toronto, Ont.

The resistances of tower footings of transmission lines are of interest from two points of view and two specific types of information may be required—first, the effective resistance of the network at a tower with all ground conductors in place, which is used to determine impedance relay settings, and second, the resistance of an individual ground which almost alone is effective in lightning protection.

Frequently, it is advisable to learn if a ground be capable of carrying current without appreciable change in its characteristics. For this reason, passing a substantial amount of current into ground and following the change in value over a period of time has merit. The usual causes of variation are frost and insufficient moisture.

Earth resistances can be measured in series provided the conditions be sufficiently determined to give the proper answer for the purpose desired. This scheme has been used satisfactorily on checking individual tower footing resistances on a 220 Kv. transmission line by lifting the sky-line clear from a tower and measuring the resistance of the loop.

The three-point method where three grounds are available and three values as the above are obtained. Individual values may be solved by the use of simultaneous equations. Practically one difficulty exists in obtaining three grounds of sufficiently similar values close enough together to be of any use. If the grounds, one or more, be of considerable area, their respective fields may overlap and the resultant figures be lower than the correct values. Possible errors in measurement also tend to throw doubt on the results when large differences exist in the value of the grounds being measured.

Power current may be passed into the ground under test and potential readings taken at various locations, thus giving a topographical diagram of potential differences that might be set up. This scheme is more elaborate than others but has been used when the maximum amount of information is desired.

Instead of the power current an auxiliary testing device may supply the current, using a temporary ground at some distance as a return path. The proportion of the total resistance assessable to the ground under test is determined by a potential probe.

The latter two methods lend themselves to considerable extension. Further development of the method and equipment leads directly into the problem of geophysical surveying with all its attractive and elusive possibilities.

Types of Measuring Instruments

Initially it must be recognized that where earth electrodes may have different metals in contact with moist soil, electrochemical reaction may set up potentials which cannot be neglected; also, the presence of stray currents from either direct or alternating sources may result in fictitious values unless the method of measurement screens out their effects satisfactorily.

Probably the simplest device ever used for measuring earth resistance on any extensive scale consists of two or three dry cells in series with the earth resistance under test and a standard resistance of ten to twenty-five ohms. A voltmeter connected across the standard resistance may be calibrated to give directly in ohms the value of the unknown resistance. The "inverse-scale" feature of this combination makes it attractive where a wide range of resistances are to be measured without the need of great precision.

Other direct-current instruments are based on the use of a slide-wire or other bridge methods of comparing an unknown resistance against three of known values. In addition to the limitations of this type already mentioned, the low voltage normally available may lead to erratic results where films such as paints are involved. Cases have arisen where three widely different values of resistance were obtained from three different scales of the same instrument. With proper precautions, however, such devices may give valuable service.

Alternating current has some distinct advantages for testing. Electrochemical potentials may be ignored and if the frequency be well within the audible range, a telephone receiver makes a very sensitive satisfactory detector for any null method of measurement. The latter feature is typical of slide-wire and other bridge methods of measurement. A possible limitation in some cases might be the presence of stray current, caused either by conduction or induction of sufficient magnitude to mask the testing current or conceivably to make the instrument inoperative altogether.

A number of such types of instrument have been used for some years past with considerable satisfaction. One type, fairly well known, obtains an alternating current by means of a buzzer with dry-cells as electric supply. The frequency is sufficiently high to permit the use of a telephone receiver as detector. The method involves the use of an auxiliary current probe and a potential probe in certain specified space relation with respect to the ground under test. One adjustment tends to give the resistance of the auxiliary current ground in series with the ground under test while a second adjustment gives the percentage subdivision of these values as indicated by the potential probe.

Another instrument, which has become very popular, derives its current from a hand-driven direct-current generator and by means of reversing switches on the generator shaft feeds alternating current into earth. The proper potential between probe and earth under test is picked up, recommutated, and combines with the initial load current in a direct current dynamometer movement to indicate the resistance of the earth under test. A fairly large number of instruments of this type have been in use for some years and they have given good satisfaction. No battery is required and, in general, it may be assumed they are always ready for use. A voltage of 75 to 100 volts is available and by varying the speed of rotation a range of frequencies can be obtained. The latter has been found of great advantage when testing grounds which were also carrying substantial amounts of load current of definite frequency at the time of test; a frequency of 25 cycles may be effectively "tuned-out" by the instrument by making the speed of the latter equivalent to 35 cycles.

Instruments of any such type in field use are subject to damage regardless of how rugged they may be, and it has been found worth while to provide standard resistors of one or more values, e.g., 5, 25 and 100 ohms, for checking the readings of the instrument from time to time. The condition of the leads should also be checked carefully and at frequent intervals for bad joints and broken strands.

Major M. Barry Watson, m.e.i.c.[5]

In relation to the grounding of the frames of portable apparatus by means of three pole receptacles and an extra ground wire, the necessity for such extra complication is not obvious.

It would appear that the simpler and equally effective means would be to enforce the use of two-wire polarized receptacles and plugs, grounding the frame to the neutral.

The only means by which the frame could then become alive would be through a broken neutral wire, or a partially inserted plug making contact on the live side only. A broken special ground wire is quite as likely to occur as a broken neutral.

It would appear also that the third wire would give an unjustified sense of security in that if the neutral conductor were broken, the device would still operate without giving any visible notice, thus leaving the circuit equivalent to present two-wire system. Also, there should be no difficulty in designing plugs such that contact cannot be made by the live side until after the neutral has made adequate contact.

[5] *Consulting Engineer*, Toronto, Ont.

Wills Maclachlan, m.e.i.c.[6]

The Institute is to be congratulated on having this comprehensive report on the matter of grounding presented by Mr. W. P. Dobson. Although this problem may not have received very serious consideration from a number of engineers, it has been receiving a great deal of attention from engineers in public utilities in Canada for some years past and is an extremely important subject at the present time.

The results of animal experimentation do not show any great difference in the severity of the electric shock between circuits at 25 or 60 cycles or direct current. One of the great dangers in electric shock is the amount of current that may flow through the body on contact with an energized device. This amount of current of course is dependent on the resistance of the circuit through the body and this resistance is greatly lessened when the hands are wet, hence the danger from electric shock in the bath room or in other wet places.

It is the sincere hope of all who have studied the subject, that the electric fence will be kept out of Canada except for the battery types. It introduces a very distinct hazard and in the hands of those who do not thoroughly understand it, has resulted in fatalities.

E. F. Hinch[7]

The writer has been concerned with the making of satisfactory ground connections and is interested in Mr. Dobson's concluding remark that earth characteristics vary more widely than atmospheric characteristics.

It is true that in the atmosphere, conditions of humidity, temperature and wind velocity are constantly changing, but the medium itself is homogeneous. In the earth, moisture content and temperature play a large rôle in seasonal variation of resistance. However, the outstanding variation is in the constituents of the soil and the manner in which nature has arranged them.

In this connection experience has shown that it is difficult to classify soils and that a common error is made in describing a soil in terms of the top soil.

An illustration of the effect of subsoils may be of value here.

The Talbot Road in south western Ontario was located primarily for military purposes and the soldier naturally chose a gravel ridge that extends for many miles from east to west. It was necessary to make satisfactory ground connections to the neutral conductor of a rural line built along this road and it was found that our standard ten foot rod in gravel did not meet the requirements. However, the workman in the district knowing his subsoil welded two rods together, penetrated the clay below and solved the problem.

In the late twenties the Hydro decided to improve grounding conditions on all their rural lines throughout Ontario. The first step in this programme was to learn about existing conditions. Each existing connection was to be measured. Fortunately instruments were then available that could be put in the hands of skilled men not necessarily technicians. A number of such instruments were purchased and the work of measuring progressed district by district. The results of these tests were studied by an engineer and estimated and specifications for the improvement work were made. In a period of three years some 20,000 locations were improved to 25 ohms or less.

The standard terminal used in this work was a driven rod of steel 10′ x ¾″ although other means were used in special cases.

The utility of the standard rod was proved due to its sturdiness under difficult driving conditions and its low first cost.

Regarding the use of Dwight's formulas for estimating the attainable ground resistance we believe them of great assistance when studying a limited area such as an important station site but not particularly applicable to an extensive distribution system.

As regards Mr. Dobson's frequency curves, 10 ohms seems a low value for clay and 50 ohms low for gravel. This opinion is based on our results for terminals installed along the line, but since Mr. Dobson's figures are largely for terminals installed on consumer's premises the suggestion occurs that probably proximity to buildings and habitations may be a factor.

The figures of the cost of improvement work, shown in the accompanying table, may be of interest in two districts.

Salt treatment as a means of lowering the resistance of a terminal is expensive and finds a limited use in soils of high resistivity.

Our original installations were made with a length of sewer pipe for storing a reserve of salt, the cost being $10.00 approximately.

Later we used what we called the "basin type," excavating a bowl shape about the rod and placing the salt directly in the earth, the cost being from $4 to $5.

Comparative Costs of Improving Ground Terminals in Rural Areas by Adding 10′ x ¾″ Steel Rods in Parallel with the Original 6′ Rod

R.P. District	Total No. of Grounds	% in Clay	% in Sand and Gravel	No. above 25 ohms originally	No. improved to 25 ohms	Total Cost	Unit Cost
Baden....................	240	31	69	200	200	$1,678.00	$8.38
Tavistock...............	219	74	26	197	197	835.00	4.24

The Author

In answer to Major Watson's question regarding the Canadian Electrical Code grounding rules, these are given in Rule 902 of the Code. This rule deals with conductors to be grounded and the details are given in a table. The introductory paragraph requires that "One conductor of all a.c. systems, and of services taken therefrom, shall be grounded if the maximum difference of potential between the conductors to be grounded and any other point on the circuit do not exceed 150 volts," and the table specifies the conductor or point to be grounded for different arrangement of circuits.

Major Watson asked why it is not permissible to ground the exposed non-current-carrying metal parts of equipment to the neutral conductor. This rule is the result of the majority of opinion of the Code Committee and is based on the avoidance of hazard which may be caused by a break in the neutral conductor. In the author's opinion the probability of breaks in the neutral conductor is very small, and this rule might well be revised to permit grounding to the neutral conductor.

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SOIL MECHANICS AT THE SHAND DAM

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Paper presented before the General Professional Meeting of The Engineering Institute of Canada, at Toronto, Ontario, on February 9th, 1940

SUMMARY—This paper describes the programme of field exploration and soils testing carried out for the earth embankments of the Shand dam now under construction on the Grand River in southern Ontario. The chief problems of design associated with the earth embankments are then briefly discussed and the application of the soil tests to these problems is given. Following this, construction methods are described and the results obtained to date presented.

Introduction

Construction of the Shand dam commenced in the early summer of 1939 and it is planned to have the work fully completed by the late autumn of 1940. This dam is the major unit of the initial phase of an undertaking to regulate and conserve the waters of the Grand river, and is being built by The Grand River Conservation Commission under powers vested in them by an act of the Ontario Legislature, entitled "The Grand River Conservation Act, 1938."

The Grand river and its two main upper tributaries, the Irvine and Conestogo rivers, shown in Fig.1, have their sources in the high country north of Fergus. In the first 50 miles of its course, down to Elora, the bed of the main stream descends rapidly. The next 75 miles, from Elora to Brantford, are less steep. In this latter region, the main concentrations of the river valley population are found. The remainder of the river course, approximately 55 miles, passes through comparatively flat country.

The Grand river is characterized by high spring floods and very low summer flows. This is particularly true for the region above Brantford. In the past, floods have resulted in extensive property and land damage, and any means that might be taken to reduce this perennial threat would be of material benefit. On the other hand, an increase in the low summer flows would reduce the potential hazard to health that accompanies relatively low dilutions of sewage effluent and, in addition, would improve the numerous small water powers along the main stream. With these factors in mind, the valley residents have long been urging the adoption of measures to improve the river regimen. The Act above mentioned is a direct result of these efforts.

Fig. 1—The Grand river and main tributaries.

The site of the Shand dam is on the main stream, about three miles north-east of Fergus. The reservoir that will be created by the dam will have a gross storage volume of 46,000 acre-feet. This capacity will be sufficient to hold back and store a large proportion of the tributary flood water every spring, which, when subsequently released in later months, will materially augment the present low summer flows.

At the dam site (shown in Fig. 2), ledge rock is exposed in the bed of the river. This rock is a dolomitic limestone of good quality and test borings have shown that its surface is reasonably level for the crest length of the dam. At the left bank an overburden of dense clayey soil rises quite sharply to the general level of the surrounding country. A similar but more gradually sloping rise of overburden forms the right contour of the valley, but in this case is separated from the normal river channel by a gravel bar of shallow depth overlying the ledge.

An outline plan and an elevation of the dam are given in Fig. 3. The central portion consists of a gravity section built of concrete, provided with three outlet pipes, and surmounted by four large crest gates. This part of the dam forms the spillway and regulating works. On either side of the concrete section are earth embankments. At their inner ends these embankments are retained by concrete wing walls of gravity section and their outer ends abut on the rising overburden of the valley banks.

A brief study of Fig. 3 will reveal the fact that it would have been possible to construct the entire dam of concrete, with suitable cut-offs into the earth abutments. Comparative estimates of cost, however, showed that the adopted design would be the cheaper of the two by a considerable amount. From the viewpoint of length of life and maintenance requirements, a well-constructed earth dam is probably superior to concrete, since weathering agents have little effect on it.

In the design of a dam situated on a river upstream from important centres of population grouped along its shores, the safety of the structure must necessarily be the primary consideration. Practically every failure of an adequately designed, well-built earth dam has been due to lack of sufficient spillway capacity, and consequent overtopping by flood waters.

Fig. 2—General view from east abutment at commencement of work, June 1939.

In the case of the Shand dam, it was necessary to give consideration also to certain factors not directly related to the passage of flood waters. As a result, four 30-ft. by 30-ft. crest gates were selected. With the reservoir at the maximum controlled level, these four gates could pass a flow more than eight times the recorded maximum, which would be equivalent to a run-off of about 250 cu. ft. per sec. per sq. mi. from the drainage area. A very high measure of safety, as related to the flood hazard, therefore, will be built into the Shand dam.

The rolled-fill method, rather than the hydraulic fill or semi-hydraulic fill method, was selected for constructing the earth embankments. This choice was governed largely by the following considerations: (1) the flow of the river usually falls so low in the late summer and early autumn that sufficient water for sluicing would ordinarily not be available, and (2) in recent years advances in the art of building rolled-earth embankments, and developments in the field of soil mechanics, have given distinct advantages to this type that it did not previously possess.

Following a report to the Grand River Conservation Commission, covering the general scheme as a whole, the Commission requested their chief engineer, in February, 1939, to prepare plans and specifications. These were made and accepted, tenders called, a contract let, and excavation commenced on June 20, 1939.

Field and Laboratory Investigations

BORROW AREAS

Before the preliminary plans for the earth embankments could be put in final form and detail working drawings issued, it was necessary to obtain certain information about the physical characteristics and properties of the soil in question. Accordingly, a programme of borrow pit investigation and soils testing was planned for the areas at and adjacent to the dam site. This included exploration with augers, sinking test pits, securing soil samples, and making the required analyses and laboratory tests.

A contract was therefore let for the auger and test pit work and arrangements made to have soil samples taken and tested. It was hoped that use could be made of hand augers for a rapid preliminary reconnaissance and exploration, but attempts to employ this method were only partially successful, because the soil explored was fairly stony and it was impossible to drill holes deeper than a few feet.

A field examination of the topography of the country in the vicinity of the dam site suggested the suitability of certain areas for initial soil exploration. Accordingly, a few widely spaced test pits were sunk and auger sampling performed, where possible, to extend the area under investigation. (See Fig. 4.) A complete record was made of the visual classification of all soil strata encountered during the sinking of the pits and samples were taken for testing. A typical recording of such test pit information is shown in Fig. 5. The density-in-place and moisture content of the soil were determined as the pits were dug.

Since it was necessary to prove out the borrow areas as rapidly as possible, mechanical analyses of the soil samples were first made and the results, plotted as grading curves, were used to form a general picture of the subsoil and to predict the results likely to be obtained from the later tests for compaction, permeability, and shearing strength. Thus a guide was established for locating additional pits.

The design contemplated for the embankment made use of both pervious and impervious materials. As the exploratory work developed, it soon became apparent that there would be no difficulty in finding a sufficient supply of material that could be used in the impervious zones, but that reasonably good pervious material would not be so readily available.

At the same time, it was discovered that both the vertical and lateral extent of the usable impervious deposits were by no means uniform or regular and, moreover, that there was a more than moderate spread in their physical character-

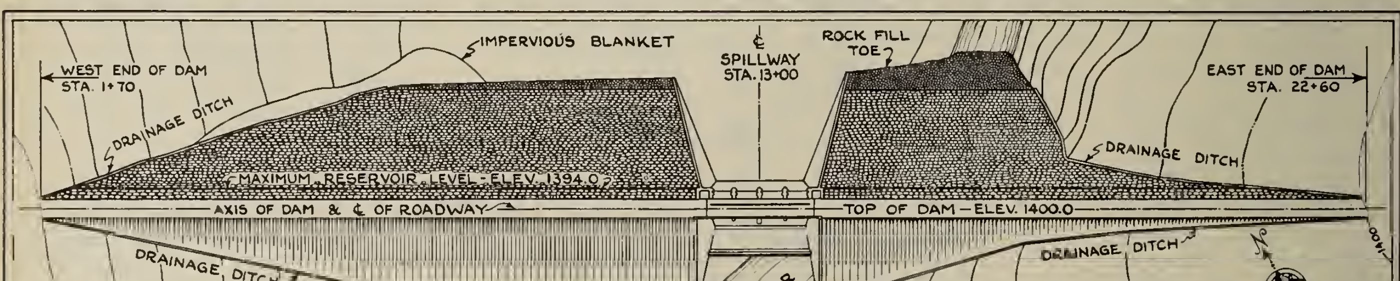

Fig. 3—General plan and elevation of Shand Dam.

istics and properties. This necessitated the sinking of many more test pits than had been anticipated and increased considerably the volume of testing work. On this preliminary phase of the work alone, 52 test pits ranging from 4 to 25 ft. in depth were dug. The apparent shortage of well-graded pervious materials referred to above was made good by later discoveries.

LABORATORY TESTS

The following laboratory tests were established for use in the design and construction of the embankments:—(1) *mechanical analysis* for the determination of the proportions by weight of the various grain sizes in a sample of soil; (2) *compaction characteristics* to fix the relation between moisture content and the soil density resulting from a given standard method of compaction; (3) *permeability tests* to establish the numerical value of the coefficient giving the relation between the discharge velocity and hydraulic gradient of seepage flow; (4) *consolidation tests* to derive a measure of the settlement to be expected under load; and (5) *shearing tests* to fix the numerical value of the shearing strength of the soil, being made on samples remoulded to simulate the embankment soil and on undisturbed samples taken from the soil foundations. A brief discussion of the reasons for making these tests follows.

The grading curve, shown on the left in Fig. 6, plotted from the results of mechanical analysis, is the starting point for the study of soils. In a general sense, it indicates certain physical characteristics and properties, since soil behaviour is dependent, in part, on grain size and the relative proportions of the various constituents. As previously mentioned, it is useful in the preliminary selection of borrow pit areas and also in appraising the probable value of additional studies and the direction they must take.

It is important, in constructing an earth dam, to secure the greatest density that is reasonably practicable. The compaction characteristics curves, Fig. 7, show the density that may be expected and the means to be taken to secure it.

The permeability coefficients, in conjunction with the "flow net" to be described later, enable a study to be made of the rate of flow and quantity of seepage at any point in the embankment and earth foundations. Such a study will indicate the necessity or otherwise for providing seepage control measures and what form they should take if needed.

For an earth dam, the major problems of structural design are concerned with the stability of the side slopes, the supporting strength of the foundation material, and the destabilizing effect of seepage flow upon the soil particles within the embankment and within any earth foundation. The solution of the latter problem has been indicated in the immediately preceding paragraph.

If the foundation material is soil, it is necessary to consider the question of its stability, in a saturated condition, against lateral movement under the weight of the embankment. Similarly, the stability of the side slopes of the embankment in their weakest condition must be investigated. Both of these studies require knowledge of the dry and saturated weights of the embankment material, as determined from the compaction characteristics tests. The shearing strength of the embankment material as compacted, and of the foundation material in its undisturbed state, are both required for these studies and can only be determined by shear tests.

For design purposes, the investigation of the borrow pit and foundation material required extensive exploration, sampling, and testing previous to construction. This work was therefore arranged to include as much as possible of the testing necessary for setting up a control procedure for construction, since the latter required the determination of some of the same soil properties.

The design studies and requirements, outlined above, indicated the need for complete mechanical analyses and shear, compaction, permeability, and consolidation tests for both pervious and impervious materials. It was found, however, that no available machines were large enough to test the pervious material for shearing strength. Fortunately, this was not a handicap, since the shearing strength of the material finally used was manifestly well above the required minimum. The permeability of the pervious materials was well established by field observation of the behaviour of such material compacted in a stockpile at the dam site. The further consolidation or settlement of material of this kind, after it is well compacted, is known to be very small, so that testing for this information was considered unnecessary. In all, then, for pervious material only the determination of grading characteristics was needed. The complete series of prescribed tests was required, of course, for the impervious materials.

A full description of the procedure followed in making the different tests would be very lengthy, but a brief review of the work done will indicate the main features. No departure was made from the standard procedures in general use elsewhere for earth dam soils work, although, not unexpectedly, minor modifications were found either necessary or advantageous.

Mechanical analyses were made by sieving to give the grading of material from the 6-inch size to the fraction passing the 200-mesh sieve. Analysis of the fine fraction was made by the use of a Bouyoucos hydrometer to at least the upper limit of the clay sizes. No further separation was required where the fraction passing the last sieve was 5 per cent of the total sample or less. The results of each analysis were plotted in the form of grading curves. Representative curves for each of the pervious and impervious materials are shown in Fig. 6.

The compaction test consists of packing a sample of soil by a standard method in a cylindrical container and then determining its density. This procedure is repeated for samples of the same soil, but of different moisture content, to determine the relation between moisture content and density. The moisture content producing the greatest density is known as the optimum moisture content. A typical compaction characteristics curve is shown in Fig. 7. While the exact method of laboratory compaction necessary to produce the same result as would be obtained with construction equipment in the embankments can only be found by correlation tests, yet the standard laboratory method furnishes a definite and reliable indication of the compaction characteristics of the soils tested.

Fig. 4—Digging test pits for borrow area exploration.

In conjunction with the field sampling for mechanical analysis and other tests, separate samples were taken for field moisture measurement and the density of the soil in its natural state was determined by the dry sand method. The latter of these two field measurements was used for comparison with the laboratory compaction tests to obtain a measure of the change in volume that might be expected when the soil was compacted in the embankments. The former measurement showed whether or not the soil would require more moisture, no additional moisture, or to be

TEST PIT LOG SHEET

Owner - Grand.River.Conservation.Commission. Project - Shand.Dam......

Date Started...July.22nd,.1939....... Pit No: CD

Location of Pit..N.8+00/E.23+10...... Ref.Dwg.No......................

Ground Elevation ...1395.8........... Size of Pit ..6'-0" x 6'-0"...................

Names of Foreman and Workmen......T. Huxtable..............................

Depth From	Depth To	Nature of Ground	Sample No.	Time Record	Notes
0	0.8	Sandy loam			
0.8	3.75	Grevelly silty sand	CD-1		3'
		4" mex. some oley			
3.75	9.0	Grevelly silty sond,			
		some clay 3" mex. few			Moisture at 7'
		6-12"	CD-2		7'.5 12 pails water
					overnight.
9.0	14.3	Hard gravelly clayey			
		silty sand, scattered			
		6" oobbles.	CD-3		13' 6" water overnight.
14.3	19.1	Herd grey gravelly			
		clayey silty sand, 5%			
		1-1/2-3" pebbles			
		4-10-12" boulders	CD-4		17'.5 1 ft. water
					3' x 6"
		Density in place at 16'			Stopped 29th July

Date Completed...July 29th, 1939....

Volume of Excavetion................ Signed..........J. Bowen..............

Total Man Hours.....................

Total Lumber........................ Form No.ST-101

Fig. 5—Test pit log sheet: typical field record of digging and sampling.

dried out, before it could be satisfactorily compacted in the embankments.

At the time of making the compaction tests, the resistance of the soil to penetration was also measured for each different moisture content. A comparison of the results thus obtained on different soil samples provided an indication of the supporting power of the soil at the optimum moisture content.

Permeability of soils may be measured under many different conditions. For the work at the Shand dam, it was considered sufficient to obtain values from soil samples under conditions that would simulate an average condition in the embankment. To do this, the sample to be tested was compacted at the previously determined optimum moisture to a dry weight very close to the compaction test maximum, and then subjected to a constant consolidating load equivalent to about 20 ft. of fill. While under this pressure, the sample was saturated with water and the amount of seepage upward through it determined under a constant head of water. This head was changed for different samples and ranged from 25 to 40 feet. For convenience, the rates of seepage thus measured were reduced to a hydraulic gradient of one. The result showed that the soils provisionally selected for use in the impervious section were all more than amply impermeable. The average of all rates of seepage was 0.0628 ft. per year, with a minimum rate of 0.0060 and a maximum of 0.2340.

During the application of the consolidating load to the sample being prepared for the permeability test, a certain compression occurs. Records of this compression were taken for use, if possible, in estimating the settlement that might be expected in the embankment. However, since the measurements were made for only one consolidating load, the results were of limited use for this purpose, although the very small amount of compression that occurred indicated definitely that very little settlement should be expected in the embankment.

All shear tests were performed on a normal load shearing machine. The majority of these tests were made on remoulded soil samples, containing no particles larger than ¼ in. in diameter and packed by hand at the optimum moisture content in the shear box. The normal load was then applied and immediately afterwards the shearing load applied in successive increments until failure occurred. A record of shearing deformations was made throughout each test. A typical plotting of the record of such measurements with the corresponding normal loads is shown in Fig. 8. Samples of the same soil were tested in this manner under three or four different normal loads. The maximum shearing resistances plotted against corresponding normal loads for a typical test are shown in Fig. 9.

Assuming that shearing strength is represented by the relation,

$$S = C + n \tan \phi$$

where S = total unit shearing strength,
C = unit cohesive strength, (independent of normal loading)
n = unit normal loading,
ϕ = angle of internal friction,

a straight line may be drawn through the plotted points. The intercept on the vertical axis is the value of C and the slope of the line is $\tan \phi$. Interpreted in this way, the average values obtained for the soil samples from the borrow pit

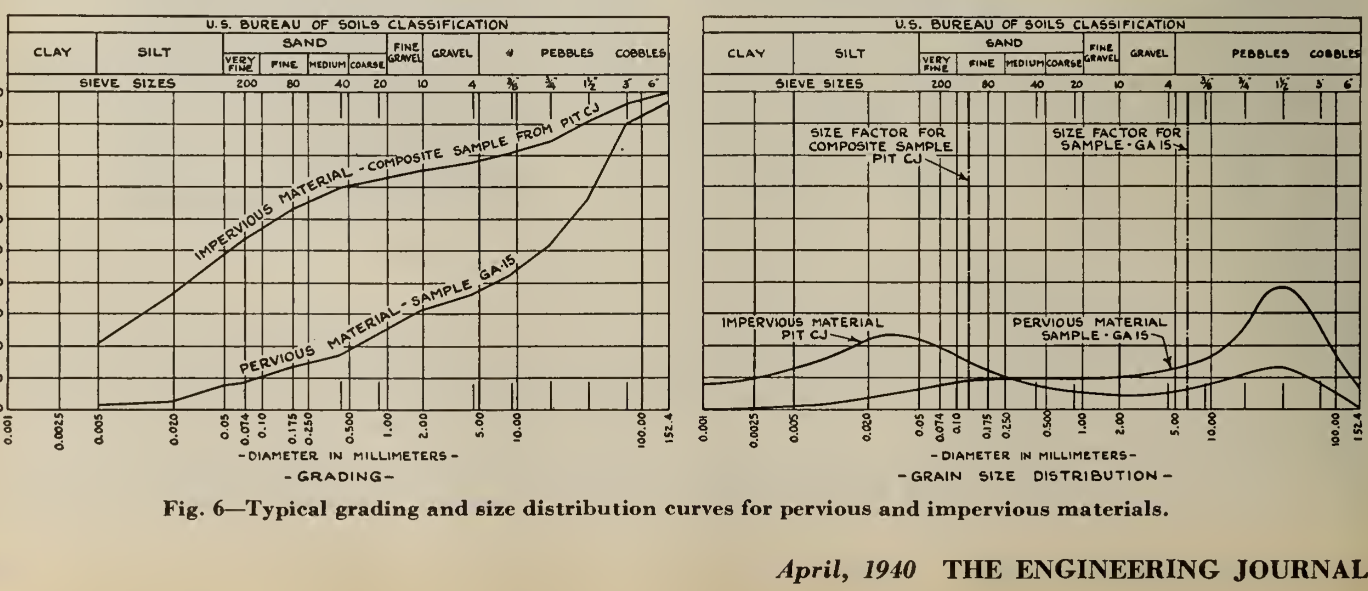

Fig. 6—Typical grading and size distribution curves for pervious and impervious materials.

area used for the 1939 season's work are $\phi = 30$ deg. 50 min. and $C = 1090$ lb. per sq. ft.

The above testing procedure was adopted as standard after comparing the results from samples of the same soil tested in shear as follows:

(a) Soil at optimum moisture, compacted in the shear box and tested immediately.

(b) Soil at optimum moisture plus 1 per cent, compacted in the shear box, left under normal load for 12 hours or more, and then tested.

(c) Soil mixed in the shear box to the consistency of fluid mud, left under vertical load for 12 hours, and then tested under water.

Since no appreciable difference in the results from these three methods could be noted, procedure (a), being the quickest and simplest, was adopted.

FOUNDATIONS

It was necessary to investigate the soil within the embankment foundation areas for three reasons: (1) to discover any material that should be removed; (2) to determine whether such material might be used as fill in the embankments, and (3) to determine the characteristics and properties of the soil actually to be used as foundation material. For this purpose, test pits were dug and samples taken. The testing procedure for (1) and (2) was the same as that already described for the borrow pit material. It was found that a considerable volume of pervious material on the valley floor could be used for fill, but that the remainder of this shallow depth material must be wasted because of unsuitable grading or too high content of organic material. For the remainder of the foundation area, only excavation of the top soil, with its undesirable organic material, was required.

To obtain information, in addition to that supplied by visual observation and mechanical analyses, concerning the material to be left in place, samples of the soil in an undisturbed condition were cut out. Due to the large stones in these samples, it was exceedingly difficult to prepare test specimens from them. No permeability samples could be secured and only a few shear test specimens. It was necessary, therefore, to estimate the permeability of the foundation soil from the grading curves.

Shear tests on undisturbed samples were made by cutting from the sample a piece to fit in the shear box. This piece was then sheared in the same manner as the remoulded samples. Where the sample provided enough material of the same kind for more than one test, different normal loadings were used to obtain a curve similar to that for the remoulded samples. Where this could not be done and only one test performed on the soil sampled, the test results give only the shearing strength under one normal load. However, disregarding any cohesion that might exist, since it would add to the shearing strength, it was found that the samples tested had ample strength in shear.

Application to Design

To carry out the purposes of the Commission's initial undertaking, the scheme of operation for the Shand dam involves the filling of the reservoir with the spring run-off, holding the stored water until early summer, and then releasing it during the months of low river flow. Under this plan, the reservoir will become empty in the fall and will remain so throughout the winter, in readiness to receive the spring flood of the following year.

Only one main consideration, as related to structural design, arises from this cycle of operation. Since there will be a complete drawdown of the reservoir at least once every year, the entire upstream slope of the embankments must be so designed as to remain stable when subjected to any hydrostatic pressure from contained water. The destabilizing effect of this outward pressure may be reduced by providing on the upstream slope an adequate depth of free-draining material. By doing this, it is not necessary to resort to as flat an upstream slope as would otherwise be required. The minimum dimensions of such a zone for any cross-section and for any given upstream slope will, of course, be fixed by the shearing strength and permeability of the material. Moreover, for slopes exposed during freezing weather, it is desirable to have free-draining material at and near the surface to prevent possible injurious frost action.

The question of water-tightness for the embankments, from the viewpoint of operation, did not arise. It mattered little, provided the necessary stability was provided, whether the water which had to pass the dam to provide for riparian rights downstream went through the outlets or through the embankments. However, from the point of view of the valley residents, a dam that appeared to have considerable seepage would probably give rise to serious, but not necessarily justifiable misgivings as to its safety.

To meet these two requirements, the embankment section required a central zone or core of relatively impervious material restrained by outer zones or shells of very pervious and stable soil. The objective in the borrow-area investigation was, therefore, the discovery of soils suitable for the two zones. The final design, based upon the materials found, took the general form shown in Fig. 10, which is a typical cross-section for the portion founded on ledge, and therefore of maximum dimensions.

SOIL CHARACTERISTICS AND PROPERTIES

The two major soil types, viz.: pervious and impervious, required for the embankments have been mentioned previously. The deposits, for which the grading curve marked "impervious material" (Fig. 6) is typical, have an extremely

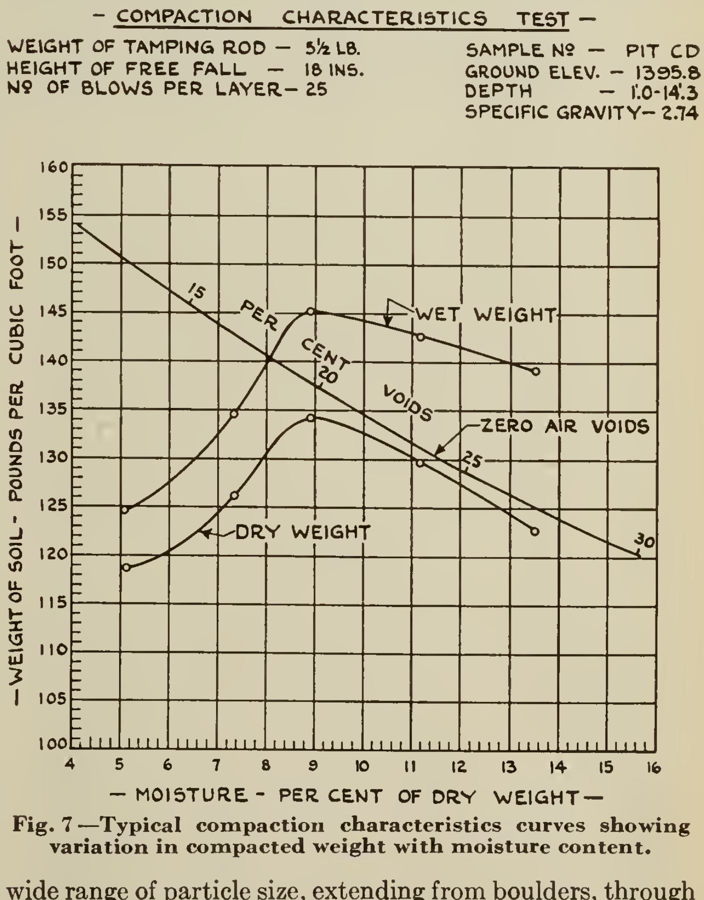

Fig. 7—Typical compaction characteristics curves showing variation in compacted weight with moisture content.

wide range of particle size, extending from boulders, through the gravels, sands, and silts to materials at least well into the clay sizes. The grain size distribution curves of Fig. 6 have been drawn so that the area under the curve and bounded by any two ordinates represents a fraction by weight of the total sample and this fraction is composed of all the grains having sizes between those sizes which correspond to the two ordinates selected. The distribution curve for the typical impervious soil shows: (1) that this material is a mixture of all sizes within its range, and (2) that there is a slight excess in the amount of very coarse material over that of other sizes with the exception of the very fine sand and silt, of which there is a considerable preponderance. As shown by both the density-in-place measurements (borrow area) and the compaction characteristics curves, soils having grain size distribution of the type in question may be quite dense and this fact has received further verification from the measurements made on this soil after compaction by construction equipment.

The low coefficients of permeability obtained from the tests indicate that this soil type more than meets the requirements of the central zone. Assuming that the test figures will apply to the compacted material in the dam, it is estimated that the total rate of seepage through the embankments should be about 30 gal. per day. In arriving at this figure, it was assumed further that water in the reservoir would be maintained at the maximum controlled level for a period of time sufficient to establish steady seepage flow through the embankments. This latter assumption will not be true under the scheme of operation contemplated for the immediate future, but the assumed condition fixes a theoretic maximum of seepage which may obtain under changed operating conditions which may come into effect within the life of the structure.

As previously mentioned, the simple but very informative test devised by R. R. Proctor[1] discloses the fact that for any given soil and given method of compaction, the resultant density is dependent only on the amount of moisture present in the soil. The representative curves of Fig. 7 show that as the moisture in the soil increases, the density increases and the voids decrease until a certain point is reached where the density is greatest and the voids least. The addition of moisture beyond this point causes the density to decrease and the voids to increase. A soil compacted at a very low moisture content would appear to be quite firm and stable. However, the amount of voids would be relatively large

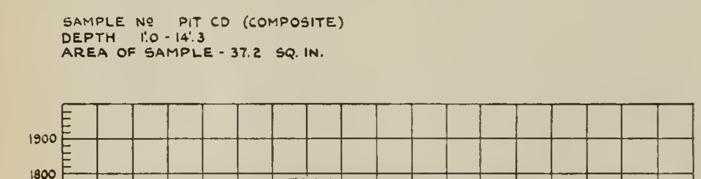

Fig. 8—Shearing load-deformation relations during typical shear test.

and these would be only partially filled with water. Soil in this state can absorb water freely and when fully saturated would become soft. For a dam, this is obviously a condition to be avoided. On the other hand, a soil compacted at the moisture content giving the greatest density will have the minimum amount of voids that the method of compaction can produce and consequently the minimum softening effect will result from saturation. This, in brief, is the basic principle used in the construction of rolled earth dams.

From the viewpoint of design, the dry and wet weights of the compacted soil are of great importance, since these are required to compute the stability of the side slopes. The compaction characteristics curves indicate the values to be assigned to these quantities. Furthermore, they allow the designer to specify the moisture content to be used in construction and the permissible range of departures from it.

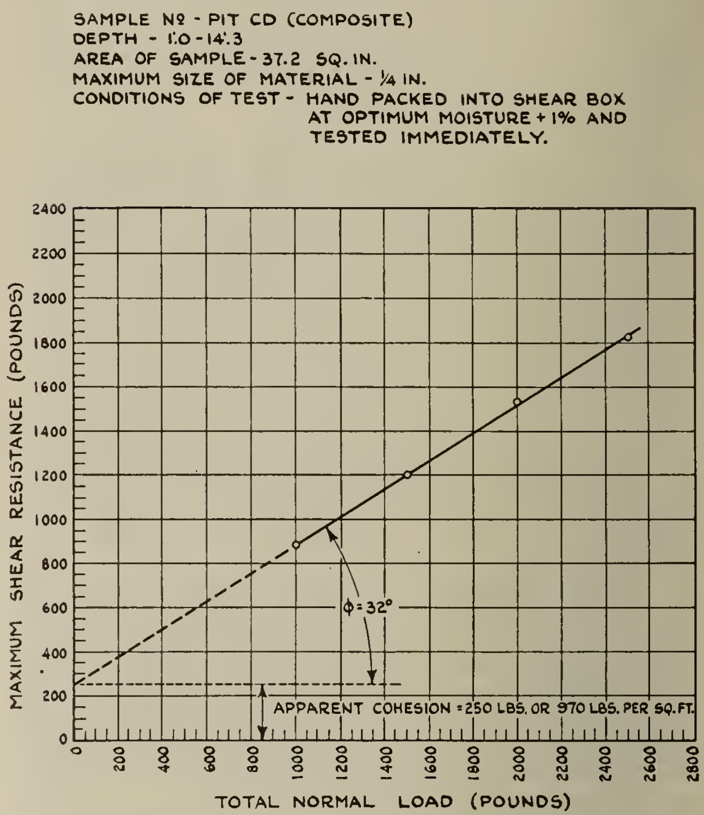

Fig. 9—Results of typical shear test on impervious soil.

In this connection, it is interesting to note that the rounding of the peak of the dry and wet weight curves of Fig. 7, which is typical of soils having moderate amounts of very fine particles, is of definite advantage since densities close to the maximum can be obtained with a reasonable variation from the optimum amount of moisture. Field experience has shown that varying moisture content in the borrow pit, changing relative humidity of the air, the action of wind, rain, and sunshine all combine to make difficult the job of holding the moisture content of the compacted fill close to the optimum.

Unduly wet weather during construction creates the most serious problem encountered in the process of maintaining an effective and practicable relationship between construction methods and the soil characteristics described above. This is primarily due to the fact that the soil in the borrow pit then absorbs more moisture than is permissible, or even practicable, for operating the compacting equipment. Methods for combating the effects of wet weather are described in a succeeding section.

Since the permeability coefficient is a function of the shape and amount of voids in the soil, it must be found from test specimens compacted to the same density as required for the soil in the dam. Here again, the compaction characteristics curves supply this necessary information.

The grading and distribution curves marked "pervious material" (Fig. 6) are representative of the second major soil type found on and near the dam site. The range of the grading curve is wide and extends from the very coarsest materials through to the silts and clays. In shape, this

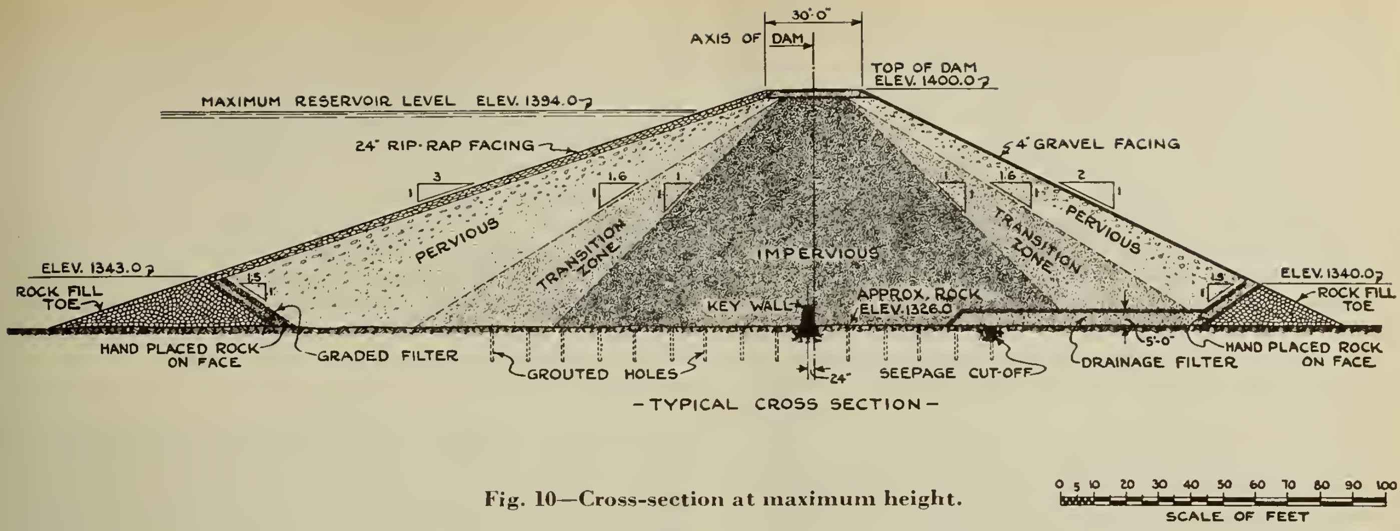

Fig. 10—Cross-section at maximum height.

curve approaches the ideal for maximum density. The main characteristics of this type, as shown by the distribution curve, are (1) it is a mixture of all grain sizes within its range, (2) it has a considerable preponderance of pebbles, and (3) it contains a very small amount of silt and clay sizes.

The investigation of the embankment foundation soil was the last phase of the exploratory work done prior to the commencement of construction. It was then found that the major portion of the river flat underlying the west embankment was composed of excellent material of the pervious type. It was surmised that this pervious material might extend over a considerable area of the flat, which conjecture was afterwards found to be a fact. As part of the construction programme, a diversion channel was excavated through this flat and the material stock-piled for later use. This pile afforded an excellent opportunity to observe the drainage characteristics of the material under conditions closely simulating those of the embankment. Much of the material was saturated when it was placed in the stockpile. Observations made at that time, as well as at periods immediately following heavy rains, afforded convincing proof of the suitability, as far as the requirement for free drainage was concerned, of this soil for the outer zones of the embankments.

Referring again to Fig. 10, it will be seen that a transition zone is shown between the impervious material and the outer shells of pervious soil. This zone is built by alternately considering it as being part of the central zone and part of the outer shell; in other words it is composed of overlapping portions of these two zones, tapered toward their outer ends. A total thickness of not more than 4 feet, measured at the central zone or outer shell, may be built up of one material before the alternate construction is commenced, with the restriction that pervious material may not extend to a higher elevation than adjoining impervious material. It is expected that this construction will provide a strong bond between the pervious and impervious soils and at the same time distribute over a larger area, and therefore lessen, any effects that may result from the difference in properties of the two soils.

THE FLOW NET

The flow of water through soils is, from the viewpoint of hydraulics, a problem in laminar motion. In laminar flow, there are no local fluctuations in velocity and the stream filaments are steady and not subject to turbulence. Such flow is, in general, produced by very low velocities and a relatively close spacing of the boundaries.

It is evident that this latter condition is reproduced in practically every soil. The voids of the soil form innumerable interconnected channels of extremely small dimensions. The form of the channel is complex, constantly changing, and presents a high resistance to flow. The velocity of seepage water, therefore, is very low and experiments demonstrate that the flow is laminar. In view of the conditions described, it is not possible to consider the actual area of the seepage channels nor the actual velocity through them. Instead, the gross area, A, of the soil through which water is flowing, is used together with an effective velocity, V, such that $V=Q/A$, where Q is the volume of seepage per unit of time. Since the flow is laminar, the energy loss will vary directly as the first power of the velocity and the equation $V=kS$ may be written, where S is the hydraulic gradient and k is a coefficient of proportionality. This equation is generally known as Darcy's law and the coefficient k as the coefficient of permeability. The latter evidently has the dimensions of a velocity.

One of the most informative methods of studying the flow of seepage through an earth embankment is the construction of a flow net (Fig. 11). If the flow is such that it may be considered as two-dimensional, it can be shown[2] that the conditions may be represented by two families of curves intersecting at right angles, and conforming with the boundary conditions. The lines of one set of curves are known as the flow lines. In reality, these are stream lines, i.e., lines so drawn that at any instant the velocity vector of every particle on the line is tangent to it. The lines of the other set of curves are called equipotential lines, and are lines connecting points having the same potential head.

The possible number of stream lines and equipotential lines is countless and any attempt to draw a flow net by selecting a few lines at random has been found to be a hopeless task. However, a construction based on the following principles is possible within reasonable limits of time. The mathematical equation for the steady flow of water through isotropic soil is satisfied by a graphical construction in which the stream lines and equipotential lines, intersecting at right angles, form the sides of curvilinear squares fitting within the boundaries of the seepage flow. A flow net drawn in this manner will have the stream lines so spaced that the same quantity of seepage water passes between any adjoining pair of stream lines and the equipotential lines will be so spaced that there is the same loss of head between any adjoining pair of such lines.

It is extremely unlikely that the permeability of the soil in a rolled earth embankment is exactly the same in all directions; in other words, from the viewpoint of seepage, soil cannot be considered as an isotropic material. Definite knowledge of this matter is at present not available. Experimental evidence, both from the laboratory and from structures in service, is badly needed. By making use of geometrically transformed cross-sections, it is possible to construct two-dimensional flow nets for any directional variation in the value of the coefficient of permeability. The use of reasonable limiting values for the ratio of k (horizontal) to k (vertical) is about the best that can be done for making studies until more knowledge is available.

Apart from the general knowledge of seepage conditions within an embankment gained from the construction of a flow net, it also allows information on the amount of percolation, seepage velocities, and pore pressures to be obtained and studied. This latter is particularly useful in making stability analyses.

The flow line representing the free water surface is called the line of seepage or the phreatic line. The position of this line with respect to the cross-section of the dam is a matter of considerable importance. For an embankment built of the same material throughout, it is determined solely by the geometry of the cross-section and the location of the discharge face, and if the embankment is founded directly on an impervious base, the line of seepage would emerge at some point on the downstream slope. The resulting free discharge of seepage water might produce piping, i.e., a progressive washing out of fine material.

The shape of the flow net and, in particular, the location of the discharge face can be controlled by the provision of an interior drainage filter. As will be seen from Fig. 11, the extension of the filter well into the central impervious zone has forced the flow net to lie entirely within this zone. All water seeping through the embankment from the upstream face will discharge into the drainage filter along its inner end, and none will appear in the downstream transition zone and outer shell.

The material used for the drainage filter of the Shand dam is gravel having a natural grading curve similar to the pervious material of Fig. 6. This is separated on a ½-inch vibrating screen, the coarser fraction placed directly on the foundation rock to a thickness of 3 ft. 6 in. and the finer fraction superimposed to a thickness of 18 inches. By this means, a progressively larger grading of material is secured in the direction of flow, from the fines of the impervious core to the coarse pebbles of the bottom filter layer. The filter material was carefully selected on the basis of the relation of its mechanical analysis to that of the soil of the central zone, so that a practicable, simple, and inexpensive method of size grading could be adopted, while at the same time there would be no migration of soil particles from the central zone through the drainage filter when seepage was established.

Two important results are obtained by the use of drainage filters. By extending the filter well into the interior of the section, the line of seepage can be withdrawn a considerable distance from the downstream face and steeper slopes may be permitted. Steeper slopes with internal drainage are much more stable than flatter slopes without drainage. The economy of the design is at once apparent. Furthermore, all possibility of piping near the downstream toe is permanently removed, and the safety of the structure thus considerably increased.

FOUNDATIONS

The construction operations of stripping and cleaning the rock for the embankment foundations, excavation in rock for the foundations of the concrete structures, and the grouting of the exploratory holes that had been made by diamond drilling at the site in the fall of 1938 disclosed the fact that down to a depth of about five feet the horizontal bedding of the rock was relatively thin and that the seams would carry water under light pressures. Some of these seams were exposed by the stripping operation alone. Evidence of some vertical cracks was also apparent. This condition had been anticipated, in some degree, by an examination of the diamond drill cores and by the known general geologic conditions at the site.

The existence of such seams and cracks would constitute an ever present threat that piping at the base of the central zone might develop as a result of seepage from this zone into and through the upper layers of the foundation rock. This was a condition that could not be tolerated, and to make such seepage impossible, an area extending from a point a short distance upstream from the impervious zone to a point slightly beyond the upstream end of the drainage filter was consolidated by grouting. Three-inch holes spaced at about 20-ft. centres were drilled over this area to a depth of 8 ft. and grouted under light pressures. Intermediate check holes, drilled and grouted in a similar manner, took much less grout and in some cases none at all. The grouting procedure, of course, could not thoroughly consolidate the top two feet or so of rock. A small trench located at the downstream end of the area in question was therefore excavated in the rock and filled with concrete prior to grouting under the trench and upstream from it. There is every guarantee that as a result of this work all possible seepage of water through the upper layers of the rock has been effectively prevented.

STABILITY OF SLOPES

The structural design of the earth embankment sections of the dam is primarily concerned with the stability, or security against movement, of the sloping upstream and downstream faces and of the foundation material. For an embankment resting on rock, the question of the stability of the foundation does not arise. As will be seen from Figs. 3 and 10, this condition obtains for the maximum cross-sections of the embankments and extends for the major portion of their length. Since the investigation of the slopes is the chief stability problem, the methods used in this connection will be outlined.

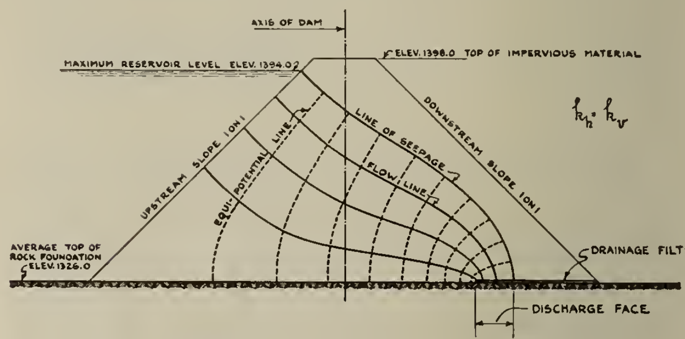

Fig. 11—A flow net study of the impervious section.

It has been found from experience [3, 4, 5] that an unstable slope in material possessing cohesive properties fails by a mass movement of the material located above a curved surface. The profile of this surface approximates a circular arc commencing at the top of the slope, or back of the top, and emerging at the toe of the slope or beyond it. Curves of this description are shown in Fig. 13, although here they must emerge above the rock fill toe. When a failure of this type does occur, the location of the actual surface of failure is generally obscured by minor local movements of material, but a stability analysis, considering failure as having taken place on a circular face, yields a result in conformity with experience. [3, 4, 5]

Considering a possible movement by rotation about the centre of an arc, it is seen that a failure will occur when all forces tending to produce a sliding or shearing movement along the arc result in a shearing stress greater than the total co-existent shearing strength of the material. This movement will continue until sufficient material is displaced to restore equilibrium on the altered surface of contact. There is, of course, an infinite number of positions that an arc of failure might occupy on any slope, so that the designer's problem is to locate the particular arc which has the smallest factor of safety against the movement in question.

For a slope not subjected to the effects of water pressure, the forces tending to produce movement along the circular arc are the tangential components of the weights of all material located above the arc, including any surface loads. The forces resisting this movement consist of the tangential frictional forces developed by the normal components of the weights in question, plus a tangential force which is independent of dead load and is developed as a consequence of the cohesive strength of the soil.

The stability analysis of the upstream slope under these conditions may be illustrated by making use of Fig. 13. Here the fill material is assumed to be homogeneous, and to have throughout the properties of the impervious fill. In locating assumed critical arcs, it is obvious that it is not necessary to consider a failure arc cutting through the rock fill toe or the foundation rock. Accordingly, the deepest arc, shown with centre at O_1, has been drawn tangent to the foundation rock and emerging at the top of the rock fill toe.

To determine the stability of the material located above this failure arc, the area shown has been divided vertically into small elements, numbered 1 to 10. The weight of each is represented as directed on the failure arc and these forces are resolved into components tangential and normal to the arc. The sum of all the tangential components of these elementary weights constitutes the total force tending to cause failure. The sum of the frictional components of the normal forces plus the total cohesive force, both of which act tangentially to the arc of failure but in the opposite direction to the tangential component of the weight, is the total resisting force. Using the determined value of the cohesion of the soil and its friction angle and density, the forces resisting sliding and the force tending to cause sliding are calculated. The factor of safety is then taken as the ratio of the moments of these forces about the centre of rotation O_1.

This analysis involves the simplifying assumption that the lateral pressures which the elementary sections must exert upon their neighbours are balanced and thus do not affect the assumed uniform distribution of the weight of an element along the section of the arc on which it rests. Since these pressures are internal ones, and must balance for the whole mass, any discrepancy thus introduced has been found to have little effect on the results.

Three possible failure arcs are shown in Fig. 13. The equilibrium of the mass of material located above each has been investigated in similar fashion.

From a consideration of the results of the shear tests on the impervious material for the east embankment, the values $\phi = 30$ deg. and $C = 200$ lb. per sq. ft. are considered applicable to this case. Taking the compacted soil weight as 145 lb. per cu. ft., the factors of safety against sliding for the critical arcs drawn for the centres shown are: $O_1 = 2.45$; $O_2 = 2.23$; $O_3 = 2.25$.

The arc having the least factor of safety would then be located between those drawn with centres O_1 and O_2.

The upstream and downstream slopes of the embankment are subjected also to the effects produced by water pressing against the embankment and seeping through it. As described in the discussion of flow nets, the interconnected pores or spaces between the soil particles of the embankment eventually become filled with water from the reservoir to the level of the seepage line. This development of a state of saturation with its resulting steady movement of water through the embankment alters the stability of the slopes considerably, and under certain conditions reduces the measure of security against movement.

The addition of water pressure against the upstream slope increases the magnitude of the external forces aiding stability, but because of the apparent lessened weight of the soil, buoyant as a result of saturation, the net effect of the forces tending to cause sliding is unchanged. However, for slopes built of some materials the shearing strength is lessened by saturation. As a result of this, the factor of safety against sliding would be reduced.

If the upstream slope has become fully saturated and the external water pressure is removed quickly, as would occur during a rapid drawdown of the water in the reservoir through the sluice gates, the equilibrium of forces may be considerably altered. This is the case if the water level descending within the embankment cannot keep pace with the descent of the external water level, causing thereby a hydrostatic pressure within the fill. When the line of seepage within the fill is above the arc of failure, the effect of this hydrostatic pressure is to buoy up any material lying above the arc of failure and thus it has a destabilizing effect on the slope. The force developed at any point on the arc from this cause is approximately equivalent to the corresponding hydrostatic pressure measured from the line of seepage, but the actual effective pressure head varies from this by an amount dependent on the direction of the seepage flow.

When seepage has been established through the embankment, the downstream slope also may be subjected to the effect of hydrostatic pressures tending to change the equilibrium of the material above the critical arc in the same manner as described for the upstream slope under the condition of rapid drawdown of the reservoir. It will be noted that the critical arc for any particular slope may cut through dry as well as saturated material with each material having different weights and possibly different unit shearing strengths.

An extension of the above basic method for the stability analysis of slopes not subjected to water pressure was used to examine their stability with water pressure present.

Field Control and Construction Methods

In accordance with the principles outlined above, the control to be exercised during construction would be directed towards securing soil in the embankment at the required density. The attainment of this objective demands a simple means of measuring (1) the density of the soil after it has been compacted in the embankment, and (2) the moisture content of impervious soils both in the borrow pit

Fig. 12—General view from east abutment, October 1939; east embankment fill being constructed; filter bed and key wall still visible.

and embankment. Density-in-place determinations may be made by any one of several methods. However, two of these were selected as being both simple and reliable; viz., the "dry sand" and the "chunk" method. For comparison, determinations were made by each method, using a series of pairs of soil samples, the members of each pair having been taken from adjacent locations. The dry sand method has been frequently described. In the chunk method a clod of earth having a volume of about 0.10 to 0.20 cu. ft. is excavated and immediately coated with paraffin. Its density is then determined by weighing and displacement, taking due account of the paraffin coating. The results from a representative pair of determinations are given in Table I.

Table I

Method	Density, Lb. per Cu. Ft.			Moisture Content, per cent of Dry Weight, Minus ¼ Material
	Wet	Wet, Minus ¼*	Dry, Minus ¼*	
Dry Sand.....	141.1	138.0	125.7	9.83
Chunk.......	140.0	137.5	125.3	9.83

*All material larger than ¼ in. dia. being removed.

Such results demonstrate the essential accuracy of either method. However, the soils technicians were more familiar with the dry sand method and it was therefore adopted for general use.

As far as moisture content measurement was concerned, the standard oven-drying method required at least four hours. This was far too long for use in field control, so experiments were made by drying the soil sample in a pan over an electric hotplate. It was found that 15 minutes gave results sufficiently close to the standard oven-drying method to permit the adoption of the hot-plate method for all field work.

TEST SECTIONS—IMPERVIOUS MATERIAL

In order to determine a construction procedure which would give the required results, a test embankment section was built immediately prior to the commencement of actual fill operations. This was constructed directly on the exposed foundation rock of the east embankment.

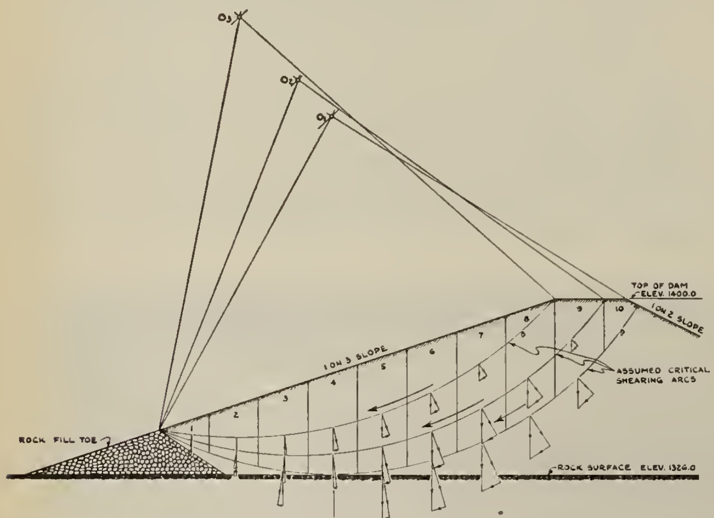

Fig. 13—Stability diagram: upstream slope without water pressure effects.

A base for the test section was made by spreading and compacting two layers of soil. As spread, each layer was from 6 to 8 in. thick, and was slightly moistened before rolling. The first layer was also moistened after compacting and before the second layer was spread. Compaction was accomplished by the use of a tractor-drawn empty sheepsfoot roller. The final thickness of the base was from 10 to 12 inches.

The horizontal dimensions of the test section were about 40 by 50 feet. It was composed of three layers, each of 6 inches spread thickness. The soil was excavated from the borrow pit by shovel, transported to the site by truck, dumped in piles and spread by a bulldozer. Each layer was slightly wetted before the next layer was placed and the freshly deposited layer sprinkled to counteract surface drying before rolling with the sheepsfoot roller. In compacting this section, the roller was filled with water and exerted a calculated pressure of 223 lb. per sq. in. on the face of the feet. Six passes of the roller were made on each layer, and sufficient water was added to raise the average moisture content from 10.2 per cent, as found in the borrow pit, to the required value.

Density-in-place and moisture determinations for this test section are given in Table II.

Table II

Test No.	Density, Lb. per Cu. Ft.			Moisture Content, per Cent of Dry Weight, Minus ¼ Material
	Wet	Wet, Minus ¼	Dry, Minus ¼	
E-7	131.0	129.0	114.7	12.5
E-8	128.5	125.7	111.2	12.9

Fig. 14—Pervious zone construction: dumping, spreading in 12-inch layers, and compacting with tractor.

These results were not considered entirely satisfactory. A second test section was therefore built on top of the first. This time the sheepsfoot rollers were filled with sand, raising the calculated tooth pressure to 255 lb. per sq. in. and ten passes made on each of the three layers. The borrow pit material now contained more moisture than formerly and it was necessary to add moisture to the third layer only. The test results for this section are given in Table III.

Table III

Test No.	Density, Lb. per Cu. Ft.			Moisture Content, per Cent of Dry Weight, Minus ¼ Material
	Wet	Wet, Minus ¼	Dry, Minus ¼	
E-16	136.7	132.0	116.4	13.4
E-19	133.8	132.2	117.4	12.9

It is interesting to note that two laboratory compaction tests on this material having the same moisture content as that given in the above table resulted in dry densities of 124.3 and 124.8 lb. per cu. ft., respectively. These figures compare directly with those of 116.4 and 117.4 of the table. While the laboratory compaction test was intended to simulate field construction methods of the type described, some variation between the field and laboratory results must be expected depending on the grading of the soil used, weight of roller, etc. In this particular case, the test samples were intentionally selected at points where it was thought that the least compaction had been secured. Tests made later on in the course of construction verified this and the results of laboratory and embankment compactions came very close together.

There were some parts of the embankment, such as those regions close to the cut-off and retaining walls, where it was impossible to employ the sheepsfoot roller. For these places, compaction was secured by the use of power tampers. Eighty pound pneumatic jackhammers fitted with a 4-inch square plate were employed on this work. A test section, 6 ft. square, using layers of 3-inch spread thickness, was built up by this method to a height of 15 inches. Tamping was done to a penetration of 2 inches on 6-inch centres which gave a surface coverage of nearly 50 per cent. Table IV gives the results obtained by this method.

Table IV

Test No.	Density, Lb. per Cu. Ft.			Moisture Content, per Cent of Dry Weight, Minus ¼ Material
	Wet	Wet, Minus ¼	Dry, Minus ¼	
E-27	146.2	142.8	127.0	12.4

These results were very satisfactory, indeed. Later, it was found that spread layers of 4-inch thickness could be used to produce the desired compaction, and so this thickness was adopted for use on the remainder of the work.

Test Sections—Pervious Material

No specific test section was constructed of the pervious material. After some experimentation, the method adopted consisted of spreading the dumped piles to a thickness of 12 in. and then sluicing well with water from hoses while compacting with a heavy crawler tractor. This tractor was operated to give at least one complete coverage of the fill surface with the treads. If the material coming from the excavation was saturated, as a considerable portion was, no hosing was required.

Density-in-place determinations were made for the pervious material as the fill progressed, although it was not always possible to obtain a result. Indeed, the fact that a result can be obtained for this test in pervious material is itself an indication of considerable compaction. Due to sand bulking, densities obtained by the dry sand method are probably slightly greater than the true density. However, the average of five tests gave wet and dry densities of 141.8 and 134.2 lb. per cu. ft., respectively, with a moisture content of 5.9 per cent, and a calculated voids ratio of 0.28. These figures may be compared with wet and dry densities of 106.4 and 103.6 lb. per cu. ft., respectively, and a voids ratio of 0.66 when this material is poured loose into a container from a height of one foot.

Construction

The upstream rock fill toe, shown in Fig. 10, was the first part of the embankment fill to be built. Sound rock from the required rock excavation and ranging in size from 3 to 24 inches in greatest dimension was spread in layers about 18 to 24 inches thick. Compaction was secured by the travel of a heavy crawler tractor over the fill.

The downstream rock fill toe was constructed in a similar manner, but in order to permit access to other work, this section was not built until fill placing operations had been in progress for some time.

It is estimated that the average voids ratio of all the rock fill toes, as built, is 0.44. This indicates a dense stable fill for material of this kind and confirms all visual observations.

The impervious test sections, which occupied a small part of the area of the impervious zone, were completed on October 4, 1939. The fill was then built up around them and the construction of the embankment continued.

Impervious material was dumped in piles, spread in 6-inch layers by crawler tractors equipped with bulldozer blades, and compacted by ten single passes of the tractor-drawn, sand-filled, sheepsfoot roller. Water was added by hose, when it appeared necessary, spraying the compacted surface before dumping fresh material. Although the moisture content of the borrow pit was above the optimum moisture determined by laboratory tests, the surface drying of excavated and spread material made the addition of water necessary at first, but as the season advanced and the weather became cooler, such wetting was not required.

Fig. 15—Embankment construction in progress. Note crowning of fill.

Pervious material was placed as described earlier under "Test Sections," with no departure from the approved method of construction being found necessary. To maintain on the fill a slope adequate for surface drainage, it was essential that the pervious material be built no higher than the adjacent transition zone at any time, since it was found that a raised shoulder of pervious material was capable of retarding surface drainage from the impervious material.

Pervious and impervious material were merged together within the limits of the transition zone by overlapping layers as referred to earlier. Fill placing and compaction procedures within this zone were varied to suit the material being placed, whether pervious or impervious. Although free water from the pervious material tended to make any adjoining impervious material too wet for obtaining the best compaction, satisfactory results were secured in this zone.

The drainage filters were constructed in much the same manner as the pervious zones, using water to assist the compacting equipment. It was found that the lower part of the drainage filter, being of coarse and more or less uniform size material, was much more difficult to compact than the upper part, which consisted of finer material containing a greater range of particle sizes.

For field control, two density-in-place determinations, generally in the impervious material, were made on each shift. As a rule these tests were made in regions of suspected low density and occasionally one was taken in power-tamped soil. In addition to the density tests, determinations of field moisture content in the borrow pit and in the compacted fill were made regularly. These tests were invaluable for giving a quick indication of the condition of the fill material as guidance in moisture correction. A summary of the averaged results of all density-in-place tests made for field control is given in Table V.

The impervious fill material placed this season has had a moisture content in most instances exceeding the optimum moisture. The average moisture content of the material in the borrow pit was 12.5 per cent and of the compacted fill material 11.6 per cent, both based on dry weight. This may be compared with a previously determined laboratory optimum moisture content of 9 per cent for the borrow pit material.

TABLE V

Material	No. of Tests	Density, Lb. per Cu. Ft.				Mois. Cont., per Cent of Dry Weight, Minus ¼ Mat.	Method of Compaction
		Wet	Wet, Minus ¼	Dry	Dry, Minus ¼		
Pervious.	5	141.8	—	134.2	—	5.9	Tractor.
"	1	133.0	—	126.0	—	5.7	Power Tamped.
Impervious.	43	141.5	137.6	128.3	123.4	11.6	Sheepsfoot Roller
"	8	143.7	139.1	133.3	125.3	11.0	Power Tamped

The most desirable moisture content for the material in the borrow pit is the optimum moisture for maximum compaction, 9 per cent, plus an amount sufficient to allow for any loss from evaporation during the excavating and fill placing operations. The permissible departure from this value will vary for different soils and depends on their compaction characteristics. The soil used for impervious fill does not vary much in compacted density for moisture variations up to one per cent above the optimum, and so the maximum moisture content allowed in the borrow pit could be 10 per cent plus the evaporation loss. However, the drop of only 0.9 per cent in moisture content from borrow pit to compacted fill shows that little drying occurred.

It was found advantageous to construct the fill so that a shutdown caused by rain would be as brief as possible. For this reason, fill placing operations were conducted so as to maintain a high crown with slopes to give ready drainage and no low spots where water might collect. (See Fig. 15.) Before an impending rain, all dumped material was spread and thoroughly compacted, and the entire fill surface then finished off with a large smooth roller. The effectiveness of these precautions was shown when an extremely heavy rainfall on November 10th, totalling 0.63 in. in 12 hours, delayed the work only while the rain fell and for one shift afterwards. Well-compacted fill was found not to be affected by rain. This is illustrated by the following. From October 2nd to October 7th the normal fill moisture averaged 12.5 per cent by test. After a very heavy rain on October 8th, wet spots on the surface of the fill were found to contain 21.8 per cent moisture and an average value for material at a depth of one inch below the surface was 18.5 per cent. But, after two more days of wet weather, at a depth of 9 in. below the surface of the fill the moisture content was measured as 12.2 per cent, i.e.—unchanged from that as placed.

* * *

There is nothing new in anything that has been described in this paper. On the contrary, use was made of only such theories and tests procedures as have proved their value in many laboratories and on many jobs, and only those construction methods the simplicity and effectiveness of which have been amply demonstrated.

In the brief period of its existence, the science of soil mechanics has changed the engineering of earth dams from a mixture of experience and a very imperfect understanding of the nature of soil and its behaviour, to an art and science in which experience is becoming more and more effectively aided by a very considerable body of knowledge drawn from the physical, chemical, and mathematical sciences.

In the design of the Shand dam, important economies have been achieved by the application of soil mechanics. In the first place, it was possible to recommend the use of soil, as against concrete, for two large sections of the dam, and thus take advantage of the low costs resulting from the introduction of modern earth-moving equipment and methods. In the second place, a scientific selection of readily available materials and the disposition of them in the structure in accordance with verified theory, enabled the engineers to provide a structure of minimum volume consistent with a high measure of safety. And finally, the use of construction methods with their attendant controls and tests, developed to reproduce laboratory findings, gives a very great degree of assurance of stability to a structure in which the consideration of safety is of paramount importance. This assurance is in itself well worth the effort and money spent on a programme of soils control and testing.

Personnel and Acknowledgment

During the period of investigation prior to the commencement of construction, the securing of all soil samples and the making of all laboratory tests was done under the direction of C. R. Young, M.E.I.C., Professor of Civil Engineering, University of Toronto and Consulting Engineer. In this work, he was assisted by R. F. Legget, A.M.E.I.C., and W. L. Sagar, A.M.E.I.C., Assistant Professors of Civil Engineering, University of Toronto. The tests were performed in the Soils Laboratory of the University. Professors Young, Legget, and Sagar also gave valuable assistance in the selection of borrow pit areas.

The soils laboratory building at the site was erected by the Commission, but was equipped and operated by G. F. Sterne & Sons, Limited, of Brantford, who supplied the necessary laboratory personnel and soils technicians, and who are responsible to the chief engineer for all the soils control and testing during the construction period. J. A. C. Bowen, A.M.E.I.C., is in charge of this work in the field.

Rayner Construction, Limited, of Toronto, are the general contractors for the Shand dam, and their contract includes the construction of the two embankments. George S. Waring is general superintendent and T. W. W. Parker, A.M.E.I.C., is engineer for the contractor.

K. C. Fellowes, as resident engineer, has general charge of all the field and construction work described in the paper. R. C. McMordie, A.M.E.I.C., as designing engineer, has direct charge of all design for the earth embankments. During the period of actual construction, he acted as chief inspector and had direct charge of the field control and testing. A. W. F. McQueen, M.E.I.C., has responsible charge, under the chief engineer, for the entire project. Dr. H. G. Acres, M.E.I.C., is chief engineer for the Grand River Conservation Commission.

The authors would like to thank W. M. Stewart for his work in preparing the diagrams and to express to all those associated with the soils work their warmest appreciation of the very great interest shown and the co-operation so freely given, which made enjoyable a very strenuous season's effort.

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Robert F. Legget, A.M.E.I.C.[1]

This paper describes the application of some of the testing methods and design processes, developed in recent years as part of the general subject of soil mechanics, to the design and construction of an earth dam. Many dams of this type will probably be needed in Canada, in connection with irrigation and conservation projects, and the paper is therefore of importance as showing what can be achieved by the scientific use of local soils. It is somewhat remarkable that a conservation project of such magnitude as that of which the Shand dam forms a part should be necessary little more than a century after the first settlers cleared land in the Grand River valley.

It may be useful to invite attention to an interesting "academic" result of the tests described in the paper. During these tests, results were obtained which suggested that the finest particles in the soils examined, although of clay size, were not clay at all in the chemical and mineralogical sense, but rather were very finely ground rock flour.

Figure 6 shows that the "clay" content of a typical impervious soil was about 20 per cent. This value varied from 12 to 40 per cent. All tests of the specific gravity of the soil particles gave a value very close to 2.77—an unusually high figure for normal soils, and much above the specific gravity of the main clay minerals (about 2.60). This result raised the first doubt as to the nature of the finest soil particles. The correctness of the specific gravity test results was confirmed as the compaction tests were carried out. Figure 7 shows a typical result, and it will be noted that the "dry weight" curve to the right of the optimum point follows closely the "zero air voids" curve, the latter having been drawn for soil particles of the specific gravity stated. This particular sample was tested in the field laboratory, its specific gravity being slightly lower than the value already mentioned. All samples tested at the University of Toronto gave the higher value, and all their compaction curves followed the 2.77 zero air voids curve very closely.

The shearing tests gave further indication that the smaller soil particles were not clay. It will be noted from the top of page 165 that the presence of excess water during the shear tests did not affect the results obtained, all shear-normal load relations being similar to that shown in Fig. 9. Had the soils contained clay particles in any quantity, some variation in the values of ϕ and the apparent cohesion would have been found. Only at the conclusion of these tests were samples of the soils studied with respect to their mineralogical content (by Dr. V. Okulitch in the Department of Geology of the University of Toronto). No trace of clay minerals was found, all the minerals examined being quite fresh—as would be the case if the particles were all of the nature of rock flour.

For the sake of clarity, the above note has been written as if the final result was unsuspected at the first. Actually, despite the extremely clayey appearance and feel of all the "impervious" soils tested, it was thought that a large rock flour content would be discovered. Proof that practically no clay was present, obtained from mechanical test results, and later confirmed by mineralogical examination, is thought to lend some interest to the investigation. It is hoped that this aspect of the soil testing may be described in detail in a paper to be published later, but the foregoing condensed account will serve to show how utilitarian investigations may yield as a by-product academic results of some significance.

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J. P. Carrière, A.M.E.I.C.[2]

The procedure adopted in investigating the stability of the structure follows well-defined theories which have already proved their value. This indicates the necessity of understanding clearly the meaning of the term "stability" which is often misinterpreted when applied to soils. For example, the gradual settlement of a building due to the consolidation of underlying clay layers is not a stability problem so far as the soil is concerned. The collapse of such a building due to settlements is due to the instability of the building and not of the underlying soil mass. In an article in the Journal of the Boston Society of Civil Engineers, Mr. Arthur Casagrande gives the following definition of the term "stability" with reference to soils:

> "Stability of a mass of soil refers to the equilibrium of all internal and external forces with the resistance of the soil, including the force of gravity, seepage pressures and any possible artificial disturbances due to construction activities, etc., as well as the effect of earthquakes. Stability does not refer to the amount of deformation which these forces produce as long as the shearing resistance of the soil is not utilized to its ultimate limit."

A direct conclusion from the foregoing is that stability is not an individual property which can be measured on samples of soils and expressed by a single quantity, but is the result of design, having in mind the balancing of all forces acting on the soil mass and forces inherent to the soil mass in view of its various properties such as shearing strength, angle of internal friction, specific gravity, permeability, compressibility, etc.

The grading and grain-size distribution curves for the pervious material in the present case show a very small percentage of clay and suggest a soil possessing very low cohesion. It has been demonstrated that cohesionless soils can only be compacted effectively by vibration, and that static pressures such as exerted by rollers or tampers have very little effect; although the soil under consideration is not absolutely cohesionless, the writer wishes to enquire if better results would not have been possible by using vibrating machines such as are used in Germany for the construction of embankments of fine sand in connection with the development of super highways. It is reported that with such equipment, layers up to eight feet in thickness are compacted satisfactorily.

The factor of safety against sliding for the critical arcs shown on Fig. 13 does not appear very high when one considers the type of material dealt with; the writer has in mind the following statement by the late Thaddeus Merriman on the subject:—

> "Every dam should be *safe beyond peradventure.* But, no dam will necessarily be safe if based wholly on theoretical design formulae."

In the present case, it is assumed that the shearing strength of the compacted soil has a magnitude approximately 2.2 times greater than that of the forces to be resisted; these forces are assumed to be due to the weight of a mass of the material itself, acting along an assumed cylindrical surface. Mathematically, the foregoing assumptions and the subsequent conclusion that the slope is stable, are correct. However, in view of the highly theoretical nature of the estimated flow of seepage water through the soil, the possible effects of frost action and other unmeasurable factors which might influence the location of the surface of rupture within the material, it would appear that a higher factor of safety should be provided.

Summing up the above, the writer would like to ask the following questions:

1. Would it be advisable from the point of view of stability and economy of construction to compact the pervious material of such a structure by means of vibrators?

2. What is the ideal factor of safety against sliding of the slopes of such a structure?

The writer wishes to congratulate the authors of this excellent paper, which, it is hoped, will be complemented by an article on detailed construction methods and cost data on completion of the project.

C. R. Young, M.E.I.C.[3]

The authors are to be commended for a helpful general discussion of the first important earth dam to be built in Canada in accordance with the new knowledge that has become available through the study and application of the principles of soil mechanics during the past fifteen years. It may be of interest to point out certain confirmations, improvements in procedure and occasional disillusionments that emerged from the exploratory and testing work carried out prior to construction.

As is stated in the paper, the use of augers for exploratory work in hard or stony soil is of very limited advantage. At best, they give merely a close-to-the-surface general indication of what might be expected to lie below, but which may not.

While densities in place determined by the common dry sand method are reliable, such cannot be said of the results obtained by the "lump" method, unless the lump is coated with paraffin. In several instances the presence of water in the pit rendered the normal dry sand method impracticable and the ordinary lump method was tried. This consisted of placing an irregular lump of the soil to be tested on a dry sand bed in a vessel and then pouring in sand to cover the lump. Knowing the volume of sand poured in, the volume of the lump, the weight of which was known, was then found by subtraction. The results were obviously unreliable. Apart from the difficulty of surrounding the lump with sand of uniform compaction, the excess moisture of the lump disturbs the sand density and vitiates the results.

The method of obtaining and shipping undisturbed soil samples in 25-lb. grease pails, mentioned in paragraphs 10 and 11 of the Table 1 given hereafter, proved to be entirely satisfactory. The column of earth could be trimmed fairly closely to accommodate the inverted pail, except where stones were encountered and had to be removed. By careful handling and transporting in an upright position, the samples arrived in good condition. When the seal around the edges of the lid was broken, often weeks after shipment, the material was found to have a moisture content conforming to that determined for the location by other means.

Some surprise was experienced when the slow rate of passage of water through the permeability samples under a head of 12 to 20 ft. was first observed. In order to carry out the tests with reasonable speed it was found necessary to use heads of 30 to 40 ft. for all of the materials considered for the impermeable portion of the dam. While it had been intended originally to make the wet analyses by placing in the hydrometer jars only such material as passed the 200-mesh sieve, it was found that much time could be saved by placing in them all material passing a No. 8 sieve (2.362 mm.). After readings extending over two hours had been taken, the whole was poured into a 200-mesh sieve and, after washing, the portion retained was dried and analyzed by sieving.

As a possible guide to those who may be called upon to plan the preliminary work of exploration and testing of soils for a project such as that described, an abridgment of the instructions issued to the field engineer on exploration is submitted in Table 1.

By reason of the extent of territory covered by the exploratory holes and pits and the number of them in progress at one time, it was found necessary to do practically all of the mechanical analyses in the Toronto laboratory. If this work all had to be done in the field it would be necessary to have at least one man in a field laboratory in addition to the inspector and sampler at the pits.

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Table 1—Exploration and Tests of Materials for the Shand Dam Prior to Construction

instructions for field engineer

1. Co-operate with the Resident Engineer in supervising the sinking of auger holes and test pits at agreed locations in conformity with the specifications for this work.

2. Take, or personally supervise the taking of, representative samples of material from test pits and sufficiently promising auger holes, as specified below.

3. In general, sieve analyses of material from auger holes will be required from only the most promising ones. Where an analysis is undertaken, it should be for a composite sample and only for that part coarser than a No. 48 sieve (0.295 mm.).

4. Take a 50-lb. sample from each pit at the level immediately below the top soil, one at the estimated mid-depth and one at the bottom. If the soil is markedly stratified, take 50-lb. samples from each *important* stratum. If the material is usable and apparently uniform, the pit may be carried to only 15 ft. in depth below the top soil, and, if possible, a 4-in. auger hole carried down an additional 5 ft. (Because of the hardness of the soil this was found to be impracticable). If the material is markedly stratified but usable, the pit should in general be carried to a depth of about 20 ft.

5. Make a sieve analysis of each pit sample, if possible, for that fraction retained on a No. 4 sieve. Send one copy of the report and of the completed log of each test pit to the Chief Engineer and one copy to the Toronto laboratory.

6. Immediately after taking, ship a 30-lb. sample taken from each adopted sampling level of each pit to the Toronto laboratory, with identification tag both inside and outside the bag.

7. For about one-half the test pits make determinations of density in place for each distinctive type of soil by means of the dry sand method in order to afford a guide to estimating the probable shrinkage. Place removed soil in a 25-lb. grease pail and seal the edges until the material is weighed. Report the results to the Chief Engineer and to the Toronto laboratory.

8. Obtain from the holes made for density-in-place determinations and ship to the Toronto laboratory properly labelled pint-jar sealed samples of soil from each distinctive stratum for moisture content determinations.

9. Secure from each pit on the dam site at least two 50-lb. samples of the material that may practicably be incorporated in the finished structure. Make sieve analyses of all material retained on the No. 4 sieve and ship at least 30 lb. of the remainder to the Toronto laboratory.

10. Utilizing the test pits already dug, determine the feasibility of securing undisturbed samples by fitting an inverted 25-lb. grease pail over a carefully trimmed column of earth for material high in clay, for material that is gravelly or stony and for sandy material. Ship these samples to Toronto in order to determine whether they are or are not affected by the method of transportation. Take samples for the full depth of the pail, filling in any open spaces around the soil with melted paraffin or soil of the same kind as that of the sample.

11. If the method prescribed in paragraph 10 proves practicable, obtain at least one undisturbed sample of 10¼-in. diameter, and, if possible, of the full depth of the pail, from each test pit sunk on the dam site; seal and label the container, and forward to the Toronto laboratory. The sample should be taken from the probable level of the base of the embankment.

12. If possible, visit the test pits in course of sinking twice in the morning and twice in the afternoon, noting all facts of possible importance to the investigation.

13. Each day send at least a brief report of the progress made during the day to the Toronto laboratory. Send also the logs of the test pits and the mechanical analysis sheets as soon as they can be completed.

G. Ross Lord, A.M.E.I.C.[4]

The writer was especially pleased to note that the authors have investigated the problem of seepage through the dam by a study of flow nets. They show in Fig. 11, a flow net for the case where the permeability in the horizontal plane is assumed equal to that in the vertical, so that $k_h = k_v$. It is a well known fact that this ratio does not always hold in actual cases. Were any calculations made assuming k_h to be larger than k_v? Was the assumption of equal values justified by an examination of the soil?

The writer has found the construction of flow nets to be a very enlightening device in many cases of both laminar and turbulent flow, but it requires the exercise of some perseverance and a great deal of practice. It would be interesting to know whether the authors used the flow nets for calculations other than the location of the line of seepage.

Finally, the writer would ask whether any provision has been made for ascertaining the actual location of the seepage line in the completed dam. If it were possible to obtain such readings they would prove very valuable when compared with calculations and laboratory tests.

D. S. Laidlaw, A.M.E.I.C.[5]

Having had the pleasure, last fall, of being employed as an inspector on the work of construction at the dam, the writer would like to emphasize some of the authors' remarks and make some comments.

In discussing the application of the principles adopted in design and the results of preliminary tests of the available material, the authors speak of

> " . . . a central zone or core of relatively impervious material restrained by outer zones or shells of very pervious and stable soil."

Following the example of the specifications, it was customary on the job to refer to these zones, and their component materials, as "impervious" and "pervious," respectively, and these two words, so similar to each other, gave rise to much confusion. If the words "core" and "shell" had been adopted both for the zones and the materials that had to be placed in them, the writer feels that this difficulty would have been eliminated, and he congratulates the authors for having used them in their paper. He strongly urges such a course on anyone engaged in similar work in the future.

In discussing construction, the authors mention that it was necessary to wet down the fill during the earlier portion of the work, but that, as the weather got cooler, the necessity for this passed off. Due to the bad weather in October, it came about that most of the fill was placed in the month of November, and keeping hose lines from freezing would have been a vexatious problem. While, for most of that month, no trouble was experienced with surface drying, there were a few days on which it gave trouble between about 11.30 and 2.00 o'clock. The only way this could be counteracted was to bring in an appropriate quantity of extra wet material, which generally involved shifting one of the steam shovels in the pit to a different location. The problem in control was one of estimating the weather about half an hour ahead of time, so that the necessary instructions could be sent to the crew in time to make the change-over when it was wanted. Of the two changes necessary in a day, the more ticklish proved to be the change back to normal, as, when the temperature started to fall, it fell rapidly, and, to bring down very wet material at such a time was simply inviting trouble.

On occasion, bad weather turned out to good effect. Once or twice, a freeze-up after a rain enabled the contractor to peel off the surface that had become water-soaked and start filling operations almost immediately. The frozen skin, in front of the blade of a bulldozer, would break up into thin chunks that could be worked up into windrows and picked up by a scraper. The operation left a surface that was in almost ideal condition for starting filling operations, and was much simpler than the operation of skimming off a layer of water-soaked material. One effect of the frost, was an apparent reduction in the depth of the saturated surface. The frozen skin was seldom found to be over 1 inch in thickness, while, after a heavy rain, about 1½ to 2 inches of water-soaked material could be expected.

The writer would, in this connection, like to call attention to the authors' remarks on the impermeability of the "impervious" or "core" fill. In the course of taking many moisture and density samples he was unable to find any indications of migration of moisture in the compacted fill, in any direction. Moisture samples taken 3 inches below a soupy surface would show, repeatedly, that the condition of the fill had, except for the surface, been unchanged by the rain. Samples taken at lower levels, even some feet below the surface, would show no appreciable blending of dry and wet patches or pockets. This condition should give confidence in the stability of the dam.

J. W. Lucas, A.M.E.I.C.[6]

During the past ten years or so we have heard much about soil mechanics but very little of its successful application to problems encountered in Canada. The authors have, in my opinion, made a definite contribution to the literature of the Engineering Institute in that the paper which they have presented shows how the new science has been successfully applied.

It is worthy of note that the method of investigation and the application of soil mechanics has made possible the choice of what the authors feel was an economical type of structure and that they were able to demonstrate its safety. Perhaps the interest might be increased if a comparison of the estimated costs of this and other types of structures considered for the site could be presented.

J. R. Montague, A.M.E.I.C.[7]

The development of the science of soil mechanics during recent years has, to a large extent, removed from the design of earth dams the indefinite factors which might be classed as experience or judgment factors, and has placed this type of work more definitely in the field of positive design. The following comments are not intended as criticisms of the design of the Shand Dam, but merely as suggested points which might be observed on dams where conditions warrant their being considered.

The construction of the transition zone by placing alternate layers of pervious and impervious materials, each to a thickness of not more than four feet, might in some cases have a tendency to defeat the purposes for which these zones are intended. Where an intermediate class of material is not economically available, and it is necessary to produce it by mixing the pervious and impervious grades, it would seem advisable to do so by placing them in layers sufficiently shallow to ensure a fair degree of mixing during the process of placing.

As pointed out by the authors, the pervious materials must be free draining. This is particularly important in a reservoir subject to radical changes in level, especially when

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these changes are rapid. A further characteristic desirable from an economic standpoint is to obtain as great a density as possible in the pervious materials, since these materials, among other requirements, serve to support the zones of finer materials in the structure. Naturally, by a reduction of voids through inclusion of fines, the density may be materially increased, but the degree to which this measure is to be followed is a matter worthy of serious scrutiny. The velocity of water in draining from the pervious material in the upstream zone, following a recession in reservoir level, or as a result of wave action, will determine what relatively fine material may be safely relied upon to contribute to the density by remaining in the fill. It would be well not to depend upon soluble materials, under most circumstances, when determining the density of supporting zones. It is understood, however, that there are no colloidal clays in the materials being used for the construction of the Shand Dam. When there is any element of doubt as to the possibility of fines being leached from the pervious fills one would be well advised to lean toward the side of safety by determining the slope of the fill on the basis of the density of the material without such fines.

Justin advises that the upstream slope "be gradually flattened as the distance below the top of the dam becomes greater." This advice is based on sound principles and, where extraordinary safety is paramount, the flattening of the lower portion of the slope provides an added assurance against sloughing; or, when foundations are of an unstable character, against subsidence and possible failure.

In earth dam construction the provision of heavy toes of broken rock (rather than boulders), both upstream and downstream, forms one of the best assurances of stability, as evidenced by the success of many structures thus protected which were not constructed along modern scientific lines.

The introduction of a drainage filter extending underneath the downstream toe of the pervious core is an ingenious means of depressing the line of seepage where the dam is founded on an impervious material such as rock. Care should be taken, however, to avoid the extension of this filter a greater distance than is absolutely necessary under the core, as it has a tendency to reduce the length of the lower flow lines, thereby reducing the effectiveness of the impervious zone. As applied in the Shand Dam, the optimum penetration beneath the pervious zone appears to have been adopted.

The construction of earth dams by means of rolled fill would appear to enable the procuring of a more ideal grading of the constituent materials than by the hydraulic or semi-hydraulic fill methods, and may be expected to find a greater field of application in future. It materially lessens the ever present hazard of slides during construction, which are, unfortunately, all too frequent in the hydraulic fill types of construction.

The Authors

The authors are grateful for the many excellent discussions contributed to the paper and would like to express their considered appreciation to the various writers. The number and quality of the discussions are evidence of the great interest on the part of many engineers in the subject of soil mechanics.

The point made by Professor Legget; namely, that soil mechanics has particular value in enabling scientific use to be made of local soils, is worth enlarging. The length of haul between borrow pit and embankment can usually have more effect on the final cost of earth work than any other single item. For equivalent suitable material, therefore, the closer borrow pits are to the dam, the cheaper the structure will be. On the other hand, earth dams can be, and have been, constructed of almost any local soil. There must, of course, be a correspondence between the design used and the characteristics and properties of such local soil. Wherever an earth dam is proposed, the above consideration gives added emphasis to the necessity for an adequate initial programme of soil exploration and testing.

The confirmation, given by Professor Legget, of the surmise that the particles of clay sizes in the impervious soil were really very finely ground rock flour is regarded as a matter of importance. This is particularly so because theory and mathematical procedures of design for earth dams are in a process of development, and dependence, in part, must be placed on the elements of experience and judgment. In the opinion of the authors, it is as necessary in such circumstances for designers to have full knowledge of the properties of the materials with which they are dealing as it is to have facility with design theories and procedures. For the case in point, as Professor Legget has indicated, some of the very important properties of the soil are a direct result of the mineralogical composition of the particles.

Mr. Carrière has drawn attention to the use of the word "stability" as applied to soils and perhaps suggests that it has a special meaning in this connection. However, the authors would submit that the usual conceptions of static and elastic stability apply unchanged to any soil stability problem, with the troublesome added complication that the properties of the soil mass, which determine its stability, may be altered with a change in loading.

Mr. Carrière enquires about the possible use of special vibrating machines for compacting the pervious material of the outer shells. When considering this, it must be remembered that any travelling equipment used for compacting will have a vibratory effect of some degree. Indeed, pervious materials have been quite successfully compacted using a very heavy smooth roller of large diameter drawn by a crawler tractor. It is more common, however, to use a heavy crawler tractor without rollers, since it has been found that the required density can be readily obtained with a reasonable amount of travel by the tractor and proper depth of spreading of the material. It is doubtful if any practical advantage would result from the use of the special pieces of equipment employed and experimented with elsewhere. The results of the tests made for the Franklin Falls dam are very illuminating in this respect.[8]

The question regarding the most appropriate factor of safety for the slope of an earth dam, raised by Mr. Carrière, concerns a matter of considerable importance. Properly speaking, if a slope is stable when all loads and conditions, including seepage effects, are considered and the true values of the strength characteristics are employed, a factor of safety greater than one indicates permanent stability. With this in mind, it is seen that the minimum factor of safety permitted for an earth slope will depend principally on the designer's knowledge of the soil composing the slope. With the results of complete and reliable soil tests available, and with the exercise of rigid control during construction, a lower factor of safety is allowable than if there is less knowledge of the soil characteristics and less rigid construction control. A common range of minimum permissible values of the factor of safety with adequate soil information and construction control is 1.5 to 1.6. A value of 1.25 has been considered ample for slopes in some types of earth dam.[9] Fellenius states that, if the soil test results are somewhat uncertain, a factor of safety of more than 1.5 is to be desired, while for cases where the test results are reliable, a minimum value of 1.2 may be used.[10]

The "Instructions for Field Engineer" given by Professor Young indicate the large amount of work involved solely in the operations of logging the test pits and securing samples. It is very desirable to commence such work far in

[8] Compaction Tests and Critical Density Investigation of Cohesionless Materials for Franklin Falls Dam. *U.S. Engineer Office, Boston, Mass.; April, 1938.*

[9] Levees in the Lower Mississippi Valley, *by Spencer J. Buchanan, A.S.C.E. Proceedings, Sept., 1937, p. 1308.*

[10] Paper D48, Calculation of the Stability of Earth Dams, *by Wolmar Fellenius, Transactions of the Second Congress on Large Dams, Washington, D.C., 1936, Volume IV.* See also discussion of Question VII *in Volume IV.*

advance of detail design. The field tests and sampling procedure were, of necessity, varied in some instances as the work developed and further acquaintance made with the soils of the region. The "lump" method for density-in-place determinations was used only experimentally, and that for a very brief period. Generally, both during exploratory work and later construction control, the dry sand method was found to be quite satisfactory for such tests. An exception to this is in the case of lightly compacted pervious material for which no very satisfactory simple method seems to have been yet devised.

The relatively low permeability of the impervious soil, mentioned by Professor Young, is in all likelihood a direct result of the very great range of particle sizes in this material.

The authors would have liked to enlarge upon the application of flow nets referred to by Professor Lord, but the necessary limitations of the paper precluded this. The flow nets, constructed graphically for simplified sections such as that shown in Fig. 11, were found to be an essential aid to design. Studies of the effect on the distribution of seepage flow, when the permeability in a horizontal direction was assumed to be greater than that in a vertical direction, gave additional force to the desirability of incorporating in the structure the drainage filter, shown in Figs. 10 and 11, and determined its location. However, inspection of the compacted embankment material, as exposed in sampling pits, up to this time has revealed no sign of stratification. On the contrary, the material appears perfectly homogeneous. Whether there is any preferred orientation of the finer particles, sufficient to produce a markedly anisotropic soil, cannot, of course, be determined by visual inspection.

In addition to their basic usage in the general study of seepage distribution, flow nets were utilized in the stability analysis of the embankment slopes. A flow net drawn for any state of seepage under consideration gives the value of the hydrostatic pressure head acting at any point within the slope and thus provides information essential to a computation of the destabilizing effect of internal water pressure.

Some study has been made of completed and proposed installations of test cells for measuring hydrostatic pressures within earth dams in order to locate the line of seepage. This matter is still under consideration for the Shand dam.

Mr. Laidlaw's comments on the construction work are interesting, but the authors must remark that they were never aware of "much confusion" resulting from the use of the words "pervious" and "impervious." Usually, the man on the job devises his own names for the things with which he is dealing. In this instance, the pervious material, very sensibly, was called "gravel" and the impervious material "clay." It is also necessary to state that the fine exactitude in moisture control indicated by shifting a shovel before and after lunch was rarely, if ever, necessary. Except under unusual circumstances, the moisture content of the undisturbed material in the borrow pit changed very slowly and might be considered to have a seasonal rather than a daily variation and hence additional moisture was not to be secured by digging into another portion of the borrow area. In one instance, some excavated material, temporarily cast aside, was later picked up, and in the interval had become wetter. Possibly Mr. Laidlaw has in mind the use of this material.

Mr. Laidlaw has described very aptly the condition of the fill when a frozen crust formed following a cessation of work because of rain. In several instances the removal of this crust enabled fill placing operations to be resumed earlier than would have been the case had no freezing occurred.

The question of the comparative cost of the earth fill structure as against other possible types, raised by Mr. Lucas, while naturally of fundamental importance and considerable interest, seems to be beyond the scope of the present subject.

Mr. Montague's comments on the construction of the transition zone are quite pertinent to the problem of joining a zone of impervious material to one of pervious material in such a way as to ensure no injurious results. An economical solution of this problem requires some departure from the ideal method of constructing the pervious zone as a continuously graded filter varying from finest against the impervious zone to coarsest at the outer limits of the pervious zone. The method adopted for use at Shand, as described in the paper, was found to result in satisfactory mixing. Actually, the use of layers of moderate thickness, referred to by Mr. Montague, was followed in the construction to date. Normally, work on all three zones will be carried on simultaneously at about the same elevation, with due allowance for the necessity of maintaining a crown on the fill. Only in exceptional circumstances when, for construction reasons, it might be advantageous to advance the central zone well ahead of the pervious shells, will the limiting thickness of four feet be permitted.

One interesting result shown by the tests is that the compacted pervious and impervious materials have practically the same high density (see Table V). A soil need not, therefore, have fines in order to exist at high densities. It may be supposed, for the pervious soil in the embankments, that this is the result of (1) a comparatively wide range in particle size, (2) the fact that this range includes the very coarsest materials, and (3) the relative amount of the various sizes. This combination of characteristics permits the material to have a very low voids ratio, while at the same time the size of the smallest voids is such as to make the material pervious. If such material had not been found and, on the contrary, it had been necessary to use material containing extremely fine particles, then serious consideration of the effects of rapid drawdown would have been necessary, as pointed out by Mr. Montague. In this connection, it may be interesting to point out that the average rate of drawdown of the Shand reservoir, during the dry weather season, will be about six inches in twenty-four hours.

The drainage filter incorporated in the Shand dam extends for the entire length of the embankments, including the portions founded on the sloping overburden of the abutments, where it performs the same function as for the sections resting on rock. The depression of the line of seepage occurs, of course, at all sections. In view of the comparatively slight thickness of impervious soil actually necessary to maintain seepage flow within tolerable limits, the flow lines could be considerably reduced in length from those of the adopted design, without any detrimental results.

Slides of rolled earth dam slopes during construction are not unknown, but of those of which the authors have knowledge, all have occurred in structures resting on a considerable depth of overburden. The possibility of a slide during construction of a rolled fill on a rock foundation would seem to be very remote.

Abstracts of Current Literature

Contributed abstracts of articles appearing in the current technical periodicals

MESSERSCHMITT ME-110 AIRPLANE

The Aeroplane (London)

Abstracted by Mechanical Engineering, March, 1940

Much secrecy has surrounded the development and construction of a new German two-engined fighter airplane designed by Prof. Willy Messerschmitt. Therefore, it is interesting to note that a complete description of this new airplane is given for the "first time in any tongue or any journal" in the Jan. 12, 1940, issue of *The Aeroplane* (*London*). The figures and estimates in the article are based on the observations of C. G. Grey and others who visited the Messerschmitt plant prior to the present war. The article includes a map of the disposition of the works of the company around the flying field just south of Augsburg, Bavaria.

The Me-110, as it is designated, was designed about three years ago, but it is only recently that it has been produced in great numbers. The wing is straight tapered (2.7:1) with a small rounded tip. The ratio of root thickness to chord is 0.185, which is fairly thick. There are slotted flaps (20 per cent. of the chord) and slotted ailerons with external mass-balance weights. The wing is in two pieces. Each half is connected directly to the side of the fuselage at four points, with 5½-deg. dihedral measured on the lower surface. As always in Messerschmitt types, there is a single spar. In the Me-110, it is at 39 per cent. of the chord from the leading edge, a percentage which remains constant along the whole span. The wing is entirely metal-covered.

The standard version of the Me-110 now in service is known to have two 1150 hp. Daimler-Benz DB 601, 12-cylinder inverted-vee liquid-cooled engines, each having a displacement of 2,069 cu. in. and a maximum speed of 2,400 r.p.m. Like all modern German aviation engines, the DB 601 has no carburetors, but is equipped for direct gasoline injection. The latest models of this engine are said to have an output of 1,360 hp., presumably for take-off.

Although the DB 601 appears to be the standard engine used in the Me-110, certain versions may have other engines, such as the 1,200 hp. Junkers Jumo 211. There are even rumours of the new Daimler-Benz X-engine, reputedly of more than 2,000 hp. having been installed. However, probably such an installation, if true, would be for experimental purposes only.

The characteristics of the Messerschmitt Me-110 are as follows:

Dimensions:

Span 55 ft.; length 35 ft.; height 10 ft., 9 in.; wing area 414 sq. ft.; and track 15 ft., 2 in.

Weights of structure and power plant (estimated):

Wing 2,000 lb.; fuselage 1,600 lb.; undercarriage 1,000 lb.; tail unit 300 lb.; and power plant (including tanks) 5,000 lb. Total weight 9,900 lb.

Weights of disposable load (estimated):

Fixed equipment 330 lb.; crew (two 400 lb.; fuel (400 gal.) 3,000 lb.; oil (28 gal.) 250 lb.; radio 120 lb.; and armament 800 lb. Total weight 4,900 lb.

Loadings:

Wing 35.8 lb. per sq. ft.; power (take-off) 6.44 lb. per h.p.; and span 4.9 lb. per sq. ft.

Performance:

Maximum speed should be about 365 m.p.h. at 16,500 ft. The range, with the aeroplane cruising at 15,000 ft., should be 420 miles at 365 m.p.h., 1,500 miles at 215 m.p.h., and 1,750 miles at 175 m.p.h.

ELECTRIC HORSES

By Robert Williamson, London, Eng.

Petrol rationing and increased taxation has given British manufacturers a chance to show what they can provide in models of "electric horses," for heavy haulage, and runabout vans and private cars driven by electricity from ordinary mains.

At the outbreak of war fewer than 5,000 electric road vehicles were turned out annually, except public transport types depending for current on overhead wires. Now the industry is planning wartime utility designs and preparing for a potential output up to 50,000 vehicles a year.

"They run at less than one-third the cost of a petrol car, the taxation is less, there is no wastage at stops, they start immediately in coldest weather, and they are perfectly silent," said an official of the British Electrical Development Association.

"Five of London's world-famous stores have used electric vans for many years, and thousands of overseas visitors to London take back vivid recollections of the familiar blue-and-silver vans of the Savoy Hotel. One of them has been going its 40 miles a day since 1921 without overhaul.

"Designs are now being drawn up for private runabout cars, suitable for shopping expeditions or for professional or social calls. They will do 35 miles on one charge, and black-out hours allow more than enough time for re-charging from the mains supply in the garage."

THE SINGAPORE AIRPORT

By Reginald Lewis Nunn, D.S.O., M.Inst., C.E.

Abstract of a paper read before the Institution of Civil Engineers (*Journal, Inst. C.E.*, March, 1939)

The paper describes the construction of the new civil airport in Singapore, which was completed and opened for traffic in June, 1937.

The principal works comprised:

(a) The reclamation of 326 acres of tidal swamp, eight million cubic yards of filling;

(b) The dredging of a seaplane-channel and anchorage;

(c) The construction of hangars, slipway, jetty, administration building, and other structures;

(d) The installation of full electric lighting equipment; and

(e) The provision of wireless, meteorological and other ancillary services.

The methods of reclamation are described, and a summarized statement of costs is included with details of quarry working, transport, etc.

The landing ground is circular, with a diameter of 1,000 yards, and there is an overrun in one direction of an additional 300 yards. To facilitate drainage, the surface is finished in the form of a flat dome, the centre being eight feet higher than the perimeter.

The layout of the airport is so arranged that the buildings present the smallest possible flying-obstruction, while at the same time effectively meeting ground-requirements. A landing can be made into the wind from any point of the compass. Amphibian aircraft can transfer from land to water or vice versa. Taxi-ways are provided around a third of the perimeter connecting with the 14 acres of paved area in front of the hangars.

The administration building contains accommodation for technical staff, customs, health and other officials, offices for operating companies, a post office, restaurant and other amenities. It is surmounted by a control room from which all aircraft-operations are under review. There are two hangars each 300 ft. by 150 ft. with 35 ft. clear height, the door arrangements being of a special kind to suit the layout.

For night operations, there are six floodlights, together with the usual boundary and obstruction lights. The seaplane-channel is also demarcated by illuminated buoys and beacons and protected by floating timberbooms. The whole lighting system is operated from a switchboard in the control tower.

Communication with aircraft and with other airports is effected on short or medium wave wireless telephony from the control tower, and there is also a Marconi Adcock direction-finder station calibrated to within one degree.

For flying boats and seaplanes there are moorings in the anchorage near the slipway up which they can be drawn to a hangar. Fast launches are provided with searchlights, short-wave radio-transmission sets, and other equipment.

The paper concluded with a description of the subsidiary buildings and equipment. The works, which were carried out by the Public Works Department, Straits Settlements, were commenced in 1931 and cost approximately £1,100,000 inclusive of land acquisitions.

BRITAIN'S HUGE RAIL ORDER

Abstracted by Robert Williamson, London, Eng.

The 240 locomotives which the Ministry of Supply has ordered through the Locomotive Manufacturers' Association of Great Britain for the Army's use in France will be of the same type as the 2-8-0 freight tender engines of which the London, Midland and Scottish Railway already has a fleet of some 200.

Also to run on sections of the French railways operated of the B.E.F. will be 10,000 20-ton covered goods wagons, ordered through the Carriage and Wagon Builders' Association. The total cost of locomotives and wagons will be about £8,000,000, and orders have been given for £1,750,000 worth of permanent way equipment and mechanical handling plants for docks.

The tender locomotives, which will be available for commercial use in Britain after the war, are known as the 8F class (taper boiler). This class measures 63 ft. ¾ in. overall; maximum height, 12 ft. 10 in.; maximum width of engine, 8 ft. 7 11/16 in.; barrel length, 11 ft. 10 1/16 in.; total weight of engine and tender, 125 tons 3 cwts.; tractive effort (at 85 per cent B.P.) 32,438 lbs.; cylinders, 18½ in. diameter by 28 in. stroke. The tender carries nine tons of coal and 4,000 gallons of water.

The industry is making munitions as well as locomotives for the Army, but Mr. R. S. Hudson, Secretary for the Department of Overseas Trade, was able to announce in Parliament recently (Dec., 1939) that as a result of negotiations with the Supply Ministry, British representatives overseas had been sent telegrams saying: "You can now approach our customers in the important markets and say that if they will place orders at once for locomotives, we can guarantee delivery."

Among the noteworthy deliveries of British-built locomotives to overseas customers during 1939 were six of the world's largest metre-gauge locomotives for the Kenya and Uganda Railways, making possible the journey from Nairobi to Kampala (Victoria Nyanza) and back, 1,106 miles, without changing engines; and a specially built Diesel locomotive, for the Peruvian Corporation, to run on one of the world's highest railway lines, near La Paz, Bolivia, which includes a six-mile climb with a gradient of 1 in 14 along a series of charp "S" curves.

The Turkish Railways have ordered 58 locomotives from Britain, for use in Asia Minor, and large consignments of rolling stock have been ordered by Egypt and the Union of South Africa.

PLASTIC FROM SAWDUST

Abstracted by Mechanical Engineering, March, 1940

Molding plastic from waste wood has been produced by chemists of the United States Forest Products Laboratory, Madison, Wis., at a cost of about 3 to 4 cents per lb., about one quarter the price of plastics in use today. Practically unlimited sawdust and log waste are available for raw material. Thus far, hardwood waste has been used to best advantage; softwood waste requires some modification of the process.

The process consists in breaking down the mortar-like bond between lignin and cellulose, which makes wood stiff, by converting some of the woody material into sugar which in washed out and can be fermented into alcohols or used in green silage. To the remaining mass of material there is added 10 to 15 per cent. of an inexpensive plasticizer, and then the batch is ground to the fineness of flour and used as a molding powder. Properly heated under pressure, the lignin plastic takes the shape of the mold and produces a black, lustrous, dense substance which can be easily sawed, turned, or otherwise machined. The resultant material has adequate tensile and compressive strengths for most uses, is an excellent electrical insulator, and absorbs little water.

One limit is its single color, black; but its surface can be modified by pressing in foil, veneer, or metallic powder, and it takes paint well. Because it flows none too rapidly and needs to cool about 20 deg. F. below the pressing temperature of 300 deg. F. in the mold, it takes a little more time in the mold than other plastics. One promising field for its use is in composition with metals. The lignin plastic bonds to metal surprisingly well, stands up to stiff tests, such as turning without chipping on the outside circumference of a cylinder laminated of alternate layers of plastic and metal. Experiments are being carried on in Detroit for possible use in trunks, fenders, and other large exterior automotive parts.

THE MYDDELTON CUP

Journal of The Institution of Civil Engineers, February, 1940

It had been arranged that in September last representatives of the Institution should visit the United States in response to an invitation from the American Society of Civil Engineers, but, having regard to the international situation, the visit was cancelled.

Had the visit taken place, it was intended that Mr. W. J. E. Binnie, who was then President of the Institution, should present to the American Society of Civil Engineers a replica of the Myddelton Cup, as a token of the friendly relations which have ever existed between the two societies. Lord Lothian, British Ambassador to the United States, has now, however, on behalf of the Institution, handed the replica to Colonel D. H. Sawyer, President of the American Society, at a gathering of the members of that Society held in Washington on Tuesday, 9th January. The original cup was presented to Sir Hugh Myddelton in 1613 by the Worshipful Company of Goldsmiths of London for his services in providing London with a supply of potable water. It remained in the possession of the Myddleton family until 1922, when it was acquired by the Goldsmiths' Company.

Lord Lothian, in making the presentation, observed that the cup was a fine example of late-sixteenth-century English work, and that the original was shown in the British Pavilion at the New York World's Fair in 1939. Referring to Myddleton's achievements, Lord Lothian said that King James I conferred a baronetcy on him in 1622, for the following reasons:

"1. For bringing to the City of London, with excessive charge and great difficulty, a new cutt or river of fresh water, to the great benefit and inestimable preservation thereof.

"2. For gaining a very great and spacious quantity of land in Brading Haven in the Isle of Wight, out of the bowels of the sea and with banks and dykes and most strange defensible and chargeable mountains, fortifying the same against the violence and fury of the waves.

"3. For finding out, with a fortunate and prosperous skill, exceeding industry, and noe small charge in the County of Cardigan, a royal and rych myne, from whence he hath extracted many silver plates which have been coyned in the Tower of London for current money of England."

Those achievements showed that Myddelton possessed the true character of an Elizabethan Englishman, and that he had his full share of the "enquiring mind" that was the outstanding characteristic of that age. Lord Lothian thought that Myddelton would have felt at home in the company of present-day civil engineers, and therefore on that account he thought that a replica of the Myddelton Cup was a most fitting vessel in which to convey to the American Society of Civil Engineers the warm feelings of esteem and admiration in which they were held by the Institution.

THE MARKETING MOVEMENT IN MECHANICAL ENGINEERING

By John R. Bangs, Jr., Cornell University, Ithaca, N.Y.

Abstracted by Mechanical Engineering, March, 1940

A trend of paramount importance to engineers is noted by Dr. Karl T. Compton, member A.S.M.E. and president of the Massachusetts Institute of Technology, when he says, "One hundred years ago the average person had about 52 wants of which 16 were regarded as necessities. To-day the wants number 484, on the average of which 94 are looked upon as necessities." This statement seems to imply that engineers can satisfy these many wants through the effective application of the principles of industrial marketing.

It is well known that the engineer has for years been trained primarily in the physical sciences and that much of his success has been due to his ability to apply these sciences to the design and development of technical devices in industrial enterprises. According to various surveys, three-fifths of all engineers who live a normal life span spend over one half of their working lives in administrative work of a technical or general nature.

One is led to wonder whether the same training can possibly prepare the engineer to cope with the problems of to-day and to-morrow. In positions of administrative responsibility, his view must encompass all the phases of an enterprise, namely, production, finance, accounting, research, human relations, and, perhaps most important of all, marketing. In other words, he must concern himself with the integrated whole, recognizing the full significance of customer research in the field, as well as technical research in the laboratory.

For example, in recent years a very marked trend was developed toward a constant study of the product. Such studies reveal that utility and purpose are paramount. Couple these with good appearance, and sales are stimulated beyond a reasonable doubt because appearance is an important factor today.

Not many years ago any attempt to improve the appearance of a product resulted in mere ornamentation, without any effort being made to improve design, utility, or purpose. To-day, however, artists and engineers are combining their efforts not only to give the public a better-looking article but also one that is basically lower in cost and much more useful.

Definition of Industrial Design

This movement, actuated by the necessities of the market and thrown into bold relief during depression years, has given rise to the comparatively new profession of industrial design. Industrial design attempts to tie together the research of the technical engineer in the laboratory and the market research in the field. It may be defined as "the art of giving a properly engineered product a striking and pleasing appearance." Hence, it may be concluded that design, utility, and purpose all point to the fact that modern selling begins in the research laboratories, in the engineering departments, and on factory floors where the engineer's influence is paramount.

In view of these facts, it appears to the author that the engineering colleges charged with the training of the engineer, and the engineering societies, such as the A.S.M.E. that guide his professional development, should sponsor curricula and programs that will aid in the development of this broader viewpoint. That such sponsorship is developing is most encouraging. An editorial which appeared in the May, 1936, issue of the magazine, *Industrial Marketing,* begins by saying that Gerard Swope, recently retired president of the General Electric Company, had suggested that most engineering courses were too narrow. It goes on to develop the idea that one way to broaden them is to include instruction in the broad principles of marketing, especially industrial marketing, in engineering schools. In conclusion it reads:

> "Here is an avenue for greater usefulness for the engineering school. We realize that most courses are already crowded and that there is a constant demand for the addition of new studies; but we believe that a survey of the field among manufacturers and among graduates will demonstrate the fact that a reasonably thorough course in industrial marketing would be a valuable addition to the curricula of most engineering schools."

But there is much work to be done! How many engineers recognize the full importance of marketing in the economic order today? How many recognize that every manufacturer must manufacture two things—the product he would sell and the order that will bring about this sale? Nearly all engineers recognize the fact that lower production costs have been achieved through intelligent design, proper organization, greater output, and the use of modern production tools. Are they equally sensitive, however, to the possibilities of lower sales costs through the intelligent choice of markets, a strong sales organization, and the proper selection and use of modern selling tools?

Industrial Marketing Is Engineering

The implication on the part of some uninformed persons that industrial marketing—the sale of industrial goods—is not engineering is most unfortunate. A sales engineer is of necessity an engineer of the highest type. A. R. Stevenson, Jr., of the General Electric Company, says, "The apparatus salesman is a consulting engineer in design."

The training of men for marketing should not be left to chance; in other words, the engineering colleges and the engineering profession must become more marketing-conscious. Engineering schools, which pioneered the teaching of industrial engineering some 25 or 30 years ago, should to-day give increasing emphasis to the teaching of industrial marketing. Engineering societies, which glorified the work of Taylor, Gantt, and Gilbreth in production two decades ago, should realize the ever-increasing importance of these principles now that they are finding wide application in the field of marketing.

The engineer of to-morrow may, with the joint help of these two bodies, become an engineer in every sense of the word; he should be able to "engineer through to the end" so that the ultimate consumer may receive the full benefits of his efforts.

COMPENSATIONS FOR DAYS OF RETIREMENT

By Robins Fleming, Structural Engineer, Retired, New York, N.Y.

Abstracted from Civil Engineering, February, 1940

Retirement these days comes to the engineer earlier than it once did. Then, too, reversing a well-known witticism, "People are living to-day who never used to live before," that is, they are living longer. Take these two factors together, and the net result is an aggravated problem for the person concerned.

Many a man has found himself "retired" when he was able to continue his work. Again, physical disability may have set in. He may or may not be regarded as an "old" man. Just here, let a sharp distinction be drawn between growing old and growing older. A man cannot help growing older; he may be able to defer growing old indefinitely. Old age has been defined as the inability to accept anything that is new.

Time May Hang Heavy.—Invariably the question comes to every one that is past the meridian of life or has laid aside its workaday activities, "What shall I do with my time?" One result is certain—he will have an opportunity to think. From such an experience, and the vantage point of eight and a third decades of living, a few stray thoughts will be presented with the retired engineer in mind.

Writing for Diversion.—A college professor, author of a widely known textbook, after his retirement wrote to me that he was revising his book. "It is a pleasure," he remarked, "to take as much time as I please on this work without other responsibilities."

Retired engineers are sometimes urged to present their best thoughts to the technical press. If they decide to offer a contribution, they should be prepared to have it returned as not available, "not from lack of merit," as rejection slips often say, but for other reasons. The pressure on the columns of engineering periodicals is tremendous.

Why not write for the purpose of acquiring knowledge? As some one has said, if you really want to understand a subject, write a book on it. A particular phase of a subject that is not clearly understood may be clarified by an effort to write explaining it—not necessarily with publication in view. Incidentally, many a published article has sprung from an effort on the part of the author to clear up his own thought on some particular subject.

Fascinations of Mathematics.—Consider the average engineer, who, having reached the retiring age or from other reasons, is "laid off" or, if in business for himself, is having his practice taken by younger men. He may not be interested in the calculus, though the differential calculus has been called the most beautiful poem that ever entered the mind of man. He may merely have heard of quaternions.

However, there are less difficult subjects of interest. There is, for example, the logarithm—not necessarily the presentation in textbooks but the line of thought of Napier himself. Why are certain logarithms called natural or hyperbolic? One looking for mathematical recreation will find plenty of it if he will only approach the logarithm the way Napier did. Mayhap, as Chrystal says in his *Algebra*, he will gain a truer "conception of the penetrating genius of the inventor of logarithms."

In the same way textbooks of student days could be reread. One of physics would prove to be of interest, especially if followed by a text of recent date. Time could well be devoted to a study of the application of physics to industry and everyday life.

Reading for Culture.—Technical articles can be read in a more leisurely way by the retired engineer than by one in active practice. He even has time to check equations and need not take it for granted that they are true. Better still, he can widen the range of his reading, employing the enormous resources of the libraries in our schools and cities if he is so fortunate as to have access to them. Time need not hang heavily on his hands. If he has a hobby, whether it be the fourth dimension or sweet pea culture, he will be surprised at the mass of available writings on the subject.

On Earth, But in the Clouds.—Or, the retired engineer could enjoy the study of nature. The companionship of mountains and trees, of brooks and green fields, may be denied him, but the sky with all his phenomena is open even to the dweller in a city flat. Cloudland is a land of delight.

If an acquaintance with the classification of clouds adds to the pleasure of the observer, a knowledge of the causes of their formation will add still more. Sky colour, the glow of the rising and setting sun, the twilight arch, the glorious cloud fringes at the sunset hour, are beautiful beyond description. The keen observer will want to know their causes.

Benefits from Chess.—The pleasures of the retired engineer may be limited by two factors—his health and his finances. Travel and many amusements may be out of the question. The game of chess is recommended as specially adapted to him. The outlay of money required is trifling and the exertion is purely mental. If an opponent is not at hand he may train one, perhaps of his own household.

Maintaining Old Contacts.—The retired engineer should keep his friendships in repair. This requires time and effort. As he grows older associates are separated by distance and circumstance; some leave this life. A feeling of sadness often comes to him as they pass in review. New interests and new personalities must be found to take their places, even if they do not replace them in full.

But in cultivating worth-while friends, there are certain weaknesses against which the older man should guard himself. Undue fondness for reminiscing and telling the same story again and again may be mentioned. This failing does not come to the surface so frequently in writing. Correspondence may be made a delight rather than a bugbear.

"Last, the Best of All the Game."—In his technical activity, an engineer seldom becomes obsolescent. Rather his value improves with age. Oddly enough he is often retired at the most productive period of his mental development. As he turns perforce to other activities, he may well anticipate a renewed usefulness and an increasing satisfaction in life. Then truly he may prove the validity of Robert Browning's immortal lines:

"The best is yet to be,
The last of life, for which the first was made."

NEW BALLOON-ROOF PETROL-SHORTAGE TANKS

***Commonwealth Engineer*, 1st August, 1939**

Abstracted by The Journal of The Institution of Civil Engineers, Engineering Abstracts, December, 1939

Two tanks equipped with the Wiggins balloon roof—developed in the United States—have been installed by the Commonwealth Oil Refineries, Ltd., of Melbourne. The roof consists of a diaphragm of 3/16-in. steel plate, and of a diameter 12 ft. greater than that of the tank. When in the "down" position it rests with a concave profile on the rafters of the roof framework. When vapour-pressure develops in the tank the roof sheeting moves upwards, and in the extreme position has a convex profile. The buckling of the plate under these conditions is controlled by a series of concrete weights located along spiral lines, together with spiral and circular control angles. The additional vapour-space thus provided for a tank 60 ft. in diameter exceeds 10,000 cubic feet.

From Month to Month

News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

FEES OF MEMBERS OVERSEAS

Following the practice established in the last war, Council has authorized the remission of fees for all members serving in the overseas forces. The official minute reads as follows:

"The remission of annual fees of members normally resident in Canada, appointed to or enlisting in His Majesty's Armed Forces, will be considered by Council upon written request, and on the following basis:

"The fee which is applicable at the first of the year is the amount for which the member shall be liable, and for which he shall be billed. If, subsequently in that year, conditions change, allowance will be made on the following basis:

"When service requires the member to leave Canada his fee will be remitted for the balance of the year, and his account credited accordingly.

"Members in the Naval or Air Services, who are intermittently absent from Canada because of the war, will be considered as eligible for this privilege.

"In computing the 'balance of the year' only half year periods will be considered, and the remission will date from January 1st or July 1st, whichever is nearest to the *date at which notice of change is received at Institute Headquarters.*

"Under such conditions all Institute services cease, except that it is the desire of Council to assist overseas members in any way that may be possible, and opportunities to render special services to such members will be welcomed. Members on active service are requested to keep Headquarters informed of their movements, as this is the only means by which a proper accounting can be rendered. This detailed information is also desirable as it is proposed to keep at Headquarters a record of all members who are on active service."

The bronze tablet at Headquarters contains the names of nine hundred and fifty members who served during the last war including one hundred and nineteen who made the supreme sacrifice. These are very high figures for an organization whose membership in 1914 numbered only 2,790. Already word has been received of many who have left Canada for "over there" to take up again the struggle which was fought so valiantly in the terrible years of 1914 to 1918.

The Institute is honoured by the national services of its members, and this remission of fees is but a modest expression of appreciation which Council feels it is making on behalf of all members who remain in Canada.

CANADIANS HONOURED IN NEW YORK

The Canadian Club of New York is holding a special function on April 10th, in honour of some senior members. The principal feature of the evening is the presentation of insignia to past-presidents and it is interesting to see, in the list of nine names, two who are members of the Institute, namely: T. Kennard Thomson, and Walter W. Colpitts.

Dr. Thomson was graduated from the School of Practical Science at Toronto in 1886. He joined the Institute in 1905. Dr. Colpitts was graduated with his Master's degree from McGill in 1899. He joined the Institute as a Student in 1897. Both gentlemen have enjoyed a lifetime of success as consulting engineers in New York City.

The Institute joins with the Canadian Club in felicitating these two grand young men who have so successfully and satisfactorily represented the profession throughout all these years on the governing body of the club.

ENGINEERS IN PARLIAMENT

Irrespective of political affiliation members will be pleased that the recent federal elections did not eliminate any of the engineers who sat in Parliament in the previous session. It is gratifying to see that an addition has been made to this number and that the profession is now represented by five members. It is also interesting to note that these engineers sit on both sides of the house in almost equal numbers.

An examination of the results shows that lawyers still predominate by a substantial majority. This is a condition which has always existed and may not of itself be an evil, but in the minds of many people it would be better if there were more representatives of other professions. There are many reasons for the failure of engineers to offer themselves for election, but it is to be hoped that the success of the recent candidates will encourage others to emulate their example.

A further reference to the members elected will be found in the Personals Column.

PICTURES

Almost since the beginning of time for each of us, pictures have provided one of the most interesting features of life. To-day they are replacing the printed word in news and story, and there is no telling where the movement may end. Such a development is not above criticism, and the *Journal* does not propose to alter its character by conforming to a popular demand, but it is proposed to publish from time to time as they become available, pictures that are complete in themselves, and are of interest to engineers.

Recently a small number of photographs of unusual merit have come to Headquarters. They have been taken by experts whose generosity in permitting the *Journal* first publishing rights without cost, is greatly appreciated. One of these, "Vacuum Tubes", was used in the February issue, and others will appear as feature pages in early numbers.

It is hoped that members of the Institute who are interested in photography will offer to the *Journal* any photos that they think might be suitable, in order to make possible the continuation of this feature. The picture first of all should be well taken. It should possess character and interest, and the subject should be related to some phase of engineering. Exclusive rights are not asked, but it is desirable that the picture be not previously published. All prints published or unpublished will be returned if it is so requested. A credit line will be given for each picture used.

Here is an opportunity for the enthusiast to secure an outlet for his work. The *Journal* will be very happy to be a medium between the photographer and "his public," in the belief that such support will encourage him to even better efforts, and will provide the readers with an interesting feature.

READING MATTER FOR THE R.C.A.F.

Any members who have publications that they think would be of interest to the air force and which they can spare for this worthy purpose, are requested to send them to the Royal Canadian Institute, 186 College St., Toronto.

Col. H. J. Lamb, M.E.I.C., who is a councillor of the Canadian Institute, advises that publications on motor mechanics in general and aircraft in particular are especially useful. Books or magazines on navigation and astronomy are also very welcome.

These will be distributed by the Canadian Institute to the various libraries of the R.C.A.F. in such a way that they will provide the maximum benefit.

THE BALLOT

About the time this Journal is being mailed, members will be receiving the ballots for amendments to the by-laws, to which attention was called in the March number. Within the last two weeks, active discussions have been underway with two provincial professional associations for agreements similar to those already completed. This renewed interest in closer relations between the Institute and the provincial associations more than ever proves the desirability of the proposal to eliminate the classification of Associate Member.

Particular attention is called to the memorandum accompanying the ballots, in which will be found full details of the proposed changes and a list of the advantages which it is expected will follow their adoption.

Council desires that all corporate members consider the proposals from the broad angle of "the greatest good for the greatest number."

CORRESPONDENCE

Sydney, N.S., 20th March, 1940

Secretary,
The Engineering Institute of Canada,
2050 Mansfield Street, Montreal, Canada.

Dear Sir:

I was pleased to note under Lord Tweedsmuir's photograph in the March Journal a quotation of the last paragraph from "Mr. Standfast."

I had written to our local paper here making the same quotation and suggesting it might well be John Buchan's epitaph. I have always been interested in his constant references to "Pilgrim's Progress" and note the fact that the memoirs which were completed by Lord Tweedsmuir shortly before his death, are to be titled "The Pilgrim's Way."

I enclose some verses I wrote in an elegiac strain which make references understandable to those who know "Pilgrim's Progress." I hope you like them.

Yours very truly,
(Signed) F. W. Gray.

Note—The editor is glad to print the verses herewith so that all members may have an opportunity to enjoy them.

JOHN BUCHAN

(A Canadian Elegy)

He moved amongst us as some planet bright
Weaves its sure course amidst the lesser stars;
Through Zodiacs of Empire, burning clear, from out
Her galaxies and constellations, as he passed.
Not dimming any light of all the general host,
Adding his austere lustre to the vaulted firmament.

His soul was lambent; passing through us lesser men,
He lit our spirits with his questioning smile.
His soaring mind communed with gods—
With all the great ones of the past,
Yet loved to walk with common folk engaged
With all the common tasks of men.

Slight was his earthly sheath, but, keen within,
Glittered the tested steel, the rapier blade.
Sharp probe of error, knightly sword,
That wounded no man in his secret heart,
And, all too soon, wore out its scabbard frail,
Unrusted and undinted by his Pilgrim's fight.

No man knew him but himself was moved
To greater things, feeling his own thoughts lift
Nearer that rarer air, that Land Delectable,
Wherein this Prince, this Wise Interpreter,
This Visitor we knew and loved, found Peace,
Passed outwards from amongst us to his Rest.

February, 1940. Francis W. Gray, M.E.I.C.

Lake Charlotte, N.S., March 1st, 1940.

Dear Sir:

I wish to report a change of address from: c/o Aer Lingus Teoranta, 39 Upper O'Connell Street, Dublin, Eire, to that shown above.

I went to Ireland as general manager of the Irish National Air Lines, known in Gaelic as "Aer Lingus Teoranta", to reorganize the company, equip it with modern aircraft and to train an Irish national to take over the job as general manager. All of this has been done and the company is now practically 100% Irish in personnel, and equipped with two Lockheed 14 aeroplanes, practically the same as those used by Trans-Canada Airlines. They also have two four engined D.H. 86 aircraft.

We had everything lined up to start using the Lockheeds between Dublin and London on October first but the war restrictions were such that we could not fly over England and it was nearly the end of November before much flying could be done and then only between Dublin and Liverpool. The company is owned by the Government but has a board of directors most of whom are not government employees. I found them a mighty fine lot of people and if any of our members are crossing the Irish Sea I hope they will make use of the Irish Air Lines.

I am at present managing director of Prasac Limited, a mining company with some mineral claims here that show several occurrences of the valuable "war mineral" tungsten.

Yours very truly,
(Signed) R. A. Logan, A.M.E.I.C.

G. C. Bateman
President of the C.I.M.M.

NEW OFFICERS OF THE C.I.M.M.

At the forty-fourth annual general meeting of The Canadian Institute of Mining and Metallurgy held at Winnipeg on March 14th, the following officers were elected: President, George C. Bateman, Toronto; Vice-Presidents: M. M. O'Brien, British Columbia; K. A. Clark, Alberta; Edward Pierce, Manitoba and Saskatchewan; A. D. Campbell, Ontario; J. M. Forbes, Quebec, and D. F. MacDonald, Maritime Provinces.

Mr. Bateman, the newly elected president, is secretary of the Ontario Mining Association. He is a graduate of Queen's (1905). His first professional work was with the Londonderry Iron and Mining Company, Nova Scotia; in 1906-07 he was engineer with the Guanajuato Reduction and Mining Company, Mexico; in 1907-08, superintendent, LaPerla Mines Company, Mexico; 1909-10, superintendent, Hudson Bay Mines, Cobalt; 1911, engineer, Dome Mines, South Porcupine; 1911-15, manager for Eastern Canada, Canadian Milling and Exploration Company, Toronto, and 1915-24, general manager and director, LaRose Mines, Cobalt.

MEETING OF COUNCIL

A meeting of the Council was held at Headquarters on Saturday, March 16th, 1940, with Past-President J. B. Challies in the chair, and nine other members of Council present.

The membership of the following committees for the year 1940, as submitted by their chairmen, were noted and approved: Library and House, Publication, Board of Examiners, International Relations, Western Water Problems, Deterioration of Concrete Structures, Membership, the Young Engineer, Past-Presidents' Prize, Duggan Medal and Prize, Plummer Medal.

Mr. Vance reported as regards the work of the Papers Committee that considerable difficulty had been found in 1939 in arranging for speakers and papers for the various branches. He felt that better results might be obtained by a change in the organization of the committee, and suggested that for this purpose the vice-presidents might be appointed to the committee to act in an advisory capacity to the branches in their several zones. After discussion, this suggestion was approved, and accordingly the following were appointed as members of the Papers Committee: J. A. Vance, chairman; McN. DuBose, J. Clark Keith, F. Newell, P. M. Sauder and W. S. Wilson. In reply to an inquiry from Mr. Vance, the chairman of the Finance Committee stated that a small fund would be available for the work of the Papers Committee.

The Secretary reported that some minor difficulties had been experienced in attempting to put into operation the regulations recently approved by Council regarding the remission of fees of members enlisting for overseas service, and that the committee would suggest certain slight revisions which would simplify their working. After discussion, the changes were approved. (The revised regulations will be found on page 182 of this issue of the Journal.)

Council considered a suggestion made at the Annual Meeting that the past-presidents be constituted an advisory committee for the discussion of important problems. It was pointed out, that although not formally organized as an advisory committee, the past-presidents, in practice, are doing exactly what is suggested. After discussion, it was the feeling of Council that the present informal arrangement would be preferable; accordingly, the Secretary was directed to thank the proposers for their suggestion, and to say that after careful consideration it had been decided to take no action.

The budget for 1940 was presented by the chairman of the Finance Committee, and after discussion, was approved. Mr. Newell drew attention to the satisfactory figures applying to the cost of the annual meeting recently held in Toronto. The Secretary was directed to express to the Toronto Branch Council's appreciation of the financial arrangements and the general conduct of the meeting which they had so successfully carried out.

A request having been received from the chairman of the Committee on the Training and Welfare of the Young Engineer for an appropriation to cover the publication of a booklet, it was felt that in view of the possibility of co-operation with the Engineers' Council for Professional Development, the publication of such a booklet by Mr. Bennett's committee should be held in abeyance for the present.

It was decided that The Engineering Institute of Canada Prizes, consisting of $25.00 in cash awarded annually to each of the Canadian engineering schools, be continued for a further period of five years.

Fourteen resignations were accepted; the names of six members were removed from the list; two reinstatements were effected; five members were granted Life Membership, and a number of special cases were considered.

A number of applications were considered, and the following elections and transfers were effected:

Elections

Members	2
Associate Member	1
Juniors	3
Affiliate	1
Students admitted	35

Transfers

Associate Member to Member	1
Student to Associate Member	2
Student to Junior	9

The Council rose at three-fifteen p.m.

AIR CONDITIONING DEFINED

After many months of study and negotiation the Air Conditioning Industries Branch of the Board of Trade of the City of Toronto has prepared and sponsored a definition of air conditioning for human comfort. In the early stages the definition was submitted to many technical bodies such as the Engineering Institute, the National Research Council, the Canadian Engineering Standards Association, the Ontario Research Foundation, the American Society of Heating and Ventilating Engineers, and the American Society of Mechanical Engineers, for constructive criticism.

The definition as published herewith has been accepted by the leading members of the industry, who have agreed strictly to abide by it. It is their hope that the public may become informed on the true requirements of air conditioning, and that this definition may become a yardstick by which they may judge values and provide themselves with protection in a field which is technical and in which the term is frequently abused.

No attempt has been made to authorize a definition for general or commercial installations, as it was felt that too many purposes were involved, and that business organizations were in a position to inform themselves properly, and therefore did not require such protection.

It is to be hoped that a wide publicity will be given to the announcement, to the end that great numbers of the public will be made aware of the protection which has been provided.

Objective

Air Conditioning for human comfort has for its objective the maintenance of such atmospheric conditions as will produce desired effects upon the occupants of a structure.

Definition

Air Conditioning for human comfort is defined as the simultaneous control within any structure of the temperature, humidity and circulation of the atmosphere therein; it shall also include an adequate supply of air from outside such structure, and may include the control of any other factors affecting either or both the physical and chemical conditions of the atmosphere within the structure.

Apparatus

Air Conditioning Apparatus, in order to comply with the above definition, shall be capable of performing as a minimum the following functions:—

Summer Air Conditioning
1. Cool the Air.
2. Dehumidify the Air.
3. Circulate the Air.

Winter Air Conditioning
1. Heat the Air.
2. Humidify the Air.
3. Circulate the Air.

Year-round Air Conditioning
1. Cool and dehumidify the air in Summer.
2. Heat and humidify the air in Winter.
3. Circulate the Air.

Most Air Conditioning Apparatus, in addition, cleans the air.

PUBLICATIONS OF AMERICAN ENGINEERING SOCIETIES

From time to time announcements have appeared in The Engineering Journal regarding the exchange arrangements which exist between The Engineering Institute of Canada and the founder engineering societies of the United States, whereby members of the Institute may secure the publications of the American societies at special rates which in most instances are the same as charged to their own members. A list of these publications with the amounts charged is given below, and subscriptions may either be sent direct to New York or through Headquarters of the Institute.

	Rate to E.I.C. Members	*Rate to Non-Members*
American Society of Civil Engineers		
Proceedings, single copies	$ 0.50	$ 1.00
Per year	4.00*	8.00†
Civil Engineering, single copies	.50	.50
Per year	4.00	5.00
(Plus $.75 to cover Canadian postage.)		
Transactions, per year	6.00‡	12.00¶
Year Book	1.00	2.00
(Other publications 50 per cent reduction on catalogue price to E.I.C. members.)		

* *If subscription is received before January 1st, otherwise $5.00.*

† *If subscription is received before January 1st, otherwise $10.00.*

‡ *If subscription is received before February 1st, otherwise $8.00.*

¶ *If subscription is received before February 1st, otherwise $16.00.*

American Institute of Electrical Engineers		
Electrical Engineering, single copies	$ 0.75	$ 1.50
Per year	6.00*	12.00*
(* Plus postage $1.00.)		
Transactions—annual, bound	6.00*	12.00*
(* Plus postage $1.00.)		
(The single copy price for Electrical Engineering includes postage charge.)		
The American Society of Mechanical Engineers		
Mechanical Engineering, single copies	$ 0.50	$ 0.60
Per year	4.00*	5.00
(*Additional Postage to Canada $.75, Outside United States and Canada, $1.50.)		
Transactions, bound, published annually, about March 1st (price of current volume)	10.00	15.00
(Other publications, same rate to E.I.C. members as to A.S.M.E. members.)		
Journal of Applied Mechanics—Quarterly publications.		
Dates of issue: March, June, Sept., Dec	4.00	5.00
American Institute of Mining and Metallurgical Engineers		
Mining and Metallurgy, single copies	$ 0.50	$ 0.50
Per year	3.00*	3.00
(* Plus $1.00 for foreign postage.)		
Metals Technology, single copies	1.00	1.00
Per year	7.00*	7.00
(* Plus $.50 for foreign postage.)		
Transactions, per volume	5.00*	7.50
(*Plus $.60 for foreign postage.)		
Technical publications: Supplied at $.01 per page, with a minimum charge of $.25 for single copies, or at a subscription rate per year of	7.00*	7.00
(* Plus $1.00 for foreign postage.)		

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

Past-President Brigadier-General C. H. Mitchell, C.B., C.M.G., D.S.O., C.E., LL.D., D.Eng., M.E.I.C., has recently been made a director of Canada Steamship Lines, Limited.

Past-President H. H. Vaughan, M.E.I.C., president of the Canadian Foreign Investment Corporation, Limited, and a director of Dominion Bridge Company, Limited, and **F. W. Taylor-Bailey,** M.E.I.C., vice-president and general manager of Dominion Bridge Company, Limited, have been elected, recently, directors of Dominion Engineering Works, Limited.

James A. Stairs, A.M.E.I.C., is now connected with Dominion Engineering Works, Limited, Lachine, Que. Upon graduation from the Royal Military College, Kingston, Ont., in 1897, he entered the Nova Scotia Steel and Coal Company. From 1904 to 1909, he was assistant superintendent and later superintendent of the rolling mills of the company, at Trenton, N.S. From 1909 to 1918, as general superintendent of the Brown Machine Company, of New Glasgow, N.S., he built and equipped foundry, machine and structural shops and he erected numerous steel buildings and bridges. During the last war, he equipped and had full charge of a shell plant working for the Imperial Munitions Board. In 1919, he was with the Ford Motor Company at River Rouge, Mich., on plant engineering work, and later, with the Calorizing Company, Pittsburgh, Pa. From 1924 to 1927, he was in India, as superintendent of the merchant bar mills of the Tata Iron and Steel Company. From 1928 to 1932, he was with the United Engineering and Foundry Company, Pittsburgh, on the design of rolling mills. Recently Mr. Stairs was manufacturing metallic packing under the name of Plasco Reg'd., in Montreal.

Major R. B. Jennings, M.E.I.C., is now office assistant to Major W. G. Swan, M.E.I.C., director of construction with the War Supply Board at Ottawa.

Alphonse Gratton, M.E.I.C., has assumed, on April 1st, the new post of assistant chief engineer of the Quebec Department of Highways for the Montreal, Hull and Eastern Townships districts. Mr. Gratton was graduated from the Ecole Polytechnique in 1912 and went with the Harbour Commission of Montreal as an assistant engineer. From 1915 to 1919 he was assistant engineer with the Montreal Water Level Commission. He entered the Department of Roads of the Province of Quebec as a division engineer in 1919. He became district engineer in 1932 and occupied this position until his recent promotion. Mr. Gratton is professor of highway engineering at the Ecole Polytechnique since 1925.

The Hon. C. D. Howe, M.P., Hon.M.E.I.C.

The Hon. C. D. Howe, HON.M.E.I.C., has been re-elected to Parliament as Liberal Member for Port Arthur, Ont. He was first elected to that seat in 1935 and on the formation of the government entered the cabinet as Minister of Railways and Canals and Minister of Marine. Under his direction these important departments were consolidated

Denton Massey, M.P., A.M.E.I.C.

The Hon. Grote Stirling, M.P., Hon.M.E.I.C.

Maurice Bourget, M.P., A.M.E.I.C.

and enlarged resulting in the formation of the Department of Transport of which Mr. Howe became Minister.

The Hon. Grote Stirling, HON.M.E.I.C., has been re-elected to Parliament as a Conservative Member for Yale, B.C. He was first elected in 1924 when the seat at Yale was vacated by the death of J. A. McKelvie and he was re-elected in the four succeeding general elections of 1925, 1926, 1930 and 1935. In 1934, he was appointed Minister of National Defence and acting Minister of Fisheries in the Bennett Cabinet.

Denton Massey, A.M.E.I.C., has been re-elected as Conservative Member of Parliament for Toronto-Greenwood. Born at Toronto in 1900, Mr. Massey received his education at the University of Toronto and at the Massachusetts Institute of Technology where he obtained, in 1924, the degree of Bachelor of Science. During the years 1924 and 1925 he worked in the shops of Massey-Harris Company, Limited, in Toronto. From 1926 to 1928, he was assistant to the superintendent of the Toronto works, in charge of the planning department. In 1928, he became in charge of the overhead and costs division.

Maurice Bourget, A.M.E.I.C., is the newly elected Liberal Member of Parliament for Levis, Que. He was born at Lauzon, in the county of Levis, in 1907. He received his early education at the Commercial Academy, at Quebec, and his engineering education at the Ecole Polytechnique de Montréal, where he obtained the degree of Bachelor of Science in 1932. From 1933 until 1937 he was with the Department of Public Works of the Province of Quebec, at Quebec, as an assistant engineer. In the fall of 1937, he joined the engineering staff of Zachée Langlais, consulting engineer of Quebec City.

Mr. Bourget is on the executive committee of the Quebec Branch of the Institute.

J. H. Harris has been re-elected as Conservative Member of Parliament for Toronto-Danforth.

T. R. Loudon, M.E.I.C., professor of applied mechanics at the University of Toronto, has been selected to take command of the first school of aeronautical engineering under the British Commonwealth Air Training Plan, which opened last month in Montreal. Squadron-Leader Loudon was born in Toronto, in 1883, and educated at the University of Toronto. During the last war he served with the Royal Canadian Engineers from 1915 to 1919, and in latter years took an active interest in the University of Toronto C.O.T.C. He was O.C. of that corps, with the rank of lieutenant-colonel.

He is also president of the Toronto Flying Club, and holds a private pilot's license. At the University of Toronto, he taught aerodynamics and aeroplane stress design, and was also supervisor of the air navigation course. He has had considerable experience in the theory of flight, air navigation, stress analysis and aeroplane design.

Squadron-Leader Loudon has served on the Council of the Institute, was a Vice-President in 1930 and 1931, and has also been chairman of the Toronto Branch.

Donald Ross, A.M.E.I.C., sailed last month for British Guiana, where he has accepted a position at McKenzie, with the Demerara Bauxite Company. For the last few months he had been with Canadian Industries Limited in Hamilton on construction work and for the two previous years, he had been engaged in the construction of the Newfoundland Airport.

I. Leebosh, A.M.E.I.C., is now again associated with Beauharnois Light, Heat & Power Company in an engineering capacity, and is located in Montreal. Born in Latvia, Mr. Leebosh was educated at the Polytechnical Institute of Coethen, Germany, where he was graduated in 1924 as a mechanical engineer. From 1926 to 1932 he was with the late Frederick B. Brown, consulting engineer of Montreal, and was engaged on work in connection with the Beauharnois power project. From 1932 to 1938, he was with the Beauharnois Light, Heat & Power Company, in Montreal, on development work, design of transmission lines, and property records. In 1938 he went with the Canadian Bridge Company at Walkerville, Ont., in the tower department, and stayed there until his recent return to Montreal.

C. S. Clendening, A.M.E.I.C., has been appointed recently manager of the Lethbridge Northern Irrigation District. He was educated at the University of Toronto, and has been a resident engineer with the Lethbridge Northern Irrigation District since 1921.

D. S. Laidlaw, A.M.E.I.C., of Toronto, has accepted a position in the engineering department of Canadian Industries Limited in Montreal. He will be welcomed by the many friends he made during the years he spent in Montreal after his graduation from the University of Toronto in 1928.

Gaylen R. Duncan, S.E.I.C., is expected back this month from Maracaibo, Venezuela, S.A., where he has been occupied for the past year as commercial superintendent of the Venezuela Power Company. After graduation from McGill University in 1935, Mr. Duncan studied business administration for two years at Harvard University. For some time, he was with John Stadler, consulting engineer of Montreal.

Last November, Mr. Duncan was married in Montreal to Frances Marie Earle, a daughter of Mr. A. P. Earle of Westmount. Mr. and Mrs. Duncan then left for Maracaibo, via New York and Curacao.

Paul Filion, s.e.i.c., has accepted a position as inspector in the Engineering and Fire Preventive Service of Reed, Shaw and McNaught, Montreal. Since graduation from McGill University in 1936, he had been an inspection engineer with the Canadian Underwriters' Association, Montreal.

E. H. Davis, Jr.E.I.C., has accepted a position with International Petroleum Company, in Ecuador, S.A. A graduate in civil engineering from the University of Alberta, in 1938, he has been engaged since as an industrial and utilities assessor for the Government of Alberta.

A. A. B. McMath, Jr.E.I.C., is now with Canadian Industries Limited at Brownsburg, Que. He was graduated in mechanical engineering from McGill University, in 1934, and went with the Sherbrooke Machineries, Limited, at Sherbrooke, Que. In 1935-1936, he was demonstrator in the Department of Mechanical Engineering at McGill. Since 1936, until his recent move, he had been with the Canadian Ingersoll-Rand Company, Limited, at Sherbrooke, Que.

T. A. I. C. Taylor, Jr.E.I.C., has received the appointment of assistant engineer with the Aluminum Company of Canada, Limited, at Arvida, Que. He was graduated in electrical engineering from the University of Alberta, in 1936, and he joined the Saguenay Power Company, Limited, at Arvida, as a junior engineer. In 1937, he was plant engineer at Isle Maligne, Que. In May 1938, he had been transferred to the Aluminum Company of Canada, Limited, at Arvida, as an apprentice engineer.

E. L. Ball, Jr.E.I.C., has lately taken a position with the Robert Simpson Eastern Limited, at Halifax, N.S. He was graduated in civil engineering from the Nova Scotia Technical College, Halifax, in 1938, and he joined the Engineering Service Company, Limited. In September 1939, he then joined the Engineering Department of the Imperial Oil Company, Limited, at Halifax, N.S.

O. Quevillon, s.e.i.c., has been appointed city engineer for St-Hyacinthe, Que. Since graduation in civil engineering from the Ecole Polytechnique in 1939, Mr. Quevillon had been with the Department of Public Works of the Dominion, in Montreal.

VISITORS TO HEADQUARTERS

C. M. Goodrich, M.E.I.C., Chief Engineer, Canadian Bridge Company, Limited, from Walkerville, Ont., on February 29th.

J. R. Hango, A.M.E.I.C., Superintendent of Distribution, Saguenay Power Company, Limited, from Arvida, Que., on March 1st.

M. N. McEwen, A.M.E.I.C., Ontario Department of Highways, from Kenora, Ont., on March 5th.

A. G. Mahon, A.M.E.I.C., Assistant Engineer, Nova Scotia Power Commission, from Halifax, N.S., on March 6th.

W. N. McCann, Jr.E.I.C., Department of Agriculture, from Swift Current, Sask., on March 8th.

H. A. McColeman, s.e.i.c., from Claybank, Sask., on March 8th.

Paul E. Buss, A.M.E.I.C., President, Spun Rock Wools Limited, from Thorold, Ont., on March 11th.

O. J. F. Rankin, s.e.i.c., 6th Fortress Signal Company, Halifax, N.S.

G. W. Rowe, A.M.E.I.C., Assistant Engineer, National Harbours Board, Churchill, Man., on March 13th.

R. F. Sadler, s.e.i.c., from Bathurst, N.B., on March 23rd.

SUMMER GRADUATE INSTITUTE

Armour Institute of Technology, Chicago, according to the announcement made by Dr. L. E. Grinter, vice-president and dean of the graduate division, will conduct a three-term Summer Graduate Institute for engineers, professional men, industrialists, and educators in engineering and science beginning with the summer of 1940. It is planned, according to Dr. Grinter, who is in charge of the Summer Institute beginning with this year, to invite scientists of great distinction to lecture each summer on modern developments in engineering and science.

Foto Press Service

Sq. Ldr. T. R. Loudon, M.E.I.C.

This Summer Institute is divided into seven separate and distinct divisions and the programmes of specialized classes have been arranged to provide an opportunity for graduate work on the highest possible plane. These divisions include Advanced Mechanics, Chemical Engineering and Chemistry, Civil and Sanitary Engineering, Electrical Engineering and Physics, Mechanical Engineering, Industrial Engineering and Applied Mathematics.

In making the announcement, it was pointed out by Institute officials that the typical Summer Graduate course will meet for the equivalent of two hours lecture daily, including Saturdays for four weeks. The student would be permitted to carry only one course for credit during each period of four weeks, making possible, in a short period of intensive study and continuous attention to one subject, a very rapid development of knowledge of the subject. Such courses, it was pointed out, would be credited toward advanced degrees. The first term of the Summer Institute will extend from June 17th to July 13th; the second term from July 15th to August 10th; and the third term from August 12th to September 7th.

COMING MEETINGS

American Water Works Association—Annual Convention, at Kansas City, Mo., Secretary, H. E. Jordan, 22 East 40th St., New York City. April 21 to 25.

American Society of Mechanical Engineers—Spring Meeting, Bancroft Hotel, Worcester, Mass. May 1-3.

American Society for Testing Materials—Annual Meeting at the Chalforte-Haddon Hall Hotel, Atlantic City, N.J. Secretary, C. L. Warwick, 260 S. Board St., Philadelphia, Pa. June 24-28.

Canadian Electrical Association—Fiftieth Annual (Golden Jubilee) Convention at the Seigniory Club, P.Q. June 25-28.

National Conference on Planning—Joint Annual Conference of American Society of Planning Officials, American Institute of Planners, the American Planning and Civic Association, and the National Economic and Social Planning Association at San Francisco, Calif. Director, Walter H. Blucher, 1313 E. 60th St., Chicago, Ill. July 8-12.

New England Sewage Works Association—Annual Meeting, exact dates to be selected and also place, but will probably be held in Middletown, Conn. Secretary, L. W. Van Kleeck, State Department of Health, Hartford, Conn.

Electrochemical Society, Inc.—Fall Meeting, at Ottawa, Ont. President, H. J. Creighton, Swarthmore College, Swarthmore, Pa. Secretary, Dr. C. G. Fink, Columbia University, New York City. October 2-3-4-5.

Obituaries

Major Theodore Edward Naish, M.E.I.C., died suddenly in Penticton, B.C., on August 10th, 1939. He was born at Bristol, England, on April 5th, 1867. He was educated at the Royal Military Academy, Woolwich, where he had a brilliant record, winning the Pollock medal for the highest marks attained by any student of his graduating year, a medal that was presented to him at Buckingham Palace by Queen Victoria. After graduation, he went, as a military pupil, to the works of Armstrong, Mitchell and Company at Newcastle-on-Tyne. Later he was in charge of the erection and repair of barracks and buildings at Belfast, Cork and Portsmouth. At the beginning of this century, he supervised the construction of the fortifications at Halifax, N.S. During the war he was in command of the Royal Engineers at Jersey, Channel Islands. Later he went to Penticton, B.C., where he became one of the outstanding citizens, and where he remained until his death.

Major Naish joined the Institute as a Member in 1904, and in 1932, he was made a Life Member.

William Allison Logan, A.M.E.I.C., died at his home in Peterborough, Ont., on March 1st, 1940. He was born at Louisville, New York, on September 26th, 1851. He began his engineering career in 1880, with the Department of Railways and Canals of the Dominion, as rodman. He held many important posts during his active career on both the St. Lawrence and Trent Valley canals. At one time he was chief of works on the Galops Rapids, and later had charge of the North Channel improvements below Prescott for a number of years. He came to Peterborough associated with the Trent Valley Canal. He surveyed the Peterborough to Hastings section in 1909, and was in charge of building of Burleigh Falls dam.

Mr. Logan was a popular figure during his long residence in Peterborough. A charter member of the Peterborough Branch of the Engineering Institute of Canada, he seldom missed a meeting and was one of the best informed men in attendance. He had been retired for about twenty years, but still took a keen interest in the engineering accomplishments of to-day.

Mr. Logan joined the Institute as an Associate Member in 1903, and he was made a Life Member in 1922.

Air Vice-Marshal James Lindsay Gordon, A.M.E.I.C., died in the hospital at Montreal on March 2nd, 1940. He was born at Montreal on December 11th, 1892. He was educated at McGill University, and at the outbreak of war in 1914, he elected to enter the air service, and with this in mind, attended the Wright Flying School at Dayton, Ohio. He went overseas as a Flight Lieutenant, R.N., in 1916. He was a famous Canadian war ace, who served with both the Royal Naval Air Service and the Royal Flying Corps, in the last war. He received numerous decorations, and was mentioned several times in dispatches.

At the conclusion of the war, Air Vice-Marshal Gordon returned to this country and joined the Air Board in Ottawa in 1920 as superintendent of flying operations. He served continuously in the Canadian defence services from that date until he resigned owing to ill-health in June, 1939.

Air Vice-Marshal Gordon graduated from the Royal Air Staff College at Andover, in March, 1926, and from the Imperial Defence College at London in December, 1931. He was director of civil government air operations from July, 1927, until November, 1932, when appointed Senior Air Officer. He served in this capacity until he was posted as District Officer Commanding Military District No. 12, Regina, in 1933, and later was transferred to Military District No. 10, in 1935.

Air Vice-Marshal Gordon joined the Institute as an Associate Member in 1924.

Charles Nicholas Monsarrat, M.E.I.C., died suddenly of a heart attack in his home, in Montreal on the evening of March 1st, 1940. He was born in Montreal on July 2nd, 1871. He traced his family back through several generations in Canada to the north of Ireland where his ancestors settled as Spanish Huguenots, fleeing from persecution.

As a youth in 1890, he joined the engineering staff of the Canadian Pacific Railway, and through the usual channels of those days, namely, rodman, chainman, transitman and draftsman, reached the office of the chief engineer where he rose by 1902 to the responsible position of engineer of bridges. He occupied this office until 1911, and during that time gave his attention to many major projects, among the more interesting of which is the Belly River Viaduct, near Lethbridge, Alta., which is a steel structure over 300 ft. in height and a mile in length.

Canadian Newspaper Service

Lieut.-Col. C. N. Monsarrat
M.E.I.C.

It was during his régime as engineer of bridges that the reconstruction of the famous Lachine Bridge over the St. Lawrence near Montreal was undertaken when the four-span continuous structure designed by the late Mr. C. Shaler Smith, in 1885, was replaced by two independent single-track structures built side by side on common piers to constitute a double-track crossing of 3,659 ft. in length. Before this work had been completed however, Mr. Monsarrat was appointed by the Department of Railways and Canals to succeed the late H. E. Vautelet as chairman and chief engineer of the Quebec Bridge Board, which Board had been set up by the Dominion Government to undertake the task of designing and supervising the construction of a double-track railway bridge over the St. Lawrence near Quebec, to carry the National Transcontinental Railway, as it was then called. The original Board of Engineers had been appointed in 1908 following the report of the special commission regarding the 1907 catastrophe.

Several years were occupied in the work of building the deep-water granite-faced piers and in fabricating and erecting this great cantilever span which still retains premier place in its own class of structure, and upon its completion, the services of Mr. Monsarrat were retained by the Department of Railways and Canals as consulting engineer, he and selected members of his staff being moved to Ottawa. In 1920, when the Dominion Government decided to take over the Grand Trunk Railway, the Department set up a special staff in Montreal to undertake the investigations which were a necessary preliminary to arbitration proceedings, and Mr. Monsarrat secured for this important work the services of Mr. P. L. Pratley who was the designing engineer for the Dominion Bridge Company, and who had served several years as assistant engineer of design on the Quebec Bridge Board under Mr. Vautelet and later as engineer in charge of design for the St. Lawrence Bridge Company, the successful tenderers for the superstructure. Shortly after the office of consulting engineer to the Department was abolished and Mr. Monsarrat was appointed to the Operating Department of the new Canadian National Railways as consulting engineer on bridges, his staff in Ottawa being absorbed into other divisions of the Department. As only a portion of his time was required by the railways, he and Mr. P. L. Pratley entered into a professional partnership and set up in private practice as consulting civil engineers in April, 1921.

This partnership continued until his death and was productive of much important engineering work, largely in the field of major bridge projects. Among the more outstanding contracts for which they were engaged as consulting, designing, and supervising engineers, are the Montreal Harbour Bridge (Jacques Cartier) 1924-1931, the reconstruction of the Second Narrows Bridge in Vancouver, 1933-1934, the suspension bridge at the Isle of Orléans near Quebec, 1933-1935; the Lions' Gate Bridge over the First Narrows at Vancouver, 1933-1939. They were engaged as consulting engineers on design to the general contractors for the Detroit-Ambassador Bridge, 1928-1929; as Canadian Associate Engineers on the International structures at Sarnia-Port Huron, 1928-1938; and the Thousand Islands, 1933-1938, and as engineering consultants on a variety of work in the Niagara District for the International Railway Company of Buffalo.

Mr. Monsarrat was always interested in military affairs and in his early life served with the Victoria Rifles of Canada, one of the oldest militia units in the Montreal District. In 1905 he took out a commission in the Royal Highlanders and rose through all the intervening ranks to the command of the regiment as Lieutenant-Colonel, in June, 1915. At the end of the Great War in 1918, he retired to the reserve of officers from which he was released upon reaching the age limit of liability to recall for service.

Since 1898, Colonel Monsarrat has been a member of the Engineering Institute of Canada, upon whose Council he served during the years 1910, 1912, 1913 and 1914, and of which he was Vice-President during 1917. He was a charter member of the Corporation of Professional Engineers of the Province of Quebec, and served on their Council during the period 1921-1937, being Vice-President during 1926, 1927 and 1933. He was also for many years a member of the American Railway Engineering Association. He was elected a member of the American Society of Civil Engineers on the 4th March, 1913.

ELECTIONS AND TRANSFERS

At the meeting of Council held on March 16th, 1940, the following elections and transfers were effected:

Members

Harrington, Conrad Dawson, B.Sc. (McGill Univ.), vice-president, Anglin-Norcross Corporation Limited, Montreal, Que.

Higgins, Alexander, (Royal Tech. Coll.), supervisor of engrg. correspondence instruction, Provincial Institute of Technology, Calgary, Alta.

Associate Member

Neilson, James Edward, B.Sc. (Mech.), (Queen's Univ.), sales engr., Foster Wheeler Limited, Montreal, Que.

Juniors

Donaldson, David Rennie, B.A.Sc. (Civil), (Univ. of B.C.), aircraft inspr., Boeing Aircraft Company, Vancouver, B.C.

Stapley, Wilfred Henry, B.Sc. (Mech.), (Univ. of Sask.), Flying Officer, R.C.A.F., Halifax, N.S.

Thomson, James Irving, B.A.Sc.. (Univ. of Toronto), hydrographer, Hydrographic Service, Dept. of Mines and Resources, Ottawa, Ont.

Affiliate

Puddester, Robert Percival, asst. engr., mtce. of way, Newfoundland Railways, St. John's, Nfld.

Transferred from the class of Associate Member to that of Member

Armstrong, John Edward, C.E. (Cornell Univ.), chief engr., Canadian Pacific Railway, Montreal, Que.

Transferred from the class of Student to that of Associate Member

Holland, Trevor, B.Eng. (McGill Univ.), vice-president, Brandram-Henderson Limited, Montreal, Que.

Mitchell, Lawrence Everett, B.Sc. (Mech.), (N.S. Tech. Coll.), chief engr., Tropical Oil Company, Barranca-Bermeja, Colombia, S.A.

Transferred from the class of Student to that of Junior

Descoteaux, Paul R., B.A.Sc., C.E. (Ecole Polytechnique, Montreal), divn. engr., Quebec Roads Dept., Cap de la Madeleine, Que.

Elliott, John Courtenay, B.Sc. (Queen's Univ.), Dominion Natural Gas Co. Ltd., Leamington, Ont.

Killam, Frank Richard, B.Eng. (Mech.), (McGill Univ.), asst. mech. mtce. supt., Fraser Companies Limited, Edmundston, N.B.

Lavergne, Emile Denis, B.Sc. (Civil), (Univ. of Mich.), shift foreman, Canadian Industries Limited, Shawinigan Falls, Que.

MacGibbon, James Alexander, B.Eng. (Mech.), (McGill Univ.), dftsman., Canadian Industries Limited, Montreal, Que.

Miller, Errol Leslie, B.Eng. (Civil), (McGill Univ.), engrg. dept., City of Westmount, Que.

Pouliot, Paul Louis, B.A.Sc., C.E. (Ecole Polytechnique, Montreal), apprentice, Shawinigan Water & Power Company, Quebec, Que.

Ross, Thomas W., B.Eng. (Mech.), (McGill Univ.), senior dftsman., New Brunswick International Paper Company, Dalhousie, N.B.

Senkler, Edmund John, B.A.Sc., (Univ. of B.C.), industrial engr., Julius Kayser & Company, Sherbrooke, Que.

Students Admitted

Bestwick, Frank S., (Univ. of Man.), 198 Hill St., Norwood, Man.

Binks, Wyman R., (Queen's Univ.), 211 Holmwood Ave., Ottawa, Ont.

Boone, W. E. R., (Univ. of Man.), Box 69, University of Manitoba, Fort Garry, Man.

Carlson, Arthur John, (Queen's Univ.), 442 Johnson St., Kingston, Ont.

Chandler, Ralph W., (Queen's Univ.), 73 Upper William, Kingston, Ont.

Collier, David Barr, B.Sc., (Civil), (Univ. of Alta.,) 9920-102 Street, Edmonton, Alta.

Cook, Charlie Henry, (Univ. of Man.), 324 Redwood Ave., Winnipeg, Man.

Corey, Bert Hatfield, B.Sc., (Univ. of Alta.), Box 65, Black Diamond, Alta.

Curtis, John Knowlton, (Queen's Univ.), 173 Alfred St., Kingston, Ont.

Davis, Robert Andrew, (Queen's Univ.), 547 Frontenac St., Kingston, Ont.

Day, Cecil Maurice, Tester, Sulphite & Kraft Dept., Bathurst Power & Paper Co., Bathurst, N.B.

Dickie, Harold G., (Queen's Univ.), 118 Earl St., Kingston, Ont.

Dineen, James Owen, (Univ. of N.B.), Lady Beaverbrook's Residence, Fredericton, N.B.

Dixson, George W., (Univ. of Man.), Box 69, University of Manitoba, Fort Garry, Man.

Dunn, Sydney M. S., (Univ. of Tor.), Ridgeway, Ont.

Forrester, Robert A.. (Univ. of Tor.), 141 Beaconsfield Ave., Toronto, Ont.

Frick, David W., (Univ. of Alta.), 11137-83 Ave., Edmonton, Alta.

Gartley, C. Almon, (Univ. of N.B.), R.R. No. 3, Woodstock, N.B.

Hugill, John T., B.Sc., (Chem.), (Univ. of Alta.), 8921-112th Street, Edmonton, Alta.

Jacobs, Clifford Roy, B.Sc., (Chem.), (Univ. of Alta.), 10981-129 Street, Edmonton, Alta.

Jarry, Aurel G., (McGill Univ.), 244 Bloomfield Ave., Outremont, Que.

Kempton, D. R., (Queen's Univ.), 20 Broad St., Brockville, Ont.

Kennedy, Russell J., (Queen's Univ.), 153 Alfred St., Kingston, Ont.

Lamb, Thomas, (Univ. of Man.), No. 18 Ruth Apts., Winnipeg, Man.

Logie, Richard B., (Univ. of N.B.), Beaverbrook Residence, Fredericton, N.B.

Manuel, Oliver H., (Univ. of N.B.), 56 Charlotte St., Fredericton, N.B.

McIntyre, Donald J. (Queen's Univ.), 528 King St. West, Chatham, Ont.

McKnight, S. W., (Univ. of N.B.), 550 Charlotte St., Fredericton, N.B.

Monkman, B. A., (Univ. of Alta.), 260-2nd Street, Medicine Hat, Alta.

Near, James D., (Univ. of Tor.), Knox College, Toronto, Ont.

Pearce, E. B., (Queen's Univ.), 219 Stuart St., Kingston, Ont.

Ring, A. J., (Univ. of N.B.), Nashwaaksis, N.B.

Saunders, W. A. B., (Univ. of N.B.), 1010-4th Ave., N.W., Calgary, Alta.

Stone, J. G., (Queen's Univ.), 22 Woodlawn Ave., Ottawa, Ont.

Wrightson, N. G., Draughtsman, Darling Bros. Ltd., Montreal.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

BORDER CITIES BRANCH

H. L. Johnston, a.m.e.i.c. - *Secretary-Treasurer*
A. H. Pask, Jr.e.i.c. - - - *Branch News Editor*

The second meeting this year of the Border Cities Branch was held on Monday evening, February 19th, 1940, in the Prince Edward Hotel at Windsor. A dinner attended by 22 members was held at 6.30 p.m. and following this there was a short business meeting.

The gathering was then addressed by Mr. George Chute of the General Electric Company who spoke on **Electrical Control Equipment in Industry.** He also covered some recent developments in the electrical field.

Mr. Chute first spoke of the electric strain gauge which, though costly, is widely used. An example was the application to old railway bridges which were to be used by high speed trains. The design formulae indicated that the bridges could not withstand the new speeds. However, the gauges proved the formulae conservative and saved a large replacement outlay. Another use is in recording the transient strains in an aeroplane undergoing test.

Until the discovery of Alnico, an aluminum-cobalt-nickel alloy, D.C. selsyns were impossible, but were demanded for use as aeroplane control indicators. 20,000 of these instruments are now in use. The alloy is used also for small motors and generators. As a permanent magnet it has 2,000 to 3,000 times the strength of other materials.

The new uses of high frequencies were explained by Mr. Chute as largely those of heating. With 3,000-cycle motor-generator sets, it is possible, as very recently developed, to heat treat only the inside surface of brake drums and leave the exterior unchanged. The depth of the hardening is controlled by the frequency and the process requires only a few seconds.

Recent production of large aeroplane engines has necessitated some method of running and loading them for the run-in period. This now is done by connecting a large synchronous motor to the engine with a hydraulic coupling. The engine can thus be turned slowly at first until finally, after full speed operation, it is started. Then the motor is used as a generator to put power back into the line and supply the factory with power.

Some recent advances in welding practice were covered by Mr. Chute as the use of very heavy currents controlled by tubes to last only one cycle. Materials four inches thick may thus be welded by interrupted pulses of current. Welding of aluminum is also possible as the secret is only one cycle of current. In the past year and a half, the welding of copper and aluminum has become commercially possible using a short current period followed by heavy pressure. Some of these processes take 2,000 to 5,000 amperes for one cycle and therefore will flicker lights on the same circuit. In the last six months, the use of static condensers in series with load has been tried to reduce this effect.

A development in radio that will become very important is the use of a frequency modulated carrier wave instead of the present amplitude modulation. This has the advantage of being free of static and has perfect separation of stations on the same frequency. Midway between such stations is a dead spot about one-half mile wide where neither station is received. At each side of this point the nearer station only is heard without distortion or noise. This makes possible many local stations.

During the visit of Their Majesties to New York, the television broadcast was picked up at Schenectady, a distance of 124 miles. Reception at a distance greater than the line of a direct ray from the antenna was not before thought possible. This receiver still operates and there is now hope that a chain of television stations is possible.

At the conclusion, a vote of thanks was moved by Mr. H. J. A. Chambers.

CALGARY BRANCH

F. J. Heuperman, a.m.e.i.c. - *Secretary-Treasurer*

On December 14, 1939, Mr. John Collier, b.sc., addressed a meeting of the Calgary Branch on **A Non-Technical Outline of the Cracking Process.** Mr. Collier described various processes employed in the manufacture of gasoline. Members of the Calgary Chemical Club were guests of the branch on this occasion, which was attended by a total of some 70 members of the two organizations.

The Development of the Combustion Chamber of the Internal Combustion Engine was the subject chosen by Professor E. A. Hardy of the University of Saskatchewan when he addressed our branch on January 11, 1940. Mr. Hardy traced the change in design of the combustion chamber and described the resulting effects on flame spread and effectiveness of cooling. He told of flame pressure and temperature studies by means of observations made through quartz windows set in the wall of the chamber and by taking moving pictures of what actually took place inside the combustion chamber.

On February 1st, Dr. J. A. Allan, Professor of Geology at the University of Alberta, spoke on **Development of the Northwest Territories.** He pointed out that accessibility of a region is an important factor when considering future development in an area as extensive as the Northwest Territories. Although it is only nine years since pitchblende was first discovered on the shores of Great Bear lake and only five years since gold mining was started in the Yellowknife area, the value of the mineral production from that part of the northland adjacent to the province of Alberta amounts to approximately $18,000 per day. The mining development to date has proved that mining can be carried out profitably in the Northwest Territories even within the shadow of the Arctic Circle.

The speaker of the evening at our meeting held on February 15th was Mr. E. J. Chambers, K.C., who spoke on **Engineering Law.** As engineers have duties and liabilities to the public, the employer, the contractor and to members of the profession the subject was of considerable interest and importance. Mr. Chambers directed attention to the dangerpoints and pitfalls that should be watched by engineers. He pointed out that the engineer's responsibility does not end with the completion of construction but that he continues to be responsible for the subsequent maintenance. Particularly is this the case with utilities such as electricity, gas and water. The interest taken in the subject was clearly evidenced by the large attendance at this meeting, some 60 being present, by the close attention given to the speaker and by the great number of questions asked and answered at the conclusion of the address.

EDMONTON BRANCH

B. W. Pitfield, a.m.e.i.c. - *Secretary-Treasurer*
J. W. Porteous, Jr.e.i.c. - *Branch News Editor*

The regular meeting of the Edmonton Branch was held in the Macdonald Hotel on February 9th, following dinner. The speaker of the evening was F. A. Brownie of the Canadian Western Natural Gas, Light, Heat and Power Company of Calgary. The title of the paper was **Soil Corrosion and Cathodic Pipe Protection.**

The speaker first discussed briefly the theory of the primary cell and the direction of current flow, and then linked this up with the soil corrosion of buried pipes. Mr. Brownie described the method used in the past of protecting pipes by painting them with an insulating enamel, and finally the modern method of cathodic protection. In discussing cathodic protection the speaker first outlined the method of using an electric current introduced into the pipe from a generator, rectifier or other sources and the results obtained. He then described the method that was being used in the case of the gas line from the gas wells to Edmonton. Buried zinc rods were used as the anodes and a very large number were buried early in 1939, and tests taken shortly after they were installed proved that they were functioning properly.

A very lively discussion took place at the end of the paper, and the meeting adjourned at about 10.00 p.m.

HALIFAX BRANCH

L. C. Young, A.M.E.I.C. - *Secretary-Treasurer*
A. G. Mahon, A.M.E.I.C. - *Branch News Editor*

An address by Dean Vincent C. MacDonald, of the Dalhousie Law School, dealing with **The Legal Aspect of Transportation** in the Dominion, by water, land, and air, and the control exercised by federal and provincial governments on these methods of transportation, was the high light of the February meeting of the Halifax Branch held on the 29th at the Halifax Hotel. The meeting was exceptionally well attended with over fifty members and guests taking part. Keen interest was given to Dean MacDonald's address, which was followed by considerable discussion.

The chairman of the Halifax Branch, Mr. Charles Scrymgeour, asked Mr. R. L. Dunsmore, retiring vice-president of the Institute, to outline the activities of the Annual Meeting recently held in Toronto. Mr. Dunsmore discussed briefly the subjects of the various papers presented and gave the members of the Halifax Branch a resumé of the activities which took place.

During the evening presentations were made by Mr. I. P. MacNab to G. T. Tibbo, L. J. Archibald, M. F. Dean and I. M. MacLaughlin, senior students of the Nova Scotia Technical College for prize winning papers, dealing with various engineering subjects which were presented at a meeting of the Halifax Branch last fall. In addition to cash prizes, each student was presented with a student membership in the Institute.

KINGSTON BRANCH

J. B. Batty, A.M.E.I.C. - *Secretary-Treasurer*

A regular dinner meeting of the Branch was held at the Students' Memorial Union, Queen's University, on Wednesday evening, February 21st. Vice-chairman P. Roy was in the chair. There was a good attendance of members and an unusual number of student members were present.

The Branch on this occasion had the pleasure of entertaining the General Secretary, L. Austin Wright. This is the first occasion on which the Branch has had the privilege of entertaining the Secretary alone. After dinner there was a short business meeting. The vice-chairman welcomed Mr. John Walter who has recently transferred from Windsor, and Mr. H. A. Wilson of Belleville who is a member of the Toronto Branch. Professor Wilgar introduced Mr. Wright.

Mr. Wright addressed the members on general Institute affairs. He first outlined the present situation in regard to the registration which had been carried out by the Institute and other professional societies in the country. The meeting was assured that the information was now in such shape that it could be used to good advantage by the Government when any special technical services were required for the prosecution of the war.

The students present were especially interested to learn that there was now no unemployment amongst engineers. In general Mr. Wright presented a very cheering picture of Institute affairs, both in regard to the total membership and the trend toward unification and consolidation in the organization of professional engineers.

After a reference to the broadcasting programme which the Institute had undertaken the Secretary gave a report upon some of the high lights of the Annual Meeting in Toronto.

Professor A. Jackson moved a vote of thanks to Mr. Wright both for his visit to the Branch and for his entertaining and instructive talk on Institute affairs. After the general meeting, Mr. Wright met the Executive for a general discussion of the problem of interesting students in the Institute. This is a major problem of the Branch since most of the members are on the staff of the Royal Military College or Queen's University.

LAKEHEAD BRANCH

H. Os, A.M.E.I.C. - *Secretary-Treasurer*

The regular monthly dinner meeting was held at the Royal Edward Hotel, Fort William, January 17th, 1940. The chairman, J. M. Fleming, presided.

C. T. Anderson, engineer at the Thunder Bay Paper Mill, was the speaker of the evening. His subject was **The Use of Echo Sounding Devices in Charting Water Depths in Survey of Lake Nipigon.** He stated that for many years there had been a need for developing means of taking soundings of water depths otherwise than with lead and line. The echo soundings not only give a continuous profile of the bottom but show hard rock bottom depth and indicate successive layers of overburden. The basic principle of the device is the transmission from a sending oscillator of a high-frequency sound which travels to the bottom and is reflected back and registered by a receiving oscillator. For this survey the cruiser *Ogima* was fitted with the Husun Echo Sounder, a practical application of a sound detector used by the British Admiralty during the last war. Mr. Anderson illustrated his talk by drawing sketches and also showed charts of results from the survey.

A discussion followed with Messrs. Small, Korcheski, Davies, and others, taking part. A hearty vote of thanks was moved by E. J. Davies and seconded by W. Bird, Jr. Twenty-four members and guests were present.

LETHBRIDGE BRANCH

E. A. Lawrence, S.E.I.C. - *Secretary-Treasurer*

The Lethbridge Branch held a dinner meeting at the Marquis Hotel on the evening of February 17th, at which the guest speaker was H. J. McLean, of Calgary, production engineer for the Calgary Power Company, who gave an address on **The Best Places in the West.**

Mr. McLean pointed out that generally speaking the best places to live are determined by abundant food supplies and favourable weather conditions. This has been proved throughout past ages when by trial and error, man has found which were the most suitable areas for settlement and the population of these areas has increased in density as compared to other less favoured regions.

While the trial and error method of finding the best places to live is reliable, it is very wasteful of human effort. The application of scientific data may furnish a short cut to a sound conclusion as to which areas are best suited for settlement, and Mr. McLean outlined a study he had made along these lines covering western Canada. He pointed out that the early explorers such as Palliser, Hind and Macoun made conflicting reports as to the Canadian plains and he concluded that they had judged the plains according to the season in which they visited them, not being aware of the wide range of conditions prevailing in wet and dry cycles. The most favourable areas consist of a strip running north-west through southern Manitoba and eastern Saskatchewan. and a series of areas running north through the middle of Alberta. Within these there are a series of progressively less favourable areas which culminate in the dry belt of south-eastern Alberta and south-western Saskatchewan. The wooded lands of the north with their short season and poor soil furnish another extreme. Mr. McLean said that the conclusions of his study did not take into consideration special developments such as coal mines, oil fields and economic irrigation projects which would considerably alter the different zones he had indicated. He hoped that engineering investigations of this nature would enable us to plot a fairly definite course for the future and avoid some of the yawning economic pitfalls along the path.

During the meeting, motions of congratulations were passed complimenting P. M. Sauder on his appointment as director of Water Resources at Edmonton, and C. S. Clendenning on his appointment as manager of the Lethbridge Northern Irrigation District. A musical programme of orchestral selections by the George Brown Instrumental Trio and solos by Geo. Brown, Jr., preceded the evening's address.

MONTREAL BRANCH

L. A. Duchastel, a.m.e.i.c. - *Secretary-Treasurer*

On February 29th, 1940, Mr. C. C. Bailey, of the Transportation Department of the General Electric Company, Schenectady, N.Y., gave a paper on **Electricity in Railroad Maintenance** and illustrated his talk with many slides. The paper dealt with the modern method of determining and graphically recording stress in tracks, bridges and traction equipment. A courtesy dinner was offered Mr. Bailey prior to the meeting.

On March 7th, the Branch was fortunate in having Dean C. J. Mackenzie address the members on **Some Phases of the Work of the National Research Council.** Dean Mackenzie was appointed Acting President of the Council to replace Major-General McNaughton during his absence overseas. The meeting was preceded by a courtesy dinner at the Windsor Hotel.

Regulating the Load Distribution on Interconnected Power Systems was the subject of an address by Mr. S. B. Morehouse, field engineer, Leeds & Northrup Company. The paper covered the complete range of utility control problems, and was preceded by a courtesy dinner.

Junior Section

On March 4th, the Junior Section heard an address by Prof. J. A. Coote, Assistant Professor of Mechanical Engineering, McGill University, on **Education Continued.**

The engineering features, description of the plant, and results of municipalization, were the points developed by Mr. Jean Bouchard in a talk given on March 18th on **Public Ownership of Electricity in St. Hyacinthe, Que.**

NIAGARA PENINSULA BRANCH

Geo. E. Griffiths, a.m.e.i.c. - *Secretary-Treasurer*
J. G. Welsh, a.m.e.i.c. - - *Branch News Editor*

On Friday evening, March 8th, the members of the Niagara Peninsula Branch, their friends and ladies met at the Welland House, St. Catharines, Ont. Chairman A. W. F. McQueen presided and introduced the speaker of the evening, Mr. John Patterson, M.A., F.R.S.C., Controller of the Meteorological Division of the Air Services Branch, Department of Transport, who gave an illustrated talk on **Weather Forecasting.**

Mr. Patterson traced the development of the Dominion Meteorological Service from its infancy, just 100 years ago, to its high degree of efficiency and achievement of to-day. This service was first inaugurated primarily for the protection of shipping, but to-day is also of vast importance to the farmer, fisherman, and especially to aircraft travel, particularly now in time of war.

At first, ground conditions alone were considered, but soon the importance of conditions in the upper atmosphere was realized, and kites were used to raise barometers and thermometers. These sometimes reached 20,000 ft., 10,000 ft. being common. These gave way to balloons to which were attached instruments weighing less than half a pound, and registering temperature and pressure from constants determined before the ascent. Metal bars, one very low and one of high known thermal expansion, gave a continuous record of the temperature, and an expanding diaphragm gave a continuous record of the pressure as the balloon ascended. The temperature and pressure were recorded by means of fine needles writing on a small silver disc. However, results were obtained only by finding the instruments after they had fallen, and, consequently, were not available for some considerable time after the ascent.

Instruments of the same basic principles are elevated by balloons. They contain small batteries and a constant synchronous motor, the speed per revolution being maintained constant by a vibrating tuning fork. This motor revolves a copper alloy spiral connected to an infinitesimal radio transmitter, the period of revolution of the spiral being determined by two brief signals, one a short time after the other. From this the pressure, temperature, and humidity can be obtained by taking the time of the contact of each element from the reference signal. These times vary with each of the elements.

The multitude of questions after the meeting attested to the keen interest Mr. Patterson's talk had aroused.

Through the courtesy of the Canada Wire and Cable Company, a film was shown depicting the Graf Spee incident at Montevideo.

A light buffet supper brought the evening to a conclusion.

OTTAWA BRANCH

R. K. Odell, a.m.e.i.c. - *Secretary-Treasurer*

A very successful joint evening meeting was held on February 20th at the National Museum with the Ottawa Branch of the Canadian Institute of Mining and Metallurgy. The subject for the evening was **Petroleum, the Keystone of Empire Defence.** Dr. J. W. Broughton of the National Research Laboratories gave an illustrated account of present day methods for making aviation gasoline. Dr. George S. Hume of the Geological Survey of Canada also addressed the meeting on the oil needs of the various countries of the world, with particular reference to Germany and the Balkan States. In addition, two sound films were shown of the principal producing areas and methods of exploration for oil and transportation to market.

Dr. Broughton stressed the importance of the octane rating in connection with modern aeroplane engines and outlined some of the processes whereby fuel of high rating is obtained. Rapid developments have taken place of recent years, he explained, and the manufacture of aviation gasoline has become highly specialized.

Dr. Hume, quoting from various authorities, declared that Germany's war-time oil requirements are estimated to be from 75 to 90 million barrels a year. To meet these requirements 4,500,000 barrels are available from wells in Germany, 3,500,000 barrels from Poland and from 10 to 11 million barrels from the distillation of coal. The remainder would have to be obtained from points outside the country but even with amounts available from Russia and Rumania there still appears to be a big deficiency.

On the other hand, although the British Empire is not provided with a large share of the world's oil resources she has access to sufficient quantities through her command of the sea.

Joint chairmen were Mr. W. H. Munro for The Engineering Institute and Dr. Hume for The Canadian Institute of Mining and Metallurgy.

At the close of the meeting, light refreshments were served.

At a noon luncheon, March 7th, Brigadier E. J. C. Schmidlin, M.C., Director of Engineer Services of the Department of National Defence, Ottawa, spoke on **The Engineer in a Modern Theatre of War.** W. H. Munro, Branch chairman, presided and head table guests also included: Major-General T. V. Anderson, D.S.O., Chief of the General Staff; Major-General H. F. H. Hertzberg, C.M.G., Quarter Master General; Colonel H. DesRosiers, Acting Deputy Minister of Militia; Lieutenant-Colonel E. C. G. Chambers, Assistant Director of Engineer Services, all of the Department of National Defence; Major W. G. Swan, of the War Supply Board, and Denis Stairs of Montreal.

This paper was published in the January, 1940, issue of the Journal.

PETERBOROUGH BRANCH

A. L. Malby - - *Secretary-Treasurer*
D. R. McGregor - *Branch News Editor*

A regular meeting of the Peterborough Branch was held on February 22nd, with the branch chairman, Mr. B. I. Burgess, presiding.

Mr. R. A. Crysler, structural engineer with the Canada Cement Co., addressed the meeting on **Recent Developments in Concrete.** Mr. Crysler was introduced by Mr. E. W. Bailey, a member of Peterborough Branch, who is also with the Canada Cement Company.

Mr. Crysler opened his talk with a brief historical sketch of the development of cement. One of the earliest types known was Roman cement which consisted of volcanic ash, sand and stone. Many people believe that this was a superior type of material, whose secret was lost; actually, it could be made to-day, but it would be inferior to our present day Portland cement.

The ingredients of Portland cement are essentially lime and clay, clinkered and ground. These have changed little in the last hundred years, but the technique of manufacture has improved considerably.

Cement is now widely used for highway construction, modern concrete highways are designed for long economical service, and require very little maintenance. The newest development in cheaper highway construction for light traffic is the soil cement road. This is a process used on gravel or dirt roads; the old bed is simply plowed up, cement is mixed in with a certain amount of water, and the whole cut and rolled.

Cement is now widely used for the construction of bridges, and the rigid frame principle which has made concrete bridges successful is now being extended to buildings, due in part to simpler methods of calculation.

Mr. Crysler demonstrated by means of slides that monolithic concrete buildings could be beautiful as well as economical. The use of weakened plane joints largely eliminates unsightly cracking which has been a nightmare in the past. Small structures may readily be built from concrete blocks, with concrete joints and floor slabs.

Mr. Killaly moved a vote of thanks to the speaker which was heartily endorsed by the meeting.

Junior Section

The Junior section of the branch was in charge of the regular Senior meeting held on March 7th. This meeting took the form of an "Information Please" programme, with the Junior and Student members doing the questioning, and with a group of "experts," made up of junior and senior members, doing the answering.

The range of questions went all the way from highly theoretical points, such as a discussion of the Amplidyne, to a wide open discussion of the relative merits of and relations between the Engineering Institute and the Association of Professional Engineers of Ontario.

At the conclusion of the meeting, refreshments were served under the supervision of the Social Committee, and the meeting broke up into several unofficial discussion groups.

QUEBEC BRANCH

Paul Vincent, a.m.e.i.c. - *Secrétaire-Trésorier*

Le 15 janvier, nous avions un déjeuner-causerie au Château Frontenac, sous la présidence de Monsieur Philippe Méthé, directeur de l'Ecole Technique de Québec et président de notre section. M. Aurèle Séguin, gérant du poste CBV. de Radio-Canada, à Québec, nous donnait une causerie des plus intéressantes.

Admirable conférencier, M. Séguin fut présenté par Monsieur Philippe Méthé et il sut très bien intéresser son auditoire. Il nous fit l'**Esquisse d'une Orientation de la Radiodiffusion.**

La radio, nous dit-il, s'impose un triple rôle: informer, instruire et distraire. Depuis l'avénement de la T.S.F. il n'y a plus d'isolement. L'univers vient à nous entre les quatre murs de notre chambre; nous sommes ainsi au courant de tous les genres de vie et de toutes les célébrités. La radio établit le contact entre les pensées de tous les pays, elle aide au développement des facultés physiques, intellectuelles et morales.

D'une façon lapidaire, la radio nous informe promptement et brièvement sur les questions religieuses, politiques, sportives et autres, que la presse discutera dans ses détails. Loin de se faire concurrence, ces deux organismes sont faits pour se compléter. Comme preuve, le tirage des grands journaux s'est accru considérablement malgré les services radiophoniques.

Si la radio renseigne, elle enseigne aussi bien. Après l'information, Monsieur Séguin nous dépeint l'utilité de la T.S.F. pour l'éducation du peuple qui est le premier but de son organisation.

La radio sert aussi à la distraction de tous par sa musique sérieuse et légère, ses émissions amusantes et comiques tant pour les adultes que pour les enfants.

Pour arriver à ce triple but, la société Radio-Canada a besoin d'un organisme approprié. Cette société fut fondée en 1933 pour unir les sentiments de tous les Canadiens. Comme médium destiné à faire connaître notre valeur dans tous les domaines tant à l'étranger qu'au Canada, Radio-Canada a besoin d'environ $5,000,000 par an pour établir un bon service.

Le conseil d'administration de la société est composé de neuf gouverneurs. La gérance de Radio-Canada a été confiée à M. Gladstone Murray qui est assisté de M. Augustin Frigon. Le travail est reparti entre les services de l'administration, des programmes et de la technique.

M. Séguin nous fit ensuite une énumération de statistiques intéressantes. En 1933, il y avait 523,000 appareils-récepteurs au Canada et présentement nous en avons 1,104,000, soit plus que le double en sept ans.

Monsieur Adrien Pouliot, gouverneur de Radio-Canada et doyen de la Faculté des Sciences de l'Université Laval de Québec remercia le conférencier.

Le lundi 12 février, la section donnait, au Palais Montcalm à Québec, une intéressante série de films documentaires. Comme innovation à Québec, les ingénieurs au nombre d'environ soixante eurent l'occasion d'échanger leurs idées tout en prenant des rafraîchissements après la séance. Les membres et leurs amis formaient une assistance totale d'environ 125.

Tous ont vu avec beaucoup d'intérêt des films sur la construction du *Duchess of Atholl*, sur la locomotive à vapeur et enfin sur la fabrication des fils conducteurs d'électricité.

Monsieur L. C. Dupuis, vice-président de la Section de Québec et ingénieur de district aux C.N.R. fut appelé à commenter l'électrification du chemin de fer. Il nous cita plusieurs chiffres intéressants sur les coûts d'entretien et de fonctionnement des locomotives en général.

En l'absence de notre président, M. Méthé, le secrétaire présidait à l'assemblée. Dans une courte allocution, au début de la réunion, le secrétaire Paul Vincent exposait comment toute la civilisation moderne constitue un monument érigé à la gloire de l'ingénieur professionnel qui y a joué un rôle prépondérant. M. Vincent terminait en faisant appel à la coopération de tous et de chacun pour combattre cette insouciance, dont plusieurs souffrent dans la profession, et prouver la valeur de l'ingénieur professionnel aux yeux du public.

SAINT JOHN BRANCH

F. L. Black, Jr.E.I.C. - *Secretary-Treasurer*

The monthly meeting of the Saint John Branch was held as a luncheon at the Admiral Beatty Hotel on February 15th, 1940. After the luncheon H. F. Morrisey, chairman of the branch, introduced the speaker of the evening, H. G. Cochrane. Mr. Cochrane, who is a member of the Montreal Branch, is temporarily employed in Saint John by the Department of Public Works of the City.

The speaker's subject was **The Oil Industry in Western Canada,** with which he was in intimate contact a short time ago during investigations to determine the feasibility of pipe lines from Turner Valley to tide water. He first described the extent of oil found in Alberta and the possibilities of further supplies located as far north as the Arctic Ocean.

These descriptions and proposed pipe lines were strikingly illustrated on a large map which the speaker had provided. The outlook for the oil industry in the west seems bright to Mr. Cochrane. The present war would indicate an increased market for this product.

At the conclusion of the address, a large number of questions were asked the speaker, which indicated the interest of the members.

SASKATCHEWAN BRANCH

J. J. White, m.e.i.c. - *Secretary-Treasurer*

Mr. P. C. Perry was elected president of the Association of Professional Engineers of the Province of Saskatchewan, at the Annual Meeting held in the Hotel Saskatchewan, Regina, on February 16, 1940. Elected vice-president is R. A. McLellan, of Saskatoon, and councillors for two years are G. L. Mackenzie, Regina, C. J. McGavin, Regina, and A. A. Murphy, Saskatoon.

Still serving for a year as councillors are: J. McD. Patton, Regina; R. J. Fyfe, Regina, and A. M. Macgillivray, Saskatoon.

The Nominating Committee for the year will be E. K. Phillips, Saskatoon, D. A. R. McCannel, Regina and S. R. Muirhead, Regina.

E. C. Leslie, K.C., of Regina, addressed the members at a banquet following the business meeting.

SAULT STE. MARIE BRANCH

O. A. Evans, - *Secretary-Treasurer*

The second general meeting for the year 1940 was held in the Grill room of the Windsor Hotel at 6.45 p.m. on Friday, February 23rd. Eighteen members and guests sat down to luncheon at 6.45 p.m., after which the business portion of the meeting began. E. M. MacQuarrie, vice-chairman, in the absence of H. J. Leitch, occupied the chair.

The vice-chairman then introduced the speaker of the evening, A. G. Clarkson, who had chosen for his subject, **The Technique of Fruit Growing.**

A tree stays in the nursery for two years, sometimes three, before it is planted in the orchard. Three-year-old trees do not give as satisfactory results as two-year-olds when transplanted to the orchard. Orchards were set with the rows 40 ft. apart by 30 ft. Some types of apples such as Spies do not produce a pay load until ten years after setting out in the orchard. Consequently, filler trees are planted between the 40 ft. spaces with trees that bear in three to four years. Such types of apples as Duchess and Wealthies were used for this purpose or cherries, plums or peaches may be used. When the standard apple reaches maturity the filler trees are removed. Some types of apples, such as Spies, become weak in pollenizing as they age, so another type must be planted such as MacIntosh Red or Delicious, say one to twenty of the other type.

Mr. Clarkson stressed that the ground must be worked so as to save moisture. With a hard soil the moisture ran off which was needed for growth. This was accomplished by three methods: (1) dust cultivation in which the earth under the trees is kept worked by disc harrows, etc.; (2) by leaving the sod undisturbed, but this method had a disadvantage in that it was a good place to harbour insects and fungi; (3) by applying a mulch mixture such as old hay and straw and cutting down the growth that springs up two or three times a year. This method has a twofold result. It retains the moisture and the mulch decaying adds fertilizer to the soil. It was found that the colour of the apples grown by the first method (dust) was not as bright as that grown on sod.

Mr. Clarkson then dealt with the transportation of fruit. He stated that fruits, such as peaches, are alive with bacteria when picked and must be chilled if moved for long distances. The old method was by placing ice in the cars and shipping. A new method is by cooling the cars down to 35 deg. and then shipping. He mentioned that one pound of peaches gives off 11 B.T.U.'s per day as the heat of respiration. Apples must also be kept in cold storage if kept longer than December. The temperature is kept at 32.5 deg. F. Apples, however, do not keep longer than two weeks when removed from storage.

The speaker concluded his address by showing the members the difference between the various types of apples. He passed samples for study by sight and taste.

A. H. Meldrum moved a vote of thanks to the speaker which was given hearty approval by the members.

The third general meeting for the year 1940 was held in the Windsor Hotel on Friday, March 15th. Nineteen members and guests sat down to dinner at 6.45 p.m. The business portion of the meeting began at 8.00 p.m. E. M. MacQuarrie acted as chairman in the absence of H. J. Leitch. The minutes of the previous meeting were read and adopted on motion of A. M. Wilson.

The chairman then called upon Mr. Perkins, manager of the Sault Branch of the Bell Telephone Company, to introduce the speaker of the evening, Mr. G. L. Long, historian for the Bell Telephone Company of Canada, who had for his topic **The History of the Development of the Telephone.**

With the aid of various pieces of equipment, ranging from the very old to the most modern, the various stages in the development of telephony were traced by Mr. Long.

In 1887, the year Sault Ste. Marie was incorporated as a town, the board of directors of The Bell Telephone Company of Canada authorized the construction of a telephone exchange here but no progress seems to have been made until a decade later, Mr. Long said. The first exchange was established in 1898, to serve 10 subscribers, the office and switchboard being located in a small partitioned section of George A. Hunter's drug store at the corner of Pim and Queen streets. Mr. Hunter became the company's first manager.

Discussing long distance telephone facilities, Mr. Long stated that the first long distance line in this vicinity was constructed in 1903 from Sault Ste. Marie to Thessalon. Two years later this line was extended to Blind River and in 1907 Sault Ste. Marie, Ont., was connected with Sault Ste. Marie, Mich. In 1911, this city came within talking distance of North Bay and Toronto.

On an average day residents of Sault Ste. Marie make about 29,000 local calls and about 150 long distance calls, he pointed out.

ST. MAURICE VALLEY BRANCH

V. Jepsen, a.m.e.i.c. - *Secretary-Treasurer*

On Friday, February 16, 1940, a meeting of the branch was held at the Cascade Inn, Shawinigan Falls, at eight o'clock.

Forty members and friends were present to hear a paper on the subject **Chromium in Steel.**

Our Branch Chairman, Mr. F. W. Bradshaw, presided and introduced the guest speaker, Mr. C. K. Lockwood of the Stainless Steel and Alloys Division of the Shawinigan Chemicals Limited, Montreal.

The speaker began by giving the history of the development of adding chromium to steel and mentioned that as early as 1869 crusher parts and grinding balls were made from a low chromium steel by a firm in Brooklyn but that it was not until 1905 that any properly conducted experimental work began.

The paper was illustrated with lantern slides which consisted mostly of phase diagrams of the various alloys under consideration. Special attention was given to the classes of alloys containing 6, 12 and 18 per cent chromium.

Continued research to produce better alloy steels brought a large number of modified alloys on the market. The most important of these are the ones containing nickel as the chief additional element. These alloys were found to be superior in their resistance to high temperatures, oxidation and acid corrosion. This has led to the widespread use of the 18/8 variety of stainless steel. It appears that 18 per cent Cr and 8 per cent Ni are about the minimum amount which can be added to steel to give a desirable result. The carbon content should be kept as low as commercially possible. Recently a chromium steel containing 7 per cent aluminum was developed which is very resistant to corrosion.

The speaker also went into the question of heat-treatment of these metals and accounted for some of the changes taking place during such a process.

An element which is very beneficial to the corrosive properties of stainless steel, because of its stabilizing property, is molybdenum. An alloy containing 18 per cent Cr, 8 per cent Ni and 3 per cent Mo has been in use in the sulphite industry of Canadian paper mills for over ten years without any apparent deterioration.

The latest development in the sphere of stainless steels is the recently patented "silver stainless" and is the result of research by Kaye, Williams & Wulff at the Massachusetts Institute of Technology.

After a lively discussion in which many of the audience took part, the speaker was thanked by Mr. Robert Dorion, city manager of Shawinigan Falls. Following this the meeting was adjourned.

The Annual Meeting of the St. Maurice Valley Branch was held in Grand'Mère on March 5, 1940, under the chairmanship of Mr. F. W. Bradshaw. The attendance was twenty-two.

The members assembled at the Laurentide Club where refreshments were served and then moved over to the Laurentide Inn for dinner and the annual meeting.

The chairman called the meeting to order at 8.30 p.m., and expressed the sympathy of the members at the untimely loss of one of its most distinguished Honorary Members, the late Lord Tweedsmuir, Governor-General of Canada. His passing was a tragic loss to the Institute and to the country as a whole at this critical time.

The chairman outlined the policy that had been followed throughout the year regarding the presentation of technical papers at branch meetings, and mentioned the difficulties which had been encountered in this respect. He suggested that in future steps be taken to arrange a definite programme at the start of the season by which outside speakers would be committed ahead of time to deliver papers on specific dates. He mentioned that this is the procedure followed by the larger branches, and asked the members to consider the feasibility of adopting such a policy in the valley.

Mr. Bradshaw thanked the members for their unfailing support during the past year and then introduced Mr. C. H. Champion, chairman-elect.

Mr. Champion thanked the members for electing him to this office and introduced the other members of his committee for 1940. He mentioned that he hoped several of the members of this branch would prepare papers for branch meetings during the coming year. He congratulated the retiring officers for the work they had done while in office, and made particular reference to the untiring efforts of the secretary-treasurer.

Following this, Mr. Bradshaw introduced the guest speaker, Mr. L. Austin Wright, General Secretary of the Institute.

Mr. Wright expressed pleasure at being in Grand'Mère again and commented favourably on the way that the St. Maurice Valley Branch had been managed during the past year; he thanked the outgoing committee for their co-operation in the affairs of the Institute.

Mr. Wright then spoke on the various activities of the Institute and referred to the active co-operation between it and the various Government departments at Ottawa since the outbreak of war.

On the consolidation question, Mr. Wright mentioned that an agreement had been signed with two provincial associations, namely, Saskatchewan and Nova Scotia, and others were well advanced. He referred to the cordial relations that presently exist between the Institute and the Corporation of Professional Engineers of Quebec.

A vote of thanks was unanimously extended to the speaker by Dr. A. H. Heatly, incoming vice-chairman.

The chairman called upon the retiring vice-president of the Institute, Professor H. O. Keay, for a few remarks, following which the meeting adjourned at 10.00 p.m. on a motion by Mr. Timmis, seconded by Mr. Dorion.

TORONTO BRANCH

J. J. Spence, A.M.E.I.C. - *Secretary-Treasurer*
D. D. Whitson, A.M.E.I.C. - *Branch News Editor*

On February 1st, Lt.-Col. Weeks, M.C., M.M., Officer Commanding First Corps Signals, C.A.S.F., addressed the Branch on Intercommunication in the Army. Col. Weeks has had a long and distinguished military career. He has served in many parts of Canada and is one of the most able officers in Canada to speak on army communications. Proposed changes in the by-laws were discussed at this meeting.

VANCOUVER BRANCH

T. V. Berry, A.M.E.I.C. - *Secretary-Treasurer*
A. Peebles, A.M.E.I.C. - *Branch News Editor*

At a meeting on March 11, Squadron Leader L. E. Wray of the R.C.A.F. Station, Vancouver, addressed the branch on **The Organization of the Royal Canadian Air Force.**

Squadron Leader Wray traced the history of organized aviation from the first balloon school opened in England in 1879 to the formation of the Royal Flying Corps in 1912, and thence to the beginning of the vast present day programme to meet war needs. Into this programme is incorporated the Royal Canadian Air Force under the Empire Air Training Plan, by which Great Britain, Canada, Australia and New Zealand are co-operating in the training of air force personnel. Fortunately for us, the scheme is being projected in Canada, even though this results in a larger share of the cost being borne by this country. The residue which will remain here after the war in the form of hangars, landing fields, aircraft and trained men, will be a great asset to Canadian aviation.

The R.C.A.F. has three phases of work: home defence, training, and the overseas division. These in turn have three principal technical subdivisions: personnel, equipment and engineering. For purposes of administration and geographical distribution of activities there are three air commands, the western, central and eastern. The central command is essentially a training command, while the others are engaged chiefly in coastal defence and patrol.

When an applicant presents himself for admission to the R.C.A.F., he must possess an acceptable personal record, and also pass a very rigid and thorough medical examination. If accepted, he is sent to a preliminary training station where his adaptability is tested further. During this period the selection of pilots and other above ground men is made, so that further training may be more specialized. Those not placed in this category will be trained as ground technicians for various specialties.

The types of aircraft used depend upon their primary function in the field as patrol craft, bombers or fighter planes. Plane speeds have been increasing rather rapidly in the past, and are expected to increase further in the future. This has been achieved partly through greater horsepower, and partly through improvements in streamlining and structural design.

Following his address, the speaker answered numerous questions which revealed the keen interest of those present. Thirty-one members and guests heard the address, made possible by the kind permission of Wing Commander E. L. McLeod, Officer Commanding, R.C.A.F. Station, Vancouver. Mr. C. E. Webb, branch chairman, presided, and a hearty vote of thanks was tendered by Mr. G. P. Stirrett.

Library Notes

Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS, ETC.

Cole's Permanent Way:

By Colonel Sir Gordon Hearn. London, E. & F. N. Spon, Limited, 1940. 196 pp., illus., 7 x 4½ in., buckram.

Cracking Art in 1938:

Ed. by Gustav Egloff. Chicago, Universal Oil Products Company, n.d. 458 pp., 9 x 6 in., paper.

Dyadic Circuit Analysis:

By A. Pen-Tung Sah. Scranton, International Textbook Company, c1939. 415 pp., illus., 8 x 5 in., buckram, $4.50.

Electric Transportation:

By Francis R. Thompson. Scranton, International Textbook Company, 1940. 427 pp., illus., 9 x 5¾ in., buckram, $4.00.

Records and Research in Engineering and Industrial Science:

By J. Edwin Holmstrom. London, Chapman & Hall Ltd., 1940. 301 pp., tab., 8½ x 5½ in., buckram, $3.75.

Story of The Mersey Tunnel:

Published by Charles Birchal & Sons, Ltd., Liverpool. 110 pp., 11½ x 10 in., paper.

Whitaker's Almanack 1940:

London, 12 Warwick Lane, 1940. 1,172 pp., 7 x 4½ in., buckram.

Public Utilities Fortnightly:

Periodical. Back copies for 1938 and 1939.

NEW AND REVISED SPECIFICATIONS

American Engineering and Industrial Standards:

Specifications. For Heavy-Walled Enameled Round Copper Magnet Wire; for Weather-Resistant Saturants and Finished for Aerial Rubber-Insulated Wire and Cable.

American Society for Testing Materials:

Tentative Standards, 1939. Part 2—Non-metallic Materials—Constructional; Part 3—Non-metallic Materials—General.

British Standards Institution:

Specifications. For Seamless Brass Tubes for General Purposes. No. 885—Hard Drawn Seamless Brass Tubes; No. 886—Annealed Seamless Brass Tubes. January, 1940.

Canadian Engineering Standards Association:

Secretary's Report, No. 45 (for the Fiscal Year April 1, 1938, to March 31, 1939); C22.2 No. 59, 1939. Canadian Electrical Code, part 2, Essential Requirements and Minimum Standards Covering Electrical Equipment. Construction and Test of Fuses (both Plug and Cartridge-enclosed types).

Canadian Government Purchasing Standards Committee:

Specification for Liquid Toilet Soap; for General Purpose Bar Soap, Rosin-free; Chip Soap and Powdered Soap, for Laundry Purposes (high titre); Soft Soap; Milled Toilet Soap; White Floating Soap; Liquid Household Soap; Bar Toilet Soap; Soap for use in Sea Water; Chip Soap and Powdered Soap, for Laundry Purposes (low titre); Bar Toilet Soap, Castile Type; Caustic Soda (Lye); Disinfectant, Coal-Tar Type; Soda Ash; Trisodium Phosphate, Technical; Sulphuric Acid, Battery Electrolyte Grade; Worsted Serge for Uniforms, Medium weight; Worsted Serge for Uniforms, Heavy weight; Coal.

U.S. Department of Commerce, National Bureau of Standards:

Building Materials and Structures BMS 25; Structural Properties of Conventional Wood-Frame Constructions for Walls Partitions, Floors, and Roofs BMS 26; Structural Properties of "Nelson Pre-Cast Concrete Foundations" Wall Construction Sponsored by the Nelson Cement Stone Company Inc. BMS 27; Structural Properties of "Bender Steel Home" Wall Construction Sponsored by the Bender Body Company BMS 29; Survey of Roofing Materials in the Northeastern States BMS 31; Structural Properties of "Insulite" Wall and "Insulite" Partition Constructions Sponsored by the Insulite Co. BMS 32; Structural Properties of the Two Brick-Concrete-Block Wall Construction Sponsored by the National Concrete Masonry Association BMS 34; Performance Test of Floor Coverings for Use in Low-Cost Housing, pdrt 1, BMS 35; Stability of Sheathing Papers as determined by Accelerated Aging BMS 36; Structural Properties of Wood-Frame Wall, Partition, Floor, and Roof Constructions with "Red Stripe" Lath Sponsored by the Weston Paper and Manufacturing Co. BMS 36; Effect of Heating and Cooling on the Permeability of Masonry Walls BMS 41.

TRANSACTIONS, PROCEEDINGS, ETC.

American Institute of Electrical Engineers:

Transactions, Vol. 58, 1939.

New Zealand Institution of Engineers:

Year Book and List of Members as on 31st December, 1939.

Royal Society of Canada:

Transactions, Section 3, Vol. 33, May, 1939; Section 2, Vol. 33, May, 1939.

South Wales Institute of Engineers:

Proceedings, Vol. 55, No. 4, Jan. 11th, 1940.

REPORTS, ETC.

American Institute of Steel Construction:

Recommended Fundamental Principles, Tentative Minimum Requirements and Tentative Standard Welded Connections for Tier Buildings.

American Public Works Association:

Refuse Materials, Classification of Refuse Materials, Definitions, Characteristics, Quantities Produced. All in relation to the problem of Refuse Collection. Bulletin No. 8.

Bell Telephone System:

On Difraction and Radiation of Electromagnetic Waves; A General Radiation Formula; Internal Electrolysis as a Method of Analysis; A 50-Kilowatt Broadcast Station; Deviations of Short Radio Waves from the London New York Great-Circle Path; Cation Exchange in Cellulosic Materials; An Electrochemical Study of the Corrosion of Painted Iron; Sol and Gel in Hevea Latex and Crude Rubber; The Toronto-Barrie Toll Cable; Experience in Applying Carrier Telephone Systems to Toll Cables; Computation of Composite Noise Resulting from Random Variable Sources; Load Rating Theory for Multi-Channel Amplifiers; The Quantum Physics of Solids—1; Dial Clutch of the Soring Type; Synthesis of Reactance 4 Poles; Theory of Secondary Emission; Metallic Bridges between Separated Contacts; Limiting Current Densitities in Electron Beams.

Canada Department of Mines and Resources:

Summary of Tests made on Three Domestic-Type Wood-Burning Hot Water Boilers by C. E. Baltzer and E. S. Mallock. Memorandum Series, No. 73, December, 1939.

Canada Department of Mines and Resources, Mines and Geology Branch:

Metallurgical Works in Canada, part 2, Non-Ferrous and Precious Metals. December, 1939.

Canada Department of Mines and Resources, Mines and Geology Branch:

Gypsum Mines in Canada. December, 1939.

Canada Department of Mines and Resources:

Rapport de la Section des Explosifs du Service des Mines pour l'Année Civile, 1938.

Defence of Canada Regulations:

Ottawa, King's Printer, 1939.

Edison Electric Institute:

First Report E.E.I.-NEMA Joint Committee on Standards for Distribution Transformers. E.E.I. Publication No. G6; NEMA Publication No. 106. February, 1940.

Electrochemical Society:

Single Metal Deposition of Copper, Cadmium, Zinc and Nickel from Thiosulfate Solutions; On Paste Compositions for Isolated Lighting Plant Lead Storage Batteries; Triple Ions and Transference Numbers; Study of the Electrolysis of the Sodium Cuprocyanide Solution; Porous Carbon Electrodes; Cold Welding of Silver; Improvement in Quality of Metal Deposits due to Rotations of Cathode Applies likewise to Metal Deposits by "Displacement"; The Structure of Heavy Electrodeposits of Copper and Nickel; Photoelectric Cells Sensitive to Long Wave Length Radiation; Oxidation-Reduction Potentials and their applications of Electromotive force measurements to Binary Metal Systems. Preprints Nos. 77-1 to 77-5, 77-7 to 77-8, 77-12, 77-13 to 77-15, 77-17.

Massachusetts Institute of Technology:

Structural Analysis Laboratory Research, 1938-39. By John B. Wilbur, Serial No. 68, December, 1939. Publication from the Department of Civil and Sanitary Engineering.

National Housing Conference, 1939:

Legislation for Low-Rent Housing in Canada, 1939.

Purdue University:

Making Strontium Nitrate and Strontium Chloride from Strontium Sulfate Using Organic Solvents by R. Norris Shreve, C. H. Watkins; A Survey of the Science of Heat Transmission by Dr. Max Jakob. Research series, Nos. 67, 68. Employee's Viewpoint toward Personnel Industrial Relations and Training, ed. J. E. Walters, R. J. Greenly.

Ontario Department of Mines:

Annual Report. Part 6, Vol. 48, 1939. Part 10, Vol. 48, 1939.

Quebec Department of Mines and Resources:

Annual Report of the Quebec Bureau of Mines for the calendar year 1936. Part D. Quebec Redempti Paradis, 1938.

Universal Oil Products Company:

A Study of Diesel-Fuel Specifications, by W. H. Hubner, G. B. Murphy, Gustav Egloff. Universal Oil Products Company, Chicago, Illinois.

University of London:

Calendar for the year 1939-1940.

University of Minnesota:

Factors affecting the Performance and Rating of Air Filters by Frank B. Rowley and Richard C. Jordan. Engineering Experiment Station Bulletin No. 16, Vol. 42, Nov. 27, 1939.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

AMERICAN MACHINISTS HANDBOOK and Dictionary of Shop Terms

By F. H. Colvin and F. A. Stanley. 7 ed. rev. and enl. McGraw-Hill Book Co., New York and London, 1940. 1,366 pp., diagrs., charts, tables, 7 x 4 in., lea., $4.00.

The new edition of this well-known pocketbook for shopmen and draftsmen retains the plan of earlier editions, but it has been thoroughly revised and is larger by over 200 pages. Obsolete data have been replaced by new throughout the book, and sections have been rearranged. A large amount of practical information on machining operations is provided.

THE COMPLETE WELDER, dealing with Up-to-date Methods of Gas and Electric Welding. 3 Vols.

Vol. 1. Non-Electrical Methods, Design and Testing. 464 pp.
Vol. 2. Electric Arc Welding. 432 pp.
Vol. 3. Resistance Welding. 432 pp.
George Newnes, Ltd., London, W.C. 2, 1939. Illus., diagrs., charts, tables, 9½ x 6 in., cloth, £3 for 3 Vols.

The three volumes of this set are composed of articles contributed by specialists, which are intended to cover every aspect of welding. The operation of equipment for all kinds of welding is explained, types of actual equipment on the market are described, and work under varying conditions and with different metals is discussed. All phases of the text are illustrated profusely with photographs and diagrams. Volume III contains a classified key and an alphabetical index to the whole work, and twenty-eight miscellaneous data sheets are contained in a separate cover.

CONSTRUCTION ESTIMATES and COSTS

By H. E. Pulver. McGraw-Hill Book Co., New York and London, 1940. 653 pp., charts, tables, 9 x 6 in., cloth, $5.00.

Written for practical men, this book gives a thorough explanation of the best methods of estimating construction costs. Through the use of tables and diagrams which are comprehensive, accurate and useful, the author gives both the time in hours required to do work and the amount of work done per hour. Many illustrative estimates have been included to show the practical application of the methods explained. Both the text and tables are based on current material costs.

THE CRACKING ART in 1938

(*U.O.P. Booklet No. 239*), *ed. by G. Egloff. Universal Oil Products Company, 310 So. Michigan Ave., Chicago. 458 pp., illus., diagrs., tables, 9½ x 6 in., cloth, apply.*

This useful volume provides a comprehensive summary of the literature that appeared during the year 1938, with references to the sources. Research work, commercial cracking, plant equipment, the treatment of cracked products, the products and byproducts obtained, and the production of high-octane fuel are considered. Brief abstracts of all domestic and foreign patents issued in 1938 are included, classed by subject.

THE ELECTRICAL YEARBOOK 1940, 33rd Year

Emmott & Co., Manchester and London. 313 pp., illus., diagrs., charts, tables, 7 x 4 in., cloth, 1s. 6d.

A compact collection of practical information and numerical data upon power-plant operation, electric motors, wiring, switchgear, metering, etc. Intended to supply information frequently needed by electrical contractors and others engaged in electrical work.

FORGING HANDBOOK

By W. Neujoks and D. C. Fabel. American Society for Metals, Cleveland, Ohio, 1939. 630 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $7.50.

This volume fills a gap in technical literature by providing a comprehensive, practical treatise on forgings and forging practice, subjects upon which little has been written. The book discusses the questions involved in the design and equipment of forge plants, the production and finishing of forgings, testing, estimating, cost accounting, etc., Many manufacturers and organizations have assisted by supplying data

FINDING and PRODUCING OIL

Prepared and published by Division of Production, American Petroleum Institute, Dallas, Texas, 1939. 338 pp., illus., diagrs., charts, maps, tables, 11 x 8 in., cloth, $3.00.

This volume is an attempt to outline the present state of the art of finding and producing oil and to indicate the various services and facilities, such as manufacturers, suppliers of equipment, consultants, contractors, educational facilities, etc., that are available. There is information on laws and regulations, and extensive bibliographies are included on all important phases of the producing branch of the oil industry.

FUNDAMENTAL PROCESSES of ELECTRICAL DISCHARGE in GASES

By L. B. Loeb. New York, John Wiley & Sons, 1939. 717 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $7.00.

The topics discussed comprise ionic mobilities, ionic and electronic recombination processes, diffusion of ions and electrons, electron mobilities, energy distribution functions of electrons in gases, electron-attachment and negative-ion formation, conduction currents, and the Townsend coefficients. Each is introduced from the classical point of view and carried through the subsequent experimentation and theory, to the present-day interpretation. The final chapters present the application to the problems of spark discharge, the glow and the arc. Many references are given.

GEOLOGY for ENGINEERS

By R. F. Sorbie. G. Bell & Sons, London; Oxford University Press, Toronto, Canada, 1938, 348 pp., diagrs., charts, tables, 9 x 5½ in., cloth, $3.75.

Part I covers dynamical and structural geology, the study of minerals and rocks, and the identification of rock types. Part II describes field geology methods. The various chapters of Part III demonstrate the application of geological knowledge to the subjects of water supply, building stones, bricks, clays, limes, cements and plasters, roads and canals, rivers, coast erosion, drainage and reclamation, and building sites. This edition has been thoroughly revised and largely rewritten.

HIGH-SPEED DIESEL ENGINES

By P. M. Heldt. 3 ed. P. M. Heldt, Nyack, N.Y., 1940. 475 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $4.00.

The purpose of this book is to discuss the principles involved in the design and operation of this engine, in the light of the research work that has been done here and abroad. Automotive, aircraft and railroad engines are considered, with special reference to the needs of designers and experimenters. One chapter is devoted to miscellaneous types of oil engines. This edition differs little from the preceding one, but contains an appendix covering the developments in research during the interval.

INDUSTRIAL ORGANIZATION AND MANAGEMENT

By R. C. Davis. Harper & Brothers, New York and London, 1940. 636 pp., illus., diagrs., charts, tables, 10 x 6 in., cloth, $5.00.

In 1928 Mr. Davis published "The Principles of Factory Organization and Management," designed as a text for students and junior executives. The present book is a complete revision of that work. In it an effort is made to draw a clear picture of the fundamental functions and principles of factory organization and management and their relations to one another, with a discussion of the specific problems that arise, illustrated by examples of the solutions adopted by various factories. There is a bibliography.

INDUSTRIAL SURVEYS and REPORTS

By W. Rautenstrauch. John Wiley & Sons, New York; Chapman & Hall, London, 1940. 189 pp., charts, diagrs., tables, 9 x 6 in., cloth, $2.50.

This textbook outlines some of the problems engineers encounter in investigating and reporting industrial operations. The subject matter has been evolved from business and manufacturing experience, and actual situations are presented to the student, with field investigation required for a number of the problems. Appendix A contains a report, embodying the results of investigating a particular company, which exemplifies the material discussed in the text.

INTERIOR ELECTRIC WIRING and ESTIMATING

By A. Uhl, A. L. Nelson and C. H. Dunlap. American Technical Society, Chicago, 1940. 342 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $2.50.

The methods, equipment and materials for all kinds of interior wiring, from small jobs to apartment and factory buildings, are described in detail. The final chapter covers estimating procedure for electrical work, including both materials and labor costs. Eight blueprints giving the architectural drawings for a small house accompany the book.

LEGAL ASPECTS OF ENGINEERING

By W. C. Sadler. John Wiley & Sons, New York, 1940. 631 pp., 9 x 6 in., fabrikoid, $4.00.

The purpose of this book is to provide

engineers with a general understanding of the legal principles that govern engineering practice and of their application by the courts. The casebook method is used, over three hundred cases being presented, dealing with professional and industrial problems, aeronautics, property and business.

MUNICIPAL ADMINISTRATION

By J. M. Pfiffner. Ronald Press Co., New York, 1940. 582 pp., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

Designed primarily as a text and reference book for college courses in political science, this work aims to give a readable general account of the organization and activities of a modern city government. Among the subjects of engineering interest are: city planning, municipal airports, streets, water supply, sewerage and housing.

PRACTICAL ELECTRIC METERING

By M. F. Smalley and others. John Wiley & Sons, New York; Chapman & Hall, London, 1940. 228 pp., diagrs., charts, tables, 9½ x 6 in., cloth, $2.75.

This book, based upon lessons from a school conducted by a large operating utility company, is designed as a textbook for metermen and others interested in meters. Following a review of the fundamentals of electricity, all makes and types of electric meters are discussed, with consideration of problems arising in connection with their construction and use.

PRINCIPLES of INDUSTRIAL MANAGEMENT for ENGINEERS

By L. P. Alford. Ronald Press Co., New York, 1940. 531 pp., diagrs., charts, tables, 9½ x 6 in., cloth, $3.50.

This book presents and interprets the teachings of management as related to the present period of economic and industrial transition. The subject matter covers the evolution of industry and of management in industry, organization and standards for the function of control, control of materials in manufacturing, time and motion study fundamentals, classification and cost accounting, maintenance, rate setting, wages, and industrial relations.

PRINCIPLES OF TELEVISION ENGINEERING

By D. G. Fink. McGraw-Hill Book Co., New York and London, 1940. 541 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $5.00.

Information is given not only on the fundamental processes of television reception and transmission, but also on design and modern equipment. The presentation is arranged in the logical sequence of events in television transmission beginning with the camera, through the subsidiary amplifying and transmitting equipment, radiation through space, reception and amplification, detection and image reproduction. Standards, recommended practices, definitions, and names of controls are appended.

The MEASUREMENT of ALTERNATING-CURRENT ENERGY

By D. T. Canfield. McGraw-Hill Book Co., New York and London, 1940. 210 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $2.00.

The fundamental questions about devices for the measurement of alternating-current energy are answered, including explanations of the inductive load adjustment, the retarding force and the recording mechanism. Meter constants and ratios are discussed, and the last part of the book shows the development and application of a method of proving the correctness of any proposed metering combination.

The MICROSCOPE

By R. M. Allen. D. Van Nostrand Co., New York, 1940. 286 pp., illus., diagrs., tables, 9½ x 6 in., cloth, $3.00.

This is a simply written practical text on the theory and manipulation of the microscope. The underlying optical principles are explained, the modern American instruments and accessories described, and directions given for preparing material. A bibliography and a glossary are included.

The PHYSICAL EXAMINATION of METALS. Vol. 1, Optical Methods

By B. Chalmers. Longmans, Green & Co., New York; Edward Arnold & Co., London, 1939. 181 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

The application of the various branches of physics to the investigation of metals is to be covered in two volumes. This first one, on optical methods, explains the underlying physical theory, describes the more important applications that have been made and, in some cases, describes the technique so that the reader can apply it himself.

PRINCIPLES of MINERAL DRESSING

By A. M. Gaudin. McGraw-Hill Book Co., New York and London, 1939. 554 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $5.00.

In this textbook for engineering students the subject is approached from the unit-process point of view. Each process in turn is analyzed on the basis of its physical and chemical principles, while keeping in mind the ultimate object of the art and its philosophy. Principles are emphasized and descriptions of machines, details of practice and auxiliary operations are minimized. References to the literature accompany each chapter.

REFRACTORIES for FURNACES, KILNS, RETORTS, etc.

By A. B. Searle. Crosby Lockwood & Son, London, 1939. 102 pp., illus., diagrs., charts, tables, 7½ x 5 in., cloth, 3s. 6d.

The characteristics of the chief raw and manufactured refractory materials are briefly described, with an explanation of the processes and machinery employed in their production.

SOIL CONSERVATION

By H. H. Bennett. McGraw-Hill Book Co., New York and London, 1939. 993 pp., illus., diagrs., charts, maps, tables, 9½ x 6 in., cloth, $6.00.

This volume, by the Chief of the U.S. Soil Conservation Bureau, is intended as a comprehensive statement of the science and practice of soil and water conservation. The first section, dealing with the problem of soil erosion, describes in detail the extent of erosion and its effects. In the second part measures for soil conservation are presented, and conditions in the different regions of the United States are discussed, with suggestions for their improvement.

RADIO as an ADVERTISING MEDIUM

By W. B. Dygert. McGraw-Hill Book Co., New York and London, 1939. 261 pp., diagrs., charts, maps, tables, 9½ x 6 in., cloth, $3.00.

Written for business men and advertising executives, this book gives enough fundamental data about radio to permit the evaluation of the possibilities of radio as a carrier of advertising messages. Types of programmes, programme construction, censorship, ratings and tests are covered, with some information on television, facsimile, and ultra high-frequency broadcasting.

RAILWAY ENGINEERING and MAINTENANCE CYCLOPEDIA, Fourth Edition, 1939

Edited by E. T. Howson and others. Simmons-Boardman Publishing Corporation, New York and Chicago, 1939. 1,008 pp., illus., diagrs., charts, tables, 12 x 8 in., fabrikoid, $5.00.

Rewritten and revised to cover changes in the last ten years, the new eidition of this authoritative manual supplies information on engineering, maintenance and signaling, assembled under their principal headings, in the respective divisions of track, bridges, buildings, water service and signaling. Methods, materials and products are described, with supplementary manufacturers' pages giving detailed descriptions of specific products. These technical discussions are preceded by a section defining words, terms and expressions which also acts as a general subject index. A directory of products, and indexes of trade names and manufacturers appearing in the volume follow the final section, which covers materials, processes, and equipment employed in more than one maintenance division.

SCIENCE SINCE 1500. (Board of Education, Science Musem)

By H. T. Pledge. His Majesty's Stationery Office, London, 1939. 357 pp., illus., diagrs., charts, maps, tables, 10 x 6 in., cloth, 7s. 6d. (obtainable from British Library of Information, 50 Rockefeller Plaza, New York, N.Y., $2.15).

A need having been felt for a general survey of the history of science, as a background for the manuals on special scientific subjects published by the Science Museum, Mr. Pledge has prepared this account of the development of mathematics, physics, chemistry and biology since the end of the fifteenth century. The book is a concise co-ordinating survey which will be very useful to users of histories of special branches of science. There is a brief, but valuable bibliography.

A SHORT HISTORY OF SCIENCE

By W. T. Sedgwick and H. W. Tyler; revised by H. W. Tyler and R. P. Bigelow. Macmillan Co., New York, 1939. 512 pp., illus., diagrs., maps, tables, 9 x 6 in., cloth, $3.75.

This book is based upon one with the same title which was published in 1917, but is to a great extent new. It is based upon lectures given to students at the Massachusetts Institute of Technology. The work provides a readable account of the evolution of scientific thought and knowledge from the dawn of civilization to the end of the nineteenth century, in which the continuity of the development is emphasized. Illustrations from early books and quotations from famous works add to the interest, and there is a useful bibliography.

PRELIMINARY NOTICE

of Application for Admission and for Transfer

March 28th, 1940

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

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

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

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

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

The Council will consider the applications herein described in May, 1940.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

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

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

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

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

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

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

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

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment 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

ARCHER—JOHN EDWARD, of Nakina, Ont. Born at Ottawa, Ont., Feb. 16th, 1904; Educ.: B.A.Sc., Univ. of Toronto, 1931; 1928, test course, General Electric Co., Schenectady; 1929, D.C. engrg. dept., Peterborough, and 1929-31, industrial heating engrg. dept., Toronto, Canadian General Electric Co. Ltd.; 1935-37 (intermittent), surveyor's helper, Dept. Public Works, Fort William; 1937 to date, instr'man. and inspector, civil aviation divn., Dept. of Transport, Nakina, Ont.

References: G. R. Hill, F. L. Davis, P. E. Doncaster, HOs, G. H. Burbidge.

BAILEY—ALEXANDRE, of Montreal, Que. Born at Three Rivers, May 22nd, 1885; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1908; R.P.E. of Quebec; 1904-05, asst. engr. for various surveyors, engrs. and architects; 1906, engr. i/c parties for contracting firms; 1907, asst. engr., Dept. of Rlys. and Canals; 1908, asst. engr., C.N.O. Rly., and private practice; 1909, engr. i/c surveys, Ha Ha Bay Rly. Co.; 1910-17, various responsible positions with technical depts. of the Dominion Govt.; From 1917, teaching maths., app. mechanics, strength of materials, etc., at the Montreal Technical School. Concurrently with the above, actively interested in construction; at present, librarian-in-charge, and professor, Montreal Technical School, Montreal, Que.

References: H. Massue, A. Frigon, O. O. Lefebvre, A. Duperron, J. A. Lalonde.

BALDWIN—OSCAR LIONEL, of Albert, N.B. Born at Saskatoon, Sask., Sept. 16th, 1912; Educ.: B.Sc. (Civil), Univ. of N.B., 1933; 1936-37, junior instr'man., and 1937-39, senior instr'man., Dept. of Public Works of N.B.

References: J. Stephens, E. O. Turner, W. J. Lawson, H. W. McKiel, C. G. Grant.

BUTCHER—STANLEY JOSEPH, of 321 St. John's Avenue, Winnipeg, Man. Born at Gimli, Man., Oct. 21st, 1911; Educ.: B.Sc. (Elec.), Univ. of Man., 1933; 1935, asst. engr., country divn., 1935-36, mtce., at oat mill, and 1937, junior engr. on constrn., Ogilvie Flour Mills Co. Ltd., Winnipeg; 1937-38, foreman, welding crew, and layout engr., Manitoba Cold Storage Co. Ltd., Winnipeg; 1938-39, elect'l. engr., Winnipeg Free Press Co., Ltd., Winnipeg, Man.

References: E. W. R. Butler, N. M. Hall, J. Hoogstraten, B. L. Reid, S. G. Hartnett, D. M. Stephens.

CROWE—JOHN MURRAY ALLEN, of 40 King's Lynn Road, Toronto, Ont. Born at Toronto, Oct. 26th, 1916; Educ.: B.A.Sc., Univ. of Toronto, 1937; 1938-39, res. engr. on Kingsway sewer project, Islington, for James, Proctor and Redfern, Toronto; at present, demonstrator in hydraulics, University of Toronto, Toronto, Ont.

References: W. B. Redfern, R. W. Angus, C. R. Young, E. A. Allcut, W. B. Dunbar, W. L. Sagar, R. C. Wiren.

FANSET—GEORGE R., of Charleswood, Man. Born at Morris, Man., Oct. 28th, 1909; Educ.: B.Sc. (Civil), Univ. of Man., 1931; 1927-28-29 (summers), rodman and concrete inspr., C.N.R.; 1930-31 (summers), reinforcing steel foreman, Carter Halls Aldinger Co.; 1931-32, res. engr., Dept. of Northern Development, Ontario Govt.; Sept. 1938 to Aug. 1939, Manitoba manager, and Aug. 1939 to date, chief engr., Ducks Unlimited (Canada), Charleswood, Man.

References: T. C. Main, D. M. Stephens, E. S. Braddell, G. H. Herriot, A. W. Fosness, A. E. Macdonald.

GRAY—WALTER DUNCAN, of 334-14th Ave. West, Calgary, Alta. Born at London, England, May 10th, 1904; Educ.: B.Eng. (Civil), Univ. of Sask., 1936; 1929-30, (summers), rodman, inspr., City of Saskatoon; 1936 (summer), instr'man., National Parks Branch; 1936-38, asst. to supt. of constrn., Cons. Mining & Smelting Co., Goldfields, Sask.; 1939 to date, junior engr., with P.F.R.A. in Southern Alberta.

References: H. I. Nicholl, W. L. Foss, E. K. Phillips, R. A. Spencer, G. H. L. Dempster.

HANCOCK—SAM, of Takuapa, Thailand, Siam. Born at Billesdon, Leics. England, Sept. 26th, 1886; Educ.: Freiberg University (Mining), last year not completed owing to war 1914; R.P.E. of B.C., 1934-36. M.C.I.M.M.; fourteen years responsibility in charge of major mining operations in the Orient; four years as consulting engineer (mining), San Francisco, California; at present, manager and attorney in charge of all operations, dredging and hydraulicingt of The East Asiatic Co. Ltd. (Copenhagen), in the Orient (Tin, Wolfran, Gold).

References: A. C. Ridgers, G. H. Bancroft.

HOLT—WILLIAM ALLISON, of Welland, Ont. Born at Toronto, Ont., March 4th, 1911; Educ.: 1928-32, Welland Technical Night Classes, maths. and dfting. I.C.S. Mech. Course; 1926-29, machinist's ap'tice, and 1929-31, machinist, United Steel Corpn., Mead Morrison Divn.; 1931-32, junior dftsman. and principal asst. to the chief engr., Jos. Stokes Rubber Co., Welland; 1933, layout man (rubber dies, etc.), Dominion Mold & Tool Co., and machinist and master mechanic's asst., Dominion Yarns Ltd.; with Atlas Steels Limited, Welland, as follows: 1934-35, junior dftsman. and asst. to the chief engr., 1935-38, mech. dftsman. and principal asst. to the chief engr., and from 1938 to date, asst. engr.

References: J. C. Street, C. H. McL. Burns, W. R. Manock, W. A. T. Gilmour, C. G. Moon, G. Morrison.

JACOBOWITZ—HANS, of 3025 Sherbrooke St. W., Montreal, Que. Born at Berlin, Germany, Nov. 27th, 1907; Educ.: Doctor of Engrg., Technische Hochschule, Berlin University, 1932; Dipl. Eng., 1931; 1931-32, supt. of bldgs. under constrn., and i/c technical work, Ephiattus Construction Company of Amsterdam; 1932-33, in office of George Jacobowitz Ltd., i/c reinforced concrete calculations and estimations, etc.; 1933-35, surveyor and dftsman, District Engineer's Office, Palestine Railways, Lydda, also supt. of outside works, calculations for earthworks and design of rly. bldgs.; 1935-39, private practice, as civil and contracting engr., Tel-Aviv, Palestine, erecting private homes, apartment houses and small factories.

References: E. Kugel, B. Margo, A. A. Wickenden, D. Bremner.

KEENAN—JOHN STEPHEN, of Toronto, Ont. Born at Johnville, N.B., Oct. 2nd, 1900; Educ.: S.B. (E.E.), Mass. Inst. Tech., 1923; R.P.E. of Ont.; 1923-24, test course, General Electric Company, Schenectady; 1924-36, sales engr., and 1936 to date, mgr., appliance and merchandise dept., Canadian General Electric Co. Ltd., Toronto, Ont.

References: E. V. Buchanan, R. L. Dobbin, M. J. McHenry, C. E. Sisson, G. R. Langley.

LANCASTER—GERALD NELSON, of 1306 Cardero St., Vancouver, B.C. Born at Liverpool, England, Oct. 7th, 1901; Liverpool Technical Institute. Stetford and Sharp Marine Engrg. Academy; 1918-23, ap'tice engr., Cunard Steamship Co. Ltd., Liverpool; 1923-26, engine fitter, Vancouver Engineering Works, Ltd.; 1926-30, sales engr., Vulcan Iron Works Ltd., Vancouver; 1930-32, sales engr., Vulcan Engineering Works; 1932 to date, sales engr., Vancouver Iron Works.

References: A. C. R. Yuill, A. S. Gentles, G. A. Walkem, F. H. Ballou, J. Robertson, R. C. Pybus.

LEIGH-MALLORY—GEORGE EDWARD, of Oshawa, Ont., Born at Burford, Ont., Dec. 1st, 1889; Educ.: McGill Univ., third year civil engrg., partly completed, 1917; 1910-11-12, rodman and acting instr'man., C.N.R.; 1912-13, struct'l. detailing, Dominion Bridge Co., Lachine, Que.; 1917-19, dftsman., General Railway Signal Co., Lachine; 1920-21, struct'l. detailing, Dominion Bridge Company, Winnipeg; with General Motors, Oshawa, Ont., as follows: 1921-31, full responsibility for drawing and specifications of export cases for automobiles, engrg. dept.; 1931-34, factory assembly work; 1934-36, inspr., incoming material; 1936 to date, inspr. of auto stampings.

References: R. B. Jennings, C. M. McKergow, A. Peden, J. B. Porter, H. M. White, G. W. Campbell, A. L. Huber, D. C. Tennant.

LINDSAY—THOMAS ALFRED, of Winnipeg, Man. Born at Belfast, Ireland, Oct. 14th, 1911; Educ.: B.Sc. (E.E.), Univ. of Man., 1933; 1928-29-30 (summers), mining surveys, underground mine work, constrn.; 1933-36, sales dept., E. F. Phillips Electrical Works Ltd., and 1937-39, sales dept., Canadian Telephones & Supplies Ltd. Work with above companies included factory training course, estimating, installn. of telephone equipment, and gen. engrg. At present, branch manager, Canadian Telephones & Supplies Ltd., Regina, Sask.

References: E. P. Fetherstonhaugh, N. M. Hall, D. M. Stephens, H. L. Briggs, E. S. Braddell.

MacCALLUM—PETER MALCOLM, of the town of Mount Royal, Que. Born at Glasgow, Scotland, Nov. 4th, 1917; Educ.: B.Eng. (Elec.), McGill Univ., 1939; 1936 (summer), floorman at Hemming Falls, Southern Canada Power Co.; 1937-38 (summers), inspr., special products dept., Northern Electric Co.; at present, engr., plant dept., Bell Telephone Company of Canada, Montreal, Que.

References: J. H. Trimingham, L. E. Ennis, W. J. S. Dormer, C. V. Christie, G. A. Wallace.

STEVENS—STEPHEN S., of 141 Lanark St., Winnipeg, Man. Born at Vancouver, B.C., April 10th, 1910; Educ.: B.S. and E.E., Univ. of So. California, 1935; 1935-36, aircrafts radio engr., T.W.A., Transcontinental and Western Air; 1936-37, supt. of radio and engrg., Eastern Air Lines; 1937 to date, supt. of communications, Trans-Canada Air Lines, Winnipeg, Man.

References: J. D. Peart, E. S. Braddell, C. B. Fisher, J. T. Dyment, E. V. Caton

TREADGOLD—WILLIAM MANTON, of Toronto, Ont. Born at Brampton, Ont., Sept. 24th, 1882; Educ.: B.A., 1903. Grad., Fac. of App. Sci. and Engrg., University of Toronto, 1905; 1905-06, Dominion Observatory; 1906, C.N.R.; 1907, T.N.O.Rly.; 1908-23, town engr., Brampton, Ont.; 1923-29, associate professor and 1929 to date, professor of civil engrg., University of Toronto, Toronto, Ont.

References: C. H. Mitchell, C. R. Young, J. R. Cockburn, W. J. Smither, W. S. Wilson, W. B. Dunbar, J. B. Challies, T. H. Hogg.

WHITE—GEORGE AUGUSTINE, of 31 Bentinck, St., Sydney, N.S. Born at Sydney, N.S., Feb. 23rd, 1913; Educ.: B.Eng. (Civil), N.S. Tech. Coll., 1935; 1930-31 and 1933 (summers), N.S. Dept. of Highways; 1935, road inspr., Milton Hersey Co. Ltd.; 1936, rock tests and instr'man. on paving project, N.S. Dept. of Highways; 1936, plant, inspr., Milton Hersey Co. Ltd.; 1936-38, instr'man. and acting office engr., Dept. of Highways, N.S.; 1938 to Feb., 1940, instr'man., Dept. of Mines and Resources, Ottawa, Ont.

References: R. W. McColough, J. E. Belliveau, A. B. Blanchard, M. F. Cossitt, H. W. L. Doane.

WHITE—WILLIAM NEWTON, of Malartic, Que. Born at North Battleford, Sask., Feb. 20th, 1912; Educ.: B.Sc. (Civil), Univ. of Sask., 1933; 1929-30-31 (summers), C.N.R. constrn. surveys; 1934-35, power development, Kanuchuan Rapids, Manitoba; with Canadian Malartic Gold Mines as follows: 1936-37, rodman underground and dftsman., 4 weeks as underground instr'man., 1937-38, surface instr'man., Dec. 1938 to date, sample boss, dftsman. and in charge of stope limits.

References: W. P. Brereton, C. J. Mackenzie, I. M. Fraser, R. A. Spencer.

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

LYNN—HAROLD RIVIERE, of Thetford Mines, Que. Born at Victoria, B.C., Nov. 17th, 1890; Educ.: Three years training under the late W. L. Lynn, C.E., M.E.; 1912-14, gen. engr. work, sewer dept., City of Edmonton; 1915-19, overseas, Major in Command of Rly. Troops, France; 1919-20, field engr., Fraser Brace Ltd., Edmonton; 1920, res. engr., Maple Leaf Asbestos Co., Thetford Mines; 1921, gen. mgr., Canada Slate Corpn.; 1922-40, president, Lynn Macleod Engineering Supplies Ltd., 1924-40, president, Lynn Macleod Engineering, Three Rivers and Ottawa, and 1931-40, president, Lynn Macleod, steel foundry and engineers; at present, Officer Commanding, 5th Army Troops Co., R.C.E., C.A.S.F. (A.M. 1920).

References: G. K. Addie, J. O'Halloran, E. D. Gray-Donald, R. J. Gibb, A. W. Haddow.

FOR TRANSFER FROM THE CLASS OF JUNIOR

POTTINGER—ALEXANDER, of 33 Barnesdale Ave., So., Hamilton, Ont. Born at Shetland Islands, Scotland, July 10th, 1905; Educ.: B.A.Sc., Univ. of B.C., 1927, (R.P.E. of Ont.) 1927-29, ap'tice course, and 1929 to date, on engrg. staff, Canadian Westinghouse Company, Hamilton, Ontario, covering design and application of meters, relays, instruments and instrument transformers, rectifiers, general switching. (Jr. 1930).

References: G. W. Arnold, D. W. Callander, J. R. Dunbar, W. L. Miller, J. C. Nash.

SCOTT—LLOYD GEORGE, of 191 Hill St., Winnipeg, Man. Born at Waskada, Man., Jan. 8th, 1912; Educ.: B.Sc. (E.E.), Univ. of Man., 1932; 1931-32 (summers), student course, Otis-Fensom Elevator Co.; 1932 to date, in the office of the supt. of bldgs. and mech. plants, Hudson's Bay Company, from Jan., 1938 to Jan., 1940, asst. on constrn. of the company's new department store at Edmonton, Alta. (St. 1930, Jr. 1936).

References: E. P. Fetherstonhaugh, N. M. Hall, W. E. Hobbs, D. M. Stephens, A. W. Haddow, E. S. Braddell, G. C. Davis.

FOR TRANSFER FROM THE CLASS OF STUDENT

BOLDUC—ARMAND, of Montreal, Que. Born at Montreal, Oct. 7th, 1907; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1937; R.P.E. of Que.; 1927-34, asst. on constrn. work for Louis Bolduc, gen. contractor; 1937-38, res. engr. i/c of surveying, preparing plans and estimating, supervision of constrn. of mining roads; 1938-39, res. engr. i/c of paving on highways, and Jan., 1939 to date, res. engr. i/c of surveying, preparing plans and estimates, and supervising constrn. on various projects of highway constrn., Quebec Dept. of Roads. (St. 1936).

References: A. O. Dufresne, A. Gratton, E. Gohier, F. J. Leduc, B. Pelletier, J. A. Lalonde.

BROWN—DONALD WHIDDEN, of Fort Erie North, Ont. Born at Ottawa, Ont., Dec. 19th, 1912; Educ.: B.Sc. (Mech.), Queen's Univ., 1938; 1929, rodman on survey of Rockcliffe Aerdrome; 1934, asst. in hydraulic lab., National Research Council; 1936, testing steel, Stanley Steel Co., 1937-39, engrg. asst. in dfting room, to field engr., and in 1940 to W. R. Manock, Horton Steel Works Ltd. (St. 1937).

References: J. H. Parkin, L. T. Rutledge, L. M. Arkley, W. R. Manock, L. C. MacMurtry, C. S. Boyd.

DesORMEAUX—DOLLARD, of 1826 Champlain St., Montreal, Que. Born at Montreal, June 24th, 1913; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1937; 1936 (summer), Geol. Survey of Canada; May 1937, Quebec Dept. of Roads; June 1937 to date, office and inspection work, technical dept., City of Montreal. (St. 1936).

References: J. G. Caron, J. Comeau, L. P. Chevalier, L. Laferme, W. Dickson.

ELLIOTT—CLARENCE W., of Calgary, Alta. Born at Peterborough, Ont., Oct. 1st, 1909; Educ.: B.Sc. (Elec.), Univ. of Alta., 1938; 1938 to date, junior engr., Calgary Power Company, Calgary, Alta. (St. 1938).

References: G. H. Thompson, H. J. McLean, H. B. LeBourveau, J. McMillan, W. E. Cornish.

HARVEY—ERNEST ALLAN, of Toronto, Ont. Born at Durban, Man., Feb. 27th, 1910; Educ.: B.Sc. (E.E.), Univ. of Man., 1938; 1938 to date, with The Maytag Co. Ltd., Winnipeg and Toronto, dfting., plant mgr., factory mgr., and at present, Toronto mgr., in charge of all depts. and operations in eastern Canada except sales promotion. (St. 1937).

References: C. J. Mackenzie, R. A. Spencer, I. M. Fraser, W. E. Lovell, E. P. Fetherstonhaugh, N. M. Hall, A. E. Macdonald.

HASTIE—FRANK JAMES, of Edmonton, Alta. Born at Edmonton, Jan. 3rd, 1913; Educ.: B.Sc. (E.E.), Univ. of Alta., 1936; 1930-32, lab. asst., Research Council of Alberta; 1936 (summer), checker, constrn. office, 1936-39, asst. engr., and 1939 to date, shift engr., Canada Packers Ltd., Edmonton, Alta. (St. 1936).

References—E. Stansfield, C. A. Robb, H. J. MacLeod, W. E. Cornish, H. R. Webb.

KLOTZ—CARL OTTO PAUL, of Ottawa, Ont. Born at Lanark, Ont., Nov. 23rd., 1912; B.Sc. (Civil), Queen's Univ., 1934. R.P.E. of Ont.; 1930-31 (summers), field work, Geol. Survey of Canada; 1934 (Apr.-Nov.), engr., for F. E. Cummings, Gen. Contractor, Westboro, Ont.; 1935 (May-Oct.,), chief of field party, Geol. Survey of Canada; 1935-36, dftsman., Canada Packers Ltd.; 1936-38, asst. to chief trade instructor, Kingston Penitentiary; 1938-39, instructor and lecturer in civil engrg., Queen's Univ.; 1939, soil examinations in lab. and field, Dept. of Highways of Ont.; Aug. 1939 to date, junior research engr., National Research Council, Ottawa, Ont. (St. 1933).

References: W. P. Wilgar, R. A. Low, A. Macphail, R. M. Stewart, W. L. Malcolm, S. D. Lash, A. E. MacRae, D. S. Ellis.

MARTIN—PERCIVAL RALPH, of Granby, Que. Born at Granby, Mar. 31st, 1911; Educ.: Diploma in Engrg., Acadia Univ., 1934. 1934-36, took 3rd year engrg. at McGill; 1936-38, plant engr., Torrington Company, Bedford, Que.; 1938 to date, quantity engr., Shawinigan Engineering Company, La Tuque, Que. (St. 1938).

References: C. R. Lindsey, J. T. R. Steeves, J. W. H. Ford, G. Rinfret, H. J. Racey.

MOSELEY—SHIRLEY CHARLES, of 1649 Aird Ave., Montreal, Que. Born at Sydney, N.S., May 5th, 1909; Educ.: B.Eng. (Mech.), McGill Univ., 1937; R.P.E. of Que.; summer work during vacations with various companies; after graduation, 3 mos., lubrication engr., Noranda Mines; 3 mos., asst. to the master mechanic, Fairbanks Morse, Montreal; 6 mos., estimating, design and drawing, engrg. dept., International Paper Co., Cornerbrook, Nfld.; June 1938 to date, sand engr., in charge of production, operation and mtce. of all sand reclaiming, sand reconditioning, sand mixing units, together with control of all sand used in the foundry, Canadian Car and Foundry Co., Longue Pointe, Que. (St. 1937).

References: W. S. Atwood, R. Collins, C. L. Blackmore, C. Brain, L. R. McCurdy, E. F. Viberg.

NORTHOVER—ARTHUR BEVERLEY CLINTON, of 91 Parkside Drive, Toronto 3, Ont. Born at Southey, Sask., Oct. 7th, 1913; Educ.: B.A.Sc. (Civil), Univ. of Toronto, 1937; 1936 (summer), geol. asst.; 1937-38, struct'l steel dtfsman., Hamilton Bridge Company; Dec. 1938, struct'l. steel dftsman., Standard Iron Works; Jan. 1939 to date, junior research engr., Toronto Transportation Commission, Toronto, Ont. (St. 1937).

References: C. R. Young, H. W. Tate, W. E. P. Duncan, F. L. Smith, E. L. Cousins, S. E. Flook, H. B. Stuart, W. B. Dunbar.

ROWAN—JOHN JAMES, of 5105 St. Catherine St. East, Montreal, Que. Born at Ottawa, Ont., Nov. 4th, 1912; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1935. B.Sc., Mass. Inst. Tech., 1936; 1936 to date, refinery engrg. dept., Imperial Oil Limited, Montreal East, dfting., surveying, supervising constrn., estimating, and at present design engr. (St. 1935).

References: F. C. Mechin, A. Frigon, S. A. Baulne, P. P. Vinet, J. W. MacDonald, E. R. Smallhorn.

STEVENS—ROBERT LEONARD, of 4949 Queen Mary Road, Montreal, Que. Born at Burmis, Alta., Dec. 18th, 1912; Educ.: B.Sc. (E.E.), Univ. of Alta., 1935. M.Sc. (E.E.), McGill Univ., 1936; 1932-33-35 (summers), constrn. and office work; 1936-38, engrg. ap'tice, Canadian Westinghouse Company; 1938-39, engr., Gatineau Power Company, Ottawa; 1939 to date, engr., Canadian Industries Limited, Montreal, Que. (St. 1936).

References: I. R. Tait, H. C. Karn, W. G. C. Gliddon, R. C. Silver, G. W. Arnold.

Employment Service Bureau

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

SITUATIONS VACANT

CHEMICAL ENGINEER OR CHEMIST who has majored in Organic Chemistry with a few years experience in Laboratory or Factory in connection with developing rubber compounds: knowledge of, or experience in, allied synthetics desirable. In applying please state age, details of educational background and experience, salary desired and availability. Box No. 2013-V.

EXPERIENCED SHOPMAN with technical training required for general shop supervision of metal working plant. Apply to Box No. 2038-V.

MANAGER, 40-55 years of age, for newsprint and boxboard plant. Applicant must be Canadian citizen, but experience gained in the United States would be desirable. Apply to Box No. 2054-V.

GRADUATE CHEMICAL ENGINEER, for sales and service with professional engineering firm dealing in scientific water treatment. Young single man prepreferred with experience in steam power plant operation. Apply to Box No. 2057-V.

ADMIRALTY VACANCIES OVERSEAS
REVISED SPECIFICATIONS

Following the announcement on the above subject in the February issue of the Journal, we are now in a position to publish certain revisions and additional information.

We have lately been advised that the basis of pay has been changed for the officers of Groups II and III, in that the Canadian Naval Service (R.C.N.V.R.) has consented to enlist these men, give them Canadian rates of pay, and lend them immediately to the Admiralty. The basic rate of pay for the lieutenants is $5 per day plus allowances, and for sub lieutenants, $4 per day plus allowances. These men will be subject to the relatively small Canadian income tax instead of the heavy British income tax. It has not been possible to make similar arrangements for Group I, i.e., civilians, but men of this group may if they wish enlist as officers in the R.C.N.V.R. as if in Group II, but under any circumstances they will be attached to civilian research stations.

Before selection, applicants will have formal interviews with official representatives and medical examinations. The Canadian Government will defray transportation and subsistence expenses of selected men from their homes to an embarkation point and to England. Before final acceptance the credentials of the selected men must be approved by the Director of Naval Intelligence of the Admiralty in the case of the civilian workers, and by the Canadian Naval Authorities in the case of the officers.

GROUP I.

Engineer–Physicists with experience of radio frequency technique, especially of very short waves. Half of these men are required for Experimental Development work in the laboratory and half for Design, i.e. turning the experimental model into production.

It is essential that all men in this group should have suitable practical experience and it is considered unlikely that anyone under the age of 25 could have obtained the experience necessary. All the men of this group are to be employed in *civilian capacity in Experimental Establishments.*

GROUP II.

Men of the Engineer-Physicist type for executive and maintenance duties in connection with a special war service. These men should have a good fundamental training in Physics or Engineering, with special knowledge of radio and considerable practical ability; and they should be capable of being trained rapidly to understand, operate and control the special apparatus of this service. They must be medically fit, of the officer type, and either possess or be capable of acquiring rapidly the power to command. These men would be given commissions as Lieutenants or Sub-Lieutenants, R.C.N.V.R. (Special Branch), and would be required to serve either afloat or ashore.

GROUP III.

Engineers with mechanical knowledge and good practical experience of high frequency electrical or of radio installations. It is desirable that they should have Engineering or equivalent degrees, but high research qualifications are not necessary. They must be medically fit, of the officer type, and capable of serving on maintenance duty. Men in this group would be entered as Probationary Temporary Sub-Lieutenants, R.C.-N.V.R. (Special Branch), in the first instance.

Applications from or suggestions concerning eligible men should be addressed to the Secretary-Treasurer, National Research Council, Ottawa.

When applying refer to Overseas Appointment, Group I, II or III as the case may be.

EMPLOYERS!

The Institute's Employment Service has on file the records of many young men graduating this spring in all the branches of engineering. Most of these graduates have had some early engineering experience during their vacations.

In recent weeks the demand for engineers has risen to a point where a scarcity has developed; therefore, we strongly recommend that employers arrange now for any extra help that they may require permanently or for the summer.

SITUATIONS WANTED

INDUSTRIAL EXECUTIVE, technically trained, 16 years experience in engineering, purchasing, production, manufacturing, technical sales, merchandise, general administration, and industrial relations. Box No. 185-W.

CIVIL ENGINEER, age 52, married, open for engagement. Experience includes 3 years at railway construction, 12 years at highway reconstruction work and asphalt paving, 8 years at municipal work. Will go anywhere required. Apply Box No. 216-W.

ELECTRICAL AND CIVIL ENGINEER, B.SC., Elec. '29, B.SC., Civil '33, JR.E.I.C. Experience includes approximately three years as engineer with a large electrical manufacturing company, about three years as assistant to electrical engineer in a small electrical repair and machine shop. For the last three years engaged in survey and construction work. Best of references. Apply to Box No. 693-W.

MECHANICAL ENGINEER, JR.E.I.C., Technical graduate, married, two children. Thirteen years experience design of steam boiler plants, heating, ventilating, air conditioning, piping layouts, estimates, specifications, also sales and general engineering. Available on short notice. Box No. 850-W.

ELECTRICAL ENGINEER, A.A.SC. General Electric test course, induction motor and D.C. machine design. Now employed in minor executive capacity. Has also had experience as instrumentman on highway construction. Wants opportunity to serve where technical training can be used to better advantage. Apply to Box No. 993-W.

MECHANICAL ENGINEER, B.SC., A.M.E.I.C., age 32, married. Ten years experience field erection; and in the preparation of plans, specifications, and estimates on various structural and mechanical projects pertaining to manufacturing plants. Desires change to position of responsibility in assisting a plant manager in problems of plant extension, new construction or maintenance. Apply Box No. 1054-W.

CHEMICAL ENGINEER, Toronto '31; nine years experience in paper and board industry as assistant chief chemist; successfully worked on pitch elimination, waste reduction and steam saving. Anxious to join up with progressive company. Bilingual. Apply Box No. 1768-W.

CIVIL ENGINEER, B.SC. '25; A.M.E.I.C. Fifteen years extensive general experience now desires permanent industrial or municipal connection. Experience includes surveying and mapping; highway construction; construction, operation and maintenance of wharves, dredged channels, water supply and sewerage systems, miscellaneous plant buildings reinforced concrete structures. Executive background with experience at purchasing and office management. Available at short notice. Box No. 1919-W.

PHYSICAL METALLURGIST, M.S., JR.E.I.C., A.S.M. Age 24, single, presently employed. Wide experience with large steel company in all types of metallographic testing, investigation of complaints, commercial heat treatment. Familiar with steel mill operation and production of automotive, alloy forging, rail and structural steels. Box No. 2080-W

MECHANICAL ENGINEER, B.Eng. Mech., N.S.T.C. '35, A.M.E.I.C. 8 mos. hwys. constr. One year surveying and mapping, one year lecturing in mathematics, 18 mos. engr. in charge of surveys and constr. Writing and speaking ability. Particularly interested in specializing. Single and at present employed. 2083-W.

ELECTRICAL ENGINEER, B.E. (N.S.T.C. '36), S.E.I.C. Age 25. Married, no children. One year's experience electrical installation, operation and maintenance of power house, motors, generators, alternators, transformers, switching gear, underground cables, airport field lighting, conduit wiring, house wiring and lighting at Newfoundland Airport. One and a half year's experience in manufacturing plant in responsible position including about six months in official capacity. References. Location immaterial. Available on about two weeks notice. Box No. 2085-W.

COST ENGINEER, B.A.SC. Age 29. General experience covers drafting, surveying, estimating and accounting. Special training in costing and management with successful experience in this work for the last two years Wishes to contact construction or manufacturing company having good opportunities for a technically trained cost man. Apply Box No. 2087-W.

AERONAUTICAL ENGINEER, B.A.SC., A.M.E.I.C. Age 37, married. Experienced in all phases of aircraft design and production. Desires position of responsibility where training can be used to better advantage. Apply Box 2126-W.

ENGINEERING STUDENT, S.E.I.C., graduating in civil engineering this spring; age 23; single; Canadian; eighteen months with large structural firm, draughting and detailing; interested in all phases of civil engineering; does not believe a graduate is entitled to a sinecure; location immaterial; good references. Apply Box No. 2133-W.

ENGINEER, B.SC. (E.E.), Manitoba '35. Married. Seven months mining engineering. Three years with large agricultural implement firm in all production departments, and employed by them now. Familiar with iron and steel specifications and production methods, machine design and estimating. Available with month's notice. Apply Box No. 2155-W.

Industrial News

Industrial development — new products — changes in personnel — special events — trade literature

PERCY H. BROOKS OF BURLINGTON STEEL PASSES

Secretary of the Burlington Steel Company for 20 years and a director of the firm, Percy Howard Brooks passed away in his 52nd year, on March 10th, at the Hamilton General Hospital following an illness of one month. The late Mr. Brooks was a native of Brantford, Ont., and was educated in Brantford public and high schools and, during the first Great War, was associated with the late Sir Frank Baillie in the operation of the Canadian Cartridge Company, and later with the Canadian Aeroplanes, Ltd., Toronto.

Mr. Brooks was actively interested in many clubs in Hamilton and was also a member of the Hamilton Chamber of Commerce, the Canadian Manufacturers' Association and the Hamilton Advertising and Sales Club. He was a past president of the Lions Club and was a member of the civic airport committee.

INDOOR-OUTDOOR AUTOMATIC TIME SWITCH

A new general-purpose automatic time switch which has been announced by Canadian General Electric Co. Limited and applications of this new automatic time switch include store and show-window lighting, electric signs, billboards, spectaculars, ornamental fountains, monuments and similar lighting, street lighting, airport lighting, airway beacon lighting, railroad yard lighting, poultry house lighting, traffic control, alarms, signal systems, domestic furnace and water heaters, and defrosting refrigerators.

SAWYER-MASSEY APPOINTMENT

E. D. Graham has been appointed assistant chief engineer of Sawyer-Massey, Limited, Hamilton. He studied mechanical engineering at the University of Toronto, and industrial engineering at General Motors Institute of Technology. Mr. Graham has had practical experience with several major Canadian industries and has an intimate knowledge of the design, construction, and application of mining machinery, air compressors, plastics and metals, machinery and general industrial requirements.

Mr. Graham is a member of the Association of Professional Engineers of the Province of Ontario, and his experience in the above fields will be an asset to Sawyer-Massey, since this company is engaged chiefly in the manufacture of roads and contractors' machinery, as well as the design and fabrication of industrial equipment.

E. D. Graham, Assistant Chief Engineer, Sawyer-Massey Limited

CLOSED CIRCUIT CONVEYOR

Cleanliness and freedom from contamination are claimed for the new Redler conveyor announced by Stephens-Adamson Manufacturing Co. of Canada, Ltd., Belleville, Ont. It is available in the horizontal closed circuit type and features the driving chain moving in a compartment separate and distinct from the compartment handling conveyed material. Conveyed material is entirely free from the metal to metal contact of sprockets and chain, or chain and casing, preventing possibility of dirt or lubricant from contaminating material.

This Redler is available in either the 90 degree or 180 degree type; in the former there are four corners, each curved at 90 degree angles, and in the latter the circuit is made with only two curved corners, each 180 degrees.

MEDIUM-SIZE STRAIN CLAMP

"O-B Intermediate Universal Strain Clamp," bulletin 693-HK, supplement to catalogue No. 21, 1 p., Canadian Ohio Brass Company, Ltd., Niagara Falls, Ont., describes, illustrates and gives complete catalogue information on the company's intermediate size of universal strain clamp which accommodates 0.188 to 0.437-inch conductors.

WAR PRODUCTION

The register of scientific and technical personnel is available to industrial firms engaged in the manufacture of war materials who may require the services of scientists, engineers, specialists or skilled tradesmen. Lists of names and qualifications for any specified line of work will be furnished on request to the Director, Technical Section, Voluntary Service Registration Bureau, Ottawa, Ont.

Dr. H. M. Tory,
Director.

Major G. H. McCallum,
Asst. Director.

RADIATION-TYPE THERMOCOUPLE FOR FURNACE CONTROL

A new radiation-type vacuum thermocouple for use wherever exceptionally high sensitivity and very rapid response are needed has been announced by Canadian General Electric Co. Limited. This thermocouple is designed to fill a specific need created by the development and use of controlled protective-atmosphere furnaces for processing materials at high temperature. Possible applications include temperature measurement and control in brazing, heat-treating furnaces, glass heat-treating, infra-red drying and solar radiation.

RECEIVER-PURIFIER

Centrifix Corporation of Cleveland, Ohio, has placed on the market a new type of "Receiver-Purifier" for the removal of oil in vapour form in exhaust steam lines. The Centrifix receiver purifier has expansion and contact capacity sufficient to condense this oil vapour. The design is such that after the oil is condensed it is easily removed by the Centrifix internal purifier, as well as all other bothersome entrainment. There are no moving parts, is self-cleaning and therefore economical of operation and maintenance. This equipment is manufactured in Canada exclusively by Sawyer-Massey, Ltd., Hamilton, Ontario.

CARDIOID DIRECTIONAL MICROPHONE

An advance in the quality of sound as heard by radio listeners and movie patrons will result from the introduction of the improved cardioid directional microphone as announced by Northern Electric Co. Ltd., Montreal, Que., and illustrated below. According to the manufacturer, the new device is, in effect, six distinct microphones in one compact unit. At the flip of a small switch, contained within the instrument, the new microphone adapts itself to the individual acoustic pattern of any studio or remote location. Sound engineers thus have wide control over the effects of acoustic conditions on the character of reproduced speech and music.

In studios where the acoustic conditions, for example, build up bass tones, the new

"multimike" will reduce the boominess associated with this type of reverberation which is often observed during musical numbers. Audience noise may also be diminished. It cuts down the hollow ringing sound associated in the minds of listeners with large halls, and, where amplification is employed for voice-re-enforcement in theatres, it enables players to stand farther away from the microphone and yet achieve greater solo emphasis.

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 23 | MAY 1940 | NUMBER 5

PUBLISHED MONTHLY BY
THE ENGINEERING INSTITUTE
OF CANADA
2050 MANSFIELD STREET - MONTREAL

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

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THE PROBLEMS AND RESPONSIBILITIES OF MANAGEMENT

W. F. HOSFORD

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Address presented before the Montreal Branch of the Engineering Institute of Canada, on February 15, 1940

The work of the engineer consists largely of developing facts and of analyzing and drawing conclusions from them. This engineering approach can often be used by management in reaching its decisions, but unfortunately, many of management's problems are not of an engineering character and can be dealt with only by the application of judgment acquired largely through experience.

Management's problems in a manufacturing business cover such varied and complex matters as the financing of the business, the choice and design of its products, the purchase and supply of materials, manufacturing practices, labour relations, pricing policies, advertising, marketing procedures, and numerous others. These problems are difficult enough in normal times, but they become much more so when the economy of a country is upset by depressions, trade barriers, or by war.

The scope of all these problems is much too broad to be discussed in one paper or perhaps even by one man. This address will therefore deal only with some of those which arise in the manufacturing division of a business, and which to-day seem to be of particular importance.

The Western Electric Company manufactures practically all of the equipment used by the Bell Telephone System in the United States. As we turn out more than 40,000 products of different design, it will be realized that our manufacturing job is a complicated one. The Company's three plants, located in Chicago, Kearny, N.J., and Baltimore, employ a total of about 25,000 people.

The views now expressed are necessarily influenced by the character of this business, and by the experience gained in dealing with the problems which arise in its operations.

It is evident that practices and policies which best meet the needs of one company may not be equally practicable for others, different in size or character. Furthermore, procedures satisfactory for peace time operations may not be applicable during periods of war time production when the primary objective is quick deliveries of large quantities of materials, rather than minimum costs of manufacture.

Advances in manufacturing practices and in the art of management are being made at a rapid rate, and many of the procedures which we consider satisfactory to-day will doubtless be supplanted by something better tomorrow.

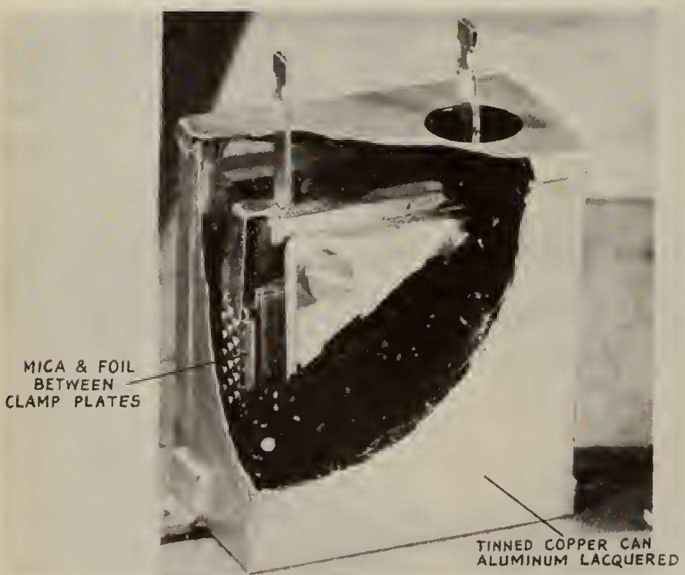

Fig. 1—Mica Condenser of Early Design.

Management's primary duty is to operate efficiently the business with which it is entrusted. If it does not do this it cannot fully meet its responsibilities to its customers, to stockholders, to employees, or to the public. The interests of these groups sometimes appear to be conflicting, but ordinarily a course of action which is best for one of the groups will in the long run also benefit the others. Inefficiency in the manufacturing division almost always means either that the company's products will not be sold at a level of prices to which its customers should be entitled, or stockholders will not obtain a fair return on their investment, or the employees will not receive wages and benefits commensurate with those being received by employees of progressive companies. Failure to meet the responsibilities to any one of these groups is likely to react seriously on any business.

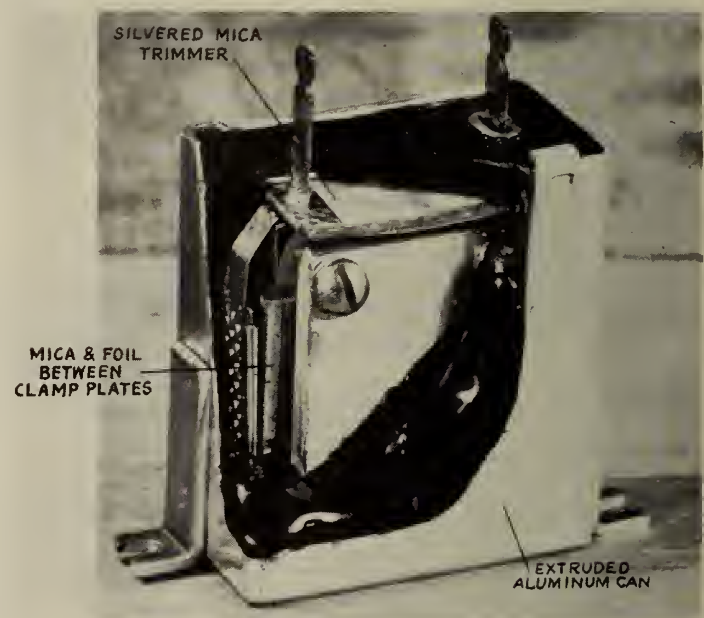

Fig. 2—Mica Condenser with Trimmer Unit.

While management's responsibilities to these three groups are fairly clear, one may wonder just what responsibility a business has to the public. It has, of course, the same responsibility that any individual has for being a good citizen and a good neighbour. But beyond this, has not industry played an important part in raising the standard of living of the citizens of our countries and does it not have some responsibility to society for further progress in this direction ? In paying fair wages and in devising means for producing more goods at lower costs, industry has made it possible for these goods to be distributed more widely, and has thus contributed greatly to the high standard of living prevailing in your country and mine. This standard in our countries is high in comparison with those prevailing in many countries of Europe, but it can, and will, through the accomplishments of industry, be made much higher than it is at present.

A company content with the *status quo* of its business methods, its product designs, its manufacturing processes, its costs of production, and with the wages and benefits received by its employees, is not helping to advance standards of living, and is not meeting its responsibility to society.

Since the success of a manufacturing company depends so largely upon the efficiency with which its manufacturing operations are conducted, the following remarks will deal with this phase of management's responsibilities.

In undertaking to attain this objective one of management's first responsibilities is to make certain that its operations are organized so as best to promote this result.

A company that is growing, or is frequently changing the character of its products, may find that a type of organization successful at one time will not fit the altered conditions. Management must keep the form of its manufacturing organization adjusted to the current needs of the business. In studying this problem it is well to try to determine what the ideal form of organization would be without regard to existing personnel, and then to modify this set-up so as to make the best use of the talent available.

The effect of contemplated organization changes on the morale of employees should, of course, be carefully considered and be so thoroughly worked out before being put into effect that no one will have any doubt as to what his job is or to whom he reports. If the change will promote more efficient operation, employees usually will recognize this promptly and will apply themselves toward making it successful.

Technical Planning in Manufacture and Design

Every manufacturing organization should have a group of engineers assigned to study how manufacture can be carried on most efficiently. Therefore, looking and planning ahead technically is one of the important features that management should provide for in its manufacturing organization. Such an engineering group has several important functions to perform.

There should be close collaboration between the engineers who plan the methods of manufacture and the engineers who design the product. Low costs can be realized only if the product is so designed as to make possible the full use of economical methods of production.

In our company, the engineers of the Bell Telephone Laboratories are our product design engineers. After they develop the model of a new product to the point where it meets the desired operating requirements, they turn it over to our manufacturing planning engineers for study and suggestions as to design changes which will enable it to be produced at a lower cost. This practice almost always results in modifications of design which will accomplish this result without in any way impairing the value of the product to the ultimate user. When the design is finally decided upon, these manufacturing engineers plan the methods of production, design the required special tool and machine equipment, and assist in launching the new product in manufacture.

Such co-operative efforts, carried on jointly by our planning engineers and those of the Bell Telephone Laboratories not only during the introduction of a new product, but also after experience has been gained through actual manufacture, result in substantial reductions in costs.

The changes made in one product, a mica condenser, will serve to show how modifications of design can substantially reduce the cost of manufacture and at the same time improve its quality.

This condenser, shown in Fig. 1, was composed of a stack of interleaved mica laminations and metal foils clamped between steel plates. As the electrical capacity of a condenser is dependent upon the distance between the metal foils on the opposite sides of the mica, the final adjustment was obtained by varying the pressure of the clamping screws. As the screws were generally not run down tight, there was a tendency for the pressure on the stack to change during later operations. This affected the capacity of the condenser and caused a rather high proportion of the product to fail to meet the close tolerances required. The cost of a typical condenser of this design was $1.00.

To reduce the proportion of rejections due to this trouble, the manufacturing engineers proposed that the number of

Fig. 3—Silvered Mica Condenser.

interleavings and consequently the capacity of the stack be reduced slightly and that the clamping screws be run down tight in all cases.

To raise the capacity to the desired rating and to keep within the required tolerances, a midget condenser unit consisting of a single piece of mica having silver fused on both sides was soldered across the terminals and thus added to the main unit (Fig. 2). The final capacity adjustment was then obtained by scraping off a small area of the silver coating.

With the laminations firmly clamped in all cases, the cost of the adjusting operation and the number of condensers falling outside of the allowable tolerances was greatly reduced.

The cost of the typical condenser was by this means reduced to 70 cents.

As the silver coated sheet of mica worked so well as an adjusting unit, sheets of this kind were next substituted for the stack of interleaved mica and foil. Capacity adjustment was made by scraping off small portions of the silver. As the silver coating was at all times in intimate contact with the mica, no clamping was necessary and it was possible to eliminate the clamping plates and screws.

Fig. 4—Moulded Silvered Mica Condenser.

A condenser of higher quality and greater stability also resulted (Fig. 3).

This change further reduced the cost of the typical condenser to about 60 cents each.

The last step was to eliminate the containing can and the potting operation by enclosing the condenser in a moulded case (Fig. 4).

This change reduced the cost of the condenser to 45

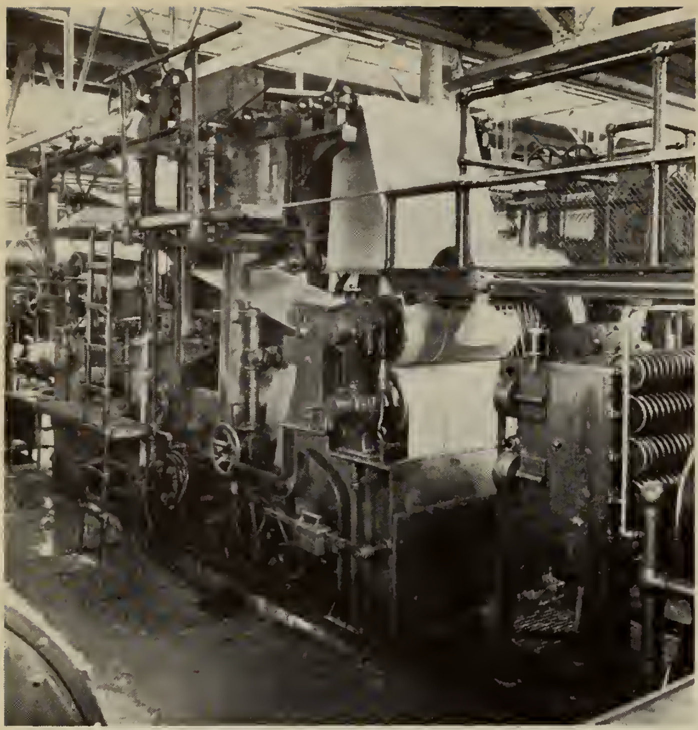

Fig. 5—Pulp Insulating Machine.

cents, or less than half that of the first design shown. At the same time the size was substantially reduced, which was also desirable.

The lower cost and higher quality, which resulted from these changes, were obtained only by continued close collaboration of the manufacturing engineers and the product design engineers over a period of about three years.

This case illustrates the value, after the initial design and methods of manufacture have been established, of continuing the efforts to reduce costs and improve the product.

Manufacturing Development

In addition to the engineers who plan the methods of manufacturing our products, we have found it very profitable to have at each plant, but under centralized control, a group of manufacturing development engineers. The efforts of these groups are applied to advancing the art of manufacture to enable production to be carried on more efficiently in the future. These engineers are most successful if they are close at hand, but not hampered by having to deal with the day-by-day production problems of the business.

They study manufacture from a fundamental standpoint and have developed many new processes which have revolutionized former methods. The merits of these processes have been recognized quite generally in industry and about 50 different companies have sought and have been granted rights to use them.

A description of one or two of the major developments achieved by this organization will illustrate their character. The first one concerns the method of insulating wire for telephone cable.

The wire conductors in lead covered telephone cable are insulated with paper. Formerly, paper purchased in the form of pads of narrow ribbon, slit from wide rolls, was wrapped around the wire. In order to apply it at a high speed, a strong paper was required and this made it necessary to use a relatively high cost manila paper.

Our engineers in trying to develop a better and less costly method of applying paper insulation to cable conductors went right back to the paper making operation.

After a long period of experimental work they developed a process in which, starting from woodpulp, a continuous paper tube is formed around the wire in a single operation. Sixty wires pass through the machine side by side, and 60 narrow strips of paper are made, and while still wet are spun around the wires. These wires with continuous paper tubes around them are passed through a high temperature oven to dry the insulation and give it the desired electrical properties. Two men per machine (Fig. 5) do the work of ten girls with the former method.

This process has made it possible to use a lower cost raw material and to combine in a single operation the former papermaking, slitting and insulating operations. It produces a more perfect insulation than the old method and has resulted in substantial reductions in cost. The insulated conductors are smaller in diameter, and as a result a greater number of them can be placed in a cable sheath of given size.

One other case will perhaps suffice to illustrate the character of the work carried on by our manufacturing development engineers. This has to do with the application of textile coverings to wires and cords.

Everyone is familiar with the may-pole type of braiding used on wires and cords. There has been very little progress in the braiding art except to increase the speed of the machines and the process remains fundamentally a slow one.

Our development engineers, studying methods of applying textile coverings to wires and cords, came in touch with a rather crude knitting machine developed by an Austrian. While this machine appeared to be impracticable in its then existing state, our engineers felt that the principle employed was a promising one. After acquiring rights under certain patents they perfected a machine (Fig. 6) which is a big advance over the Austrian model and a very great advance over the former braiding machines.

The improved knitting machine has a production rate about ten times that of a braider. Its development has so far made it possible to replace 564 braiders, which cost $450,000 with 54 knitting machines costing about $75,000.

As a matter of interest it may be noted that a large number of the discarded braiders, more than ten years old, were sold to a shoe string manufacturer for enough to pay for the lesser number of new knitting machines which replaced them.

The knitters have reduced annual costs about $150,000. They have released 13,000 sq. ft. of floor space badly needed for other uses, making unnecessary a capital expenditure for additional floor space.

They have the further advantage of being comparatively noiseless, whereas a room equipped with braiders is so noisy that one has to strain to carry on a conversation. Progress of this kind, which makes working conditions more pleasant for the operating force, is, of course, highly desirable.

While many developments of this character have been perfected by our engineers, there are numerous others which do not involve such fundamental changes in manufacturing methods and equipment. All of them, however, are directed toward reducing costs, and substantial savings are often made possible by relatively simple innovations.

Annual cost savings of about $2.50 are realized for each dollar of expense incurred by our development engineers, and these savings continue to be realized throughout the life of the particular product design or until some still better method of producing it is evolved.

The improved processes of manufacture are frequently simpler than the ones they replace and it is an interesting fact that in addition to reducing costs they almost always improve the quality of the product, either through raising the quality level, or by bringing about greater uniformity of quality among the articles turned out.

As the manufacturing development engineers not only keep informed regarding advances in manufacturing practices made by other companies, and in other countries, but in addition carry on original development work on processes having special application to our business, they provide for the company the assurance that there will be continual progress in the manner in which its manufacturing operations are conducted.

Product Manufacturing Organization

In organizing the shops which perform the actual manufacturing work, every effort should be made to eliminate divided responsibility as its presence inevitably leads to confusion and inefficiency. For this reason, it seems desirable to set up the producing end of a manufacturing organization in such a manner that a single executive will be in charge of the manufacture of a given class of product, and will have the responsibility for producing his own parts, for meeting production schedules, for realizing low costs, for turning out a product of satisfactory quality, and for maintaining harmonious labour relations in his shop.

Our manufacturing work at one time was organized on a functional basis, under which the production of all shops was controlled by a centralized production department; all inspection work reported to a centralized inspection organization; so that, for example, the punch press parts for all products were made in one department, screw machine parts for all products were made in another shop, and so on.

Where the number of different products made is relatively small, this functional type of organization is often a good one. However, where a great variety of products are made and the demand for the different classes of products is large enough to require the continuous use of a fairly large group of machines, organization on a product basis is likely to be more efficient.

While our manufacturing activities are still carried on in large works, the operations have been decentralized into several separate self-contained shops, each of which performs practically all of the manufacturing operations involved in turning out a given class of product.

The division of machines of the same type among several product shops makes their use somewhat less flexible for handling peak demands for a single product than when they are all installed in one shop and are readily available for making parts for any product. A slightly higher investment in plant equipment may result from such a division, for on some classes of work, such as plating, several small installations are more costly than a single large installation of equal capacity. This disadvantage, however, is more than offset by the many other advantages which result.

Manufacturing intervals, under the product shop organization, are much shorter; the investment in process materials is substantially reduced; routines and paper work are greatly simplified; and less non-productive help is needed.

Our experience indicates that decentralized product shops within large works provide the advantages of the small type of shop without losing the advantages of a large works organization.

An important responsibility of management is to establish reports and methods of control which enable it to keep informed on how each unit of the organization is performing. For this purpose a stimulus for continued improvement in a shop's performance is provided in our organization by monthly control reports which show not only the shop's overall result, but its performance on the various elements which contribute to it, and which give a direct comparison of these current results with those of past months.

Where the enterprise is of such a size that the manufacturing operations can be divided among several product shops, the competitive spirit which can be developed by comparing one shop's results with those of the other shops can be made an additional incentive for increased efficiency.

Measuring Shop Efficiency

Such comparisons are made possible in our business through the use of standard costs and annual budget studies which convert them to a budget cost level for the expected rate of activity. Standard costs are based on engineering study and represent the costs possible of realization under efficient manufacturing conditions when working at the full operating capacity. Standard costs adjusted for the expected activity of a shop provide a fair bogey against which to measure its current cost performance. The standard cost level for each shop is adjusted to a budget cost level, taking into consideration the expected activity, the improvement which it is felt the shop should make in its operating efficiency, and the effect of expected improvements in methods of manufacture. Each shop is credited for its output priced at this "budget cost level," and it is charged with all costs which it incurs. The effect of variations in raw material costs is eliminated by charging raw materials to the shops at uniform prices throughout the year. The difference between the charges and credits represents its performance tested against its budget and is a measure of its operating efficiency. The resulting figure is called "shop profit."

In the monthly shop control reports it was found helpful to record for each shop its performance on a number of different elements and to rate each shop on each item in comparison with other shops.

A portion of this control report, with certain months eliminated for reasons of space, is given in Fig. 7, and shows the items used for the control of shop operations.

In the columns headed RES, the shop's results for the month for each of the items are shown. In the adjacent column headed RAT the shop's relative rating in comparison with other shops is shown.

The first column shows the objective established for the 1939 budget and the last column, those for the 1940 budget in comparison with 1939 results.

The starred items are the ones used in determining the shop's overall rating as shown on the bottom line of the report.

(a) Activity

On activity, which is the relation of current activity to normal activity, this shop stood sixth for the month. The shop has no control over this item and it is recorded merely to show the activity trend and how current activity compares with that on which the budget was based.

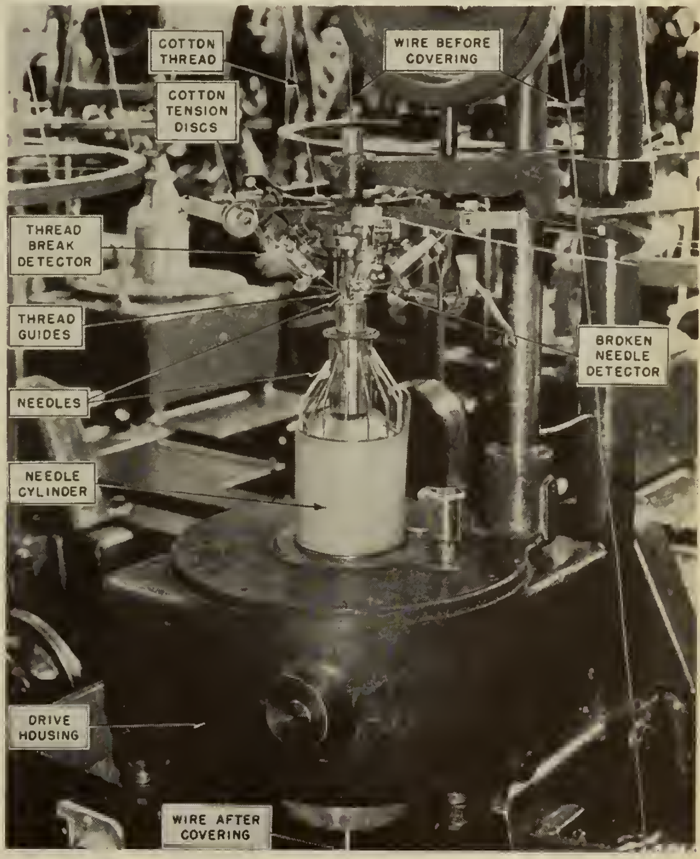

Fig. 6—Knitting Machine Head.

RESULTS REPORT
GENERAL APPARATUS
SHOPS

	1939 BUDGET		JANUARY		JUNE		OCTOBER		DECEMBER		CUMULATIVE 12 MONTHS		1940 BUDGET ON 1939 BASIS	
	RATING	RES	RAT.	RES	RAT.	RES	RAT.	RES	RAT.	RES	RAT.	RES.	RAT.	RES.
1. ACTIVITY	9	33.8	10	32 1	10	35 4	10	39.6	9	42.3	9	36.2	8	43 6
2. EMPLOYEES-NO. AT END OF PERIOD														
TOTAL	5	1,089	5	922	5	991	4	1,103	5	1,131	5	–	5	1,138
DIRECT	X	907	X	743	X	816	X	936	X	959	X	–	X	974
EXPENSE	X	182	X	179	X	175	X	167	X	172	X	–	X	164
% EXPENSE OF DIRECT	5	20 1	5	24.1	5	21 4	5	17.8	5	17 9	5	–	5	16.8
3. PRODUCTION-VALUE AT STD. COSTS	X	$4,605	X	$330	X	$430	X	$534	X	$550	X	$5,605	X	$6,814
4. MDSE. INVEST.-AT END OF PERIOD														
AMOUNT	X	$994	X	$915	X	$840	X	$896	X	$980	X	$ –	X	$1,102
* NO. OF WEEKS STOCK	8	9 3	5	8 5	4	67	5	6 4	5	6.6	5	–	5	6.5
* 5. QUALITY-REL. OF ACTUAL TO STANDARD	X	–	1	1000	1	1000	1	1000	1	100.0	2	99.9	X	–
* 6. ACCIDENTS-FREQ RATE PER MILLION HRS	X	–	8	23 6	7	31.4	3	5.7	3	8.1	7	14 0	X	–
* 7. SUPERVISORS-NO OF EMPLS. PER EACH	10	14.0	8	13.0	7	14 0	5	16 2	5	15 8	5	–	5	16.0
* 8. INSPECTORS-NO OF PROD. EMPLS. PER EA.	2	13.0	3	9 3	2	11 4	2	13 5	1	16.1	1	–	1	16.5
9. EQUIPMENT REPAIR COST-VARIATION FROM BUDGET														
* % SURPLUS	X	–	5	+9 8	8	+2 3	10	-5 5	11	-2 1	8	-.1	6	–
AMOUNT SURPLUS	X	$ –	X	$+1.8	X	$+ 5	X	$-1 4	X	$- .7	X	$-6	X	$ –
* 10. PRODUCT LOSSES-JUNK, REPAIR, & CONVERT. PER $1 OF OWN PRODUCTION	4	$.010	8	$.019	5	$.012	3	$.009	2	$.009	5	$.010	5	$.008
11. EXPENSE-BUDGET BASIS														
* PER $1 OF OWN LOADING RETURNS	X	$1.00	5	$1.01	6	$1.01	6	$.91	4	$.90	6	$.95	4	$.89
AMOUNT SURPLUS	X	$ –	X	$- .7	X	$- 5	X	$+7 9	X	$+8 2	X	$+53.2	X	$+120.0
12. SHOP PROFIT ON PRODUCTION (A)														
TOTAL SHOP PROFIT	X	$ –	X	$+ 3.7	X	$+16 0	X	$+18.7	X	$+19.8	X	$+182.6	X	$+274.0
AMT DUE TO COST REDUCTION	X	$ –	X	$+ 4	X	$+ 1.5	X	$+ 1.1	X	$+ 1.8	X	$+ 14.5	X	$+ 34.7
AMT. DUE TO SHOP EFFICIENCY	X	$ –	X	$+ 3 3	X	$+14 5	X	$+17.6	X	$+18 0	X	$+168.1	X	$+239.3
* % PROFIT DUE TO SHOP EFFICIENCY	X	–	4	+ .9	1	+ 3 1	1	+ 3.1	1	+ 3.1	1	+ 2 9	1	+ 4 3
13. RELATIVE RATING EQUAL WEIGHTING OF (*) ITEMS	X	–	6	5 2	6	4 6	4	4 0	4	3.7	5	4.4	X	

(A) AMOUNT BY WHICH CURRENT COSTS ARE LESS THAN BUDGET COSTS WHICH AT EXPECTED ACTIVITY ARE 105 8% OF STANDARD COSTS.

APPROVED BY John Doe
SUPERINTENDENT

Fig. 7—Shop Control Report.

(b) RATIO OF EXPENSE HELP TO DIRECT HELP

The ratio of expense employees to direct employees has an important bearing on the shop's overall results.

(c) MERCHANDISE INVESTMENT

The control item here is the number of week's stock of raw and process material on hand. This is obtained by dividing the dollar value of this stock by the dollar value of a week's production. In this case the shop is turning over its investment about eight times a year.

(d) QUALITY is determined by check inspections made by our Manufacturing Engineering Department.

(e) ACCIDENT FREQUENCY is the number of lost time accidents per million hours of work.

(f) NUMBER OF EMPLOYEES PER SUPERVISOR

(g) NUMBER OF EMPLOYEES PER INSPECTOR

(h) EQUIPMENT REPAIR COSTS

The control item here is the percentage by which the repair costs exceed or are under the approved budget.

(i) MERCHANDISE LOSSES

This item covers the cost incurred by the shop in repairing, converting, or junking its own product per dollar of its own production.

(j) EXPENSE PER $ OF LOADING RETURNS

This is the relation of the expense incurred by the shop for all purposes, to the allowance in its budget costs for such purposes.

(k) SHOP PROFIT

This is the difference between the actual cost of its month's production and the amount received for it at the budget costs. If the shop just meets its budget costs, it breaks even; if it turns out its product at less than its budget costs it makes a profit.

Each shop is furnished monthly with copies of the Results Reports of all other shops and a summary which shows the relative rating of each shop on each item and its composite shop rating.

It may be felt that we are recording the performance on quite a large number of elements and that some overlap others. This is to some extent true, but the items chosen are those which we feel shop supervisors should be closely following.

It may also seem that this rating practice might cause a shop to put undue pressure on some item at the sacrifice of another one of importance. This situation is more or less self-regulating. If a shop should go too far in trying to obtain a high rating on number of employees per inspector, it risks getting an offsetting reduction in its quality rating. If it goes too far in holding down repairs to plant equipment it may get an offsetting rating not only on quality, but on the cost of repairing and junking its product, and also on its shop profit. Likewise, going too far in holding down the amount of supervision will bring about offsetting reductions in one or more of the other items.

With Results Reports of this kind, we have found that executive pressure on an organization to improve its results is practically unnecessary, as the stimulus for improvement is largely self-imposed. Each superintendent and his subordinates know just how the results of their shop compare in detail with those of other shops, and they also realize that these facts are known by the executives who receive the control reports. They naturally do not like to have their performance compare unfavourably and they do not need urging to try to improve it.

Training and Promotion of Supervisors

Sound organization and control procedures will not accomplish the results desired unless there are capable executives and supervisors to direct the work. Another important duty of management, therefore, is to see that its supervisors and executives are so trained and developed that they will be capable of taking over greater responsibility when the necessity arises.

Time is not available to discuss the training of first line supervisors, a very important subject in this day of increasingly difficult labour relations. Because not much has been written on the subject, it is of interest to mention one form of training, that is "rotational training," which we have found of great value in developing the higher, as well as lower supervisory personnel.

Two different methods of bringing about rotational training are employed, although the objectives and the results in both cases are the same.

The first consists of making rotations when no promotions are involved. Periodically we carefully review the supervisors in a given organization level and after giving consideration to their previous experience and length of time on their present jobs, we select a group which it is felt will benefit by experience in a different type of work. We then rotate each of these men to a job which has been held by one of the others, giving due consideration, of course, to the probability of their being able to handle the new job successfully.

A similar practice is followed in connection with promotions. When an opening occurs in a higher supervisory position, we consider for this position all of the people in the next lower level of all organizations and endeavour to select the man best qualified and most entitled to the promotion from the standpoint of accomplishment and service. This rotational practice provides a number of people in each organization level who have had experience in several phases of the business, and as a result, some man other than the immediate subordinate of the man whose position is to be filled is quite likely to be promoted to the vacancy.

The position held by this man is, of course, available for some one else and we generally take advantage of this to make a series of rotations. The position may be filled by a man in the same organization level from some other department and this move in turn may be followed by several other horizontal transfers, finally leaving a vacancy to be filled by promotion in a different department from the one in which the first promotion occurred. Thus, each promotion may bring about several changes in position in the next lower level of organization, as well as an advancement into that level from the one beneath it.

In making these rotations, men are frequently transferred from one kind of work to an entirely different kind. We have put a chemical engineer in charge of personnel work, accountants in charge of shop production departments, engineers on accounting work, etc. While we have at times felt a little uncertain about some of these moves, the results have been almost universally successful. A man who has initiative, keen analytical ability, and sound judgment will usually make good on any job he is put on, and a variety of supervisory experiences aids in developing these attributes. Quite often in making rotations we discover in a man latent abilities that had not been revealed in the positions which he formerly held.

Very often, if a supervisor remains too long in one position he may come to feel that the procedures followed in carrying on the work under him are about as good as can be employed and he may just ride along contentedly with the job. When a supervisor is rotated to a class of work about which he knows little, he has to study the whole job thoroughly. As he analyzes the work, his inclination is to question the logic and the soundness of the practices being followed, and very often he will conceive methods of performing some part of it in a more efficient manner.

This rotational training method is especially desirable during a depression period when moves can be readily made, and when there are usually few opportunities for advancement. Employees who have been on a job for a considerable period of time get quite a lift in their morale by being placed on another job which offers them an opportunity to acquire a wider experience and learn more about the business, even though the job to which they are transferred is in the same organization level and results in no increase in salary.

This training method is looked upon with favour by our supervisors as it not only gives them a broader knowledge of manufacturing practices, but makes it clear to them that opportunities for development and advancement are not restricted solely to promotion to the job directly above them.

The training which many of our supervisors had received as a result of this practice has enabled us without difficulty to reorganize our works from the "functional" type of organization, where the executive usually supervises a single function, to the "product" type of organization where the executive has to supervise many different types of work.

Management's Relations with Employees

One of management's most important responsibilities is to establish policies and practices which promote a high state of loyalty and morale in its force.

The subject of personnel relations can only be touched upon briefly here.

Our policies on personnel matters, which had long been in effect, were, in 1924, put into writing in a statement to supervisors. This statement, which is generally known throughout the organization as the Company's "Ten Commandments," is shown on the next page.

We have endeavoured to establish suitable practices to insure that these policies are made effective. Practices naturally change from time to time but the fundamental principles of employee relations outlined in these statements have remained basic throughout the years. Each of these statements is important and no company's personnel policy is complete which does not in some measure provide for all of them. The spirit exemplified by them has been absorbed by our higher supervisory and management personnel and it is the spirit reflected in their every day relationships.

While a broad gauge set of personnel policies is important, it is of still greater importance to have them well understood and sincerely lived up to by all supervisors. Much of our supervisory training is devoted to this end and the sincere effort on the part of our management and supervisors to fully live up to these policies has resulted in an efficient and loyal body of employees and harmonious relations throughout the organization.

In the troublesome times through which we have been passing the problem of security of employment has come to be one of the most important personnel problems faced by management. There is no problem more depressing than the one faced by management when due to lack of sufficient work it becomes necessary to lay off employees. This situation usually arises when other companies are also laying off employees and when the opportunity to secure employment elsewhere is very poor. The loss of his means of supporting himself and his family is one of the most serious blows that a man can suffer. Aside from the humanitarian aspect of this problem, there is nothing that has such a disastrous effect on manufacturing efficiency as violent fluctuations in personnel. There is no problem of which management is to-day more keenly aware than this one, and while much thought is being given to means of alleviating this distressing situation, its seriousness demands that even greater attention be given to it by management.

In our business we are fortunate in having a close family relationship with our customers and we get much help from them in our efforts to level out our load.

We have a Company Employment Stabilization Committee, which meets each quarter before the Sales Department releases its schedule on the factories for the next quarter. This committee, of which our works managers are members, studies the effect of the proposed schedules on the employee force. If it appears that it will have a serious effect, either up or down, the Sales Department representative takes the matter up with our customers and by this method and by adjusting the size of their own merchandise stocks endeavours to arrange the schedules so as to make the load a more satisfactory one from an employee force standpoint.

While the results obtained through this procedure assist us in maintaining a reasonably uniform force during more or less normal business periods, it, of course, can accomplish little when the whole country is in the throes of a severe depression.

There are some things that a business can do to alleviate the seriousness of the situation during these periods, such as building up stocks of merchandise beyond the current needs, carrying on plant maintenance work which might otherwise be deferred, and undertaking certain "made work" programmes covering steps which are desirable but not necessary at the time.

Such things all cost money at a time when profits are low or non-existent. To provide funds which will enable us to carry on such activities for maintaining employment during depression times, we have recently instituted the practice of building up during good times a reserve for this purpose, known as an "Employment Stabilization Reserve."

Conclusion

The views expressed in this paper can be summarized by saying that a manufacturing organization to be efficient must have:

1. An effective plan of organization of its various activities.
2. An experienced and capable management staff constantly trying to develop improvements in policies and practices which will aid in bringing about better company performance.
3. A force of competent manufacturing engineers constantly striving to develop and introduce better and cheaper materials and methods of manufacture.
4. A staff of alert and capable supervisors and effective provision for training them.
5. A system of reporting operating results which enables management and the supervisors to know what *is* happening as related to what it is thought *should be* happening in each operating unit.
6. A broad industrial relations policy, so administered as to inspire in the employee force a loyal and enthusiastic interest in the company's work and a morale conducive to co-operative effort.

In actual practice the various responsibilities of management are so interwoven that the day-by-day job of management becomes one of dealing with an ever changing series of overlapping problems, and of giving the proper weighting to each of them in arriving at its decisions.

It is this changing panorama which we all have to meet that challenges our best efforts.

To build up a successful and efficient manufacturing organization requires time, patience, and persistent effort. There is no short cut to success. Each organization must work out its problems for itself, drawing on the experience of others for assistance, but using its own experience as its chief guide.

My remarks have dealt with certain general lines of management policy along which we have been able to make progress in our business. I shall be happy if this address will be of value to you in the solution of your problems.

RELATIONS WITH EMPLOYEES

To Employees Responsible For Directing The Work Of Others

It is the purpose of this statement to promote a more complete understanding of the Company's Employee Relations Policy. Attention is called to your responsibility for carrying out all of its provisions and to the methods adopted for maintaining uniformity of practice in all departments of the Company.

Although Personnel Departments have been established to advise and assist executives and supervisors in their dealings with employees, responsibility for making the policy effective in the every-day relationships with all employees must rest with you.

Right relations with employees is one of the fundamental elements in the success of the Company, and must be founded upon the conviction of every employee that the policies of the Company are based upon a spirit of justice in its dealings with every person with whom it comes in contact.

It is the policy—

I. To pay all employees adequately for services rendered.

When the individual records of all employees are reviewed periodically, it is your duty to see that their rates of pay are adjusted fairly. Compensation should be based upon ability, responsibility, length of service and capacity for growth, giving due consideration to cost of living, general business conditions and wages paid by other concerns in the same territory for comparable work.

II. To maintain reasonable hours of work and safe working conditions.

Special attention must be paid to conserving the well-being of employees in equipping and maintaining shops, warehouses, offices, restaurants and rest rooms and other facilities for comfort and convenience. Careful consideration must be given to hours of work, vacations, medical service and payment in case of absence.

III. To provide continuous employment consistent with business conditions.

In the management of the business a continuous effort must be made to provide steady work and permanent employment. When reduction in force is unavoidable, consideration should be given to retaining long-service employees. When additions are made to the force, preference should be given to former employees. Continuity of employees' service records should be guarded.

IV. To place employees in the kind of work best suited to their abilities.

Consideration must be given to placing each employee in the kind of work which offers opportunity for his maximum growth and usefulness. Great care should be used in assigning employees to work when they are first employed, and trial should be given on different types of work when necessary.

V. To help each individual to progress in the Company's service.

When vacancies occur, those already in the Company are entitled to first consideration. Every employee should understand the relation of his work to that of the Company as a whole, and there should be provision for training on the job, variety and progression of experience. Information and advice should be made available for those wishing to take advantage of outside educational opportunities.

VI. To aid employees in times of need.

It is necessary for you to understand fully the purpose and scope of the Employees' Benefit Plan for giving aid in times of disability due to sickness or accident, and for granting retiring allowances. You should keep informed regarding loan funds available for meeting other emergencies.

VII. To encourage thrift.

You are responsible for keeping your people informed and interested in the Stock Purchase Plan and other means available for encouraging thrift. Employees desiring information and counsel should be put in touch with those best qualified to advise on matters of home buying or building, use of banking facilities, insurance programs and other personal financial problems.

VIII. To co-operate in social, athletic and other recreational activities.

Encouragement may be given by supplying facilities, by sharing in the operating expenses of organized activities of this character, and by making better use of opportunities existing in the community.

IX. To accord to each employee the right to discuss freely with executives any matter concerning his or her welfare or the Company's interest.

It is your duty to establish the conviction among those whom you direct or with whom you come in contact that sympathetic and unprejudiced consideration will be given to any employee who wishes to discuss with you and with Company executives matters of his or her welfare or the Company's interest.

X. To carry on the daily work in a spirit of friendliness.

As the Company grows it must be more human—not less so. Discipline standards and precedents become more necessary with size, but the spirit in which they are administered must be friendly as well as just. Courtesy is as important within the organization as in dealing with outsiders. Inefficiency and indifference cannot be tolerated, but the effort of supervisors must be increasingly directed at building up in every department a loyal and enthusiastic interest in the Company's work.

THE NEED OF WATER CONSERVATION IN SOUTHERN ALBERTA

MAJOR F. G. CROSS, M.E.I.C.
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An address delivered before a joint meeting of the Lethbridge Branch of the Engineering Institute of Canada and the Association of Professional Engineers of Alberta, at Lethbridge, Alberta, on October 25th, 1939

Those of us who live in the southern part of Alberta often use a pleasant expression, "Sunny Southern Alberta." It is not only a pleasant phrase but it also acts as a smoke screen to cover the tragedy of the homesteader. You know the fellow:

"Eyes burned out with the summer sun,
Face like a beefsteak—underdone.
You'd think him fifty—he's thirty-one,
But then he's an homesteader.
Summer was dry and nothing grew,
So he sells his gun and a cow or two
And hopes—does the homesteader."

Our brown prairie soils are the most fertile in the world; we have long hours of sunshine but unfortunately natural precipitation is insufficient to provide stabilized living for our people on the land. We live in a semi-arid region, known as part of the great American desert which reaches down into Mexico. Over a long period of years the average rainfall of much of southern Alberta is less than ten inches in the crop growing period, April 1st to July 31st. During the last thirty-six years the average total from March 1st to September 30th has been only 12.04 in. and for sixteen of these years the precipitation for the same seven month period ranged from less than five to ten inches. As you are aware, public enemy number one of this meagre moisture is brilliant sunshine and warm winds; evaporation takes heavy toll of ground moisture. The average evaporation for the period May 1st to October 31st, during the last seventeen years, has been 27.92 inches. In 1936 it was 38.3 in.; 1937, 29.16 in., and 1939, 22.58 inches. This situation was known many years ago, even though very few records were available. As early as 1893, the cause of irrigation and water conservation was so advanced that the Lethbridge Board of Trade passed a resolution which was moved by Mr. C. A. Magrath and seconded by Mr. W. A. Galliher—"That the promotion of irrigation in this district of southern Alberta is absolutely necessary for the development of the district, and it is deemed advisable to place the matter properly before the Government and that 'A Joint Commission' composed of men from Lethbridge, Macleod and Calgary be appointed to collect evidence, statistics, etc., and that we set aside $200.00 to cover the necessary expenses."

And so Lethbridge reached out and grew up. Without the foresight of those pioneers, without irrigation, the city of Lethbridge would still be a cow town. The work of public-spirited men made possible the existing development which benefits the whole of Canada. The present aspect would have been very different if the lands stretching east along the southern part of our province had been used solely for raising a few head of stock. To illustrate, look at a picture in August, 1939:

High up in the sky, out of the east, comes a plane winging its way westward; the pilot and passengers look down on a carpet of gold, interspersed with emeralds linked together with silver strands. The carpet of gold is ripening grain; the emeralds are fields of alfalfa, timothy, sugar beets, or vegetables; the silver strands are lifegiving water, flowing in irrigation ditches. Technical skill and efficiency have given to these lands—cattle, crops, hay, irrigation, fruit, flowers, honey bees and homes—in other words, water conservation.

Since 1900, private enterprise has expended large sums of money on irrigation and conservation projects. Some of these projects have been disappointing, but this fact should not affect the issue of future water conservation. Our past troubles have been largely growing pains, aided and abetted by unintelligent diet. We can rectify the diet and go forward to ultimate triumph, benefiting by past experiences.

There are numerous water development schemes which can and should develop in Alberta and Saskatchewan, all worthy of thought by engineers and business-men. The limited time to-night must be devoted to an urgent message for this Joint District Meeting of Engineers, regarding the waters of the Milk and St. Mary rivers, the flow of which is covered by international treaty.

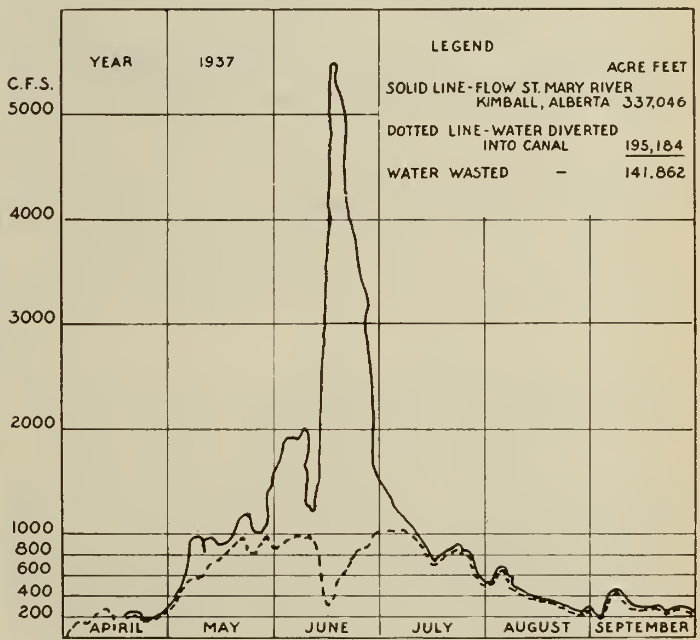

Fig. 1—Flow of St. Mary river in 1933.

The water supply for a vast area of land south and east of Lethbridge comes from streams which have their origin in the United States and flow northward into Canada. This has created an international problem.

The Canadian Government having granted to the Canadian North-West Irrigation Company the right to divert the entire flow of both the St. Mary and Milk rivers, the company proceeded to construct an irrigation canal from the St. Mary river, at a point three or four miles north of the international boundary, known as Kimball, Alberta. This aroused the interest of the Montana people, and the fear that they would be deprived of water which they claimed belonged entirely to them. The agitation south of the line rapidly increased in intensity. Surveys by United States engineers showed the possibility of diverting the St. Mary river over into the Milk river. Such a procedure would apparently mean ruin to the Canadian company.

The United States commenced the construction of a canal south of Babb in Montana to divert the waters of the St. Mary in an easterly direction into the Milk river, but they lost sight of the fact that the Milk river flows north into Canada at a point south of what is now the village of Del Bonita, Alberta, and then flows east in Canada for approximately one hundred and fifty miles, before it passes back into the United States. As soon as this was realized, further investigation and surveys showed that while it was possible to divert the Milk river by building an "all-American canal," the cost would be prohibitive. The work was started on this canal, and some thousands of dollars were expended before the project was abandoned as unprofitable.

All this was very disquieting to the Canadian company, and in 1903 the Canadian North-West Irrigation Company built diversion works on the Milk river at a point downstream from where the United States discharged the St. Mary river water into the Milk river. The Canadian company also built 14½ miles of canal, crossing the Milk river ridge in Alberta, to a coulée running into Verdigres lake; water was turned into it November 17th, 1904. This canal has never been used since, but it demonstrated that in the event of failure to reach an understanding with the United States, and if water were diverted from the St. Mary river into Montana to the detriment of the Canadian

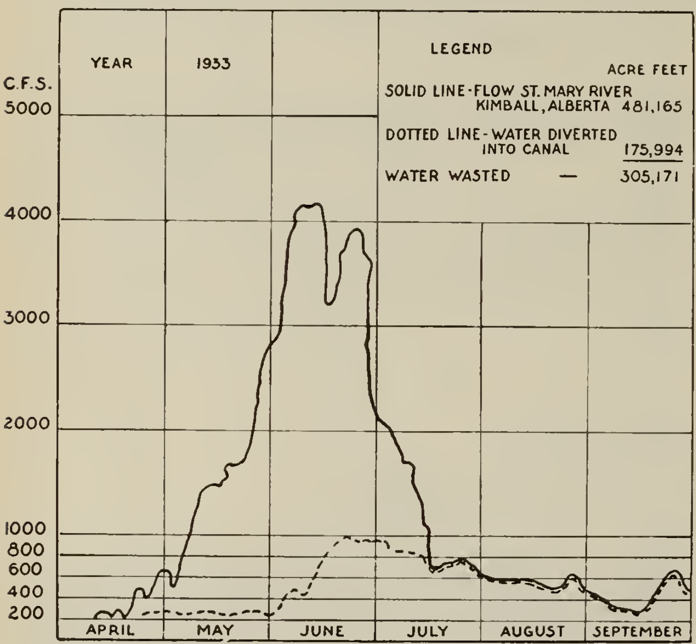

Fig. 2—Flow of St. Mary river in 1937.

canal, then Canada could take water from the Milk river and carry it northward, along the eastern slope of the Milk river ridge, to a point a few miles northwest of Raymond, Alberta. The people of the Milk river valley in Montana, feeling their rights were endangered by the construction of the Canadian canal, now urged their Government to enter into an agreement with Canada on the question of the joint use of these two streams.

As a result, a treaty was signed by the United States and Great Britain on July 11th, 1909, which provided that the St. Mary and Milk rivers and their tributaries in the state of Montana and the provinces of Alberta and Saskatchewan are to be treated as one stream for the purpose of irrigation and power, and that the waters thereof should be apportioned equally between the two countries.

In partitioning the waters, the International Joint Commission gave the United States priority right on the Milk river as follows:—During the irrigation season, when the natural flow of the river at the point where it crosses the international boundary for the last time is 666 cu. ft. per sec. or less, the United States should be entitled to three-fourths of the flow and Canada one-fourth. When the natural flow is more than 666 cu. ft. per sec. the United States should be entitled to a prior appropriation of 500 cu. ft. per sec. and the excess over 666 cu. ft. should be divided equally between the two countries.

On the other hand, Canada has priority right over the United States on the St. Mary river. When the flow is 666 cu. ft. per sec. or less, Canada is entitled to three-fourths of the flow and the United States one-fourth. When the flow is in excess of 666 cu. ft. per sec., Canada is entitled to a prior appropriation of 500 cu. ft. per sec. and the excess over 666 cu. ft. is divided equally between the two countries.

Both rivers have their sources in Glacier National Park, Montana, and the St. Mary head-water drainage basin covers an area of approximately 278 sq. mi. of which 208 sq. mi. are above 5,000 ft. elevation. This drainage basin includes two sub-basins, one known as Swift Current creek and the other as Red Eagle. The United States have constructed a reservoir in Glacier National Park on Swift Current creek, which is known as Sherbourne lake. The designed capacity is supposed to be 75,000 acre feet, but owing to some difficulty encountered with an earth-bank or shoulder immediately north of the overflow spillway, the safe capacity is only 60,000 acre feet. Spring floods on the Swift Current creek are impounded in this reservoir and released to good advantage of the United States when the natural flow is low. Actually their share of the natural flow of the St. Mary river, plus water impounded in Sherbourne lake, is diverted through a canal having a carrying capacity of approximately 800 cu. ft. per sec., the diversion works being in the vicinity of Babb, Montana. The outlet end of this canal discharges into the Milk river in Montana, south of Whiskey Gap, Alberta. Following several years work and the expenditure of considerable money, they have brought to completion the construction of a large dam across the Milk river, just west of Havre, Montana. This is known as the Fresno dam, and is capable of impounding flood water amounting to approximately 250,000 acre feet.

The present flow capacity of the Canadian company works which divert water from the St. Mary river, is between 1,100 and 1,200 cu. ft. per sec. After snow in the head-water valleys has melted, (usually the last week in June or early in July), the natural flow is confined to the melting of glacial ice, plus local showers and the flow falls away as the season advances at a rate proportionate to declining temperature at high altitudes. This causes shortage of water during July, August and September.

While Canada is supposedly in a favourable position regarding the international treaty, the situation is in reality adverse. We have not made beneficial use of our rightful share of the water. In 1921 the International Joint Commission urged the creation of reservoirs by the United States and Canada to conserve the winter flow and spring flood waters of the two streams and to ensure the greatest beneficial use of the same to both countries. The United States have pressed steadily forward, and are now in a position to make beneficial use of most of their share of the waters of both streams. Canada has done nothing. Our present beneficial use of the water of the St. Mary river is approximately 46 per cent. of our share.

This critical situation can no doubt be rectified by quick action. Canada could impound her share of spring flood and winter flow water by the creation of a reservoir on the St. Mary river, at a point west of Spring Coulée and north of Raley. This appears to be an excellent site for a dam capable of impounding from 250,000 to 300,000 acre feet of water, at very reasonable cost, estimated at not more than $10.00 or $12.00 per acre foot of storage capacity. Beneficial use of the water so impounded can be obtained at moderate cost, as fortunately, there are four subsidiary natural reservoir sites capable of impounding a further 300,000 acre feet of water and these sites, situate north, south and east of the main reservoir, could be linked up by the construction of arterial canals.

Our Government engineers have a wealth of records and information on stream flows; further, that very capable organization, The Prairie Farm Rehabilitation Association, has made a close study of these international streams during recent years. It is understood that sufficient water is available not only to give security to those people presently farming irrigable land in the vicinity south and east of Lethbridge, but also to irrigate an additional 390,000 acres of land within the area known as the proposed Lethbridge South-Eastern District, which extends toward and south of Medicine Hat.

The ability to bring this additional area under irrigation at reasonable cost is a factor worthy of consideration from another angle—namely, as a war measure.

Essential food-stuffs are sinews of war; we are urged to mobilize and step-up production as part of our present war effort. Nations and their fighting forces cannot live on grain alone; they need meat, wool, sugar and other food products. We in Alberta now have a marvellous opportunity if able to utilize our natural resources to produce more and more essential food-stuffs.

After the war there will undoubtedly be a great movement of capital and people to Canada; let us bring into Alberta an additional million people to help consume the greater production from our soil.

For years it was left to private interests of the "empire builder" type to meet the cost of water conservation and development; they in turn expected that their investments would be made remunerative by the settlers on the projects. Nothing in the way of help toward paying the bill was expected from the business and professional persons living in and around such projects, or from manufacturers and people in other parts of Canada who were benefited by the results of greater production from the soil, due to water conservation.

To-day, governments and businessmen generally agree that the man on the land should not be called upon to bear any part of the capital cost of water conservation projects, because they are national in their importance, just like ship canals, or harbours. National undertakings in time of war should be subject to curtailment unless definitely established as a war measure. The situation regarding winter flow and spring flood water of the St. Mary river is more than national—it is international, and therefore should receive immediate and earnest consideration.

During the past few months a strong organization has been formed, namely, The South Alberta Water Conservation Council, whose president is present to-night. The purpose of this organization is to develop concerted action on the part of our people and to impress our Governments with the necessity of action.

It is my earnest plea that this Joint District Meeting of Engineers will give the South Alberta Water Conservation Council the fullest support, evidencing this by adopting a resolution to that effect.

THE DESIRABILITY OF INVENTORY VERIFICATION BY INDEPENDENT ENGINEERS

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Recent years have witnessed a marked growth in the amount of information presented to the public in the reports of incorporated companies. Particularly is this true in the use of the published annual report as a public relations builder. Many of the larger corporations in the United States are now spending a considerable amount of time and money to prepare reports which disclose interesting and informative material on the corporation's activities, for the purpose of creating favourable public opinion. An extension of this practice is the employment of independent engineers to complement the work of the public accountant in verifying values, and the publication of the engineers' certificate in the company's annual report.

Inventory Verification Complementary to Auditors' Function

The work of the engineer in inventory verification is not a substitute for the work of the auditor in certifying the accounts, but is complementary to it. Almost invariably the public accountant conducting the annual audit of a corporation has neither the time nor the opportunity to do more than test the clerical accuracy of inventory pricing and review the book records, or, in instances where they have taken a physical count, the procedure followed by the company personnel. Usually the auditor is not present when the physical count, if any, is taken. In order to protect himself and to keep faith with the public, therefore, the auditor is usually forced to qualify his certificate as regards inventory values. Frequently these qualifications are very sweeping in nature. For example:

> "The quantities and conditions of inventories were certified to by the management and the prices and extensions tested by us"; or
>
> "The inventory records were reviewed by us and appear to be correct, and in substantiation of inventory quantities we have accepted certificates from officials of the company"; or again
>
> "The inventories, taken and priced by the management, were reviewed by us as to clerical accuracy and pricing and it is our opinion that the valuation has been established in accordance with accepted practice."

Where the inventory constitutes a large part of the total assets (as in the liquor industry where it amounts to upwards of 50 per cent), or where the inventory makes up a large part of the available working capital (as in such industries as canning, meat packing, lumber and paper where it amounts to 75 to 90 per cent of current assets), the qualified statement of the public accountant does not provide definite proof of the integrity of this important element of the balance sheet. But a definite statement such as the following, which appeared on the balance sheet of a large distilling corporation last spring, gives assurance of integrity to the inventory valuation.

> "Inventories of new, maturing, and matured whiskey and other spirits, imported products, materials and supplies and distillations in process, at the lower of cost or market (physical quantities and condition determined under direction of Blank, Consulting Engineers, as per their certificate on page —)."

Reference to the engineers' certificate discloses a concise, definite statement of what they did and what they verified, without qualification.

> "In accordance with our engagement by you, we have prescribed the general procedure for and directed the taking of physical inventories of products, materials and supplies located at all of the distilleries and more important warehousing points of Blank Corporation and its subsidiary companies as at December 31, 1938. In connection therewith, we made test counts and inspections which we considered appropriate as to the quantities and condition of such products, materials and supplies and as to the accuracy of the Company's records with respect to quantities, ages and types thereof.
>
> "Based on the foregoing, we certify that in our opinion (a) the physical quantities of the aforesaid products, materials and supplies as of December 31, 1938, as shown on the Company's records thereof are correct and (b) the aforesaid products, materials and supplies were in good physical condition."

Practice of Benefit to Investors, Bankers and Public

The elimination of the possibility or suggestion of fraud in the conduct of any enterprise is definitely in the public interest. The most obvious example of fraud which would have been prevented if such an independent verification of inventory had been made, is that of the McKesson and Robbins case which was in the headlines a little over a year ago. There, not only were many of the goods non-existent, but even the warehouses where some of the stocks were reputedly kept were fictitious. While it is true that most enterprises do not conduct their affairs in the same manner as the former management of McKesson and Robbins, still it is just such instances which arouse suspicion in the public mind. The best method of laying a ghost has proved to be to drag him into the light. There is room for little doubt as to the existence of the physical quantities behind the inventory value when these have been verified by an unbiased third party of established reputation.

An important element in the engineers' appraisal of the inventory is that the condition and grade of the goods are given independent inspection. Thus the presence of obsolescence in any part of the inventory is brought to light. Goods in doubtful or unsaleable condition are noted and their deterioration in value allowed for when valuing the inventory. In other words, the commercial utility of the inventory can be certified as well as the physical quantities involved. In situations where the condition of the goods is subject to considerable variation, and where this might be questioned, the engineers' certificate eliminates such doubts as to the integrity of the dollar value.

From the investor's and banker's point of view, a definite certification of inventory value which can be relied upon removes the last major item of indefiniteness from the current assets and working capital. There is no difficulty in having the auditors count the cash or appraise the value of marketable securities. It is also quite possible for the auditors to satisfy themselves as to the net value of receivables on the balance sheet. But with inventories, there is no substitute for an actual physical count and appraisal.

Such definite and reassuring information is valuable to the investor, to the banker contemplating an extension of credit, to the investment banker considering the advisability of a new public issue of securities, and to suppliers dealing with the company. All of these are vitally interested in knowing, at least insofar as an accurate presentation of the current position can disclose this condition, that the company is in sound condition to continue in business.

Benefits to the Company Itself

Naturally, the reflex of the above is good for the company. Not only is it established in the public mind as being above reproach, but the impression is created that the management are anxious to take the public into their confidence—that they have nothing to conceal.

The favourable publicity received in the press, since it is unsolicited, is of utmost value. Upon the occasion of the above mentioned distilling corporation publishing its annual report containing the engineers' certificate as to inventory valuation, the New York papers carried stories of this procedure in the news columns of their financial pages and financial writers commented favourably. Thus a considerable amount of goodwill was created for the company directly as a result of taking such a step.

Under present-day conditions of large scale, widespread operations, the advisability of the management obtaining independent, third party checks on the adequacy and reliability of their control records and mechanism is becoming generally recognized. The fact that the management does this is prima facie evidence of their endeavour to protect both their stockholders and the public from any unconscious misrepresentation. As a matter of fact, the president of a company, who can face his annual meeting of stockholders secure in the knowledge that he has a ready answer for the recalcitrant stockholder who gets up and demands to know what actual proof there is that the amount shown for inventories on the balance sheet is really in existence, is in an enviable position.

As in many circumstances where an expert is employed for one purpose, there may be by-products of the main investigation of considerable value. It is entirely probable that, in his review of company procedures and records, the engineer, on the basis of his experience with other companies, will see places where improvements are possible. These are not necessarily restricted to improvements in inventory control and stock-taking procedures, but frequently they cover also the storing, handling and even purchasing of materials.

Engineers Qualified for the Work

The American Institute of Accountants has last year, on the basis of its study of the need for extending auditing procedures, been very explicit in laying down a line beyond which the public accountant should not be expected to go in certifying inventories. In the report of the Special Committee on Auditing Procedure, dated May 9, 1939, the following remarks appear:

> "In making, or observing the making of, physical tests by count, weight or measurement, the independent certified public accountant does not hold himself out as, or assume the responsibilities of, a general appraiser, valuer, or expert in materials."

It is here, then, that the engineer's role is so important. He is an expert in dealing with materials, supplies, products. He has a general knowledge of plant procedures and production processes which enables him to make an accurate check of goods in process, for instance, which it is not possible to count directly. In specialized businesses where the precise condition of the product is an important element in valuing the inventory (such as tobacco, whiskey, etc.), the engineer can hire an expert in these commodities to test the quality. In such cases these experts are responsible to the engineer, and it is the latter alone who is responsible to the client.

The fact that the independent consulting engineer has a reputation for integrity which, above all else, it is important to him to maintain, and that the engineer is inherently conservatively minded, is the prime reason why his certificate is of unquestionable value in the opinion of the public. It is this that the client relies upon when hiring the engineer to do such work for him.

There is no desire on the part of the engineer to trespass on the ground of the public accountant in these matters. Each has a function to perform which is complementary to the other. The work of the engineer lightens the burden of the auditor without in any way detracting from his value or effectiveness. Close co-operation between the two is essential. The accountant picks up where the engineer leaves off. In some instances it may even be advisable to have an interlocking reference between the certificates of the engineers and auditors.

From the client's point of view, the definite check obtained on an important balance sheet item and the valuable intangible benefits received greatly outweigh the small additional cost involved.

In conclusion, then, we may summarize the special qualifications of the engineer for this class of work as follows:

(a) His training and experience admirably fit the requirements of dealing with materials, products and industrial processes.

(b) His familiarity with estimating and computing procedures, and his recognized practice of testing computations and theories inspire confidence in his results.

(c) The recognized professional qualifications of the engineer are definite assurance to the public that the the work has been capably handled.

(d) The reputation for integrity, which is the engineer's greatest asset, definitely establishes the reliability of the amounts certified by him on the balance sheet.

CONCRETE REPAIR METHODS

CLAUDE GLIDDON, A.M.E.I.C.
Chief Engineer, Gatineau Power Company, Ottawa, Ont.

Third Section of Report of the Committee on the Deterioration of Concrete Structures

After ten years experience in applying various methods of concrete repairs during which there have been tried out different types of cement paints, gunite, concrete coverings containing various admixtures and ordinary concrete coverings, the Gatineau Power Company now uses ordinary concrete almost exclusively in making concrete repairs. A covering of good concrete from 1 in. to as much as 30 in. thick and with or without reinforcing steel is used depending on the particular type of repair to be accomplished.

This company realizes that the making of good concrete requires special care and experience and with this in mind has adopted the following procedure:

(1) In all important repairs only labour experienced in this type of work is used.

(2) An experienced engineer must be present during all the time concrete is being placed. His instructions must be followed implicitly by those making and placing the concrete.

Fig. 1—Reinforced concrete covering on spillway dam. Thickness 12 to 30 in. depending on condition of old concrete. At left: old concrete surface. Left centre: chipping proceeding. Centre: chipping including joints completed. Right centre: reinforcing installed, joints concreted in. Some of the latter contain concrete tile for drainage of leaks. Right: completed covering.

(3) Only materials which are known by test to be suitable are used. Crushed limestone and sand are generally used although a certain amount of concrete is made in which screened gravel is used. The latter is preferred where it is available since a smaller percentage of fine aggregates is required resulting in less cement and more durable concrete.

(4) The mix is designed to suit the particular job and having regard to the materials available. Two sizes of crushed stone are usually used in the thicker coverings.

(5) All ingredients are weighed or measured by volume.

(6) As cement is considered to be the least durable of the elements in concrete, a minimum of cement is used consistent with good design.

(7) Water-cement ratio is used to give between 3,000 and 4,000 lb. 28-day strength for the thicker coverings and between 4,000 and 5,000 lb. for the thinner coverings.

(8) A mixing time of at least two minutes is used.

(9) Before placing the concrete repair covering, as much as possible of the old loose and disintegrated concrete is removed. The surface is then cleaned by picking where necessary and by air blasting. The surface is then water blasted (using an ordinary injector scheme connected to the regular air line). After thorough saturation all excess water in depressions is removed. This is followed by blasting with a water-cement paste to give a thin coat; after half an hour or when this coat has become tacky, another coat of water-cement paste is applied and about a half hour to an hour later the concrete covering is applied.

(10) In all but the thin coverings the concrete is vibrated internally and also from the outside of the forms in placing. For the thin layers where forms are used, external form vibration is employed using an ordinary air operated chipping hammer and where no forms are used, the concrete is thoroughly tamped.

(11) Wherever possible the final vibrating or tamping is not done until one-half to one hour after the mixing is complete. This allows shrinkage (most of which occurs during the period of initial set) to take place before the concrete gets into its final position.

(12) Form clamps are used so that no form wires or other metal appear at the surface of the finished concrete. For finishing horizontal surfaces or other surfaces where no forms have been used, the surface is first screeded with a wooden screed followed by a minimum of trowelling to fill the voids left by the screed. Finally a fairly rough surface finish is obtained by brushing lightly in one direction with an ordinary whitewash brush having fairly coarse bristles. This gives a uniform and pleasing appearance to the finished surface, leaving the surface particles coated with

Fig. 2—Placing thin non-reinforced covering at toe of spillway dam shown in Fig. 1. This covering is 3 to 6 in. thick; strength, 4,000 to 5,000 lb. at 28 days. Note the cement bonding coat on the old concrete in the foreground. This type of covering is applied where the old underlying concrete is reasonably strong. After 3 years under severe exposure facing in a southerly direction, including spilling conditions and passage of ice in the spring, this covering showed no appreciable deterioration.

cement and appears to give a more durable surface than that obtained by trowelling only.

(13) Test cylinders are made on all important jobs.

(14) The surface of the new concrete is kept continuously wet for at least seven days.

Fig. 3—Bond between new covering (dark) and old concrete (light). This sample was broken from the covering shown in Fig. 2 three years after placing. When broken away the new concrete invariably takes with it a layer of the old concrete to which it is bonded.

(15) Joints are made in all new concrete opposite all vertical joints in the old concrete. For the thicker coverings, horizontal joints are omitted, the covering being placed monolithically. For the thinner coverings, joints are made both ways every 10 to 15 ft. For making joints a 50-50 tar-pitch mixture is applied hot about 1-16 in. thick. This tar-pitch mixture is composed of ordinary gas-house coal tar and ordinary coal tar roofing pitch, the pitch being the residue after distilling the tar to about 675 deg. F. The melting point of the pitch is about 150 deg. F. This mixture does not appear to run excessively under summer temperatures nor become too brittle under winter temperatures. When covering the downstream face of water-retaining structures, concrete tile is embedded in all horizontal joints of the old structure which are leaking or likely to leak, to guide the leakage to the vertical joints; at the vertical joints concrete tile is embedded to carry the leakage to the base of the structure. In this way all leakage is carried away without appearing on the face of the new covering.

Fig. 4—Tailrace piers under repair. Reinforced concrete covering is applied approximately 6 in. thick. Repaired pier at left. Disintegrated concrete removed from two piers at middle right. Disintegrated condition of concrete on piers at normal water level before repairs is indicated by piers near right. (In this picture the water has been lowered while the repairs proceed.)

(16) The combination of water and alternate freezing and thawing are considered to be the greatest causes of deterioration of concrete surfaces and steps are taken wherever possible to minimize this action. All horizontal surfaces are sloped at least ¼ in. to the foot for drainage and screeded to eliminate depressions where water may lie. Horizontal surfaces rather than being drained towards an edge where water may run down over a vertical concrete face are usually sloped so that water is drained to pipes where it may be carried off or directed free of other concrete surfaces.

(17) Where pipes, used as railing posts, are embedded in concrete these are filled with a 50-50 tar-pitch mixture in the embedded section to prevent the entrance of water and consequent damage due to frost action. Where anchor bolts are installed in concrete and space left between the bolt and the concrete for adjustment, this space is filled with the same tar-pitch mixture.

Fig. 5—Sealed horizontal joints in reinforced concrete scroll case.

In addition to the use of ordinary concrete for making repairs to concrete structures, the following special applications have been found successful:

(a) Asphalt covering for horizontal concrete surfaces. After cleaning off loose concrete and applying an asphaltic bonding coat, a layer 1½ in. to 2½ in. thick of asphalt such as used in ordinary road work is applied. In 1930, 20,000 sq. ft. of concrete deck which acts as a road over a dam was treated in this manner and although there is little traffic over this deck the asphalt has not cracked (except where there are construction joints in the concrete deck below) and at present shows no particular deterioration. In 1935 two additional concrete decks were treated in this manner totalling 3,000 sq. ft. Although these three asphalt jobs have been entirely satisfactory, this company at present is inclined to favour a concrete covering on account of slightly lower overall cost and harder surface and better bond obtained to the old concrete.

(b) For vertical cracks or vertical construction joints in power houses where water is leaking through from the river into the power house a strip of sheet rubber has been used on the downstream side backed by a steel plate, both the rubber and the plate being cinch anchored into the concrete. The plate and rubber used were 8 in. wide, the plate being 5/16 in. thick and the rubber ¼ in. thick.

(c) For sealing horizontal joints where it is possible to get at the upstream side, as in scroll cases, a V-shaped recess has been chipped out approximately 4 in. deep and extending 2 in. above and below the joint; this void is filled with 4,000 to 5,000 lb. unreinforced concrete.

(d) For vertical cracks or vertical construction joints in concrete roofs where rain water is leaking into the building the crack has been chipped out on the weather side to form a slot about ¼ in. wide and 1 in. deep and filled with self-vulcanizing liquid rubber. This has formed an effective and inexpensive repair. The use of liquid rubber in making resilient joints in concrete is limited to locations where the concrete is dry as the rubber will not adhere to wet surfaces.

THE WAR POTENTIAL OF CANADIAN INDUSTRY

R. J. MAGOR

Chairman and President of the National Steel Car Corporation, Limited, Montreal

Luncheon Address delivered at the Annual Meeting of the Engineering Institute of Canada, at Toronto, Ont., on February 8th, 1940

The following remarks are largely based on a series of visits to Great Britain, for the purpose of studying the industrial operations connected with her preparedness programme.

Since 1936 the time spent in these five trips has amounted, collectively, to something over eighteen months. Over the same period, we had also on the other side a number of engineers and production departmental heads.

The advanced technique which the highly mechanized units now require, as against the last war, has greatly increased the cost of equipping and maintaining a division in the present war, the ratio of expense being about four to one.

In addition to working out the problems incident to the items we were concentrating on, it was a pleasure to be associated with the Canadian Manufacturers' Association Mission in their survey in England and Scotland made last July, when General McNaughton and Colonel Noel Carr were with us. This industrial survey included everything that might be required from Canada for the fighting services.

In addition to the physical survey of the articles to be produced and the methods by which they were turned out, the question of standardizing specifications was also studied.

The above survey took place prior to the declaration of war. Nobody could foresee what was going to happen but as far back as 1936, it was obvious that Great Britain and, in fact, the Dominions as well, could not ignore the war preparations which were being made in continental Europe. Were we ever thinking seriously when we imagined that our great and wealthy Empire would be protected from aggression by relatively small outside countries and, therefore, not have to arm herself?

In the meantime, it has been realized that the Empire, having once been caught in such a state of unpreparedness, must develop and continue a co-ordinated defence policy. The first substantial move in this direction is the air training scheme, which is now being started here in Canada.

In the *Montreal Star* of January 10th, 1939, I expressed the opinion that Britain ought to be able to successfully defend herself in nine months, which would be October 10th, 1939, and be able to take a strong offensive position within nine months thereafter, which would be July 10th, 1940.

It is important to note, however, that with the maximum concentration, it takes a long while for an industrial concern to work out all the problems incident to the production of present day war requirements, and it is too bad that more was not accomplished before war broke out. There is no use deploring what has not been done by either industry or government—rather should we now do all in our power to make up for lost time. In my opinion, late as the hour is, a joint effort by Canadian industry and the Engineering Institute could accomplish much.

Perhaps it would be fair to say that in this emergency Canada occupies the third line of industrial defence. British industry and engineers are in the first line. They were deplorably late in preparing themselves for what has happened. Thanks to kind Providence, they have had more time to catch up than was anticipated. The tremendous production which they have secured during this period of grace, has resulted in their having an enormous stock of all kinds of munitions ready for immediate use. If the war becomes intensive and these reserves are gradually depleted, no doubt an increasing quantity will have to come from this side.

The United States can be considered the Allies' second line of industrial production. In a number of commodities they are in a position to give quick delivery.

The serious situation, however, for the Allies in the United States is two-fold:

1. Britain and France have no borrowing power there and when their American securities have been liquidated, they will have no more American dollars.
2. The United States appear to be constantly on the verge of a large production programme for their own services, and therefore might at any time cut down on shipments to the Allies.

This would move up Canada's position from the third line to the second and if the war of destruction should continue, we might even find ourselves in the first line.

At this point, we must ask ourselves the question, what have we done to prepare ourselves for this eventuality? The answer must obviously be, very little. We have blamed the government. This is every free man's prerogative. Negative action, however, on the part of either the government or ourselves is not going to save the situation. No matter what any others do or do not do—whether good or ill—they must take the consequences.

As engineering and industry are much to the front in this preparedness matter, it is of vital importance that they should take stock and be ready for any eventuality. There has been criticism in regard to the lack of orders for war materials. This is undoubtedly so, but we must remember, when the need becomes accentuated, it takes only a very short time to place a great many orders. The real question is, if the Canadian and British Government, and perhaps France, started to place a large number of orders tomorrow, would we, the industrialists, and you, the engineers, know all about these commodities and the best way in which to turn them out ? Do we know exactly the kind of machinery that will be required ? Do we know all about the gauges which we would be using ? Do we know about such matters as jigs, dies, templates, analysis of steel, forging methods and tolerances, etc. ? Do we know what shop personnel would be required to handle this work; the position which each man would occupy and what qualifications he would need ? Are we ready now to start, without a moment's delay, in preparing and later producing such work as we may be called upon to turn out ? Have we given consideration to and decided on, just what items of production we would go in for, or have we tried to cover too broad a field of items that would preclude our producing efficiently ? On the other hand, have we underestimated what we might properly undertake ? In brief, have we been too optimistic or too conservative ?

It is not too late, gentlemen, to consider these questions and arrive at the answers. All of us, who directly or indirectly have to do with heavy or special industries, should ask ourselves and those in positions of responsibility in our industries and technical institutions, what are we doing to prepare ourselves to secure maximum results ? When that is determined, the next thing to do is to take action, so that the contemplated effort will be implemented.

As a suggestion, have you thought of maintaining in England a picked committee of, say, half a dozen of your members, each one capable of specializing in some particular branch of munitions production ? It would seem to me that this would be an excellent way to keep up-to-date on what is transpiring on the other side. The personnel of this committee would be changed from time to time, that is, one or two members should return periodically and be replaced by others. This would mean that, in addition to receiving periodical reports, you would have returning members supplying the central organization here with the most up-to-date information.

It must be realized that all investigation up to the present time, took place before the war started, when the design and construction of many things produced were based on theoretical calculations. Much of this equipment has now been subjected to the acid test of actual war conditions and, as a result, many changes have been made in analysis of materials and design. In my belief substantial benefits would be secured if several competent engineers from your Institute were maintained on the other side, for the purpose which I have indicated. If, after closer analysis, such a procedure is decided upon, my Company will be pleased to co-operate in the effort and also subscribe to the cost of such an undertaking.

DISCUSSION ON LIMIT DESIGN

Paper by C. M. Goodrich, M.E.I.C.,[1] published in The Engineering Journal, January, 1940

J. A. Van den Broek[2]

Since the author appears to be not quite certain as to whether or not limit design is worthy of being called a distinct theory, it may be well to offer a definition of theory of structural design and test some of the current design theories, as well as the theory of limit design, by this definition.

The theory of structural design is a logical correlation of observed facts arranged with a view to predicting probable future behaviour of engineering structures. The value of a theory is determined by the soundness of the philosophy to which it gives expression and by the number of pertinent facts which it encompasses. We are all familiar with the stress-strain curves of mild steel as given in Fig. 1. But are we clearly aware that, for this material, the curve B-D is substantially a horizontal line, that the strain represented by A′-D is more than ten times that represented by A′-B, and that the strain represented by A″-E is more than a hundred times that of A′-B ? The conventional theory of structural design is based on the theory of strength of materials, which in turn is a popularization of the mathematical theory of elasticity.

In structural design an extraordinary contradiction is found. We assume elasticity and superposition (Hooke's Law). Our theory is built on the assumption of a straight line relation between stress and strain (Portion A-B, Fig. 1). At the same time we condemn as unfit for use a material such as glass which manifests perfect elasticity as well as extraordinary strength (60,000 lb. per sq. in.). In our theory we consider only elasticity, while in our specifications we place the greatest emphasis on ductility.

The majority of the so-called theories of strength of materials, theory of elastic energy, theory of the elastic curve, slope deflection, conjugate beam, least work, kinetic theory of structures, end moment distribution, etc., are but variations on one and the same theme, the theory of elasticity. The theory of limit design, on the other hand, proposes to include more pertinent facts. It considers the ductile as well as the elastic behaviour of structural material. This then marks it as a distinct theory.

The intricacies of the theory of elasticity may make it seem impressive. We should not, however, lose sight of the fact that in the analysis of redundant structures the theory of elasticity functions only as a supplementary or secondary theory.

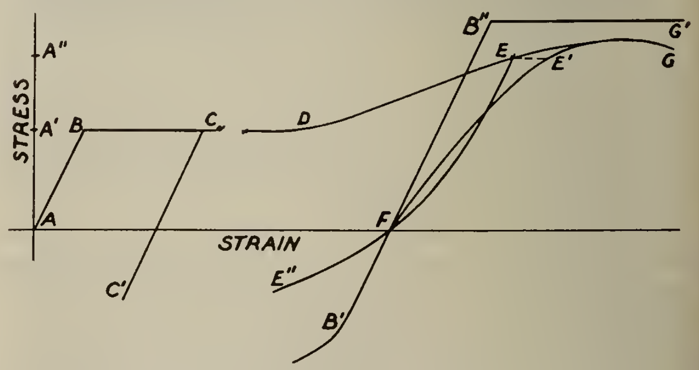

Fig. 1—Stress-strain curves of mild steel.

A simple example will illustrate this point. Figure 2a represents a 10-W.F.-49 beam, simply supported and loaded with a uniformly distributed load w_1. When the elastic limit is first reached in the outer fibre the value of w_1 is 10,920 lb. per ft. If the load is increased, the stress distribution over the cross section of the beam changes from Fig. 2f through Fig. 2g to Fig. 2h. In Fig. 2b the portion of the beam strained beyond the elastic

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limit is shown in black, and the limit load which the beam will sustain is also indicated.

Consider next an identical beam over three supports (Fig. 3a) spanning two openings, each equal to the span shown in Fig. 2a. According to the theory of elasticity the maximum bending moment in this beam occurs over the support and equals $\frac{wl^2}{8}$. The theory of elasticity tells us that each of the two beams, shown in

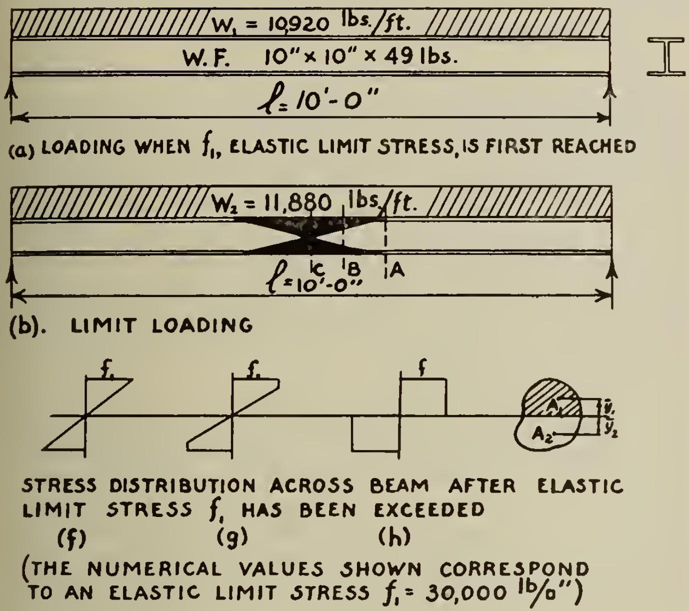

Fig. 2

Figs. 2 and 3, can safely carry the same load. Such an authoritative book as the U.S. Steel Pocket Companion, 1937 Edition, page 157, makes precisely this claim. In other words, it says in effect that one can take a hack saw and cut the beam shown in Fig. 3 in two over its centre support without affecting its strength. Does anyone really believe that ?

If the load on the beam shown in Fig. 3a is increased, then ductile flow will take place over the support. The stress pattern at that point will change from that shown in Fig. 2f through that of Fig. 2g until it reaches the configuration given in Fig. 2h. If, however, the loading continues to increase beyond this point, the stress pattern over the support will remain constant. At the point of maximum moment between supports, the stresses continue to increase until the elastic limit is finally reached. Then the beam carries a load of 16,320 lb. per ft., and its maximum deflection is 0.262 inches. Note that in the beam shown in Fig. 2a the maximum elastic deflection was 0.30 inches.

Therefore, should we specify a factor of safety of two, we may conclude that, whereas the beam shown in Fig. 2a will carry only a safe load of $\frac{10,920}{2} = 5,460$ lb. per ft., the one shown in Fig. 3b will carry a load of $\frac{16,320}{2} = 8,160$ lb. per ft. with the same margin of safety. This indicates a 50 per cent superiority in strength in favour of the continuous beam.

Either the theory of elasticity or the theory of limit design supplements the theory of equilibrium. The one computes strength on the basis of stress distribution within the elastic limit, the other computes strength on the basis of stress distribution just before complete collapse.

Mr. Goodrich is to be complimented on his presentation of limit design, but although he mentions Holland, Buda-Pest and Hamburg as the regions where limit design is practised, he ignores one place near at hand—Walkerville, Ontario. In my opinion, it is practised to some extent by every structural engineer. It, or allied theories, were discussed at the Congress of Bridge Engineering at Berlin-München, 1936. The theory illustrated by means of Figs. 2 and 3 is based on the assumption that the load deformation relationship—not only of material, but of the complete structural members—is that represented by the curve A-B-D (Fig. 1). If members in compression are involved, the question arises as to whether or not the load deformation relationship of a buckled column is sufficiently similar to this curve to permit applications of the philosophy of limit design. Some of us theorize about it, while the author and his company have so applied limit design principles for thirty years. His company has tested several hundred full-size transmission towers. The experience gained from these tests is largely hidden in the archives of the company and in the minds of its engineering staff. It is disappointing that his paper does not refer to this engineering field in which he is such an unquestioned authority. The transmission tower design employed by the Canadian Bridge Company is probably the most advanced practice in structural engineering. A presentation and discussion of it in the light of these test results would be of very great value. It would seem that the Engineering Institute of Canada is the proper body to be entrusted with such a record.

S. D. Lash, ph.d., a.m.e.i.c.[3]

The term "limit design," as used by Professor Van den Broek, was applied to statically indeterminate structures and the method attempted to show that such structures could safely carry loads in excess of those obtained by the usual methods of design. Mr. Goodrich, however, has used the term in a more general sense to indicate the proportioning of any structure on the basis of its ultimate load-carrying capacity. It will be obvious that such a method is the only sound way of designing a structural member when the slope of the curve showing the relation

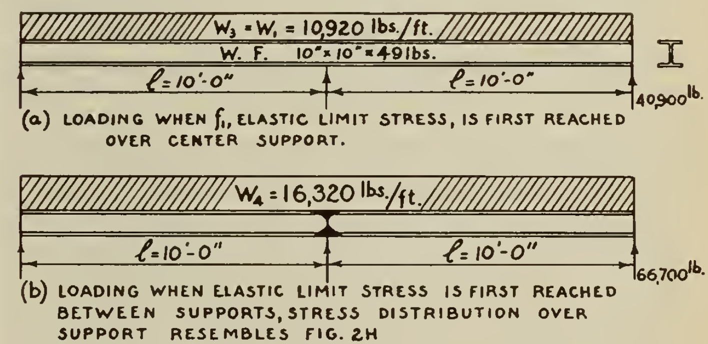

Fig. 3

between load and unit stress decreases with increase of load. Many structural units show this type of behaviour, for example, columns, most beam-to-column connections, and beams subject to buckling. In such instances it is clearly wrong to consider only the stresses occurring at working loads, and the application of the theory of limit design will result in a restriction of working stress beyond that normally considered necessary. This method is the basis of all rational column formulas. In such instances a working stress is not the unit stress occurring in the member if the working load be applied, but is a convenient method of ensuring a certain load factor against failure. Mention may also be made of aircraft structures, which, I believe, are always designed on an ultimate load basis. There can be no question, therefore, of the fundamental soundness of limit design considered as a general method.

On the other hand, discussion of Professor Van den

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Broek's paper in the proceedings of the American Society of Civil Engineers has indicated certain limitations that must be applied to the more restricted form of the theory. These may be summarized as follows:

1. The theory does not strictly apply to frameworks in which redundant members are acting as columns or struts, since their load-carrying capacity reaches a definite maximum and then diminishes as buckling of the member occurs.

2. The theory cannot be used to design structures subject to frequently repeated loads, since certain redundant members would be stressed above the safe range, and fatigue failure might occur.

3. It is questionable if the theory should be applied to the design of steel structures subject to rapidly applied loads, since the stress-strain curve for structural steel shows a well defined drop at yield in such cases.

If these limitations on the more restricted theory are admitted its application is greatly limited.

The author has referred to the work of the Steel Structures Research Committee and perhaps some further explanation of this will be of interest. The conclusions quoted were those drawn from tests carried out on the experimental frame constructed at the Building Research station. It is no criticism of the value of this work to say that the experimental frame was not found to be entirely satisfactory, and certainly more weight should be given to the results of tests on actual buildings described in the Final Report of the committee. In the later tests, although occasionally large variations in bending moments in similar columns were found, in general the results agreed within ten per cent or less. It should be pointed out that tests on actual buildings are normally carried out with comparably small loads, and thus do not necessarily indicate the load-carrying capacity of the structures. When the loads are small there are large variations, for example, in the behaviour of beam-column connections, resulting from variations in initial tension of rivets, and other factors. With increase of load, however, the proportionate effects of these variations become smaller, and it is reasonable to assume that when loads near to the ultimate capacity of the structure are applied, they will be exceedingly small. The draft rules for design, both of beams and columns, recommended by the Steel Structures Research Committee, may be considered to be examples of limit design, since, in both cases, the yield stress is considered to be the critical stress and a definite load factor is incorporated in the design method.

In common with most papers of value this one introduces some matters of a somewhat controversial nature. Two points are of interest in this respect. Firstly there is the reference to the method of least work as antiquated. This may be true of some particular applications of the method but the principle underlying the method itself, viz., that elastic materials tend always to assume a configuration of minimum strain energy, is of the greatest utility in many practical problems. For example, Timoshenko's fundamental work on elastic instability, although not recent, is based on this method, and for such problems no other approach appears possible. Deflections of framed structures are commonly determined using the first theorem of Castigliano. More recently the work of Professor R. V. Southwell and Mr. E. H. Bateman has shown that the method of least work can be applied to the analysis of rigid frameworks and other indeterminate structures with about the same amount of labour as is required to use the moment distribution method introduced by Professor Hardy Cross. Secondly, the writer believes the tendency that many of us show to avoid the use of less familiar mathematical equations such, for example, as the equation of elasticity, should be tempered by our appreciation of the fact that mathematics and a knowledge of the properties of materials are the foundations of structural analysis. Kant has said, "There is just as much science in a subject as there is mathematics." With the tendency towards greater unit stresses and consequently more slender members, it seems inevitable that the equations of elasticity should take on increased importance in the minds of engineers. Mr. Goodrich has pointed out that deformation may be more important than stresses; in general, these can only be determined by the method of elastic analysis. Certainly the literature on plasticity does not appear to offer any refuge from the toils of higher mathematics.

I. F. Morrison[4]

This paper presents briefly—and perhaps not quite as clearly as one would wish—an aspect of structural design which is beginning to be recognized as of importance and in which there is an increasing interest. Although the term "limit design" is unfamiliar, its meaning, but not all of its implications, is set forth in the opening paragraphs, so that one is not in doubt as to what is intended. The writer feels, however, that it is merely another expression, broadly speaking, of the art of structural design. The art of structural design involves many factors and may well be taken to include all of the topics mentioned in the paper.

With the rapidly increasing adoption of statically indeterminate structures—which do not always possess the advantages claimed for them—due to facilitation in methods of calculation, the question of the factor of safety of such structures naturally arises. Mild steel, which is still the most important structural material, possesses a well defined yield point; a fact of more importance than its elastic properties. Moreover, the elasticity of the material should not, as it so often is, be taken to imply the elasticity of the whole structure.

Much of what has been expressed in the paper comes from attempts—often confirmed by experimental investigations—of certain European engineers to introduce the plastic state of the material into the design process, and the writer believes that in certain suitable cases this can be done successfully. For example, he thinks that an adequate design for an indeterminate frame can be worked out on the basis of the assumption that certain redundant members, in the stress analysis process, can be replaced by their yield point loads, thus rendering the structure statically determinate and susceptible to simple computation of stress in the remaining members. Naturally a judicious selection of the plastically stressed redundant members needs to be made.

Another example of this sort of thing is to be found in the design of the web of a plate girder. The present process is to attempt to prevent the buckling of the web by the introduction of intermediate stiffeners. No question is raised as to what would happen if the web did actually buckle slightly. Careful analysis shows that nothing serious would occur and in the design of aeroplanes thin sheets of metal are allowed to buckle, no attempt being made to stiffen them. It is better to allow a suspension bunker to take up its natural shape, which depends on the way in which the contained material is deposited, than to attempt to use stiffeners to maintain the shape.

The factor of safety is not, however, the only consideration in design. The question of how much a certain structure may be allowed to deflect or deform or settle, and still be adequate for the service desired, is of considerable importance.

In the design of a low head dam a number of years ago, the writer carried out a design in which the deflection was given important consideration rather than attempting to resist the assumed ice pressure. A flexible structure was designed which would not permit the building up

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of a large ice pressure and the consequent saving was considerable.

In addition, there are also practical and economic considerations. For example, in the design of deep rolled section beams, the webs at the ends are often adequate to resist, without buckling, the anticipated reactions. Stiffeners, however, will enormously increase the reactive carrying capacity. The added cost is small and, as beams once in place are not always readily accessible for additions and are often subsequently called upon to support larger loads than those for which they were originally designed, the writer believes the use of such stiffeners fully justified.

The same remark applies to the intermediate stiffeners on plate girders. Their advantage and justification lies not in stiffening the web against diagonal buckling but in the additional torsional rigidity and general stiffness which is of value especially during transportation and erection.

The present method of design does not generally provide for different factors of safety for the various members of a structure and yet such would appear more reasonable than having a constant factor throughout. For example, tension members can be adequately designed with a smaller factor of safety than compression members; parts subjected to cyclic stressing need different consideration from those having only static stresses. This leads to the attitude suggested in the paper.

Finally, there should be a discrimination in the character of the loads. Elsewhere the writer has suggested that loads may be classified as gravity-type and reaction-type. Testing machines are of the latter, and loads in practice usually of the former, type. This distinction is too often overlooked. On the other hand, loads of the reaction-type do occur in practice and their essential character is often overlooked. Redundant members in statically indeterminate frames may be put in this class as well as temperature stresses, ice pressures, etc. When a piece of steel reaches its yield-point under a gravity-type load, the load does not diminish and the member stretches by a considerable amount until the strain hardening intervenes to save it from complete fracture. With reaction-type loads, even a small amount of plastic strain is sufficient to relieve the member of further loading and in such case failure or even excessive distortion will not occur. The statically determinate stresses which arise from such loads are of the same character as the loads which cause them. The riveted joint in the redundant member of a frame should be put into a different category in design than the other joints.

While the writer agrees on the whole with the ideas expressed by the author, he cannot accept without comment, his remarks on raising of the elastic limit of the material at a connection in a bridge. For in the first instance, it is not the elastic limit which is of importance, but rather the yield point, and in the second, strain hardening, in the case of structural steel, does not set in until a considerable amount of plastic deformation has taken place so that there is but little raising of the elastic limit until the deformation has been considerable.

D. C. Tennant, m.e.i.c.[5]

It has been, for a long time, recognized by experienced engineers that in actual practice many steel structures, due to their design, manner of detail, or actual construction, present under load a complexity of deformations and consequent stresses in the material. It has also been realized that within limits this complexity due to redundant members, stiff details, and so called indeterminacy has been a source of real strength rather than weakness to certain structures.

Some years ago, a camel-back through highway bridge of about 200-ft. span with lattice sway bracing at each panel point extending from the clearance line over the roadway up to the top chord level had a portion of one end masonry abutment completely washed away, so that the shoe at one of the four corners of the span was entirely deprived of its support. But the span did not collapse in the river; instead, the sway bracing took a load that it was never designed for, distorted considerably and succeeded in supporting the undermined corner in an approximately horizontal position. The engineer responsible for the maintenance of highway bridges in that district insisted always thereafter on similar fairly elaborate sway bracing being inserted in all such spans.

This example of the arrested failure of the highway span is not quoted as a legitimate field for limit design, but it illustrates very simply how a secondary path of stiffness can and does help before ultimate failure occurs, and to borrow Mr. Goodrich's apt phrase, these extra paths of stiffness are factors in "setting limits within which failure is practically certain not to occur."

Another common example of design where secondary resistance is recognized is in the design of wind bracing for steel frame loft buildings where the stiffness of the walls themselves, particularly of the more solid type, has to be overcome before the steel can be distorted sufficiently to take the wind stresses for which it is figured. The writer recollects two distinct cases where in remodelling store fronts the upper portions of the front walls of the buildings were for a short time quite without adequate support, and yet the walls stayed in place without even a sign of a crack and the new supports were successfully placed below them. The walls thus showed strength that would not ordinarily have been imputed to them, enhanced by the circumstance that in both cases there were existing buildings on both sides so that the wall acted as a continuous beam.

It would seem that there are broadly two essentials in the intelligent application of the principles of limit design and neither of these is quickly and easily learned, viz.:

1. Imagination:

The imagination to envision in how many ways a structure may fail and how the various portions and members will tend to prevent failure.

2. Experience:

The experience gained through the years of actual failures and of other cases where structures continue to stand up and give good service largely because of their redundancy rather than their primary design, and because also of the ductility of the steel itself.

It is to be hoped that the results of actual tests of any structures to destruction or nearly so will be freely given to our engineering societies and published by them, so that we may all have the opportunity of gaining in both imagination and experience regarding adequate design, as distinguished from merely "safety first."

Robins Fleming[6]

The author mentions in his paper that the first design for towers for the Hydro-Electric Power Commission of Ontario was condemned by four eminent authorities and the weakest of the two first towers, tested in 1910, carried a 50 per cent overload. In his discussion (May 1939 issue of the *Proceedings*, Am. Soc. C.E.) of Professor Van den Broek's outstanding paper on "The Theory of Limit Design," Mr. Goodrich states that these towers were designed by his Company, using limit design ideas freely. He also says that structures containing more than 7,000 tons, built under one contract to these and similar designs and employing methods advocated by Professor Van den Broek, are in service to-day.

Mr. Goodrich alludes to the matter of wind bracing. In their widely known monograph, "Wind Stresses in

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the Steel Frames of Office Buildings," dated June 1915, issued as Bulletin No. 80 of the Engineering Experiment Station of the University of Illinois, Wilson and Maney condemn the conventional cantilever and portal methods of design. Yet, in most of the more than 5,000 skyscrapers in the United States one or the other of these two methods was used in designing the wind bracing. The "exact" slope-deflection method proposed by the authors of that monograph has been used in very few, if any, instances—the writer knows of none. A pertinent question is: Does the theory of limit design come into play in the analysis of a many-storied bent to resist wind?

A significant sentence in Mr. Goodrich's paper is: "There is in existence no extended treatment of limit design." Such a treatment is needed. It should begin with fundamentals.

Mr. Goodrich is qualified both by scholarship and a long experience in the design of structures to write a treatise on the method of limit design. Coming from him it would be welcomed by structural engineers.

F. P. Shearwood, m.e.i.c.[7]

This paper should appeal to every structural designer because it has presented obvious facts and avoided the confusion of thought with intricate mathematics. To those who have been obliged to design and detail steel structures to meet hard and fast standard specifications, and who have been forced to conform to rigid limitations of definite unit stresses based on computations from the elastic theory, Mr. Goodrich's statements bring a breath of freedom from conventional restrictions.

The fascination of solving difficult theoretical problems by intricate mathematical calculations, and the demand for precisely meeting the figures of arbitrary specified requirements have forced designers to lessen their proper sense of perspective. As an example, very elaborate calculations are demanded to determine the exact division of the stresses between the several parts of the chords of continuous trusses, ignoring the fact that an extremely small difference in the assumed conditions, (due to probable inaccuracies in fabrication, erection or level of supports) will alter all this distribution materially. Also that an overstrain at one part of the chord will bring other parts into increasing resistance, and so automatically relieve further increases, just as the paper points out that the maximum moment of a continuous beam will be $\frac{wl^2}{16}$ before failure, instead of $\frac{wl^2}{12}$ as present custom demands.

Structural designing is tending more and more towards continuity, toward multiple systems as well as many other so-called indeterminate forms. In the interest of economy it becomes important that we utilize the full strength of structures instead of merely ensuring that the figured strain in any member will not, under the specified conditions and methods of figuring, exceed the allowed unit, even when the structure as a whole has excess strength.

It is extraordinary that medium steel which is so reliable in its physical properties, especially in elasticity and ductility designing should be so restricted in the use of these properties. Structural steel material specifications call for minimum elongation of 20 per cent but the use of even one per cent of it is prohibited in designing, while during fabrication the material is excessively strained and no compensating modification is made in the allowed units.

The continued functioning of many structures which have been damaged or distorted so severely as to strain some member far above its elastic limit, is evidence of the safety of counting on the assistance of all paths of resistance, viz., the limit design theory.

In applying this method it is very important to consider such matters as the probability and frequency of stressing so as to avoid any possibility of fatigue; but with structures carrying only static loads or those proportioned for high winds and such like forces (which seldom, if ever, occur) the full use of this method should be quite permissible.

The keener realization of every path of resistance would also ensure more precaution in avoiding abrupt alterations along all lines of direct or bending stress, where strains would be concentrated to endanger local failure. This feature becomes increasingly important in welded construction, since welded joints have no yield equivalent to the slipping of rivets to relieve secondary resistances.

Those who have watched the fabrication and erection of steel structures or who have examined thoughtfully the resistance of framed structures will readily agree with the facts that the author has discussed so clearly. His simple explanation of what is really happening in a loaded structure in contrast to what conventional theories demand, should do much towards bringing about the greatly needed modifications in present practice.

Carson F. Morrison, a.m.e.i.c.[8]

In the solution of any problem, all the pertinent facts should be considered and since the object of structural analysis is to predict the behaviour and strength of structures, a thorough study of the behaviour of the material used is obviously desirable. The distinguishing feature of limit design is that in the analysis of structures, according to this method, the plastic as well as the elastic behaviour of the material is considered. That structural material exhibits this plastic as well as the more commonly discussed elastic property is not disputed. Figure 4 is a stress-strain curve for structural steel.

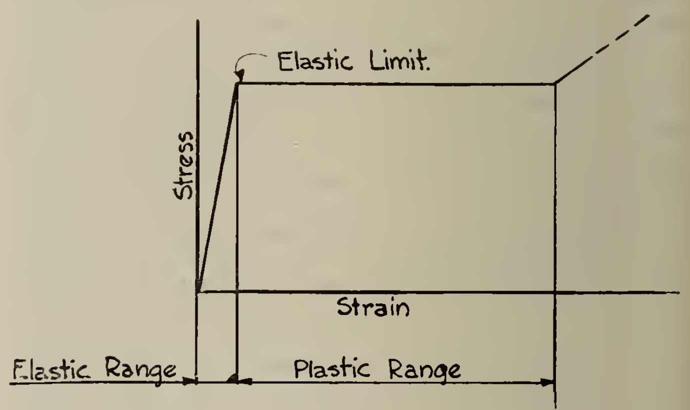

Fig. 4

The difference between elastic analysis and limit analysis may be illustrated by a study of the simple structure shown in Figure 5. With steel having an elastic limit of 40 kips per sq. in. and a factor of 2, a stress of 20 k.s.i. would be permitted in the hangers A and B. Neglecting the deflection of the beam, the strain in rod A is one-half the strain in rod B, consequently, when B is stressed to 20 k.s.i., A will be stressed to 10 k.s.i. and the load at C will be 15 kips. When A is stressed to 40 k.s.i. (the elastic limit) B will be stressed to 40 k.s.i. (in the plastic range) and the load at C will be 36 kips. Dividing this by a factor of 2 we get a safe load of 18 kips, which is 3 kips or 20 per cent in excess of the 15 kips safe capacity indicated by the elastic analysis. It is interesting to note that this 18-kip load would not stress the rods to the elastic limit but would stress A to 12 k.s.i. and B to 24 k.s.i. The three kips difference in capacity in this example may be a small amount and unimportant—that, of course, is a matter of opinion—

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but there is an important difference between the theories of the two methods of analysis.

Obviously, the factors referred to above do not have the same meaning and this suggests a need for a more careful definition of this much discussed "factor of safety." In elastic analysis a common definition of the factor of safety is the elastic limit of the material divided by the maximum existing stress. In limit analysis the factor of safety is considered as the capacity load of the structure divided by the applied load. In the case

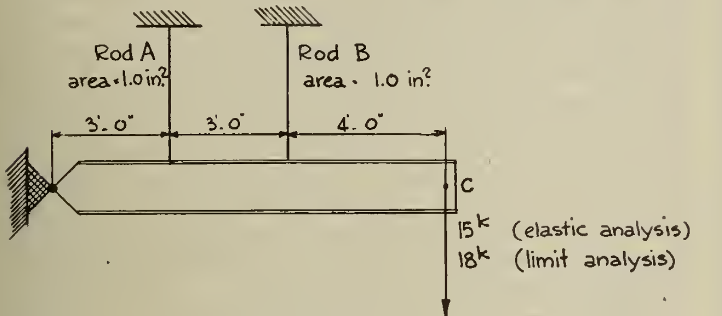

Fig. 5

of the structure shown in Figure 5 carrying an 18-kip load at C, elastic analysis would consider the factor of safety $\frac{40}{24}=1.67$, while limit analysis would consider it $\frac{36}{18}=2$, an increase of 20 per cent.

In the opinion of the writer, limit analysis gives the more reasonable indication of the strength of the structure.

A. E. Macdonald, m.e.i.c.[9]

In this paper the author has put in words ideas which, to a greater or less degree, structural designers have consciously or unconsciously applied at times to modify analyses based on the theory of elasticity.

It would be interesting to know how limit design proposes to determine the strains in a ductile material for any load up to the ultimate strength. To facilitate design, if we should look to our strains for our stresses, surely we should have some simple means of finding the strains.

In the design of a symmetrical plate girder web splice composed of two splice plates carrying both shear and bending stress, the end rivet is that most highly stressed. Would the author suggest that, in addition to dividing the vertical shear by the number of rivets on one side of the connection in order to determine the shear per rivet, the straight line variation of stress should be discarded in favour of two rectangles of stress for determining the direct stress on the rivets ? In a deep splice, might not the ductile strain at the end rivet be appreciable unless an adequate factor of safety were applied, and if the factor of safety were such as to bring the stress within the elastic range why not use the straight line variation ?

In the flexural design of loaded reinforced concrete structures, once the tendency for distortion can be visualized, it only remains to provide sufficient reinforcing steel to limit the tensile strains and sufficient concrete to limit the compressive strains. Because of practical considerations, sometimes the distortions in certain members, or in parts of the same member, are actually less than those indicated by the theoretical elastic curve, resulting in less strain and an opportunity for economy elsewhere. To illustrate this simply, in the case of a fixed horizontal concrete slab carrying uniform vertical loading, the elastic theory gives a moment of $\frac{wl^2}{12}$ at the supports and $\frac{wl^2}{24}$ at the centre. This is based on the assumption that the tangents to the deflection curve at the supports remain horizontal while the full load comes on the slab. Common sense would dictate that this assumption is rarely true in fact, however, assuming these moments are used in the design of a reinforced concrete slab having no reinforcing steel available from an adjoining slab, the design moment for the concrete section is $\frac{wl^2}{12}$ and sufficient reinforcing steel could be placed at the centre for a moment of $\frac{wl^2}{24}$ and at the ends for $\frac{wl^2}{12}$, but this would necessitate providing extra reinforcing steel in the top of the slab at the supports and the chances are that these extra pieces would be lost or not placed in the correct position in the slab. How much easier to recognize that the tangents at supports are not likely to remain horizontal, design the steel at the centre of the slab for a moment of $\frac{wl^2}{12}$ and bend up alternate bars at the points of contraflexure to provide for (more than) the $\frac{wl^2}{24}$ remaining at the supports. Specifications generally require the designer to provide for greater moments than these. To design such a slab for a positive moment at the centre of $\frac{wl^2}{8}$ without providing some reinforcing steel in the top of the slab at the supports would not be in conformity with limit design, as normal deflection might cause cracks in the concrete at the face of the supports and seriously impair the shear resistance of the slab. If some steel is provided in the top of the slab at the supports, as the external moment at the supports plus that at the centre of the span cannot exceed $\frac{wl^2}{8}$, then the actual moment to be provided for at the centre must be less than $\frac{wl^2}{8}$.

It is not quite clear what the author means by "In reinforced concrete formulae there is a curved stress-strain line, while in structural steel it is straight." A straight line relationship between stress and strain is assumed in flexural design formulae for reinforced concrete. The curved stress-strain line for concrete gives results which check remarkably well with ultimate flexural tests, (provided the ultimate strength of the concrete is reached before the elastic limit of the reinforcing steel is exceeded), but is rarely used in design. In this case the elastic limit of the reinforcing steel and not its ultimate strength limits the strength of the member.

Hooke's law has been with us for many years and its well known and generally accepted application will not be hastily discarded. It is of course true that many an involved and imposing elastic equation can be constructed on one or more general assumptions which themselves may be in error. Might it not be possible that it is our application and interpretation of elastic theory that is sometimes at fault rather than the theory itself ? By all means let us be sensible about it.

P. L. Pratley, d.Eng., m.e.i.c.[10]

In the closing paragraph of his paper the author expresses some doubt as to the propriety of calling this method of limit design a theory. In spite of Professor Van den Broek's assertion that it is a theory, I am still inclined to regard it as a practice based to some extent on the disregard of certain familiar theories. In any case the name chosen seems to me rather unfortunate. Mr. Goodrich states in the introductory summary to his paper that limit design is implicit in various current practices. On the other hand, later on he seems to charge the conventional engineer with a refusal to recognize the very thing that constitutes the practice of limit design.

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[10] Consulting Engineer, Montreal, Que.

It is not fair to take the attitude that the engineer in actual practice ties himself down to solutions that can be obtained by the application of the elastic theory. As one of these conventional engineers, I actually do prefer, and seek solutions of indeterminate problems lying between outside limits. My first understanding of the term limit design, before reading Professor Van den Broek's paper, was, that for indeterminate structures there are two or more reasonable assumptions regarding the path of the stresses, and that by making each of these successively and visualizing the resulting design in each case, the engineer can use his judgment anywhere within the range determined by the upper and lower limits and can be satisfied that any solution he chooses to adopt within this range is quite safe.

From recent papers on the subject it appears that the present use of the term "limit design," while including my original understanding, goes very much further.

It is not always easy to properly appraise the relative stiffness of the various paths, and the theory of elasticity has often been invoked to assist in this appraisal, but the basic thought has always been that of controlling distribution by liability to deformation. We accept the same idea when we distribute the bending moments that may be introduced into a framework by eccentricity of reaction or by lack of intersection of axes at some panel point, according to the relative stiffness of the intersecting members, although again we use the elastic theory to guide us in appraising this relative stiffness.

The writer therefore cannot see much that is new in this proposed method presented under the name of limit design. It is definitely limited to indeterminate structures and in that field common sense or "judgmatics" has always been an available, and a sound, process.

Mention has been made of the method of least work, which is another very useful tool, one that is always sound and often quite practicable. The writer cannot agree that it is antiquated, neither does he think it is fair to label it as excessively laborious. It has the further advantage of being very clear as to theory and purpose.

It seems that there are real dangers in the advocacy of this so-called "limit design." Much is said both by Professor Van den Broek and other proponents in criticism of the assumptions made under the elastic theory, but most of these assumptions are familiar qualitatively, and fairly well established quantitatively by our experience. In the examples given to illustrate the application of limit design, however, do we know as much regarding the assumptions ? The classic case of the restrained beam carrying uniform load is offered to us without any discussion as to what happens to the fixing medium restraining the ends of the beam when the steel is stressed beyond the limit of proportionality or when this medium "gives." Can we be sure that the deformation at the fixed end will persist, or do we know to what degree or by what means the fixing medium may recover ? One of the discussors of Professor Van den Broek's paper stated, page 939, *Proceedings*, A.S.C.E., May, 1939, "It is precisely this question of deformation which in the last analysis remains unsolved. Any design theory that does not provide the means of determining the deformation... is incomplete and questionable. It is the indisputable strength of the theory of elasticity that it provides these means with a high degree of accuracy. Any design theory extending beyond the elastic range should at least attempt to satisfy this same condition and even more so should a theory which consciously assumes as its base the criterion of permissible deformation." Another discussor, Professor Freudenthal, page 1140, *Proceedings*, A.S.C.E., June, 1939, points out in his paragraph d(4), "The theory of limit design, in the form presented by the author is applicable to an extremely limited number of structures under permanent or slowly changing loads. It must not be applied to trusses even under fixed or slowly changing loads. In the design of bridges where the endurance limit of the material and the notch action in the connections are the dominant factors, its application would not be justified;" and still another, Dr. Bleich of Vienna, writes warning that the theory is not applicable to trusses because it is necessary that all compression members be so designed that the stresses induced will never reach the buckling limit.

In the case of the rivet group quoted both by Professor Van den Broek and Mr. Goodrich we can readily agree that there is no guarantee of uniformity or at least no initial uniformity in the stress distribution among the rivets placed along the load axis and that the extreme rivets must, at the outset, pick up the stress. But what improvement in design does the new theory offer ? It is all very well for Professor Van den Broek and the proponents to state that the philosophy underlining the proved practice of using ductile steel for rivets is the theory of limit design (page 213, *Proceedings*, A.S.C.E., February, 1939), but nothing much is gained by calling a well-established practice by a new name. In fact there seems to be some tendency on the part of the proponents of limit design to let their enthusiasm lead them into much unnecessary and unwise criticism of established practice, without the production of something equally sound and more advantageous.

Possibly the weakness in this new practice is the danger which grows out of the introduction of unfamiliar assumptions. The normal theory of elasticity is admittedly based on assumptions, but we have become accustomed to these assumptions and to the degree to which they are realized in practice, and we know that our factors of safety are established after having mentally agreed that there are certain loosenesses in the assumptions, certain inaccuracies in fabrication, certain unknowns for which no definite quantitative allowance can be made, and in presenting this new thought to students particularly, some corresponding appraisal of the new assumptions should certainly accompany the claims that the method is superior or economic. The writer is inclined to think that in reality this limit design idea is just the expression of an internal or instinctive satisfaction that the apparent factor of safety can be cut somewhat, when multiple systems, or redundant members are available for the passage of stress, in the assurance that both or all such systems will work together, regardless of how we figure them. This fact, I contend, has long been recognized and the new idea merely contributes another method of tackling the problem of distribution.

The Author

Limit design invites us to consider and talk over various facts, some of them rather puzzling, which arise in design work; perhaps we may assist one another to a better understanding of them.

It is a source of satisfaction to find that the invitation to discuss such matters has on the whole met with approval, and the thanks of all of us are due the gentlemen who have discussed the paper, those of the author especially to Professor Van den Broek, who has so clearly presented certain basic thoughts.

Dr. Lash, and many others, object to assigning a load to redundant columns in frameworks. Many such columns are long enough to bend and shorten, at which point they still carry a considerable load, and are yet able to straighten again when the load is removed; Euler's formula is familiar in this connection. Professor I. F. Morrison refers to another class of columns, loaded with a "reaction-type" loading, which also should not offend the most exigent follower of elasticity. One remembers the old multiple intersection bridges, and the current use of plus and minus bracing; these are instances of very satisfactory compression redundants. The author has seen many tests where members acted plus and minus; he remembers at least one test in which the tension member in equally stressed (from the standpoint of statics and of elasticity) X-bracing failed first, because its end connection gave way. One wonders whether Dr. Lash and the many other learned objectors have made tests of such X-bracing; the author knows of no published accounts of them. There seems to be no reason that one should not apply the same logic to a redundant column, that one uses in connection with rivet groups. In the absence of tests confirming the objections, one may perhaps follow practice and tests that refute the objections.

As to Dr. Lash's objection (2) one might point out that in plus and minus bracing, working 50-50, one member is a redundant. The arrangement would not seem to be dangerous. It all depends.

It is not clear just what is meant by objection (3), and the author is not familiar with tests showing the stress strain curve for impact loadings. May we not hope that Dr. Lash will cover this point in a paper for the Journal ? Apparently both Dr. Lash and Dr. Pratley are offended by an unfortunate disrespect for the method of least work; no one questions its truth, but in the work-a-day world no case has come before the author where some other method did not serve better.

"There is just as much science in a subject, as there is mathematics." There was an immense amount of mathematics connected with the subject of a recent continuous bridge over four supports; the piers, however, rested on a layer of quicksand, and did not behave at all well. Professor Bouasse of the University of Toulouse in his "Théorie de l'Elasticité"—rather an interesting as well as formidable treatise—says, "For fifty years now mathematicians have descended upon our unfortunate university like an army of evil and encumbering crickets. One has not even the satisfaction of eating them boiled, like the crickets of Algeria." The writer once had a full year's course on the "Kritik der reinen Vernunft," and is not fond of Kant.

Mr. Tennant accents the value of imagination, and of experience; they can hardly be too greatly emphasized. Mathematics is a tool; they are brains. In a recent bulletin of the A.R.E.A. is a series of instances of unfortunate design —most interesting and valuable. Mr. Godfrey's book, "Engineering Failures and Their Lessons," is well worth perusal.

Dr. Fleming is altogether too kind. Only if we engineers collect and compare instances will it be possible—after some years—for someone to collect and digest enough cases to warrant a complete treatise. In the meantime let us hope for theoretic treatments, and for frequent discussion.

Mr. Shearwood has contributed much. One of his points should be written in letters of fire—that every path capable of carrying loads to ground should be carefully considered and treated according to its possibilities for good.

Professor I. F. Morrison speaks of the "art of design," an admirable expression; it prompts one to wish he would write an extended paper on that subject alone. As to the adjustments possible in bridge connections, see Pritchard, A.S.C.E. *Transactions 89*, pages 1217-19.

Professor Macdonald gives some excellent instances of limit design, but doubts if we should neglect the theory of elasticity. One must agree with him, but pointing out that the elastic theory does not in all cases cover all the ground.

Dr. Pratley calls limit design "a practice based to some extent on the disregard of certain familiar theories"; may we not say rather that it respects the old truths and seeks to incorporate further elements in the body of theory. His objections seem to centre on the theory being both very new and very old, and this is indeed the case, although hardly a good cause for objection.

As Dr. Pratley describes his methods they seem to be very much what the author would try to do; one might fairly class them as limit design. As the last paragraph of the paper suggests, limit design discards nothing of value, but suggests that we consider carefully if in any given case usual methods are the best, if factors are not present that deserve other than a traditional treatment.

Limit design is admittedly dangerous, since it asks for intelligence and caution in its use; any sharp tool is dangerous. Limit design appeals to us to use sharp tools carefully; and it also points out occasional dangers in traditional methods. One comes to the truth very slowly; a Frenchman once said, "All generalizations are false, including this one."

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PHOTOGRAPHY IN ENGINEERING

Abstracted by Mechanical Engineering, April, 1940

Photography has become one of the most valuable tools of engineering. Many of the advances made so far in alloys, machine design, high-pressure and high-temperature boilers and turbines, time and motion study, and other fields have been due to the use of photography in one form or another. Some of these applications are described in an article by A. H. Styring, which appears in the December, 1939, *Journal of the Junior Institution of Engineers* (London).

Infrared sensitive materials have proved of the greatest value in spectroscopy and astronomy. When photographing at great distances, the best results are obtained with infrared materials and filters. The rays are less easily scattered by water and dust particles in the intervening atmosphere than are the shorter rays in the normal visibility range. The power of haze penetration is important and has an engineering application. Research is in progress for the adaptation of infrared sensitive materials for navigational and military purposes. Good work has been done in permitting vision of objects invisible to the naked eye up to six miles, and distances up to 20 miles have been claimed.

It is possible to reveal by infrared photography many structures invisible to the eye, and to differentiate between materials which to the eye appear similar, as in photomicrography. According to the author, one of the most promising fields of application of infrared materials in engineering lies in the direction of research in the realm of elevated temperatures. Heat rays are visible to infrared materials, but the difficulty at the present time is the great length of exposure necessary when photographing with such rays.

Polarized-light photography makes it possible for photographs to be taken obliquely through water or glass. Similarly, the polaroid material when used as a screen subdues oblique reflections arising from opaque substances having a glossy surface. Oblique reflections from metallic surfaces are not eliminated unless screens are placed between the subject and light and also between the subject and lens.

The principal application of X-rays to industry is in the examination of articles during manufacture, to verify either the quality of material or workmanship, to check correctness of assembly, or to analyze failures in service. The atomic weight of the substance examined has a marked effect on the depth of penetration of the rays. Apart from this fact, penetration depends on the voltage applied to the tube. Experience shows that 40,000 volts will penetrate 4 in. of aluminum and 250,000 volts will penetrate 4 in. of steel. Some materials which are now being examined by means of X-rays are castings, bombs, fuses, ball bearings, steel plate, boiler drums and tubes, high-pressure piping, and welds.

The gamma radiations of radioactive substances, such as radium, have lately been employed for the same purposes as X-rays. By reason of their much shorter wave length, the gamma rays have a much greater penetrative power. The substance usually employed is a salt of radium known as radium bromide. In use, the salt is kept in a thick leaden casket, which is fitted with a removable lead plug. The container is placed a definite distance in front of the specimen to be examined, a photographic plate being placed behind the latter and, with the plug removed, left for an appropriate time. With this technique it is possible to penetrate and examine up to eight inches of steel. Photographs taken in this manner are conspicuous for the lack of scatter of the rays. The process is particularly suitable for use with irregularly shaped and heavy objects.

UNIONIZATION OF ENGINEERS

From Mechanical Engineering, April, 1940

To the Editor of *Mechanical Engineering*:

My attention has been called to the article in the November, 1939, issue of your publication by James H. Herron entitled, "Unionization of Engineers," and I have been invited to write you my reaction to this article. I am glad to do so as follows:

First, I would like to say that I think Mr. Herron has rendered a real service to the engineering profession and particularly to the younger members thereof in writing as he did. His article is most thought-provoking.

My experience both in dealing with younger men in my own business and in trying to bring up my four sons in the way in which they should go leads me to believe that while Mr. Herron is absolutely sound in stating that the engineer should think of service as his principal concern and pointing out that the engineer's salary depends upon the services he renders—service first then salary—it is most difficult to make young men believe that the job seeks the man. Logically, the amount of salary must depend upon the amount of service rendered. Promotion and success follow service and are absolutely dependent upon it. Men at the top in any profession or in business are always seeking young men upon whom additional responsibility can be placed and to whom they are glad to pay larger salaries if they can earn them. These principles are immutable and no organization, union or otherwise, can in general or for the long pull modify this fundamental.

The real question is how to make the young man believe these facts, particularly in the face of his knowledge of the benefits which unionization, so far as monetary compensation goes, has given to so many hundreds of thousands of employees the country over. Perhaps if they could appreciate that there is no true analogy between what bricklayers, automobile workers, or textile workers can do for themselves through unionization and the situation with respect to professional engineers, they would look at this question differently.

As Mr. Herron so well points out, unionization is in many ways the antithesis of professional ideals and ethics. To me they are as much the opposite ends of the stick as the term "professional sport" has always seemed. You can't be a professional and be a sportsman. You can't conform to union principles and at the same time live up to the ideals and precedents of the engineering profession.

The recent activities of one or two organizations attempting to unionize the younger groups of the engineering profession are in actuality nothing new. Some twenty years ago the American Association of Engineers staged a nation-wide campaign to raise young engineers' salaries. While they didn't call themselves a union, their goal was the same as that of the present-day agitators.

The past is a pretty good guide to the future. What happened to the A.A.E. ? They went up like a skyrocket and came down like a stick. In a very few years their membership grew to 20,000. To-day, I would have difficulty in locating their office and I doubt if they have more than 1,500 members. Why did this drive for collective bargaining in the ranks of the engineering profession fail ? Didn't it founder on the rocks of objectives impossible of attaining and maintaining in a profession ?

Are there any unions amongst lawyers, doctors, dentists, or architects ?

Can the young men serve two masters? Can they be faithful to the ideals of the engineering profession and be slaves to union delegates or put their own immediate monetary welfare ahead of their life's goal?

Youth should remember that the race of life is not a sprint won in the first ten seconds. It is a cross-country run where the sprint comes at the end of the contest.

While I believe all the foregoing to be uncontradictable, I realize it is difficult to sell preachments to youth, particularly in this day when even the law of supply and demand is questioned by modern crackbrained economists and that some answer which will appeal to youth should be found by those managing the great engineering societies of the country. Increased activity along welfare lines by the Founder Societies is probably desirable.

Perhaps if youth realized how unions break the scale in tough times and have to bow to the law of supply and demand they would appreciate that even the strongest union of subprofessional engineers, draftsmen, and technicians can't get blood out of a stone and that in general wages paid in the drafting rooms and the field forces of the engineering world are market-wise, fair, and all that traffic will bear.

Most experienced men know the futility of membership drives, whether for a Y.M.C.A., chamber of commerce, or country club. High-pressure salesmen can double the membership of almost any organization. The real test, however, is: Will such membership continue? Most sound organizations grow slowly and membership that sticks flows to the institution on a basis of need or merit. I believe any high-pressure selling of unionization amongst engineers withers in the fierce sun of facts.

Grant that unionization may temporarily raise wages—it does so at a grievous cost in that it levels men and leveling is the obverse of leavening; and leavening of the spirit of service is what youth in the engineering profession needs above all else.

J. P. H. Perry, Mem. Am. Soc. C.E.

Ed. Note—Mr. Perry is chairman of the Engineers' Council for Professional Development.

HERBERT AKROYD STUART

From *Diesel Railway Traction* (Supplement to the *Railway Gazette*, London, Eng.), March 15th, 1940

Few people in these days believe the story of James Watt and the kettle, but 55 years ago the accidental spilling of oil from a paraffin lamp led to a train of thought in the mind of Herbert Akroyd Stuart which resulted eventually in the heavy oil engine as we know it to-day. Stuart's first important patent was not taken out until 1890, and to commemorate the jubilee of the crucial period of his work, as well as to give recognition to the work he did, the Diesel Engine Users Association on January 11 held an Akroyd Stuart lunch, followed by a paper on the inventor and his work compiled by Messrs. T. Hornbuckle and A. K. Bruce. Slightly ante-dating Diesel in his ideas, and by some years in the production of commercially-successful engines, Stuart introduced the features of injecting the fuel into the air near the end of the compression stroke, ignition being achieved by the heat of compression. A vaporizer was used to vaporize the fuel, thus supplying some of the heat needed to give certain ignition, and enabling ignition to be obtained with a moderate compression pressure. The injection equipment was of the airless type, and naturally was of crude construction; it was unsuitable for working in conjunction with high compression. Stuart made use of an ante-chamber, the forerunner of modern precombustion chambers rather than of the air-cell or dual-turbulence heads adopted so extensively in modern high-speed designs, and he appears to have been fully aware of the combustion control which such an arrangement gave over a wide range of engine load and speed. Although Stuart was not the first man to draw attention to the possibilities of compression ignition, there is little doubt that he was the first to construct an engine along these lines, and, in association with Richard Hornsby & Sons, of Grantham, to make a practical success of it.

SEALING THE LAGOON LINING AT TREASURE ISLAND WITH SALT

By Chas. H. Lee, M.Am.Soc.C.E., *Proceedings*, American Society of Civil Engineers, February, 1940

Abstracted by D. S. Laidlaw, A.M.E.I.C.

A part of the landscape development at the site of the Golden Gate International Exposition, on the artificial island built in San Francisco Bay known as Treasure Island, consisted of a set of three connected fresh water lagoons, 3 ft. deep, with a total surface area of 7.62 acres. As evaporation from open water in the bay was known to exceed ¼ in. per day during the summer months, an evaporation loss from these lagoons of 50,000 U.S. gal. per day could be expected. The dredger-fill material of the island, moreover, was capable of absorbing surface water at the rate of 6 in. per day, a possible loss of 1,250,000 U.S. gal. per day. As the only supply of fresh water for all purposes on the island was through a 10-in. main laid over the bridge from San Francisco, feeding a 3,000,000 U.S. gal. reservoir on Yerba Buena Island, it became necessary to provide an impervious lining for the lagoons if they were to be included as a feature of the exposition.

Various materials were considered for the lining, including concrete, asphalt, bentonite, and clay, the last of these being chosen as meeting both physical and cost requirements. The adopted design called for a layer of clay 10 in. thick on the lagoon bottoms, and 12 in. thick on the side slopes (1 on 3) to a point 20 in. vertically below the water surface. From there to a point 1 ft. above water level, the slopes were to be covered with a layer of gunite, not less than 2 in. thick, reinforced with wire fabric, and masked by rock and top soil. The clay selected for the lining, as generally the most suitable of all samples submitted by bidders, had the gradings shown in the following table:

Screen No.	Percentage of Total Sample Held	Per Cent Passing	Classification	Diameter in Millimeters	Percentage by Weight
8	0.88	99.12	Gravel	2–plus	0
14	1.21	97.91	Fine Gravel	2–1	1.0
28	1.64	96.27	Coarse Sand	1.0–0.5	1.3
48	8.37	87.90	Medium Sand	0.5–0.25	6.7
100	18.85	69.05	Fine Sand	0.25–0.1	18.2
150	4.84	64.21	Very Fine Sand	0.1–0.05	12.8
200	3.28	60.93	Silt	0.05–0.005	27.8
270	6.26	54.67	Clay	0.005–0.0005	32.2
–270	54.67	.....			
	100.00				100.0

Tests run by the Proctor method gave the following figures:

Dry weight, lb. per cu. ft.	118.0
Moisture, percentage of dry weight	14.5
Plasticity-needle reading, lb. per sq. ft.	990.0
Air voids, expressed as equivalent percentage of moisture	1.4
Porosity, percentage by volume	29.8
Allowable working moisture range, based on dry weight	14.5 to 17.0

Chemical analysis for exchangeable bases showed the material to be a calcium clay, typical of fresh water conditions, as indicated by the following figures:

Exchangeable Bases	Exchangeable Base Capacity	Per Cent of Total Capacity
Calcium	6.8	60.7
Magnesium	3.6	32.1
Sodium	0.6	5.4
Potassium	Trace	...
Hydrogen	0.2	1.8
	11.2	100.0

The material was a decomposed sandstone, of a brownish-yellowish colour. After dumping, it was sprinkled with water, spread, and rolled with a 14-ton road roller in two layers, the lower being about 6 to 7 in. thick. A sheepsfoot roller was not used, as those in charge of construction feared that it might break through such a thin membrane. Density and moisture content tests made after rolling gave dry densities of 69 to 108 lb. per cu. ft. with moisture running from 13 to 16 per cent. The density figures pointed to the possibility that the method of rolling used had caused air to be entrapped in the lower portions of the layers, probably at a pressure greater than atmospheric.

A seepage test, made in September, by levelling off a small area and filling it with water 13 in. deep, showed a daily seepage loss of 187,000 U.S. gal. from the whole area. This loss was considered to be so great that further steps would have to be undertaken.

It was known that some of the properties of sodium and calcium clays were pronouncedly different, the former being inclined to be cohesive and sticky, and the latter tending to form very small balls or crumbs, not adhering very strongly to each other. Experiments were, therefore, undertaken to study the possibility of transforming the calcium clay of the lining into a sodium clay.

The results indicated the use of salt as a sealing agent, and it was considered cheaper to use sea water than raw salt. The lagoons were filled to a depth of 18 in., which immediately caused the seepage loss to drop from 0.90 to 0.60 in. per day. Filling was continued, however, until the calculated amount of 40 in. of sea water had been passed through the lining, when the lagoons were drained and filled with fresh water to a depth of 34 in. Tests of samples of the lining material taken after these operations showed that the ratio of replaceable sodium to calcium had changed from its previous figure of 1/11 to 1.7/1 for the top material, 2.6/1 for the middle of the lining, and 2.4/1 at the bottom of the lining, a 24-fold increase of sodium that accompanied a 30 per cent increase in the total of the replaceable bases.

After filling with fresh water, it was noticed that quantities of air were held in the upper portions of the clay lining and could be released by disturbing its surface. For the first month after filling, the seepage rate held steadily at 0.46 in. per day, when it suddenly dropped to 0.28 in., later again falling to 0.18 in., and, at the end of the third month, to 0.10 in. per day. It was found that the sudden drops in the seepage rate occurred at times of exceptionally low atmospheric pressure, which probably permitted entrapped air to escape from the clay, allowing the sodium gel to extend to all parts of the lining, knitting its particles into a more dense and cohesive structure.

To prevent salt water from reaching the tree roots on the island, it was necessary to pump out ground water continuously. Seepage was apparently sufficient, however, to carry off any excess salt, as no adverse effect was observed on any aquatic plants placed later in the lagoons.

The author suggests this method as an effective and economical one for sealing such structures as reservoirs, dams, and swimming pools. Once free of entrapped air, the clay particles will disperse to form a sticky gel that will remain solid and stable as long as it is in contact with fresh water, and will not, apparently, leach out with time. The salt treatment, in the case cited, cost only a few hundred dollars, as against estimates of as high as $15,000 for sealing the lagoons with bentonite.

SICKNESS ABSENTEEISM

Abstracted by Mechanical Engineering, April, 1940

Sickness from ordinary diseases and nonoccupational injuries accounts for the absence of ten per cent of all workers in American industry eight days or longer per year, with an average of slightly more than 39 days for men and 35 days for women. If absences of less than eight days are included the grand total of days lost is just about doubled. In giving these figures in a talk presented at the winter meeting of the American Institute of Mining and Metallurgical Engineers in New York, February 12-16, 1940, Dr. C. D. Selby, medical consultant of General Motors, stated that of 8,000 absences in his company during the first half of 1939, about 50 per cent resulted from respiratory diseases and 15 per cent from digestive diseases, most of which are preventable. Particular emphasis should be given by industry, he said, to cutting down the ordinary disease rate among workers. Up to the present time the emphasis has been entirely upon occupational hazards, which are responsible for only ten per cent of the absenteeism.

SHALL WE TEACH CULTURE

By N. W. Dougherty, *Assistant Dean of Engineering, The University of Tennessee, Knoxville, Tenn.*

Civil Engineering, March 1940

Engineers are seeking a liberal education or culture. They have not defined the object of their search sufficiently to speak a common language; some say, "Lo, here!"; others say, "Lo, there!" And all say, "Let us seek it."

No doubt this attitude has come about because of the great variety of men who call themselves engineers; some wear overalls, some sit in the halls of learning, others have reached fame in industry. Many of them are rough men given to doing rather than to saying—men who are at home among wheels, who fear not the lightning, who achieve wonders in materials, but who are embarrassed by social ideas and abstract expression.

What the Engineer Needs

They can manufacture steel, mix concrete, construct skyscrapers, design dynamos, install turbines, transmit speech, transform materials, transmute chemicals—and never break their stride. They can produce goods, convey commodities, conquer the air with the wings of the morning, mine into the earth, tap sources of energy stored by the sun for future generations; they can speak fluently in their own jargon, but they become panicky at a few phrases from Shakespeare. They need a liberal education.

At first the engineer was so interested in what he was doing that he did not care what he was saying. His work brought him in contact with all kinds of people, some boors, some refined. And then began his desire to be identified with the refined and distinguished from the coarse. This he thought would come by worship at the shrine of culture.

A More General Education

In this, engineering is not greatly different from other professions. All are seeking something in addition to their prescribed minimum training in professional subjects. Their search is only beginning because professional demands will become more insistent as the fields of knowledge grow and the need for basic science increases and as their field of activity, though specialized, impinges upon many avenues of life.

General education is becoming an essential for all who assume leadership in public life. All the professions are coming into contact with the public and it seems that we are in the initial stages of public employment for professional men. Certainly increasing public demands are being made upon them. All the professions have some form of licensing to protect the public against the fakir, the charlatan, the shyster, and the incompetent, by requiring that only those with accepted minimum qualifications may call themselves by professional titles. There is definitely a movement to socialize the professions. More than 60 per cent of the civil engineering group are employed by the public; other engineers, though they are resisting, are being inducted into public service. Doctors and dentists are obstructing it now, but socialized medicine and dentistry are nearer than the distant future. Preachers and teachers have worked for the public so long that they think it has always been so.

These trends are making the engineer conscious of the need for knowledge of human relations, the need for training in government, the desire for participation in government itself. The demand for formal training in human relations is inevitable; it will come, and for many it is already here.

Choice of Action

What are we trying to find when we seek culture ? Is its essence "voluntary disinterestedness," something divorced from the useful, something that is ornamental, something that gives polish to actions and thoughts ?

The old Jewish prophet realized that there were at least two conflicting attitudes toward life which would be at battle for many generations to come.

Our culture is an odd mixture of both—not a mixing of oil and water but a blending of wine with sorrow, a compounding of temperance with service; a weighing of the balloon of imagination with the practical ballast of accomplishment. We sit at the feast of the Eucharist with a joyful song in celebration of one of the greatest tragedies of the human race, and detect no inconsistency. Our priests and prophets assure us that piety, goodness, sobriety, and general temperance are not enough; we need self-sacrifice and some form of vicarious atonement.

Attempting to Delimit Culture

Engineers are wont to express the belief that culture is bounded by the walls of the liberal arts college. No branch of human knowledge has a corner on culture or liberal training. No series of courses, without reference to the way they are taught or studied, have cultural value. Culture is acquired by the method of study, the spirit of approach, and not by the kind of knowledge.

We associate culture with writing and reading poetry and think of it as being foreign to plumbing or mixing concrete. Normally these associations are true but we can think of a verse-maker whose mind savors of the sewer, and we can think of a concrete-maker who is building a cathedral.

Hunger for Truth

Is liberal education a program of study, or a method of study ? Is culture a kind of knowledge, or an attitude of mind ? Does broad general training consist of useful things or ornamental shrubbery and flowers which cause the mind to bloom in spring, bear fruit in middle age, and grow old gracefully ?

Can these things be taught ? Our answer is "yes," but not in regular assignments and by examination. They can only be taught by those who possess them and then by contact, association, contagion, and as by-products and incidentals rather than formal study. Any subject taught by a master has possibilities.

Any teaching which instills in students a desire to know more and inspires them with a willingness to exert real effort to acquire greater knowledge and understanding, is bordering on culture. The desire may be tainted with selfishness and still have the leaven in it. If it be a disinterested hungering and thirsting for truth, the seeker will be filled and he will know the truth and the truth will make him free.

Spirit of Liberal Training

Freedom is a prime requisite of liberal education and culture. It is the voluntary effort, the undemanded service, the unresisted leading, the "second mile" that pays dividends in culture. It is not fine manners, it is not polished speech, it is not this course or that; it is a spirit, an attitude, an approach, a method, a living thing which has fine manners, polished speech, and a human understanding. It is free from fads, and styles; it is not put up in fancy packages, with high-sounding labels; it is not confined to poetry or to art galleries. "Wherever there is good breeding, gentle tastes, manly delicacy, openness and activity of mind, intellectual interest, and a sense of public duty," there will be found the object of our search.

An Essential Philosophy of Teaching

Engineers must have what the liberal arts college has to give, not as liberal education or culture *per se* but as a part of their professional education, because where there is an element of disinterestedness, boundless limits to educational possibilities, and contact with human relations, laws of nature, and proficiency in expression, there is real possibility for acquiring liberal culture. Because the professions need certain kinds of knowledge and mental disciplines there is no reason to think they cannot worship at the shrine.

Some day—not until we children of the old school have passed away—some person with a knowledge of engineering, the imagination of an artist, and the vocabulary of a poet will express the cultural value to be found in applied science, engineering principles, and a technology that has revolutionized our everyday living. He will make a distinction between things and ideas; he will point to the difference between information and learning; and he will distinguish between the parrotlike repetition of authority and the deep flowing stream of intellectual integrity. He will find universal laws, common methods, and the same final result. He will conclude that the warp and woof of all knowledge stems from a common thread, but the different patterns show the handiwork of many skilled workers.

A Learning That Discriminates

Let us emphasize the need for teachers who can cause students to leave their classes with a hungering and thirsting after more knowledge, more understanding, and a desire for more humility and less prejudice and self-satisfaction.

Americans have fallen into the snare and the delusion that all learning must come during the formal schooling period, and that if subjects are not introduced somewhere in the organized curriculum, they will be hidden for all time. A student, who believes that his period of study is over, is doomed to ignorance and barbarism. If he knows that his studying days have just begun and that he has acquired an intellectual appetite which discriminates, he will be on the road leading to a liberal education and possibly ultimately to culture.

From Month to Month

News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

CANADIAN INDUSTRIES IN WARTIME

In a recent review* of the industrial situation in Canada, the view is taken that developments due to war conditions may to some extent free Canadian business from its dependence on activities in the United States. This does not mean that the economic relations between the two countries will be weakened, or that United States capital and industry will not help to meet Canada's requirements in fulfilling war demands. Exchange control will tend to restrict some Canadian purchases in the United States, but on the other hand the cessation of supplies from enemy countries will have the opposite effect. The results of transport difficulties have to be considered also, as in the case of crude oil, where the increased demand for tankers will hamper ocean transport from South America and will lead to increased supplies from the United States.

The Canadian railways are efficiently managed and are proving equal to the heavy demands which are being made upon them. An example of this is the transport of lumber by rail from British Columbia to Atlantic ports, a service which will release many vessels from the Panama canal route.

Reference is made to the considerable capital expended by Canadian manufacturing interests in meeting wartime requirements, notably those by the Aluminum Company of Canada, the Steel Company of Canada, Dominion Foundries and Steel, Canadian Industries Limited, and the various Canadian firms engaged in the production of aircraft, parts and equipment.

Domestic business is good in Canada and exports are expanding, particularly of course as regards food products. The fuel situation is receiving attention. Primary iron and steel industries are working nearly at capacity and electric power consumption is on an ascending scale. The involvement of the Baltic area in hostilities is likely to increase the demand for Canadian pulp and paper.

The mining industry is active. An interesting development is proceeding in Ontario, west of Lake Superior, where extensive deposits of high grade hematite iron ore have been found by diamond drilling and geophysical prospecting.

THE "PRIZE YEAR"

The conditions governing the award of the medals and prizes of the Institute, as printed in this issue of the *Journal*, indicate clearly the importance attached by the Council and by the past presidents and benefactors of the Institute to one of the main aims of all engineering societies, the collection and publication in concise and readable form of professional information and records of engineering activities. It is for this purpose, and to give members practice in preparing and discussing technical papers, that most of the prizes have been established.

It will be noted that five of the awards have attached to them the names of distinguished past presidents and members, four of whom are no longer with us. These memorials help to build up in the Institute an ideal of high professional standing and public service which cannot fail to influence the careers and ambitions of our members.

The list of prizes is headed by the highest honour in the gift of the Institute—The Sir John Kennedy Medal,—given for standing, merit, and service to the community and the profession. This is followed by a group of prizes to be awarded for papers contributed by members. Those in competition for the Past-Presidents' Prize of one hundred dollars, are on a subject selected annually by the Council. For the current year the topic is a timely one, "Engineering in National Defence" particularly as it concerns the work of the civilian engineer in any of his multifarious war-time activities. The Duggan Prize, of like value, is for papers dealing with any of the wide range of constructional engineering problems concerning the use of metals in moulded or fabricated shape for structural or mechanical purposes. The Gzowski Medal bears the name of one of the early presidents of the Institute and is given for that paper of the year which may be adjudged the best contribution to the literature of the profession of civil engineering, the term civil engineering being used in its widest sense.

The list of awards for which our senior members are eligible is rounded off by the Leonard and Plummer Medals given respectively for papers on mining subjects and on chemical or metallurgical work.

For the encouragement of the younger members five prizes are given for Students and Juniors in the several vice-presidential zones of the Institute, special provision being made in the province of Quebec for those whose mother tongue is French. The Council has also established at the leading Canadian engineering schools eleven prizes, bearing the name of the Institute, for award to students just prior to their graduating year, who are selected by the college authorities as being most deserving. Non-members of the Institute are eligible for these prizes.

During their years of student and early professional life, young engineers should be aided in every possible way to gain facility in expressing themselves, both in writing and orally; the preparation and delivery of original papers is therefore a necessary part of their training. If greater interest were shown by our members in pursuits of this kind, the criticism that engineers are inarticulate would not be heard so frequently.

No one can write a worth-while technical paper without discovering two things, first, that he has had to fill many gaps in his previous knowledge of the subject, and next, that the effort to marshal his facts and draw the proper conclusions from them has notably increased his power of expressing his views clearly and forcibly. The delivery and publication of a good paper has also the very desirable result of making the author favourably known to a wider circle of members of the profession as well as to the public at large.

At this time, when the sessions of our branches are ending and the time for sending in papers is nearing its close, the Council desires again to draw attention to the opportunities provided by the Institute prizes and medals, and to urge members to contribute papers which will compare favourably in number and character with those of previous years. This applies particularly to the Past-Presidents' Prize.

The Prize year ends on June 30th.

CORPORATION OF PROFESSIONAL ENGINEERS OF QUEBEC

The annual general meeting of the Corporation of Professional Engineers of the Province of Quebec was held at the headquarters of the Engineering Institute of Canada, Mansfield Street, Montreal, on Saturday, March 30th, with about 100 members of the Corporation present. In discussing the annual report of the Council members expressed approval of the issuance of the interim reports in June and January, and it was suggested that such reports might well be issued at even more frequent intervals. Mr. F. P. Shearwood offered some carefully prepared suggestions concerning ultimate policies of the Corporation. The

**Trade & Engineering* (London), April 1940.

treasurer's report and financial statements showing a continued satisfactory condition were adopted unanimously.

Reports of the Membership Committee were presented by Mr. B. R. Perry, chairman, and by Mr. Léo Dufresne, chairman of the sub-committee for Quebec, with the recommendation that the work of these committees be continued along the lines suggested in the reports. This recommendation was approved. Mr. Hector Cimon reported on the actions taken by the Dominion Council, and Mr. Eric Muntz, representative for Ontario on that Council, also spoke, referring especially to matters concerning which the Dominion Council had been in touch with the federal government.

Annual elections to Council were announced, as follows: for the district of Montreal, Messrs, R. E. Jamieson and O. O. Lefebvre; for the district of Quebec, Messrs. A. Larivière and J. O. Martineau. Mr. C. René Dufresne was appointed auditor for the current year. The President announced that Council had accepted, with great regret, the resignation from Council of Mr. Jas. A. Kearns, who found that he could not devote to the affairs of the Corporation the time which he felt was necessary.

At a meeting of the new Council held immediately after the Annual Meeting, Mr. L. O'Sullivan was appointed to fill the vacancy on Council caused by the resignation of Mr. Kearns. The Council for the ensuing year consists of Messrs. Hector Cimon, W. F. Drysdale, R. E. Jamieson, A. Larivière, O. O. Lefebvre, J. O. Martineau, L. O'Sullivan, and B. R. Perry. Mr. R. E. Jamieson was elected president, Dr. O. O. Lefebvre vice-president, and Mr. W. F. Drysdale secretary-treasurer.

In the evening, the Corporation held a dinner at the Windsor Hotel at which upwards of 100 members were present. The guests included Mr. E. P. Muntz, representing the Association of Professional Engineers of Ontario, Dr. J. B. Challies, representing The Engineering Institute of Canada, Mr. J. R. Smith, representing the Province of Quebec Association of Architects, and Mr. J. A. Lalonde, representing the Graduates Society of the Ecole Polytechnique de Montréal.

AN OPEN LETTER

Montreal, May 7th, 1940

To the Editor of *Canadian Motorist*,
Ontario Motor League,
Toronto, Ont.

Dear Sir:—

The greater part of your recent editorial "Doubtless The Anti-Motor-Transport Rail Propagandists Rejoiced" attacking my paper delivered before the Engineering Institute of Canada can be dismissed with the comment that it is regrettable that in Canada we have yet to reach the point where one can discuss important public questions without being reviled by propagandists of special interests. One is reminded of the old saying "It makes a difference whose ox is gored," and it does seem too bad that in this national emergency we are not all of us big enough to see beyond the narrow limits of our own interests.

While I am not greatly disturbed by your personal reflections, I am interested in your attempt to belittle the abilities of engineers in the field of economics. Fortunately your criticism is not shared by businessmen in general. If your admonition that engineers should stick to engineering were accepted, the executive heads of many financial and industrial organizations, and many established authorities on economics, would have to retire.

It might be assumed, from the caption and general tenor of your editorial, that the paper was contrived especially to support the "Anti-Motor-Transport Rail Propagandists." This, of course, is a substantial distortion of the truth. The paper discusses very broadly a variety of pressing economic problems with particular reference to Canada's ability to "defeat the enemy . . . with the minimum loss of life and the minimum of permanent impoverishment of our country."

Your contention, stripped of its irrelevancies, inaccuracies and abusive verbiage, boils down to this:—the rationing of gasoline would not be in the best interests of our country because it would curtail the American motor tourist traffic, from which we derive so much in U.S. funds, and the curtailment of the use of busses and trucks is not justifiable because the railways likewise require American exchange for supplies.

My suggestion that our exchange position should be built up so as to obtain indispensable war materials in sufficient volume is neither radical nor novel. Within the past few days two eminent bankers, Mr. Graham Towers and Mr. Huntly Drummond, have stressed this, and I gather you do not dispute it. Stringent rationing of gasoline has already been put into effect in Britain as one of the means for conserving foreign exchange.

I am in entire agreement with you as to the desirability of retaining and developing our tourist trade, as is indicated elsewhere in my paper, but surely our Government can be counted upon to exempt American tourists from any such restrictions. Herein lies the advantage of rationing as against taxation as a means of reducing the drain on American dollars. As for your second point, the question is, which involves the least use of foreign exchange per ton mile, movement of freight by train or movement by truck? I think the answer is obvious.

If I appeared to you to be unduly eulogistic of the engineer, I can assure you that it is not vanity, but an ardent desire to arouse more engineers to the urgent need of utilizing their experience and talents to assist in solving the war problems that confront us.

Finally, I would suggest that the sooner we all learn to discuss matters of public interest objectively and without malice, the better.

Yours sincerely,

G. A. Gaherty.

MEETING OF COUNCIL

A meeting of the Council was held at Headquarters on Thursday, April 18th, 1940, at eight o'clock p.m., with Vice-President Fred Newell in the chair, and seven other members of Council present.

It was unanimously resolved that Messrs. J. G. Hall, H. Massue and E. A. Ryan be appointed scrutineers to canvass the ballot for the amendments to the by-laws, which is returnable on May 1st, 1940. The General Secretary reminded members present of the regional meeting of Council to be held at Windsor, Ontario, on Saturday, May 11th, advance notice of which had already been sent to all councillors. It was at present planned to hold the Council meeting in the morning; to have a joint luncheon with the Council of the Association of Professional Engineers of Ontario, and to leave the afternoon free for visits to industrial plants. In the evening there would be a joint banquet, to which all members of the branch and of the Association, as well as representatives from the American societies in Detroit, would be invited.

Past-President Challies reported briefly on the informal discussions which he and the General Secretary had had recently in New York with Chairman Perry and Secretary Davies of the Engineers' Council for Professional Development (E.C.P.D.) regarding the Institute's possible affiliation with that body.

Mr. Wright read a letter from Mr. Perry in which he reported that the suggestion had been brought before the executive committee and they had given approval to it. Mr. Perry was authorized to appoint a committee to make a specific recommendation to the meeting of the Council which is to be held in Pittsburgh in October. Mr. Perry said the next step would be for a formal request to be received from the Institute, which would be submitted to this committee, and by it to the meeting of Council. Mr. Perry expressed his personal pleasure at the prospect of having The Engineering Institute of Canada join the E.C.P.D.

Dr. Challies stated that the Committee on International Relations was prepared to make a definite recommendation along this line at the next meeting of Council. In the meantime the matter would be referred to the Finance Committee for their consideration and recommendation.

Mr. Newell felt that before the proposal is discussed at Windsor, members of Council should know just what such affiliation would really mean to the Institute, and Dr. Challies suggested that the Committee on International Relations should send a copy of the last annual report of the E.C.P.D. and other pertinent information to all members of Council so they would be familiar with the aims and objects of this body.

A number of applications were considered, and the following elections and transfers were effected:

ELECTIONS

Members	4
Associate Members	7
Juniors	9
Affiliate	1
Students admitted	23

TRANSFERS

Associate Member to Member	1
Junior to Associate Member	2
Student to Associate Member	4
Student to Junior	6

The Council rose at eight forty-five p.m.

ELECTIONS AND TRANSFERS

At the meeting of Council held on April 18th, 1940, the following elections and transfers were effected:

Members

Angus, Harry Holborn, B.A.Sc., (Univ. of Toronto), consltg. engr., 1221 Bay St., Toronto, Ont.

Gill, J. Emile, B.A.Sc., C.E., (Ecole Polytechnique, Montreal), asst. engr., Quebec Streams Commission, Montreal, Que.

Hand, Norman C., vice-president and general manager, S. Morgan Smith Inglis Co. Ltd., Toronto, Ont.

Maclachlan, Kellogg Sinclair, B.A.Sc., (Univ. of Toronto), president and general manager, Fraser Companies Limited, and at present Acting Deputy Minister, Department of National Defence, Ottawa, Ont.

Associate Members

Brebner, Kenneth Alexander, B.Sc., (Queen's Univ.), plant engr., Price Bros. & Co. Ltd., Riverbend, Que.

Donaldson, Adam Gillespie, B.Sc., (Univ. of Alta.), mine supt. at Standard Mine, Shaughnessy, Alta., for Lethbridge Collieries Limited.

Hillman, William Angus, Apt. 85, 142 Wellesley Crescent, Toronto, Ont.

Kindersley, Robert Erskine Gordon, (Cambridge Univ.), statistician, Imperial Oil Limited, Toronto, Ont.

Laird, Robert G., B.Sc. (Mining), (N. Dakota Sch. of Mines), i/c engrg. dept., Valley Pipe Line Company, Turner Valley, Alta.

Mott, Charles Allan, city engr., bldg. inspr., & supt. of public works, Belleville, Ont.

Rabb, Arthur H., B.Sc., (Queen's Univ.), asst. highway engr., Dept. of Highways of Ontario, Kenora, Ont.

Juniors

Bales, Robert P., B.A.Sc., (Univ. of Toronto), chem. engr., Dominion Rubber Co. Ltd., Montreal, Que.

Boucher, Omer Joseph Roger, B.A.Sc., C.E., (Ecole Polytechnique, Montreal), 6572 Louis-Hebert St., Montreal, Que.

Douglas, Ralph Louis, B.Sc., (Queen's Univ.), engr. in charge, coil & air conditioning dept., The Trane Company of Canada Ltd., Montreal, Que.

Fraser, Robert, B.Eng., (N.S. Tech. Coll.), operating engr., Consolidated Paper Corporation Ltd., Grand Mere, Que.

Gent, William James, B.Eng., (N.S. Tech. Coll.), power plant operator, Newfoundland Airport, Nfld.

Gung, George, B.A.Sc., M.A.Sc., (Univ. of Toronto), junior testing engr., H.E.P.C. of Ontario, Toronto, Ont.

Lexier, Herschel Louis, Bach. Mech. Engrg., (Univ. of Min.), 1706 15th Ave., Regina Sask.

Pittis, Ralph Colin Alfred, B.A.Sc., (Univ. of Toronto), constrn. engr. & inspr., Imperial Oil Limited, Toronto, Ont.

Trethewey, Graham D., B.A.Sc., (Univ. of B.C.), test chemist, B.C. Pulp & Paper Co., Port Alice, B.C.

Affiliate

Barnard, William Alfred Charles, cartographer & asst. to the chief geographer, Surveys Branch, Dept. of Lands & Forests, Queen's Park, Toronto, Ont.

Transferred from the class of Associate Member to that of Member

Eager, Norman Aldwyn, B.Sc., (McGill Univ.), M.C.E. (Cornell Univ.), asst. sales mgr., Burlington Steel Co. Ltd., Hamilton, Ont.

Transferred from class of Junior to that of Associate Member

Cooper, John Sidney, B.A.Sc., (Univ. of Toronto), chief dftsman., The Wabi Iron Works Ltd., New Liskeard, Ont.

Stephenson, Stephen, engineer, The Herbert Morris Crane & Hoist Company, Ltd., Niagara Falls, Ont.

Transferred from the class of Student to that of Associate Member

Duncan, John Daniel, B.A.Sc., (Univ. of B.C.), Lieut., 1st Corps Signals, C.A.S.F., P.O. Box 202, Milton, Ont.

Hankin, Edmund A., B.Eng., (McGill Univ.), engr. i/c air conditioning dept., Francis Hankin & Co. Ltd., Montreal, Que.

Hawkey, Bertram Jackson, B.Sc., (E.E.), (Univ. of Alta.), consltg. engr., Fernie, B.C.

Rogers, Carl L., B.Eng., (McGill Univ.), industrial engr., H.E.P.C. of Ontario, Toronto, Ont.

Transferred from the class of Student to that of Junior

Gunter, Allan Nelson, B.Sc. (Chem.), (Univ. of Alta.), junior engr., Prairie Farm Rehabilitation Engrg. Staff, Regina, Sask.

Hood, George Leslie, B.Sc., (Univ. of Man.), junior asst. meter engr., H.E.P.C. of Ontario, North Bay, Ont.

McGinnis, Arthur David, B.Sc., (Queen's Univ.), M.C.E., (Cornell Univ.), engr. McGinnis & O'Connor, Kingston, Ont.

Schofield, Robert John Graham, B.Eng., (McGill Univ.), chemist & asst. dyer, Canadian Cottons Ltd., Hamilton, Ont.

Smyth, William Christopher, B.Eng., (McGill Univ.), supt. engr. H. J. O'Connell Ltd., Montreal, Que.

Thorssen, LeRoy Allan, B.Sc. (Civil), (Univ. of Alta.), lecturer in civil engrg., Univ. of Alberta, Edmonton, Alta.

Students Admitted

Adams, John Lindley, (Univ. of Man.), P.O. Box 151, Newdale, Man.

Brown, George Cameron, (McGill Univ.), 4322 Marcil Avenue, Montreal, P.Q.

Conlin, Gerard Herbert, (Queen's Univ.), 16 Rosedale Heights Drive, Toronto, Ont.

Curtis, George Louis, (Univ. of Man.), No. 6 Belmont Apts., Moose Jaw, Sask.

deGrey, Edward Hesketh, (McGill Univ.), 4015 Grey Avenue, Montreal, P.Q.

Dewis, Marshall Woodworth, (Univ. of Alta.), Canmore, Alta.

Graham, Richard James, (McGill Univ.), 306 Sanford Ave., St. Lambert, P.Q.

Grant, Frank A., (McGill Univ.), 95 Fifty-fourth Ave., Lachine, P.Q.

Hoar, Charles Richard, (Univ. of Alta.), Knee Hill Valley, Alta.

Howard, Henry Mervyn, (Univ. of Tor.), 454 Crawford St., Toronto, Ont.

MacInnes, Thomas Robert Lampman Malcolm, (McGill Univ.) Ottawa, Ont.

MacNabb, Thomas Crighton, Jr., (Univ. of Tor.), Rothesay, N.B.

Merson, Lawrence Nelson, (McGill Univ.), 189 Mozart St. W., Montreal, P.Q.

Milhausen, William James, (Univ. of Man.), Morden, Man.

McDonnough, William Ralph, (McGill Univ.), 308 St. Cyrille St. Quebec, P.Q.

McLean, Alexander Francis, (Univ. of Tor.), Melbourne, Ont.

Murphy, Herbert John, (Univ. of Mass.), South River, Ont.

Neil, Charles Hamilton, (Queen's Univ.), Kingston, Ont.

Paithouski, Nicholas Joseph, (Queen's Univ.), 589 Vidal St., Sarnia, Ont.

Rogers, Robert G., (Univ. of Tor.), 116 Highbourne Road, Toronto, Ont.

Tuttle, Paul Douglas, (McGill Univ.), 5162 Westbury Ave., Montreal, P.Q.

Walker, Howard James, (McGill Univ.), 866 Hartland Ave., Outremont, P.Q.

Wills, N. James, (McGill Univ.), 3579 Shuter St., Montreal, P.Q.

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

The Hon. C. D. Howe, M.E.I.C., Minister of Transport in the federal cabinet, has been appointed to the portfolio of the newly created department of Munitions and Supply, which supersedes his former charge, the War Supply Board.

Lesslie R. Thomson, M.E.I.C., who was assistant to R. A. C. Henry, M.E.I.C., executive assistant to the Minister of Transport, has been named controller and secretary of the new department of Munitions and Supply at Ottawa.

DeGaspé Beaubien, M.E.I.C., has been appointed joint chairman of the National War Savings Committee charged with launching the sale of war savings certificates. Mr. Beaubien is the treasurer of the Institute and its representative on the executive committee of the Canadian Chamber of Commerce. He is a director of a number of industrial companies. Recently he was elected a director of Howard Smith Paper Mills. He has just retired as president of the Canadian Club of Montreal.

Foto Press Service

Lesslie R. Thomson, M.E.I.C.

Gordon McL. Pitts, M.E.I.C., has been elected president of the McGill University Graduates' Society. He was graduated in 1908, with the degree of bachelor of science and in 1909, he received the degree of master of science. In 1916, he received the degree of bachelor of architecture. He is a member of the firm of Maxwell & Pitts, architects, Montreal.

T. J. Lafrenière, M.E.I.C., chief engineer of the Quebec Provincial Department of Health, is the winner of the 1940 Fuller Medal of the American Water Works Association. The announcement was made at the banquet which followed the 20th annual convention of the Canadian section of the American Water Works Association at Toronto, Ont., in March. Dr. A. E. Berry, M.E.I.C., Sanitary engineer for Ontario, read the citation which said the award is "for conspicous leadership in the fields of water purification, supervision of public water supplies, control of water-borne diseases and the general betterment of environmental factors associated with public health." The presentation was made at the annual meeting of the Association at Kansas City last month.

Mr. Lafrenière was graduated as a bachelor of applied sciences from the Ecole Polytechnique in 1909 and he received the degree of master of science from the Massachusetts Institute of Technology in 1912. Since graduation, he has been with the Province of Quebec service of health, first as an assistant sanitary engineer, later as sanitary engineer in charge, and then as chief engineer. He has been a member of many commissions inquiring into public health questions. Mr. Lafrenière has been a professor of sanitary engineering at the Ecole Polytechnique for many years past.

Major A. J. S. Taunton, D.S.O., M.E.I.C., has been appointed district engineer to supervise the construction work being done by the Department of Munitions and Supply for the Department of National Defense in the prairie provinces. From 1914 to 1919, Major Taunton served overseas with the 27th Battalion of the Canadian Expeditionary Forces. He has had extensive construction experience both with the Manitoba Government and with the Department of Public Works of Canada. He is the councillor of the Institute for the Winnipeg Branch.

Canadian Newspaper Service

Beaudry Leman, A.M.E.I.C.

Beaudry Leman, A.M.E.I.C., president of the Banque Canadienne Nationale, has been elected as a director of the Delaware and Hudson Company, Limited, and the Delaware and Hudson Railway.

H. J. Roast, M.E.I.C., vice-president of the Canadian Bronze Company, Limited, has been appointed director of the American Foundrymen's Association, the leading organization of its kind in North America. Born in London, England, in 1882, he came to Canada in 1903, as a chemist in charge, for the Canadian Iron Foundries, Radnor Forges, Que. From 1904 to 1907, he was works manager of the Canadian Carbonate Company at Montreal. In 1907, he became general manager of the Canadian Magnesite Company of Montreal and Newark, N.J. From 1914 to 1922, he was manager of the testing department at the James Robertson Company, Montreal. He became vice-president and general manager of the National Bronze Company Limited, Montreal, in 1922, and president in 1926. For some time, he was proprietor of the Roast Laboratories Registered in Montreal. In 1935 he became technical adviser of the Canadian Bronze Company Limited, and later vice-president.

R. A. Baldwin, M.E.I.C., engineer of construction with the Canadian National Railways at Toronto has recently retired on pension. He entered the service of the Grand Trunk Railway at Toronto in March 1899, as draughtsman in the engineering department. In September 1900, he was employed on the construction of the Algoma Central

Railway, as transitman and draughtsman at Sault Ste. Marie, Ont., In September 1901, he entered the employ of the New York Central Railway as transitman at Buffalo, N.Y., and became chief draughtsman of the Wabash Railway at St. Louis, Mo., in April 1904. In August 1905, he returned to Canada to join the engineering staff of the Canadian Northern Railway, as chief draughtsman at Toronto, Ont., and was later appointed assistant engineer, district engineer, and engineer, maintenance of way. He was appointed engineer of construction in January 1922, having held that position to the date of his retirement. During this period, he has been connected with practically all of the railway construction and grade separation work carried out by the Canadian National Railways in Ontario and Quebec, and has, during the last three years, had charge of the construction of the new line, one hundred miles in length, from Noranda to Senneterre, through the northern Quebec mining district.

L. H. Robinson, C.E. (Toronto), M.E.I.C., division engineer, Canadian National Railways, Halifax, N.S., retired on March 1st, on account of ill health. Upon graduation from the School of Practical Science, Toronto University, he joined the lines of the Canadian National Railways in October, 1904. He was on preliminary and location surveys for several years in northern Quebec, Ontario and eastern Manitoba and later was resident engineer on construction in the same territory. He was in charge of the construction of the divisional terminal at Sioux Lookout until its completion in May 1913. For nine months he was location engineer with the Canadian Pacific Railway in the Lake Superior and Toronto districts, rejoining the Canadian National Railways as location engineer in March 1914, in the Atlantic region. In 1919, he was made division engineer, maintenance of way and structures, with headquarters at Bridgewater, for the rehabilitation of the Canadian Northern lines in Nova Scotia when they were taken over by the Canadian National Railways. In 1924, he was appointed division engineer at Campbellton, N.B. In 1927, he was made assistant engineer, maintenance of way, with headquarters at Moncton, N.B. From 1933, until his retirement he was stationed at Halifax, N.S.

R. B. Jennings, A.M.E.I.C., has been appointed inspecting engineer of construction for Quebec and eastern Ontario for the new department of Munitions and Supply.

G. B. Mitchell, M.E.I.C., is now employed by Fraser-Brace Engineering Company, Limited, at Nobel, Ont. Mr. Mitchell has been for many years with Peter Lyall & Sons Construction Company at Victoria, B.C., and with the Atlas Construction Company, Limited, of Montreal.

R. B. Young, M.E.I.C., testing engineer with the Hydro-Electric Power Commission of Ontario. is the president of the American Concrete Institute for 1940. He has been a member of the Board of Direction of the Concrete Institute since 1930, and a vice-president since 1938. He is an active worker on both administrative and technical committees and is the author of numerous papers. Mr. Young is the chairman of the Engineering Institute's Committee on Deterioration of Concrete Structures.

Sidney Hogg, A.M.E.I.C., who is with the Saint John Dry Dock and Shipbuilding Company, Limited, has been transferred from the structural steel department, and put in charge of new ship construction contracts. Mr. Hogg is the councillor for the Saint John Branch.

R. C. McMordie, A.M.E.I.C., has resigned from his position of designing engineer with H. G. Acres & Company Limited, Niagara Falls, Ont., to accept a position with the Hydro-Electric Power Commission of Ontario, at Toronto. Upon graduation in civil engineering from the University of Toronto in 1930, he went with the Hydro-Electric Power Commission of Ontario, as a designing draughtsman. In 1934, he became structural designing engineer with the Commission. After a short time with the Canadian Bridge Company, Limited, at Walkerville, Ont., and with Gordon L. Wallace, consulting engineer of Toronto, he joined the staff of H. G. Acres & Company, Limited, in 1936, to work on the design of the Outardes Falls development, Que.

F. Bowman, A.M.E.I.C., who since 1936 was with Evans, Deacon, Hornibrook Construction Pty. Limited, in Brisbane, Australia, has now returned to Montreal and is again connected with the Dominion Bridge Company, Limited.

Jules Leblanc, A.M.E.I.C., is now consulting engineer for the technical services of the Department of Labour of the Province of Quebec, in Montreal.

T. H. Henry, A.M.E.I.C., is now with the Demerara Bauxite Company, at Georgetown, British Guiana. Upon graduation from McGill University in 1914, he went overseas with the Canadian Expeditionary Forces. Upon demobilization in 1919, he went with the Canadian Pacific Railway, and later with T. Pringle and Son, Montreal. Mr. Henry later became connected, as superintendent, with many large construction projects with various contractors.

F. R. Pope, Jr. E.I.C., of Peterborough, has recently been appointed assistant superintendent of the Western Clock Company at Peterborough, Ont. Mr. Pope graduated from McGill University with honours in mechanical engineering, in 1935. He worked with the Bell Telephone Company until January 1938, when he joined the staff of the Western Clock Company.

Gerald N. Martin, Jr. E.I.C., who had been granted a two years' leave of absence from the Dominion Bridge Company, Limited, to study modern combustion engineering has now returned to Canada. While in England, Mr. Martin worked on the design and operation of the highest pressure boiler units in use, and he is now working in the boiler department of the Dominion Bridge Company, Limited, in Montreal.

Dick Lazorka, Jr.E.I.C., is now with the Aluminum Company of Canada, Limited, in Montreal. He was graduated in civil engineering from the University of Saskatchewan, in 1932, and has been engaged in engineering work in Saskatchewan since graduation. During the past four years he has been employed with the Department of Mines and Resources in Prince Albert National Park.

D. L. Mackinnon, S.E.I.C., is now with the Foundation Company of Canada, Limited at Montreal. Upon graduation in civil engineering, from the University of British Columbia, in 1939, he went with the Diamond Construction Company, Limited, general contractors in Fredericton, N.B.

T. L. Woodhall, S.E.I.C., has been employed for the last year and a half as chief draughtsman with the Manitoba Power Commission, at Winnipeg, Man.

H. P. Godard, S.E.I.C., has obtained a National Research Council's scholarship to study in the chemistry department at McGill University. He obtained his degree of master of applied science in chemical engineering from the University of British Columbia, in 1937. He has had laboratory and metallurgical experience in several plants. For the last two years he has done research work in organic chemistry toward a Ph.D. degree at McGill University.

J. T. Hugill, S.E.I.C., has obtained a National Research Council's scholarship, and he proposes to work in the physical chemistry department of McGill University. Mr. Hugill was graduated in chemical engineering from the University of Alberta last year, and he has been a research assistant with the Gas Commission at the National Research Council for the past months.

VISITORS TO HEADQUARTERS

G. H. Davis, Affiliate of the Winnipeg Branch, from Winnipeg, Man., on March 29th.

Paul Vincent, A.M.E.I.C., secretary-treasurer of the Quebec Branch, from Quebec, on March 30th.

J. L. Rannie, M.E.I.C., chief of triangulation, Geodetic Service of Canada, from Ottawa, Ont., on April 2nd.

Sidney Hogg, A.M.E.I.C., of the Saint John Drydock and Shipbuilding Company, Limited, and councillor of the Institute, from Saint John, N.B., on April 3rd.

T. R. Durley, A.M.E.I.C., of the Associated Factory Mutual Fire Insurance Companies, from Boston, Mass., on April 3rd.

Gerald N. Martin, Jr.E.I.C., upon his return from a two-year stay in England, on April 3rd.

Emmanuel Hahn, sculptor, who designed the Julian C. Smith memorial medal, from Toronto, on April 3rd.

R. B. Young, M.E.I.C., testing engineer, The Hydro-Electric Power Commission of Ontario, from Toronto, Ont., on April 9th.

Dick Lazorka, Jr.E.I.C., from Prince Albert, Sask., on April 10th.

M. Barry Watson, M.E.I.C., consulting engineer and registrar of the Association of Professional Engineers of Ontario, from Toronto, Ont., on April 13th.

T. W. Brackinreid, M.E.I.C., president, Phillips Electrical Works, Limited, from Brockville, Ont., on April 13th.

A. J. S. Taunton, M.E.I.C., district engineer for the prairie provinces, Department of Munitions and Supply from Winnipeg, Man., on April 18th.

McNeely DuBose, M.E.I.C., general manager, Saguenay Power Company, Limited, and vice-president of the Institute, from Arvida, Que., on April 18th.

Roland Marchand, A.M.E.I.C., Bridge Department, Department of Public Works of the Province of Quebec, from Quebec, on April 18th.

G. R. Duncan, S.E.I.C., from Maracaibo, Venezuela, on April 18th.

B. D. McDermott, S.E.I.C., from Edmunston, N.B., on April 22nd.

Past President Brig.-Gen. C. H. Mitchell, M.E.I.C., from Toronto, on April 24th.

R. A. Baldwin, M.E.I.C., from Toronto, on April 24th.

Obituaries

Matthew Alexander Sammett, A.M.E.I.C., died in the hospital in Montreal, after a long illness, on January 11th, 1940. He was born at Baku, Russia, on November 2nd, 1872. He received his education at the University of California, where he was graduated as an electrical engineer in 1899. For some years after graduation, he was with the General Electric Company at Schenectady, N.Y., where he held the positions of tester, draughtsman and design engineer in the transformer department. In 1903, he joined the Montreal Light, Heat & Power Company at Montreal, and was in charge of the testing department. After some years with the company, he entered private practice, which he discontinued in 1922, on account of ill health. A few years later, he was with the Northern Electric Company, Limited in Montreal. For many years past, he had been in the hospital.

Mr. Sammett joined the Institute as an Associate Member in 1904.

James A. Jamieson, M.E.I.C., died in the Royal Victoria Hospital at Montreal, on March 27th, 1940. He was born at Cobourg, Ont., on December 17th, 1859. From 1881 to 1884, he was a pupil in the office of Alexander McMartin, mechanical engineer of Buffalo, N.Y. From 1884 until 1889 he was engaged in the construction of elevators for the Canadian Pacific Railway, first with A. L. Hertzberg, civil engineer, and later with P. A. Peterson. In 1889, he entered the engineering department of the Canadian Pacific Railway, taking charge of the design and construction of the company's grain elevators, under Mr. P. A. Peterson, chief engineer. From 1891 until 1895, he was superintendent of elevators for the company, and in that capacity he designed and built elevators at Fort William, Saint John, N.B., and Quebec. In 1895 he opened his office as a consulting engineer. During his long career, he was associated with many important building projects, including the Port Colborne grain elevator and similar elevators in other cities of the Dominion.

Mr. Jamieson joined the Institute as a Member in 1903, and he was made a Life Member in 1924.

Shirley Barr, M.E.I.C., died in the Montreal General Hospital in Montreal, following a long illness, on March 31st, 1940. He was born at Mechanicsburg, Ohio, on October 12th, 1878. He began his engineering career with the Arnold Company, Chicago, Ill., as a draughtsman working on steam power plant and railway shop design and construction. He came to Canada in 1906 as a draughtsman for the Western Canada Cement and Coal Company at Exshaw, Alta. From 1907 to 1909, he was with the International Portland Cement Company, Limited, at Hull, Que., in charge of draughting and detailing for additions to the Hull plant of the company. Upon the foundation of the Canada Cement Company in Montreal in 1909, he came to Montreal as chief draughtsman of the company. Later he became chief engineer, a position which he held until 1936, when he became consulting engineer of the company. Ill health forced his retirement in 1937.

Mr. Barr joined the Institute as a Member in 1921.

Joseph Edward Woods, A.M.E.I.C., died in the hospital at Sherbrooke, Que., on April 5th, 1940. He was born at Aylmer, Que., on October 13th, 1861. He was admitted to the study of land surveying for Quebec in 1880, and became articled to Bolton Magrath, D.L.S., C.E., with whom he served for five years. He was admitted to practice in Quebec in 1885, and the same year he was commissioned as a Dominion land surveyor. During the eighteen following years, he was on the staff of the surveyor general in the Department of the Interior of the Dominion. He soon became an expert in land surveying and spent much of his time in Manitoba, Saskatchewan and Alberta. Leaving the government service in 1903, Mr. Woods continued as land surveyor and civil engineer for many years and was closely associated with railway and mining developments throughout Canada. He opened offices at Frank and Pincher Creek, in Alberta, and was widely known in both these districts. For some time he was prominently associated with the West Canadian Coal and Coke Company. As an engineer, Mr. Woods worked on the Lake St. John railway development as well as on the construction of the Ottawa-Pontiac line and the Labelle county line. Important American interests retained his services for large oil developments in Texas and in Alberta.

Mr. Woods had retired from active business some years ago and up to last fall he was living in Ottawa. Last November, he had left for Sherbrooke, Que., and the eastern townships to visit relatives and friends.

Mr. Woods was one of the oldest members of the Institute, having joined upon foundation in 1887, as an Associate Member. He had been made a Life Member in 1932.

John Bell McRae, M.E.I.C., died suddenly at his home in Ottawa, on April 8th, 1940. He was born at Ottawa, Ont., on August 10th, 1875. He was educated at McGill University, where he was graduated in mechanical engineering in 1898. Upon graduation, he joined the Canada Atlantic Railway in Ottawa as a mechanical draughtsman. After a few months, he left and went with the Ontario Graphite Company, and became mechanical superintendent at Black Donald, Ont. In 1903, he went with Charles H. Keefer, consulting engineer, of Ottawa, as an assistant engineer. Two years later, he entered into partnership in the firm of McDougall & McRae, consulting engineers, at Ottawa. This partnership was dissolved in 1903, and a year later Mr. McRae joined with William Kennedy, Jr., of Montreal, in the design and construction of the Chaudière dam. Following the two typhoid epidemics in 1912, he was engaged by the Board of Trade to investigate Ottawa's water supply, and it was mainly through his reports that the movement was set on foot which culminated in the construction of the filtration plant. He also designed and superintended the construction of a new pumping station at Lemieux Island. Since then he had designed and been in charge of construction of many hydro-electric plants throughout the province of Ontario. His last job in that work was the erection of the power plant near Kingston Mills last year.

Mr. McRae joined the Institute in 1904 as an Associate Member. He became a Member in 1916.

Horace Llewellyn Seymour, M.E.I.C., died in the Civic hospital at Ottawa, on April 21st, 1940. He was born at Burford, Ont., on June 11th, 1882. He was educated at the University of Toronto, where he received his degree of bachelor of applied sciences in 1903. He obtained the degree of civil engineer from the same University in 1921. Upon graduation he joined the staff of the Topographical Surveys branch in Ottawa. From 1908 until 1914, he was engaged in general and municipal engineering, township and townsite surveys and estate development in the prairie provinces, as a partner, first in the firm of Saunders & Seymour, at Edmonton, Alta., and later in the firm of Seymour & Dawe. From 1915 until 1920, he was engaged in town planning engineering for the Dominion government. In 1920, he left the federal service to become a partner in the firm of Barber, Wynne-Roberts & Seymour, consulting engineers of Toronto. In 1925 and 1926, he was in South America surveying for an oil company and prepared a plan for the city of Maracaibo, Venezuela. On his return he went to Vancouver as resident engineer, and then, in 1929, he went to Edmonton, Alta., where he was director of town planning for the Alberta government until 1932. After two years as consulting engineer for municipalities in Alberta, he went to Ottawa, where he has resided for the past seven years.

Mr. Seymour lectured and advised on town planning in many Canadian communities and did work on housing in almost every province in the Dominion. He formulated the town planning acts of three provinces, Alberta in 1929, New Brunswick in 1936 and Nova Scotia last year. Recently he had been advisor to Saint John, N.B. and five Ontario cities, Cornwall, Fort William, Port Arthur, Sault Ste. Marie and Sudbury. After the Halifax explosion, he replanned the devastated area. At that time, at the request of the commissioner of works and mines, he prepared some amendments to the Nova Scotia Planning Act. From 1926 to 1929 he was resident engineer of the Vancouver Town Planning Commission and many projects in that city were carried out under his supervision.

Mr. Seymour joined the Institute as an Associate Member in 1912, and he was transferred to Member in 1923.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

BORDER CITIES BRANCH

H. L. Johnston, A.M.E.I.C. - *Secretary-Treasurer*
A. H. Pask, Jr.E.I.C. - *Branch News Editor*

On the evening of March 15, 1940, the regular monthly meeting of the Border Cities Branch was held in the Prince Edward Hotel. A dinner preceding the meeting was attended by 18 members, and at the meeting, about 40 members and visitors were present.

The chairman, Mr. J. F. Bridge, introduced the speaker, Mr. K. H. J. Clarke of the International Nickel Co. of Canada, Limited, who gave an address on **Recent Developments in Non-ferrous Nickel Alloys.**

These alloys require 25 per cent. of the world's production of nickel. Many of them are corrosion-resistant and they are widely diversified in quality. Nickel silver, a nickel-copper-zinc alloy, was first produced by the Chinese in 235 B.C. In brasses, nickel is now used where it acts as a decolorizer and increases the corrosion resistance. The toughness at high temperatures is also increased. Nickel bronzes have been developed with exceptional properties in yield point and elongation.

The automotive and aviation industries have led to light alloys with good properties as "Y" alloy, an aluminum-copper-nickel alloy which has the strength of soft steel and good ductility. Rolls-Royce has developed for bearings a nickel alloy containing considerable silver which is standard for that engine.

Nickel-chromium alloys such as chromel and nichrome, are used for many electrical and heat resistant purposes as in pyrometers. For electrical work at high temperatures, where sulphur is present as in spark plugs, alloys using manganese and nickel have been developed.

Cupro-nickels are widely used for condenser tubes and salt water piping, because of their corrosion resistance and mechanical properties.

Constantin is an alloy of high nickel and low manganese. It has high electrical resistance with a low temperature resistance coefficient, and is used in thermocouples and pyrometer connections.

Monel is the most important copper-nickel alloy, containing approximately ⅔ nickel and ⅓ copper. It is a general purpose alloy of high strength, good durability and remarkable corrosion resistance. "R" monel is a special grade containing sulphur and has high machinability. Hardness is increased with the addition of 3 or 4 per cent of silicon.

Inconel, which is 80 per cent nickel, 14 per cent chromium and 6 per cent iron, has exceptionally high corrosion and heat resistance. It is intended for dairies and food handling equipment, but is also the best material for airplane exhaust collector rings.

The speaker emphasized the importance of the discovery of precipitation or age hardening. This gives such alloys as "K" monel, nickel bronze and beryllium copper, high resistance to deformation, probably due to the distortion of the slip bands caused by a molecular structure that is not normal. "K" monel is created by the addition of only 2.75 per cent of aluminum to standard monel. An example of its use was on valve stems for sluice gates, which were 6 in. in diameter and over 12 ft. long. These had a yield strength of 109,000 lb. per sq. in. and tensile strength of 153,500 lb. per sq. in.

Another of the above group is "Z" nickel which contains 98 per cent nickel with the rest de-oxidants. When heat treated, it is as hard as heat treated steel and has a tensile strength of 250,000 lb. per sq. in. It is used for electrical contacts and springs.

The speaker closed by pointing out that research has developed alloys so that they can be almost made to order.

Then followed a talking motion picture film of the plants and mines of the International Nickel Company of Canada. This covered the mines, smelter and copper refinery at Copper Cliff, and the electrolytic nickel refinery at Port Colborne, Ont., showing the mining and process work.

At the end of an interesting question period, a vote of thanks to the speaker was moved by Mr. C. M. Goodrich.

EDMONTON BRANCH

B. W. Pitfield, A.M.E.I.C. - *Secretary-Treasurer*
J. W. Porteous, Jr.E.I.C. - *Branch News Editor*

The regular monthly meeting of the Edmonton Branch was held in the Macdonald Hotel on Tuesday, March 12. After dinner, the chairman, Mr. C. E. Garnett, called on Mr. J. D. Baker to introduce the speaker of the evening, Mr. W. Mason of the Alberta Government Telephones. Mr. Baker, in doing so, paid tribute to the men who have made possible the rapid growth of telephone communication.

Mr. Mason during his talk showed the lines of progress during this growth. The speaker dealt particularly with **Carrier Telephony**, illustrating the various systems by means of slides. Several demonstrations were shown including tests on the cathode ray oscilloscope and a model of Bell's first telephone system. A very interesting discussion and question time followed. The meeting adjourned at about 10.30 p.m. with a cordial vote of thanks to Mr. Mason.

The May meeting of the Edmonton Branch was held in the Macdonald Hotel on April 16, following dinner. The members were taken on a ten thousand mile trip of Arctic Adventure in northern Alberta and the Northwest Territories by means of coloured movies taken by the chairman, Mr. C. E. Garnett. Some very beautiful scenes were shown of the various old forts and the new mining locations in the north country. There were also a great number of interesting shots of the natives and the white people who live in comparative isolation except for the aeroplane. The pictures taken from the aeroplanes were particularly interesting. Mr. Garnett also showed a black and white movie of winter flying taken by Major R. W. Hale of the Post Office Department. A number of questions were asked after the showing, and following a hearty vote of thanks to Mr. Garnett, the meeting adjourned.

HAMILTON BRANCH

A. R. Hannaford, A.M.E.I.C. - *Secretary-Treasurer*
W. E. Brown, Jr.E.I.C. - *Branch News Agent*

At its regular monthly meeting on March 12th, at McMaster University, the Hamilton Branch was addressed by Mr. W. D. Lamont, chief metallurgist of Dominion Foundries and Steel Limited. The speaker was introduced by T. S. Glover who pointed out that here in Hamilton was a rapidly expanding unit of the steel industry which had met with considerable success in introducing several new lines to Canada.

The speaker traced the **Development of the Tin Plate Industry.** The tinning of copper and iron cooking vessels was known to the Romans. Coating of sheet iron with tin, however, is of much more recent origin. It was not until 1720 that the industry was definitely established in Great Britain at Pontypool in Wales. Manufacture of tin plate in the United States was begun about 1891 and in 1935 there were seventeen companies in the United States operating twenty-eight plants with a capacity of 2,574,000 long tons of tin plate.

It is not uncommon at the present time for steel ingots to be rolled into tin plate gauge strip over 5,000 ft. long and 3 ft. wide. Cold strip is usually cold rolled down to about 0.010 in., the width in some mills being as great as 90 inches. The thickness of the tin coating is ordinarily less than 1/10,000 of an inch on each side.

The use of canned foods has been largely responsible for the great development of the tin plate industry.

The sequence of operations in Canadian practice is to roll the hot strip on a 2-high reversing mill. A thick slab weighing up to 7,000 lb. is rolled down to about ½ in. thick, then coiled on one of two reels respectively enclosed in furnaces upon opposite sides of the mill, and the procedure is then similar to that of a single strand cold rolling mill until the strip is sufficiently light for cold rolling. The strip is next pickled in a 10 per cent sulphuric acid bath at about 180 deg. F. to remove scale. After passing through pickling tanks, the strip is washed in cold water, scrubbed, rinsed in hot water and dried previous to oiling and recoiling.

The next operation is cold rolling which is done in a 42-in. 4-high cold mill driven by a 1,500 h.p. motor with 600 h.p. motors driving the reels on each side of the mill. The pressure exerted may exceed 2,000,000 pounds. Other steps in the manufacturing process were traced, following the progress of the cold rolled strip through the cleaning line and the flying shears where it is cut into sheets. These sheets are packed and placed in annealing ovens. From there they go through the temper or skin pass mill which brightens the surface and slightly hardens the soft metal, giving it the necessary stiffness. Further operations include more cleaning, tinning and careful sorting by highly skilled girls who quickly detect any irregularities. Illustrations projected on the screen showed the vast amount of machinery installed by Dominion Foundries and Steel Limited for the production of tin plate.

Alex H. Love, chairman of the branch, presided, and a vote of thanks to the speaker was moved by V. S. Thompson. Added interest was provided by the circulation of a "steel quiz," containing ten questions about steel, to each person at the meeting. Prizes for the two best answers were won by Reg. N. Williams and H. Leckie.

Most instructive was a lecture entitled **New Lighting Tools for To-morrow's Job** and amazing predictions were made by the speaker Samuel G. Hibben, Director of Applied Lighting, Westinghouse Electric & Manufacturing Company, Bloomfield, New Jersey, before a combined meeting of the Toronto Section, Illuminating Engineering Society; Toronto Section, American Institute of Electrical Engineers, and Hamilton Branch, Engineering Institute of Canada, in the Westinghouse Auditorium on April 12th at Hamilton, Ontario.

Into 3⅓ decades of lighting history has been crammed a tremendous advance in illuminants previous to which methods used were crude and unsuccessful. Hitherto the lighting industry has only concerned itself with a few wave lengths of what is known as the visible spectrum but it is with the invisible wave lengths that future lighting is going to make its greatest stride. Already we are making use of the invisible ultra-violet in the excitation of fluorescent paints, for tanning or health purposes and also for germicidal use in the killing of bacteria and prevention of formation of mould in food.

In the invisible infra-red, which is the other side of the spectrum, we are using lamps in infra-red drying ovens. They are also being used for the penetration of tissues for health purposes and there is a possibility of a non-luminous heater being employed, utilizing infra-red.

Mr. Hibben then proceeded to demonstrate lamps, commencing with the beautiful chemi-luminiscence produced by chemicals in a jug of cold water. He showed many beautiful effects of ultra-violet light exciting signs, table cloths and gowns, which had been treated with fluorescent paint. Fluorescence is obtained by coating the inside of a gaseous discharge tube emitting ultra-violet light with a chemical or salt. This salt fluoresces under the influence of ultra-violet. The speaker showed a design of one of the buildings of the New York World's Fair that showed the daylight view under ordinary incandescent light. Under ultra-violet the same sign glowed as if it had been illuminated. This showed an additional use for ultra-violet. One of his most beautiful examples was a collection of small neon glow lamps which have been made in the shape of flowers; these, the speaker stated, could be so arranged in a room they would burn all night long for less than a cent. The possibility of using fluorescent paint on outdoor signs was shown by some beautiful examples.

In addition Mr. Hibben showed a small lamp whose purpose is not to provide light, but to provide steam. In a few seconds steam was gushing out of an orifice to be used as a sterilizer in a dentist's office—to take wall paper off the walls of a room—or any processing where small quantities of steam are required.

He also showed a thousand watt mercury vapour lamp less than 2 in. in length that requires water cooling for operation.

The meeting was opened by Alec Love, chairman of the Hamilton Branch of the Institute, who turned it over to D. G. Geiger, chairman of the Toronto Section, A.I.E.E. Mr. Geiger in turn handed the meeting over to Professor K. Jackson, chairman of the Illuminating Society.

The speaker was introduced by Mr. G. F. Mudgett of the Canadian Westinghouse Company.

The attendance was 339 which includes a large party from both Toronto and the Niagara district.

After the meeting refreshments were served by the kindness of the Westinghouse Company.

LONDON BRANCH

D. S. Scrymgeour, a.m.e.i.c. - *Secretary-Treasurer*
J. R. Rostron, a.m.e.i.c. - *Branch News Editor*

A meeting of the Hamilton Branch, was held on the 27th March, 1940, at the Hotel London, during the American Water Works Association Convention (Canadian Section) and about 80 people were present, composed of our own members and a number of guests. A suitable repast was provided with H. F. Bennett at the head table and along with him were H. E. Jordan, of New York, the Secretary of the A.W.W.A., Dr. A. E. Berry, Fraser Keith, E. V. Buchanan and J. A. Vance.

Mr. Bennett introduced the speaker, Mr. Jordan, who spoke on **Technical versus Social Progress.**

Present day economic conditions among the nations, whether at war or in a state of peace, have led people to consider the problems of unemployment and want, and to inquire whether or not such conditions are necessarily a part of the modern world. While there is a clear record of organized human life for a period of not less than 12,500 years, it should be remembered that up to the last 200 years of this span of time, life has been comparatively simple and the ability of people to produce was very little in advance of their actual living needs. When the so-called industrial revolution developed in the middle of the eighteenth century in Europe and particularly in England, and man began to apply steam power to work formerly done with human hands, a transition began.

In the United States it appears that every individual has available, upon a prorata basis, not less than one-third electric horse power. The province of Ontario is far in advance of this development. On the farm where, 150 years ago, production was mostly by hand methods, mechanization has made it possible for the farm labourer to produce about four times as much as his eighteenth century predecessor.

Science and sanitation have increased the standards of human life so that compared to an average of 23 years in medieval Europe, the modern North American has an average life expectancy of not less than 55 years. While the population in North America has grown at a rapid rate during the past century, many of us are inclined to overlook the fact that in Europe the population has increased 2½ times since 1800. The rapidly increasing list of materials produced from the inventive mind of man and the increased ability of an individual to produce with the aid of machine, have unquestionably brought about a situation where there is not an opportunity to employ all of the people available for employment in the production of things that the average individual wishes to buy and sell. Some individuals have suggested that the logical way to correct this would be to set a moratorium on invention. It is also suggested that the easiest method would be to return to a simpler way of living. While either one of these methods has promise of simplifying the unemployment problem to a certain degree, both are necessarily defeatist in their conception. It seems preferable to continue to give the fullest opportunity to inventive genius and to use to the fullest possible degree, the products of industry.

This apparently faces us with the necessity of providing for a portion of the population at all times, which does not find itself usefully employed in the ordinary channels of commerce. There does not seem to be any fundamental reason why, just as the community has taken upon itself various municipal service and services in the field of environmental sanitation, it should not also take upon itself the planning of a permanent use programme for those persons not normally employed. The use for these services could be in the field of public transportation, such as roads; recreation areas such as streams, lakes and forests, and the development of smaller public facilities to be used by all of the people as their leisure time gave them opportunity. Work of this character involves repeated operation in order to maintain good conditions and if developed upon a professionally planned basis, should neither be considered a state of peonage by those employed in it nor should it be the means of waste of community funds and resources.

OTTAWA BRANCH

R. K. Odell, a.m.e.i.c. - *Secretary-Treasurer*

A graphic description of the construction of the well known **Pattullo Bridge** over the Fraser river at New Westminster, B.C., was given by Major W. G. Swan, B.A.Sc., D.S.O., director of construction, War Supply Board, at a noon luncheon at the Chateau Laurier on April 4th, 1940.

Major Swan, a native of Ontario born at Kincardine, for ten years held engineering positions with the Canadian Northern Railway in eastern Canada and British Columbia. From 1915 to 1918 he served overseas with the Canadian and Royal Engineers and in 1920 was appointed chief engineer to the Vancouver Harbour Commissioners. It was in 1936 that he was appointed designing and supervising engineer for the Pattullo bridge.

With the aid of slides and moving pictures he presented many facts and figures in connection with the bridge, which was built over the period September 1935 to October 1937.

Mr. W. H. Munro, chairman of the Branch, presided. An invitation to attend the meetings of the Institute was extended by Mr. Munro to members of all other branches now in Ottawa on war work, to officers of the R.C.A.F. and also to British officers of the Royal Air Force or Royal Engineers who are here for a similar purpose.

PETERBOROUGH BRANCH

A. L. Malby, Jr.e.i.c. - *Secretary-Treasurer*
D. R. McGregor, s.e.i.c. - *Branch News Editor*

Mr. B. I. Burgess, switchgear engineer at the Canadian General Electric Company factory in Peterborough, gave an address on **New Developments in Switchgear,** before a regular meeting of Peterborough Branch held on April 4th. Mr. Burgess has long been a member of Peterborough Branch and is the Branch chairman for this season.

Mr. Burgess first discussed the major trends which have occurred in switchboard design over the course of the last 15 or 20 years. Early switchboards often used wooden bases or panels, and surface mounted relays and instruments and live switches mounted on the front of the board were considered standard.

Wooden panels were soon superseded by treated asbestos lumber compound panels, and lately the trend has been more and more towards the use of steel panels. Modern boards are usually dead front; that is to say there are usually no live connections open on the front of the board. Surface mounted instruments and relays are still widely used, but there is now a definite trend towards the use of semiflush instruments, which give a streamlined design to the board and which is perhaps an improvement in appearance.

For the last 10 or 15 years, black finishes have been standard for switchboards. Recently, however, users have become interested in dressing up boards, and as a result manufacturers today are prepared to furnish switchboards either with the standard black finish, or finished in colour.

The advantages inherent in metal clad switchgear and in cubicle gear have resulted in a decided trend to the use of these types of gear for the more important installations. These types of gear are shipped from the factory in factory assembled units up to the limit of handling and transportation facilities. This permits the factory to ship equipment in place and adjusted, and the user receives an equipment on which the minimum amount of installation and co-ordination work is required, which results in a reduction in the cost and time required to place equipment in service.

A comparatively recent development is the unit substation, in which the control gear is co-ordinated with the power transformer. This provides great flexibility to the user in that as a substation becomes overloaded the complete equipment can be removed to a new location, with very little loss in capital expenditure. The control gear is shipped completely assembled, and at the site it is only necessary to place the equipment in position and connect to the transformers and to the feeder cable. Here again the installation time and expense is reduced to a minimum.

Mr. Burgess also discussed recent trends in circuit breaker design. He mentioned the air circuit breaker, which is becoming increasingly popular in European countries. While oil circuit breakers are definitely on the way out in some European countries there is no reason to believe that there will be any rapid change-over to air circuit breakers on this continent. Conditions in Europe are considerably different from those which exist here, and oil circuit breakers of reputable design here are considerably in advance of the designs which are being superseded by air circuit breakers in Europe. Nevertheless the air circuit breaker does have certain desirable features, and if it can be placed on a parity as regards price and performance it should find a place in switchgear on this continent.

Mr. Burgess closed his paper with a brief discussion of modern trends in switchboard relays, instrument transformers, voltage regulators, and other devices on each of which a complete paper could be presented.

A vote of thanks moved by Mr. McKeever was heartily concurred in by the meeting.

QUEBEC BRANCH

Paul Vincent, a.m.e.i.c. - *Secretary-Treasurer*

Saturday, March 9th, the Quebec Branch had a social gathering at the Quebec Winter Club. This innovation was a real success considering the slight organization and publicity given to its preparation. Nevertheless, 65 couples attended the dinner in a gay spirit. Mr. Philippe Méthé presided the activities. Seated at the head table were Mr. Ernest Gohier, chief engineer of the Quebec Highways Department and Mrs. Gohier; Mr. and Mrs. Alfred Marois; Mr. Eugène Pelletier, assistant chief engineer of the Quebec Highways Department, and Mrs. Pelletier; Mr. and Mrs. J. O. Martineau, Mr. and Mrs. Ls. Ph. Paiement, Mr. and Mrs. Alexandre Larivière, Mr. Louis Trudel, assistant general secretary of the Institute, and Mrs. Trudel.

Short after-dinner speeches were given. The chairman of the Quebec Branch thanked branch members for their fine co-operation in this social gathering and announced that similar activities would take place from time to time, if the members approved.

Following the dinner, dancing was on the programme and every one enjoyed the melodious harmonies of Will Brodrigue's Orchestra. All present welcomed the idea of further activities of this kind.

The members of the Quebec Branch held a well attended Junior Meeting at the Montcalm Palace on Monday, March 18th. Two very interesting and educational lectures were given by two of Quebec's younger engineers.

Mr. Y. R. Tassé, a Canadian General Electric Apparatus Sales Engineer, gave an illustrated talk on **Motors, Controls and their Applications.** He described the various types of electric motors used in modern industry, their

Dinner meeting of the Quebec Branch on March 9th, 1940.

advantages and their defects, as well as the apparatus used to control their operation.

"The electric motor is a most adaptable servant" he stated, "which can do almost any kind of work; a most efficient and devoted servant. . . . It will work and keep on working even if it is given too big a load to carry, and under such conditions will even go so far as to destroy itself before giving up." But an electric motor must be provided with the appropriate current, otherwise a motor which normally should have a life of twenty years may be ruined inside of two years. It is then of the utmost importance to protect electric motors by adequate control apparatus.

The great majority of problems pertaining to motive power, asserted Mr. Tassé, can be most elegantly and efficiently solved with electric motors and industrial control devices.

Mr. Roland Lemieux, Assistant Division Engineer for the District of Quebec in the Provincial Roads Department, spoke on the **Problem of Winter Road Maintenance in the Quebec District.** Mr. Lemieux's lecture was well illustrated.

The most important problem is that of preventing the snow from drifting on the highways. For this purpose a fence of appropriate construction is made use of.

In the district of Quebec along the length of 144 miles of winter road circuit, there are some 330,000 ft. of fencing, which represents approximately one mile of fence for every two and three-tenths mile of highway. Incidentally, this is the highest proportion in United States or Canada.

The laying down, upkeep and removal of these drift fences costs the Highway Department close to $70 per mile of winter roads at the present time while a few years ago it totalled as much as $150.00 per mile.

Speaking of the expense of winter road upkeep, Mr. Lemieux declared that, with the exception of one locality, in the Rocky Mountains where the annual cost nears $1,000 per mile, the district of Quebec is the highest, with an outlay of more than $300 per mile.

In conclusion, Mr. Lemieux stressed the fact that each year, due to more modern and simplified methods, the cost of maintaining winter roads is steadily diminishing.

This Junior night was presided over by Philippe Méthé, director of the local Technical School and chairman of the Quebec Branch. Mr. Jean St-Jacques, of the Quebec Power Company, thanked the speakers.

SAINT JOHN BRANCH

F. L. Black, Jr.E.I.C. - *Secretary-Treasurer*

Giving his conception of the favourable and unfavourable points in connection with the **St. Lawrence Deep Waterway Project,** his subject for the evening, C. H. Wright, of Halifax, Maritime manager of the Canadian General Electric Company, Ltd., addressed the Saint John branch at the Admiral Beatty Hotel on May 11th, 1940.

He expressed the opinion it "would be wise to defer, until some years after the war, further deepening of the St. Lawrence east of Lake Ontario." He did not think the Maritimes would be "directly affected" by deepening of St. Lawrence waterways or power development in central Canada.

Rand H. Matheson, Moncton, transportation manager of the Transportation Commission of the Maritime Board of Trade, also attended the engineers' monthly supper meeting and after Mr. Wright's address he supplemented the latter's remarks. Councillor G. E. Barbour, Saint John, also spoke briefly on the question as did G. A. Vandervoort, Saint John, chief engineer of the New Brunswick Electric Power Commission. The latter was of the opinion a great opportunity lay before Canadians from an engineer's standpoint of appreciation of the "low" price of "$10.00 per horsepower year," estimated as available from the proposed development.

John P. Mooney, vice-chairman, presided at the meeting.

SASKATCHEWAN BRANCH

J. J. White, M.E.I.C. - *Secretary-Treasurer*

On the evening of March 15th, the Saskatchewan Branch held its monthly meeting in the King's Hotel, Regina.

The chairman of the meeting, which was preceded by a dinner, was A. P. Linton, the councillor for the Saskatchewan Branch. There were approximately sixty members and friends present.

The speaker was Professor E. A. Hardy of the University of Saskatchewan; his topic was **The Development of the Combustion Chamber of the Internal Combustion Engine.** Illustrative slides were used to indicate the changes in design from the earliest stages to the present day. The keen interest taken in the address was indicated by the number of questions asked, which Professor Hardy enjoyed to the full.

E. W. Bull moved a hearty vote of thanks to the speaker for his excellent talk.

It is a pleasure to report recent activities of the Saskatoon Section of the Saskatchewan Branch of the Institute. The following meetings have been held:

Dec. 8, 1938—The Geology of Oil and Gas—Professor F. H. Edmunds.

Feb. 16, 1939—Great Lakes to Ocean Waterway—Dr. C. P. Wright.

Mar. 23, 1939—Stream Control in Relation to Droughts and Floods, Mr. P. C. Perry, Summaries of seven papers presented at the General Meeting of the Engineering Institute in Ottawa, 1939, were also given by three of the members.

Oct. 9, 1939—Visit of the President, Dean H. W. McKiel.

Nov. 9, 1939—Trends in Modern Combustion Chamber Design, paper by Professor E. A. Hardy.

Jan. 22, 1940—The Future Development of Irrigation in Western Canada—Mr. Ben Russell.

The meetings were preceded by dinner in the Oak Room of the King George Hotel, Saskatoon, with an average attendance of forty engineers. An increasing number of students from the College of Engineering, University of Saskatchewan, are becoming interested in the work of the Institute. The visits of President McKiel and the General Secretary, L. A. Wright, did much in this respect.

Professor I. M. Fraser acted as chairman of these meetings and N. B. Hutcheon has been acting as local secretary for the section. The responsibility for the arrangements of the meetings was entrusted to a committee consisting of G. W. Parkinson, chairman, L. M. Howe and C. Cook.

VANCOUVER BRANCH

T. V. Berry, A.M.E.I.C. - *Secretary-Treasurer*
Archie Peebles, A.M.E.I.C. - *Branch News Editor*

At the meeting of the Vancouver Branch, held on February 19th, H. Nolan Macpherson spoke on the **Effect of Earth Pressures on Flexible Pipes in Earth Fills.**

The speaker recalled the quality of cohesion in materials used for earth fills. The "arching" effect that resulted from this cohesion was explained. Simple illustrations demonstrated the other well-known quality of earth—its compressibility.

It is so easy to fail to take these two items—"cohesion" and "compacting"—into account, although everyone knows they exist.

The speaker referred to diagrams illustrating how these two qualities of the earth fill are taken advantage of in the well known "trench" method of placing culvert pipe. He pointed out why the pipe is spared, and how the load of the earth mass is carried by the solid sides of the trench.

Mr. Macpherson illustrated the manner in which the flexible type of sewer or culvert pipe deformed and built up firm sides in the adjacent fill material which served as "haunches" for the arching of the fill material.

In a specially made box press, he applied pressure on the top of the fill material by a small hydraulic jack. The pressure was measured by a recording pressure gauge and, through a heavy plate glass window, the small models representing pipe could be observed. The deformation of the models could be measured by graduations on the window.

On Friday evening, April 12, the Vancouver Branch met to listen to an address on **The Design and Construction of Modern Airport Runways.** The speaker was Norman W. McLeod, Sc.D., of the Department of Asphalt Technology, Imperial Oil Co., Ltd., Sarnia, Ont. In his paper Dr. McLeod treated very completely every aspect of runway design and construction, and placed special emphasis on the use of soil stabilization for subgrade and base courses. The following is an outline of his address.

The requirements of a modern airport are such that many landing fields located and built in the early days of commercial aviation have been or must soon be abandoned, owing to lack of provision for expansion, particularly in the length of runways and flight strips. Apart from reasons of safety, modern transport planes carrying wing loads of 18 to 24 lb. per sq. ft. require long take-off distances, and ample clearances in the immediate vicinity of the airport. Factors which enter into the selection of an airport site are topography, land values, distance from city, relation to city traffic, prevailing winds and smoke, ground fog in low areas, and industrial or other development nearby. Fields for military use require large areas for practice flying, for bombing practice, and accommodation for large numbers of planes; but may be located with less reference to a community. The usual public services, however—water, light, telephone, sewage—must be considered in any airport location.

The size of an airport is governed by the take-off requirements of both present and likely future planes. In the interests of safety, engine failure during take-off must be considered, and runway lengths and flight strips provided to permit landing again under such circumstances. Altitude above sea level, and temperature and barometric pressure variations influence the take-off characteristics of a plane, necessitating additional room under unfavourable conditions, in some cases to the extent of 100 per cent. Recommended minimum runway lengths at sea level vary from 2,500 to 4,500 ft. with extended flight strips, depending on the importance of the airport. European practice provides even greater lengths, as the 6,000 ft. runway at Berlin, and the 8,500 ft. runway at Paris.

In orienting runways, requirements usually permit a maximum variation of 22½ deg. from the direction of the prevailing wind, which means not less than three full length runways. Future runways for increased traffic may be parallel or in other directions. Wind conditions may change at night sufficiently to warrant special consideration. Clearances to provide climbing slopes vary in different countries, but in Canada a slope of 1 in 50 is specified. This necessitates zoning regulations in the vicinity of the airport to prevent the erection of obstructions such as buildings, chimneys, radio towers or power lines. Runway widths should be a minimum of 100 ft. with graded flight strips on each side. A clearance of 200 ft. to buildings is necessary, which may have to be raised to 500 ft. to permit instrument landings.

The drainage of an airport site is one of the major problems of location and design. Surface water should be estimated by some generally accepted formula providing for all important variables. The run-off rate will be very high because of the large portions of the site occupied by surfaced runways, aprons and buildings. Percolating water is removed by subdrains which must be placed below the capillary fringe in the soil to be effective.

Base courses for flight strips may be dense or porous. The former have the greatest stability if they are constructed of a properly stabilized soil mixture, placed at the optimum moisture content in layers not exceeding six inches in thickness, and thoroughly tamped with the heaviest type of sheep's foot roller. A stabilized soil mixture consists of material graded from about one inch down to clay, according to the generally accepted grading chart used in highway work. The stability and resistance to moisture penetration of such a mixture can be greatly increased by the addition of one or two per cent of a rapid curing cutback asphalt. The porous type of base course will be satisfactory if the right crushed stone or gravel is used, and the best practice observed in its construction. It must be thick enough to carry the applied loads or settlement will occur. When used on clay subgrades, the clay is apt to work up into the porous base over a period of years, reducing its effective depth and obstructing drainage.

Runway surfaces may be provided at costs varying over a wide range, from bituminous surface treatments to asphaltic or portland cement concrete.

Dr. McLeod illustrated his paper with lantern slides, blackboard diagrams, and samples of stabilized soils. The meeting was presided over by C. E. Webb, branch chairman, and the appreciation of the audience was extended to the speaker by H. N. Macpherson. About 100 members and guests attended.

VICTORIA BRANCH

Kenneth Reid, a.m.e.i.c. - *Secretary-Treasurer*

A general meeting of the Victoria Branch was held in Spencer's Dining Room on the evening of April 12th, and was preceded by a dinner at which Mr. E. W. Izard, chairman of the branch, presided.

Following the dinner a short business meeting was held during which certain matters pertaining to the branch and to the Institute as a whole were discussed. The chairman called upon Mr. A. L. Carruthers, councillor for the branch, who spoke briefly on the current ballot on the proposed changes to the by-laws and requested all corporate members to be sure and cast their ballots.

The feature of the evening was the showing of a number of reels of coloured motion pictures by Mr. Norman Yarrow, taken by himself in the summer of 1938 while on a tour of Europe and Great Britain, including France, Italy, Switzerland, Germany and England. The natural colouring and excellent photography as well as the subject matter were largely commented upon by the membership. Mr. Yarrow also showed a number of very excellent coloured still pictures showing the landscape and scenery in and around Victoria and illustrating the technical details and aspects of the art of colour photography which were likewise greatly enjoyed by those present.

On Thursday evening, April 18th, following a branch dinner at Spencer's Dining Room, thirty-five members and friends of the branch comprising visiting engineers and members of the various military, naval and air forces met to hear Dr. Norman McLeod of the Asphalt Division, Imperial Oil Co., Ltd., speak to the Branch on the subject, **The Design and Construction of Modern Airport Runways.**

In contrast with the previous meeting of the branch Dr. McLeod's paper was of a highly technical nature and many actively engaged engineers particularly from the public works departments and from the services took the opportunity to be present.

Dr. McLeod's address is summarized in the Vancouver Branch news.

RULES GOVERNING AWARD OF INSTITUTE PRIZES

THE SIR JOHN KENNEDY MEDAL

A medal, called the "Sir John Kennedy Medal," was established in 1927, to be 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 first. 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.

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, 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.

DUGGAN MEDAL AND PRIZE

A prize of a medal and cash to a combined value of approximately one hundred dollars was established in 1935, to be given each year from the proceeds of a donation by Past-President G. H. Duggan, D.SC., LL.D., M.E.I.C., for the purpose of encouraging the development of the branches of engineering in which he practised.

The prize will be awarded for the best paper presented to the Institute in accordance with the following rules:

(1) Competition shall be open to all members of the Institute.

(2) The papers shall be presented to the Institute either at the regular meeting of a branch or at a professional meeting of the Institute, or directly to Headquarters. They shall not have been presented previously to any other body or meeting.

(3) Papers to be eligible for this competition shall deal with such subjects as arise in that sphere of constructional engineering which concerns the use of metals in moulded or fabricated shape for structural or mechanical purposes. Without limiting the generality of the foregoing, it is suggested that papers describing works should deal with the economic and theoretical elements of design, fabricating, machining, transporting, erecting, problems solved, methods of overcoming difficulties and other interesting features.

There will also be admitted to the competition papers describing new methods or the recording of important tests that add to engineering knowledge.

(4) Papers shall be the bona fide production of the author and proper credit shall be given for any assistance received from other parties, partners or reports. The relation of the author to the work shall be clearly stated. Papers shall be compiled and arranged with proper regard to literary value and shall constitute worthy contributions to the records of the engineering profession.

In judging the competition consideration will be given to the personal knowledge and appreciation of the problems and processes involved and the joint application of theoretical and practical considerations to the execution of the subject which are displayed on the part of the author.

(5) The papers shall be judged by a committee of three corporate members, eminent in the corresponding branch of the profession, appointed for the purpose by council as required.

(6) The award shall be made only when a paper of sufficient merit is presented. The prize year shall be from July 1st to June 30th and papers must be presented to Headquarters of the Institute by the 30th day of June.

(7) The prize shall be awarded at the annual meeting.

THE GZOWSKI MEDAL

A gold medal, called "The Gzowski Medal," is provided from the fund established in 1889 by Col. Sir Casimir Gzowski, A.D.C., K.C.M.G., late past-president of the Institute, and will be awarded according to the following rules for papers presented to the Institute.

(1) Competition for the medal shall be open only to those who belong to the Institute.

(2) The award of medals shall not be made oftener than once a year, the medal year shall be the year ended June last previous to the annual meeting at which the award is to be made.

(3) The papers entered for competition shall be judged by a committee of five, to be called the Gzowski Medal Committee, which shall be appointed by the council as soon after the annual meeting of the Institute as practicable. Members and Honorary Members only shall be eligible to act on this committee.

(4) Papers to be eligible for competition must be the bona fide productions of those who contribute them, and must not have been previously made public, nor contributed to any other society in whole or in part.

(5) The medal shall be awarded for the best paper of the medal year, provided such paper shall be adjudged of sufficient merit as *a contribution to the literature of the profession of civil engineering*, but not otherwise.

(6) In the event of the committee not considering a paper in any one year of sufficient merit, no award shall be made; but in the following year or years, it shall be in the power of the committee to award the accumulated medals to the authors of different papers which may be deemed of sufficient merit.

(7) The medal shall be suitably engraved by the Institute, and shall be handed to the successful authors at the annual meeting, or be given to them as soon afterwards as possible.

THE LEONARD MEDAL

A gold medal, called "The Leonard Medal," is provided from the annual proceeds of a fund established in 1917 by the late Lieut.-Col. R. W. Leonard, and will be awarded in accordance with the following rules for *papers on mining subjects* presented either to The Canadian Institute of Mining and Metallurgy or to The Engineering Institute of Canada.

(1) Competition for the medal shall be open to those who belong to The Canadian Institute of Mining and Metallurgy or to The Engineering Institute of Canada.

(2) Award shall be made not oftener than once a year, and the medal year shall be the year ended June last previous to the year in which the award is made.

(3) The medal shall be presented at annual meetings of The Engineering Institute of Canada.

(4) A committee of five shall judge the papers entered for competition, all of whom shall be members both of The Canadian Institute of Mining and Metallurgy and The Engineering Institute of Canada, this committee to be appointed by the council of The Engineering Institute of Canada.

(5) All papers presented shall be the work of the author or authors and must not have been made previously public, except as part of the literature of The Canadian Institute of Mining and Metallurgy or The Engineering Institute of Canada.

(6) Should the committee not consider the papers presented in any one year of sufficient merit, no award shall be made, but in the following year, or years, the committee shall have power to award the accumulated medals or to award a second prize in the nature of a silver medal, or a third prize of books to be selected by the committee.

(7) The medal shall be suitably engraved, containing the name of The Engineering Institute of Canada, and the words, "The Leonard Medal" together with the adopted design, and on the reverse side the name of the recipient, the date and any other inscription that may be decided upon by the committee.

THE PLUMMER MEDAL

A gold medal, called "The Plummer Medal," is provided from the annual proceeds of a fund established in 1917 by J. H. Plummer, D.C.L., and will 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.

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

PRIZES TO UNIVERSITY STUDENTS

In 1930 Council established eleven cash prizes of twenty-five dollars each for competition among students of Canadian engineering schools, in the year prior to the graduating year. Awards are made annually to the following institutions:

University of Alberta
University of British Columbia
Ecole Polytechnique, Montreal
University of Manitoba
McGill University
University of New Brunswick
Nova Scotia Technical College
Queen's University
*Royal Military College
University of Saskatchewan
University of Toronto.

It is the desire of council that the method of their award shall be determined by the appropriate authority in each school or university, so that a prize may be given to the student in any department of engineering who has proved himself most deserving, not only in connection with his college work, but also as judged by his activities in the student engineering organization, if any, or in the local branch of a recognized engineering society.

It is not necessary for the recipient to belong to the Institute, and in this respect the prizes are quite distinct from those offered to Students and Juniors of the Institute, or from the prizes which are offered by a number of our branches to the Students attached to them.

It is felt that the establishment of these prizes not only aids deserving students, but assists in developing their interest in engineering societies' work, and in the resulting acquirement and interchange of professional knowledge.

*At the request of the College authorities, the award has been discontinued for the duration of the war.

Library Notes

Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

LIST OF THE NEW AND REVISED BRITISH STANDARDS

Issued during October, November and December, 1939

B.S. No.

63-1939—Sizes of Road Stone and Chippings. (Revision).

This revision has been effected to introduce the use of square mesh sieves to B.S. 410 in place of the round hole sieves previously adopted.

Each standard size has been specified in greater detail and the tolerances have been adjusted.

77-1939—Voltages for Transmission and Distribution A.C. Systems. (Revision).

Specifies (a) system voltage and (b) declared voltages, instead of the four voltages included in the 1932 edition. Also, the Specification is not now confined to new systems. Revised standard voltages are given.

329-1939—Round Strand Steel Wire Ropes for Lifts and Hoists. (Revision).

This Specification is intended to provide for round strand ropes of Lang's or Ordinary Lay of 6 x 12 and fibre, 6 x 19. 6 x 18 Seale, and 6 x 24 constructions, for use with cage or platform hoists or lifts (for passengers or goods) working in guides. This Specification is not intended to apply to ropes for coal hoists or similar lifting appliances.

358-1939—Rules for the Measurement of Voltage with Sphere-Gaps. (Revision).

This revision of the 629 edition is based on a review of all available data arising from researches carried out in all countries during the last ten years. Calibration tables are given for spheres ranging from 2 up to 200 cm. diameter.

443-1939—Testing of the Zinc Coating on Galvanized Wires. (Revision).

Introduces a test for the weight of spelter deposited on the galvanized wire. The copper-sulphate test is retained with certain reservations.

853-1939—Calorifiers.

This Specification applies to riveted and welded steel, cast iron and copper calorifiers for central heating and hot water supply; it applies to steam heated calorifiers exceeding 50 gallons holding capacity.

861-1939—Air-Break Switches (including Isolating Switches, Totally-enclosed and Flameproof Types) for Voltages not exceeding 660 Volts.

862-1939—Air-Break Circuit-Breakers (including Totally-enclosed and Flameproof Types) for Voltages not exceeding 660 Volts.

A considerable number of the clauses in several standards were in their respective series, common to each. These have now been combined and issued as two specifications: B.S.861. Supersedes B.S. 109-1934, 1924-1934, and 126-1930. B.S. 862. Supersedes B.S. 110-1934, 127-1930 and 130-1934.

870-1939—Micrometers (External).

This Specification relates to external micrometers having ranges of measurement of 1″ to 12″. Full details are given as to maximum permissible errors both in the micrometers themselves and the setting gauges. An Appendix relates to recommended methods of testing.

875-1939—Silica Basins, Crucibles and Capsules.

This British Standard which gives dimensions of silica basins, crucibles and capsules forms part of a series of standards for scientific glassware and silica ware.

876-1939—Hand Hammers.

This British Standard applies to joiners, engineers, smiths, stonebreakers and boiler scaling hammers, including sledge and club hammers.

877-1939—Foamed Blast-furnace Slag for Concrete Aggregate.

Specifies the essential characteristics of a slag suitable for use as concrete aggregate. It is stated, however, that concrete made with such aggregate should not be used for external work without the protection of some rendering.

The requirements specified include the weight per unit volume, freedom from impurities, freedom from coke, percentage of sulphate and stability.

Details of the methods for testing for these requirements are given in an Appendix.

878-1939—Code for Comparative Commercial Tests of Coal or Coke and Appliances in Small Steam Raising Plants.

This code lays down standard tests for the determination of the evaporation and fuel consumption of steam raising plant in order to determine the relative value of different solid fuels and the relative value of new equipment, such as grates, circulators, economizers, air heaters, smoke eliminators and such like auxiliary boiler apparatus.

879-1939—Steel Tubes for Water Well Casing.

Prescribes the quality of material and the dimensions of lapwelded and weldless tubes from 4 in. to 48 in. diameter, and includes tensile, bend, weld, and hydraulic tests.

Three types of joints are dealt with:—

(a) screwed and socketed with V threads.
(b) screwed and socketed with square form threads.
(c) flush joints (inside and out) with square form threads.

880-1939—Concert Pitch.

Sets out and adopts, as a British Standard, the international standard of Concert Pitch agreed upon by the International Standards Association for Soloists, Orchestras, Choirs, etc., and for recorded music, together with a set of technical recommendations in connection therewith; and arrangements made by the B.B.C. for broadcasting the standard note.

881-1939—Nomenclature of Hardwoods (including Botanical Species and Sources of Supply).

Gives the standard names that have been adopted for hardwoods, includes the botanical names, the sources of supply and the other commercial or botanical names applying to the woods.

CF. 4420—Terms used in Radio Direction-Finding.

Gives terms and definitions prepared by the Direction-finding Committee of the Radio Research Board of the Department of Scientific and Industrial Research and published as a supplement to the B.S. Glossary (No. 205-1936) with the approval of the appropriate B.S.I. Committees.

Prices:—Nos. 77, 880, CF, 442p, 1/- each; post free 1/2d each. Nos. 853, 881, 3/6d each; post free 3/8d each. Remainder 2/- each; post free 2/2d each.

Copies of the new specifications may be obtained from: Canadian Engineering Standards Association, 79, Sussex Street, Ottawa.

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

Alternating Current Circuits

By K. Y. Tang, Scranton, International Textbook Company, 1940. 438 pp., 6 x 9¼ in. cloth, $4.00.

Elementary Design of Structural Steel and Reinforced Concrete

By Charles Kandall, N.Y. Federation of Architects, Engineers, Chemists and Technicians, 1939. 162 pp., 5½ x 8¼ in. cloth.

Story of Highway Traffic Control, 1899-1939

By William Phelps Eno, Eno Foundation for Highway Traffic Control, 1939. 293 pp., 7 x 9¼ in., cloth, $4.00.

PROCEEDINGS, TRANSACTIONS, ETC.

American Institute of Consulting Engineers

Proceedings of the Annual Meeting, January 15th, 1940.

American Society of Civil Engineers

Year Book Number, 1940. Proceedings, Part 2, Volume 66, No. 4.

American Society of Mechanical Engineers

Transactions, 1939, Volume 61.

American Society for Testing Materials

1939 Book of A.S.T.M. Standards including Tentative Standards. Part 1, Metals.

Institution of Water Engineers

Transactions, Vol. XLIV, 1939.

REPORTS

Association of Professional Engineers of the Province of Ontario

Act of Incorporation, By-Laws, Code of Ethics, List of Members, 1939.

Canada, Department of Mines and Resources—Forest Service

Wooden Tanks in Industry, by M. J. Brophy, Ottawa, 1939, Circular 55. Animal Glues and Their Use in Woodworking by George L. Rosser, Ottawa, 1939. (Bulletin 96). Spruce "Waste" in the Sawmills of Quebec and the Maritime Provinces, by J. B. Prince; Strength of Dowel Joints, by George L. Rosser; The Preparation and Marketing of Spruce Sawmill "Waste" for Chemical-Pulp Chips in Quebec and the Maritime Provinces, by E. S. Fellows; Concentrations of Water-Soluble Preservatives in Treated Timber, by G. E. Moore. (Forest Products Laboratories.)

Canada, Department of Mines and Resources—Mines and Geology Branch

Canadian Mineral Industry in 1938. Ottawa, 1939.

Canadian Government Purchasing Standards Committee

Specifications: Methods of Sampling and Analysis of Soaps; General Purpose Bar Soap, Containing Rosin, Builder-Free; General Purpose Bar Soap, Containing Builder, Rosin-Free; General Purpose Bar Soap Containing Rosin and Builder.

Corporation des Ingénieurs Professionnels de Québec

Rapport du Président et du Conseil, 1939.

Edison Electric Institute

Methods of Measuring Radio Noise, 1940. Report of the Joint Co-ordination Committee on Radio Reception of E.E.I., N.E.M.A. and R.M.A.

Electrochemical Society

Recent History of Certain Cobalt-Nickel Alloy Plating Solutions; Electric Furnace in the Steel Foundry; Electrolytic Etching of Brass; Electrochemical Oxidation of n-Hexanol; Electrolytic Stripping of Copper from Zinc Base Die Castings; Theory of the Potential and the Technical Practice of Electrodepostion; Effect of Direct and Alternating Currents on the Growth of Oat Seedlings; Progress in Electrolytic Refining of Metals, with Special Reference to the Last Decade; Electro-Organic Chemical Preparations. Preprints Nos. 77-18 to 77-26.

Engineering Foundation

Annual Report, 1938-1939.

Highway Research Board

Roadside Development—Reports at the Nineteenth Annual Meeting by the Joint Committee on Roadside Development Highway Research Board and American Association of State Highway Officials. Washington, National Research Council, 1940.

Institution of Structural Engineers

Year Book and List of Members, Session 1939-1940.

International Nickel Company of Canada

Annual Report, December 31, 1939.

Montreal Tramways Company

Annual Report, 1939.

Nova Scotia Power Commission

Twentieth Annual Report, November 30, 1939.

Ontario, Department of Mines

Bulletin No. 126, Preliminary Report on the Mineral Production of Ontario in 1939. Toronto, 1940.

Port of New York Authority

Nineteenth Annual Report, December 31, 1939.

Professor Glushkov

Two articles entitled "The Elastic Line of a Beam of Variable Cross-section" and "Determination of the Elements of the Elastic Line of Beams of Uniform Section with the Help of the moments of High Orders." Manuscript form.

Society for the Promotion of Engineering Education

Preliminary Report of Special Committee on Aims and Scope of Engineering Curricula, November 16th, 1939.

U.S. Department of Commerce: National Bureau of Standards

Building Materials and Structures; BMS33 Plastic Calking Materials; BMS39 Structural Properties of a Wall Construction of "Pfeifer Units"; BMS38; Structural Properties of Two "Dunstone" Wall Constructions; BMS37 Structural Properties "Palisade Homes" Constructions for Walls, Partitions, and Floors; BMS43 Performance Test of Floor Coverings for Use in Low-Cost Housing: Part 2.

U.S. Department of the Interior. Geological Survey Bulletin

Mizpah Coal Field, Custer County, Montana, 906-C: Geology of the Searchlight District, Clark County, Nevada, 906-D; Platinum Deposits of the Goodnews Bay District, Alaska, 910-B; Transit Traverse in Missouri, part 2, South-Central Missouri, 1908-37, 916-B.

University of Alberta

Calendar, 1939-40.

University of Illinois Bulletin. Engineering Experiment Station Bulletin Series

Hardenability of Carburizing Steels by Walter H. Bruckner, No. 320; Investigation of Oil-Fired Force-Air Furnace Systems in the Research Residence by Alonzo P. Kratz and Seichi Konzo, No. 318; Laminar Flow of Sludges in Pipes with Special Reference to Sewage Sludge by Harold E. Babbitt and David H. Caldwell, No. 319. German-English Glossary for Civil Engineering by Alphonse A. Brielmaier, Circular Series No. 40.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

ACOUSTICAL SOCIETY OF AMERICA JOURNAL, CUMULATIVE INDEX, Vols. 1-10, 1929-1939

Published for the Acoustical Society of America by the American Institute of Physics, Lancaster, Pa., and New York, N.Y., 1939. 131 pp., 10½ x 8 in., paper, $3.00.

This work contains author and subject indexes to the first ten volumes of the Journal, as well as to books and papers on acoustical subjects which appeared elsewhere during 1937 and 1938 and were referred to in the Journal.

A.S.T.M. STANDARDS, including Tentative Standards, 1939. 3 Vols.

Vol. I, Metals. 1,308 pp.
Vol. II, Nonmetallic Materials, Constructional. 1,217 pp.
Vol. III, Nonmetallic Materials, General. 1,175 pp. American Society for Testing Materials, Phila., Pa., 1939–1940. illus., diagrs., charts, tables, 9½ x 6 in., cloth, $8.00, any one pt.: $15.00, any two pts.; $22.00, all three pts.

With this issue, a change in the method of publication has been adopted. Hereafter, the standards and tentative standards will be issued collectively, every three years, in one publication divided into three parts: Metals; Non-metallic materials—constructional; and Non-metallic materials—general. Individual parts may be purchased. Supplements will be issued to the parts in the two years between editions. The new arrangement will greatly facilitate reference. Improvements in typography and indexing have also been introduced.

BUSINESS METHODS IN THE BUILDING FIELD

By G. Schobinger and A. M. Lackey. McGraw-Hill Book Co., New York, 1940, 350 pp., diagrs., charts, tables, 9½ x 6 in., cloth, $3.50.

This practical manual of business methods and documentary procedure in the development and execution of industrial, power and building projects analyzes the administrative functions of the work against the background of the contract responsibilities involved, and outlines methods for the production of competent documents for use in performing these functions. A check list and specimen forms are given for a complete building project.

COLE'S PERMANENT WAY, Material, Maintenance, Points and Crossings

By Col. Sir G. Hearn. 10 ed. E. & F. N. Spon, London, 1940. 196 pp., diagrs., charts, tables, 7½ x 5 in., fabrikoid, 10s.6d.

Standards for track and permanent way in British practice are dealt with in the first chapter. The succeeding three chapters describe maintenance work, track laying and relaying, switches and crossings. Chapter five contains mathematical calculations for string lining and other layout problems. Standard dimensions for Indian Railways are appended.

(The) DICTIONARY OF PAPER, including Pulps, Boards, Paper Properties and Related Papermaking Terms.

American Paper and Pulp Association, New York, 1940. 365 pp., tables, 9½ x 6 in., cloth, $5.00; prepublication price, $4.00.

This dictionary is an ambitious and highly successful attempt to provide the paper industry with an accurate, comprehensive nomenclature. As far as possible, the definitions are given in nontechnical terms which can be understood by those unacquainted with the industry. The book is the work of a committee of the American Pulp and Paper Association, with the co-operation of The Institute of Paper Chemistry.

ELECTRIC TRANSPORTATION

By F. R. Thompson. International Textbook Co., Scranton, Pa., 1940. 427 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $4.00.

The purpose of this volume is to present methods of applying electrical equipment in passenger and freight transportation. The procedure involves the establishment of the problem, the selection of the general classes of equipment, the function of the individual groups of parts, the ratings and limitations that are commercially practicable, and the operating results. Transportation by city surface cars and buses, subway and elevated systems and main railways is discussed.

EXPERIMENTAL AERODYNAMICS

By H. C. Pavian. Pitman Publishing Corp., New York and Chicago, 1940. 168 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $2.50.

This text contains a simple, concise presentation of the elements of wind-tunnel work, in which stress is laid on its applications in air conditioning, streamlining, etc., as well as in aviation. The work is intended as a text and laboratory handbook in technical schools and colleges. In addition to numerous experiments, brief notes on model building and the construction of small wind tunnels are included.

GAS ENGINE HANDBOOK, Gas Engine Power Committee

American Gas Association, Industrial Gas Section, New York, 1939. 58 pp., illus., diagrs., charts, tables, 11 x 8½ in., paper, $1.00.

A concise manual on the functioning of gas engines, their selection for various purposes and their installation. The information is practical, clear and devoid of unnecessary technicalities. The book is intended primarily for those interested in the sale and promotion of gas engines.

GREAT BRITAIN. Dept. of Scientific and Industrial Research. Report of the Road Research Board, with the Report of the Director of Road Research for the Year Ended 31st March, 1939

His Majesty's Stationery Office, London, 1939. 172 pp., illus., diagrs., charts, tables, 10 x 6 in., paper, 3s. 6d. (Obtainable from British Library of Information, 50 Rockefeller Plaza, New York, $1.05.)

This report summarizes the progress during the year in the investigations undertaken by the Board. Research work included the study of earthworks and road and bridge foundations, road materials and methods of construction, the surface characteristics of roads and the forces between vehicle and road surface. A list of publications by the Board and its staff during the year is included.

HEATING, VENTILATING, AIR CONDITIONING GUIDE, Vol. 18, 1940. American Society of Heating and Ventilating Engineers, New York

1,088 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $5.00.

This annual publication is an admirable summary of the scientific and practical information needed by heating and ventilating engineers, kept up to date by constant revision. The needs of designers and installers of apparatus for heating, ventilating and air conditioning are fully covered, both for domestic and industrial purposes. In addition to revision where necessary, a new chapter has been added, on Unit air conditioners, cooling units and attic fans. The Guide also contains a Manufacturers' section, which lists apparatus and materials, and the membership list of the Society.

IMPACT CLEANING

By W. A. Rosenberger. Penton Publishing Co., Cleveland, Ohio, 1939. 466 pp., diagrs., charts, tables, 9½ x 6 in., cloth, $7.00.

The term, "impact cleaning," has been coined as a comprehensive name for those processes which employ an abrasive projected at high velocity. This book provides a practical account of the equipment used in the different methods, the details of the working processes, their fields of usefulness, etc. A section is devoted to the ventilation problems that arise.

MECHANICS OF LIQUIDS, an Elementary Text in Hydraulics and Fluid Mechanics.

By R. W. Powell. Macmillan Co., New York, 1940. 271 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $3.50.

Believing that the time usually available and the mathematical preparation of most students make it unwise to undertake a thorough presentation of fluid mechanics in an introductory course, the author has confined this work to non-compressible fluids. The result differs very little from the old hydraulics except in point of view and the introduction of recent improvements. The book provides a brief course emphasizing principles and approaching the subject historically.

METALS—How They Behave in Service

By W. J. Diederichs and others. American Society for Metals, Cleveland, Ohio, 1939. 45 pp., illus., diagrs., charts, tables, 9 x 6 in., paper, $1.00.

This pamphlet contains five lectures delivered during 1936 and 1937, under the auspices of the Philadelphia chapter of the American Society for Metals. The speakers discussed behavior under static loads, repeated loads and impact; and the effects of corrosion and behavior at different temperatures.

(The) MODERN RAILWAY

By J. H. Parmalee. Longmans, Green & Co., New York and London, 1940. 730 pp., diagrs., charts, tables, maps, 9 x 6 in., cloth, $4.00.

This definitive treatment of rail transport in our time covers the historical background, operation problems and processes, and public relations. The wide range of the work takes in the physical plant, human activities, finance, and competitive complications. There are many tables and charts, and digests of Federal railway legislation and Federal railway labor legislation are appended.

NATIONAL CONFERENCE ON PLANNING, Proceedings of the Conference held at Boston, Massachusetts, May 15-17, 1939

American Society of Planning Officials, Chicago, Ill., 1939. 166 pp., 9½ x 6 in., cloth, $2.00.

Participants in the conference were: the American Institute of Planners, the American Planning and Civic Association, the American Society of Planning Officials, and the National Economic and Planning Association. Over thirty papers were presented, dealing with various problems of community reclamation, industrial migration, obstacles to planning, rural planning, public works, etc.

PNEUMOCONIOSIS (Silicosis), the Story of Dusty Lungs, a Preliminary Report

By L. G. Cole and W. G. Cole. John B. Pierce Foundation, New York, 1940. 100 pp., illus., charts, 11 x 8 in., cloth, $1.00.

For several years the Doctors Cole have been investigating this subject under the auspices of the John B. Pierce Foundation. This volume presents the conclusions reached, many of which, the authors say, are not in accord with the accepted ideas. The cause of the disease, its physiological effects, its diagnosis, the social and economic problem that it presents, and the legislative and judicial treatment that should be provided are discussed.

PRACTICAL ELECTRICITY

By T. Croft, rev. by G. H. Hall. 4 ed. McGraw-Hill Book Co., New York, 1940. 701 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $3.00.

This well-known textbook covers the fundamentals of electricity in a simple, practical manner, illustrating them by many practical applications encountered in everyday life. The book calls for no special mathematical knowledge and is admirably adapted to home study This edition has been extensively revised in the light of recent developments.

PROCEEDINGS OF THE SEVENTH SUMMER CONFERENCE ON SPECTROSCOPY AND ITS APPLICATIONS

A publication of the Technology Press, Massachusetts Institute of Technology; John Wiley & Sons, New York; Chapman & Hall, London, 1940. 154 pp., illus., diagrs., charts, tables, 10 x 7 in., paper, $2.75.

This volume contains twenty-nine papers presented at the conference. They are grouped roughly with reference to the following broad subjects: general background and methods of analysis of materials, specific types of analysis, recently developed apparatus, light sources, absorption spectrophotometry and miscellaneous topics.

PROPERTIES OF ORDINARY WATER-SUBSTANCE. (American Chemical Society Monograph Series No. 81)

Compiled by N. E. Dorsey. Reinhold Publishing Corp., New York, 1940. 673 pp., diagrs., charts, tables, 9½ x 6 in., cloth, $15.00.

This work aims to present "specifically or by reference all the material likely to be of interest to anyone studying the properties of ordinary water-substance, *i.e.*, that of the usual isotopic composition." The properties of water-vapor, water and the several ices are presented, with information upon the synthesis and dissociation of water-substance and its transition from phase to phase. The literature has been searched to the end of 1937, and references to sources of data are given throughout.

RUTHERFORD, Being the Life and Letters of the Rt. Hon. Lord Rutherford, O.M.

By A. S. Eve, with a foreword by Earl Baldwin of Bewdley. Macmillan Company, New York; University Press, Cambridge, England, 1939. 451 pp., illus., diagrs., charts, tables, 10 x 7 in., cloth, $5.00.

This is the authorized biography of the great physicist, by a former colleague. Dr. Eve's aim has been "to hold up a mirror in which Rutherford may reveal himself, just as he was, in lectures, books, papers, speeches, portraits, letters and casual talk." The result is a fine biography and also a valuable contribution to the history of physics in the twentieth century.

SIMPLE AERODYNAMICS AND THE AIRPLANE

By C. C. Carter. 5 ed. Ronald Press Co., New York, 1940. 510 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $4.50.

This elementary textbook covers airfoil design and criteria for the selection of airfoils, parasite resistance, the propeller, the airplane as a unit, stability and control surfaces, performance, dynamic loads, and aircraft instruments. There are questions and many graphs and diagrams with each chapter, and there are appendices containing nomenclature, aerodynamic equations, and problems.

SOIL MECHANICS AND FOUNDATIONS

By F. L. Plummer and S. M. Dore. Pitman Publishing Corp., New York and Chicago, 1940. 473 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.50.

The aim of this work is to correlate, systematize and simplify the increased understanding of the performance of soils which new methods of research work have produced, and to present the information in convenient form for use by engineers and students. The principles of soil mechanics, the terminology and the types of tests employed are described, and the ways in which the results are used in foundation work, in retaining walls and highway and dam construction are presented. A bibliography is included.

STANDARD METAL DIRECTORY, 8th ed., 1940

New York, Atlas Publishing Co., 1939. 610 pp., tables, 9½ x 6 in., cloth, $10.00.

This directory lists over 11,000 industrial establishments engaged in the manufacture and sale of ferrous and non-ferrous materials. Iron and steel plants, ferrous and non-ferrous foundries, rolling mills, smelters and refiners of non-ferrous metals, dealers in scrap metals and used pipe, etc., are included. The various lists are arranged geographically. The capitalization, officers, plant equipment, capacity and other useful data are given in each case. The directory covers the United States and Canada.

STATISTICAL THERMODYNAMICS

By R. H. Fowler and E. A. Guggenheim. Macmillan Co., New York; Cambridge (England) University Press, 1939. 693 pp., diagrs., charts, tables, 10½ x 7 in., cloth, $9.50.

This version of statistical mechanics for students of physics and chemistry presents the first extensive exposition making full use of all available "à priori" evaluations of thermodynamic functions. These functions are constructed by the application to particular molecular models of the fundamental theorems of statistical mechanics. The wide scope is indicated by the following list of chapter headings: Introduction; general theorems; permanent perfect gases; crystals; chemical equilibria; grand partition functions; imperfect gases; liquids and solutions; surface layers; electron theory; chemical kinetics; lattice imperfections; electric and magnetic properties.

TELEVISION, the Electronics of Image Transmission

By V. K. Zworykin and G. A. Morton. John Wiley & Sons, New York, 1940. 646 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $6.00.

While a large literature exists upon television, most of it exists only in periodicals, and books upon the subject are few. The present work, by two prominent workers in the field, is intended as an integrated, detailed survey of the field, and should prove of interest and value to all investigators. The fundamental physical phenomena involved in television are first considered. Next the field of television as a whole is dealt with. The components of the electronic television system based upon the storage principle are then analyzed. Finally, the television system used in the RCA-NBC project is described. Brief bibliographies accompany many chapters.

(The) TOOLS OF THE CHEMIST, Their Ancestry and American Evolution

By E. Child. Reinhold Publishing Corp., New York, 1940. 220 pp., illus., diagrs., 9 x 6 in., cloth, $3.50.

This interesting contribution to the history of American chemistry is devoted to the development of laboratory apparatus and to its distributors. An introductory section discusses the beginning of laboratories in America and tells something of early teachers and experimenters. The history of apparatus is then presented, followed by accounts of important supply houses. The European origins of apparatus are brought into the picture.

TRAINING PROCEDURE

By F. Cushman. John Wiley & Sons, New York, 1940. 230 pp., charts, tables, 7½ x 5 in., cloth, $2.00.

The author discusses the problems encountered in planning, organizing, operating and maintaining efficient training programs in industrial, business, and public-service organizations. The discussion is limited to employed personnel, and the principal objective is improvement in the performance of work. Much practical information is given in the text and appendices.

WATTHOUR METERS

By W. C. Wagner. International Textbook Co., Scranton, Pa., 1939. 3 sections paged separately, illus., diagrs., tables, 8 x 5 in., lea., $1.70.

This instruction book provides an excellent account of the varieties of watthour meters and of their applications. The characteristics of each type, the construction of various commercial patterns, installation and testing, wiring, etc., are described in simple, practical fashion. The work fills the needs of metermen.

WRITING THE TECHNICAL REPORT

By J. R. Nelson. McGraw-Hill Book Co., New York and London, 1940. 373 pp., diagrs., tables, 9½ x 6 in., cloth, $2.50.

The technical report is regarded as a structure designed to meet certain definite requirements. Fundamental considerations which bear on the design and composition of a report are reviewed. Specific directions are given for the setup of the report, with several annotated illustrative reports. A systematic procedure is outlined for the critical examination of reports, including some typical cases, and suggestions are made with regard to classroom procedure. The result is an unusually helpful book.

WROUGHT IRON

By J. Aston and E. B. Story. 2 ed. A. M. Byers Co., Pittsburgh, Pa., 1939. 97 pp., illus., charts, tables, 9 x 6 in., cloth, $1.00.

This little book by two well-known metallurgists is a brief, but up-to-date account of the way wrought iron was made in the past, of current methods of manufacture, and of its special properties and principal uses.

ZONING, the Laws, Administration, and Court Decisions During the First Twenty Years

By E. M. Bassett. Russell Sage Foundation, New York, 1940. 275 pp., 9½ x 6 in., cloth, $3.00.

The work of an attorney of wide experience with zoning problems, this book discusses the origins of zoning, its legal development and present status. Its review of court decisions upon many problems that arise is a valuable contribution to the literature. This edition contains fuller citations than the previous one and some clarifications and extensions.

COMING MEETINGS

National Construction Council of Canada—Annual Meeting, Royal York Hotel, Toronto, May 21.

American Society of Mechanical Engineers—Semi-annual Meeting, Milwaukee, June 17-20.

American Society for Testing Materials—Forty-third Annual Meeting at Chalfonte-Haddon Hall, Atlantic City, N.J., June 24 to 28 inclusive.

American Institute of Electrical Engineers—Summer Convention at Swampscott, Mass., June 24-28; Pacific Coast Convention, Los Angeles, Calif., August 26-30.

Canadian Electrical Association—Fiftieth Annual (Golden Jubilee) Convention at the Seigniory Club, P.Q., June 25-28.

National Conference on Planning—Joint Annual Conference of American Society of Planning Officials, American Institute of Planners, the American Planning and Civic Association, and the National Economic and Social Planning Association at San Francisco, Calif. Director, Walter H. Blucher, 1313 E. 60th St., Chicago, Ill., July 8-12.

The Society for the Promotion of Engineering Education—Conference on Soil Mechanics and its Applications. To be held at Purdue University, Lafayette, Indiana, September 2-6.

American Society of Mechanical Engineers—Fall Meeting, Spokane, September 3-5.

American Chemical Society—Detroit, Mich., September 9-13.

Electrochemical Society, Inc.—Fall Meeting, at Ottawa, Ont. President H. J. Creighton, Swarthmore College, Swarthmore, Pa. Secretary, Dr. C. G. Fink, Columbia University, New York City. October 2-3-4-5.

PRELIMINARY NOTICE

of Application for Admission and for Transfer

April 24th, 1940

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

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

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

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

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

The Council will consider the applications herein described in June, 1940.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

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

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

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

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

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

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

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

An Affiliate shall be one who is not an engineer by profession but whose pursuits, scientific attainment 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

BALDWIN—JOHN GODDERIDGE, of 1441 Drummond St., Montreal, Que. Born at Dadlington, Leics., England, Aug. 2nd, 1903; Educ.: 1918-21. Leicester City Technical Schools. Montreal Technical School, course in advanced electr'l. theory; 1921-25, ap'ticeship, British Electrical Repairs Ltd., Birmingham; 1928-30 substation designing, Northern Electric Co. Ltd., Montreal; 1930 to date, with the Montreal Light, Heat & Power Cons., two years, dfting & designing, engrg. dept., and 8 years to date, supt. of constrn.

References: R. M. Walker, L. L. O'Sullivan, R. N. Code, A. Benjamin, H. Milliken.

BEARD—GEORGE FRANCIS, of 30A Triller Ave., Toronto, Ont. Born at Toronto, Nov. 21st, 1913; Educ.: B.A.Sc., Univ. of Toronto, 1938; Summer work as labourer, Hollinger Cons. Gold Mines, mill operator, Ross Mine, student in methods and production, Canada Metal Company; 1938 to date, metallurgist, Canada Metal Company, Toronto, Ont.

References: W. J. T. Wright, W. S. Wilson, J. J. Spence, C. H. Mitchell, J. R. Cockburn.

BOUX—JOSEPH FRANCIS, of 450 St. Jean Baptiste St., St. Boniface, Man. Born at Calgary, Alta., April 24th, 1918; Educ.: B.Sc. (C.E.), Univ. of Man., 1939; Summer work for father, plastering and cast stone contractor; 1939-40, demonstrator in civil engrg., Univ. of Manitoba, Winnipeg, Man.

References: A. E. Macdonald, G. H. Herriot, W. F. Riddell, R. W. Moffatt, J. Hoogstraten.

CLARK—FRANCIS W., of Toronto, Ont. Born at St. Paul, Minn., Jan. 23rd, 1887; Educ.: Grad., Faculty of Engrg., Univ. of Toronto, 1911; 1906-07, chairman and rodman, C.P.R.; 1909-10, engr. in charge of survey party, H.E.P.C. of Ontario; 1911-13, asst. engr., International Waterways Commission; 1913 to date, with the H.E.P.C. of Ontario, as follows; 1913-14, i/c topographic surveys, Grand River, Conservation; 1914-16, Queenston-Chippawa development; 1917-24, divn. engr. on constrn. Queenston-Chippawa development; 1924-26, i/c topographic surveys, Ottawa River, for power development; 1927-28, head office; 1928-29, res. engr., Lac Seul conservation dam; 1929, Ear Falls development; 1930, Nipigon River power survey; 1931 to date, asst. engr.

References: J. R. Montague, O. Holden, J. Mackintosh, J. J. Traill, S. W. B. Black.

JACKSON—WILLIAM HAYES, of 1 Hawthorne Ave., Toronto, Ont. Born at Simcoe, Ont., April 18th, 1915; Educ.:B.A.Sc., Univ. of Toronto, 1939; 1936 (summer) Link-Belt Co.; May 1939 to date, designing engr., DeHaviland Aircraft of Canada Ltd., Toronto, Ont.

References: T. R. Loudon, R. W. Angus, E. A. Allcut, J. R. Cockburn, C. H. Mitchell.

JOHNSTONE—ROBERT WILLIAM, of Toronto, Ont. Born at Edinburgh, Scotland, Nov. 18th, 1900; Educ.: Civil Engr., Edinburgh Univ., 1922. Fellow of the Surveyors' Institution. Member, Royal Sanitary Institute (by exam.); 1918-22, articled pupil to A. W. Millar, F.S.I., chartered surveyor, of firm of Millar, Scott & Wyllie, Architects, Civil Engrs. & Surveyors, Edinburgh. 1922-24, asst. engr. & surveyor, and senior asst. surveyor, with same firm; 1924-30, estimator, Anglin Norcross Ltd.; 1930-37, engr. & estimator, contract dept., Anglin Norcross Quebec Ltd.; 1937 to date, asst. mgr., Anglin Norcross Ontario Ltd.

References: P. N. Gross, C. D. Harrington, D. G. Anglin, A. H. Harkness, G. L. Wallace.

MacDONALD—MARTIN JOHN, of Glen Lake, Victoria, B.C. Born at Truro, N.S., Nov. 19th, 1899; Educ.: Private tuition. I.C.S. bridge engrg.; 1916-17, chainman, rodman and land surveyor in Nova Scotia. With the Dept. of Public Works of B.C. as follows: 1926-27, rodman, timekpr., leveller, transitman; 1927-28, asst. to res. engr.; 1928 (Mar.-Aug.), acting res. engr.; 1928 (Aug.-Dec.), prelim. location; 1929 (Mar.-Aug.), power site survey; 1929-31, hydrometric recorder; 1931 (Aug.-Oct.), instr'man.; 1931-39, intermittent work, partly in electrical retail business; Feb. 1940 to date, asst. engr., Western Air Command, Works Branch, R.C.A.F.

References: C. A. Davidson, A. L. Carruthers, J. H. McIntosh, C. E. Webb, J. C. MacDonald, I. C. Barltrop, C. R. Cornish.

MATHESON—ARMEN, of 675 Richard Ave., Verdun, Que. Born at Angora, Asia Minor, Mar. 18th, 1905; Educ.: B.Sc. (Tech.), Manchester Univ., 1924; 1924-27, gen. elect'l. engrg. experience, on switchgear, design, testing, and 1927-28, testing, inspection and supervision of switchgear erection in the field, Ferguson, Pailin Ltd., Manchester, England; 1929-31, switchgear design, Canadian Westinghouse Company; 1931-33, switchgear engrg., Delta Star Electric Co.; 1935-37, elect'l. engr., estimating and design, Taylor Electric Mfg. Co., London, Ont.; Jan. 1938 to date, senior dftsman, Bepco Canada Limited, Montreal, Que.

References: R. A. Yapp, J. D. Chisholm, H. Lillie, H. W. Fairlie, D. S. Scrymgeour.

MERRIMAN—HORACE OWEN, of 308 Mackay St., Ottawa, Ont. Born at Hamilton, Ont., Nov. 21st, 1888; Educ.: B.A.Sc., Univ. of Toronto, 1911; 1911-12, dftsman., Can. Westinghouse Co., Hamilton; 1912-14, asst engr., Hamilton Hydro Electric System; 1914-15, demonstrator in elec. engrg., Univ. of Toronto; 1915-19, Capt. (Tech.), R.N.A.S., and R.A.F. Testing aircraft and designing aircraft instruments, joint inventor of Guest and Merriman anti-aircraft gun control system; 1919-23, research engr., i/c of development of Guest & Merriman system of recording sound; 1924, research engr., i/c of investigation of radio inductive interference for the Research Council of Canada. From 1925, inductive interference engr. Dept. of Marine and Fisheries, under the Director of Radio Services, i/c of research investigation and suppression of radio inductive interference throughout Canada. Present position—engr. in charge, Interference Section, Department of Transport, Ottawa, Ont.

References: W. P. Dobson, L. A. Wright, E. V. Buchanan, W. A. Rush, W. R. McCaffrey, C. P. Edwards.

PINET—JOSEPH F. MARCEL, of Quebec, Que. Born at Montreal, May 12th, 1910; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1934. R.P.E. of Que.; 1934-35, instr'man., Quebec Roads Dept.; 1935 (6 mos.), asst. to engr. i/c constrn. on R.C.M.P.Bldg., Ottawa, for Ulric Boileau Ltée.; 1935 to date, with the Quebec Roads Dept. as follows: 1935, asst. to surveyor i/c Montreal District; 1936 (3 mos.), asst. to divn. engr., Mont-Joli; 1936 (5 mos.), i/c contract work, Cap St. Ignace; 1936-38, asst. to divn. Engr., Carleton; 1938-40, divn. engr., Carleton, Que.

References: J. A. Lefebvre, A. Frigon, J. O. Martineau, S. A. Baulne, O. Lefebvre.

TELMOSSE—PAUL GODFROI, of Shawinigan Falls, Que. Born at Montreal, Aug. 16th, 1899; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1923. With the Shawinigan Water & Power Company as follows: 1923-25, on LaGabelle development; 1925-26, on St. Narcisse Development; 1926-27, local office, engrg. dept., Shawinigan Falls; and 1937 to date, res. engr. at Shawinigan Falls.

References: J. B. Challies, C. R. Lindsay, H. J. Ward, R. Dorion, H. K. Wyman.

TORELL—JOHN DAVID, of 202 Braemar Ave., Norwood, Man. Born at Winnipeg, Man., April 4th, 1914; Educ.: 1928-36, Univ. of Man. Supplemental exam. to be written to qualify for B.Sc. (E.E.); 1936-37, warehouse asst., 1937-38, traffic clerk, and 1938 to date, sales and service correspondent, i/c of acceptance, adjusting and securing of orders for electrical equipment throughout province of Manitoba for the Northern Electric Co. Ltd., Winnipeg, Man.

References: E. S. Braddell, J. D. Peart, A. Sandilands, E. P. Fetherstonhaugh, N. M. Hall, H. L. Briggs, C. T. Eyford.

(CONTINUED AT BOTTOM OF NEXT PAGE)

Employment Service Bureau

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

SITUATIONS VACANT

GENERAL SUPERINTENDENT for specialty pulp and paper mill in eastern Canada; desirable living conditions. Applicants must have managerial ability, a good working knowledge of pulp and paper processing and qualities of initiative and leadership. Only experienced men need apply and preference will be given university graduates. Apply Box No. 2063-V.

ENGINEER DRAUGHTSMAN. A good opening in pulp and paper mill in Ontario for a graduate mechanical or civil engineer with some industrial experience. Work to consist of design and draughting, usual in large mill. Please write giving full details of experience and stating nationality, age, dependents, etc., to Box No. 2066-V.

ENGINEER. Excellent opportunity for young engineering graduate, preferably mechanical, with several years' industrial experience. Work involves analysis of plant operations. Offers wide scope for initiative and ingenuity. Describe briefly education, training and experience with special reference to specific accomplishments. Apply to Box No. 2070.

PRODUCTION ENGINEER thoroughly experienced in manufacture of plows, harrows, cultivators and other light agricultural implements. Must be competent to organize and lay out new factory on the most economical, modern lines. Good salary and excellent prospects for the right man. Travelling expenses paid to new position. Apply giving full particulars to Box No. 2078-V.

EMPLOYERS!

The Institute's Employment Service has on file the records of many young men graduating this spring in all the branches of engineering. Most of these graduates have had some early engineering experience during their vacations.

In recent weeks the demand for engineers has risen to a point where a scarcity has developed; therefore, we strongly recommend that employers arrange now for any extra help that they may require permanently or for the summer.

SITUATIONS WANTED

INDUSTRIAL EXECUTIVE, technically trained, 16 years experience in engineering, purchasing, production, manufacturing, technical sales, merchandise, general administration, and industrial relations. Box No. 185-W.

CIVIL ENGINEER, age 52, married, open for engagement. Experience includes 3 years at railway construction, 12 years at highway reconstruction work and asphalt paving, 8 years at municipal work. Will go anywhere required. Apply Box No. 216-W.

MECHANICAL ENGINEER, JR.E.I.C., Technical graduate, married, two children. Thirteen years experience design of steam boiler plants, heating, ventilating, air conditioning, piping layouts, estimates, specifications, also sales and general engineering. Available on short notice. Box No. 850-W.

MECHANICAL ENGINEER, B.SC., A.M.E.I.C., age 32, married. Ten years experience field erection; and in the preparation of plans, specifications, and estimates on various structural and mechanical projects pertaining to manufacturing plants. Desires change to position of responsibility in assisting a plant manager in problems of plant extension, new construction or maintenance. Apply Box No. 1054-W.

CIVIL ENGINEER, B.SC., E.C. (U.N.B. '32) A.M.E.I.C. P.E. of N.B. Age 34. Married. Experience, general construction, mining, surveying, reinforced concrete, railroad, water and sewerage layouts. Apply to Box No. 1562-W.

CHEMICAL ENGINEER, Toronto '31; nine years experience in paper and board industry as assistant chief chemist; successfully worked on pitch elimination, waste reduction and steam saving. Anxious to join up with progressive company. Bilingual. Apply Box No. 1768-W.

CIVIL ENGINEER, B.SC. '25; A.M.E.I.C. Fifteen years extensive general experience now desires permanent industrial or municipal connection. Experience includes surveying and mapping; highway construction; construction, operation and maintenance of wharves, dredged channels, water supply and sewerage systems, miscellaneous plant buildings reinforced concrete structures. Executive background with experience at purchasing and office management. Available at short notice. Box No. 1919-W.

ELECTRICAL ENGINEER, B.SC. (Queen's Univ., 1938). JR.E.I.C. Canadian, age 27, single. Experience includes 3 mos. testing transmitters and associated equipment with Canadian Marconi Co.; 4 mos. draughting, designing and redesigning, with the Northern Petroleum Corp.; 4 mos. assembly, testing and research on electric fence controllers with The W. C. Wood Electric Co.; on spare time radio servicing and generator rewinding. Wishes to take an apprenticeship course with radio engineering firm or power transmission company. Good references are available, will consider any location. Available on about one week's notice. Apply to Box No. 1969-W.

PHYSICAL METALLURGIST, M.S., JR.E.I.C., A.S.M. Age 24, single, presently employed. Wide experience with large steel company in all types of metallographic testing, investigation of complaints, commercial heat treatment. Familiar with steel mill operation and production of automotive, alloy forging, rail and structural steels. Box No. 2080-W

MECHANICAL ENGINEER, B.Eng. Mech., N.S.T.C. '35, A.M.E.I.C. 8 mos. hwys. constr. One year surveying and mapping, one year lecturing in mathematics, 18 mos. engr. in charge of surveys and constr. Writing and speaking ability. Particularly interested in specializing. Single and at present employed. 2083-W.

ELECTRICAL ENGINEER, B.E. (N.S.T.C. '36), S.E.I.C. Age 25. Married, no children. One year's experience electrical installation, operation and maintenance of power house, motors, generators, alternators, transformers, switching gear, underground cables, airport field lighting, conduit wiring, house wiring and lighting at Newfoundland Airport. One and a half year's experience in manufacturing plant in responsible position including about six months in official capacity. References. Location immaterial. Available on about two weeks notice. Box No.2085-W.

COST ENGINEER, B.A.SC. Age 29. General experience covers drafting, surveying, estimating and accounting. Special training in costing and management with successful experience in this work for the last two years. Wishes to contact construction or manufacturing company having good opportunities for a technically trained cost man. Apply Box No. 2087-W.

AERONAUTICAL ENGINEER, B.A.SC., A.M.E.I.C. Age 37, married. Experienced in all phases of aircraft design and production. Desires position of responsibility where training can be used to better advantage. Apply Box 2126-W.

ENGINEERING STUDENT, S.E.I.C., graduating in civil engineering this spring; age 23; single; Canadian; eighteen months with large structural firm, draughting and detailing; interested in all phases of civil engineering; does not believe a graduate is entitled to a sinecure; location immaterial; good references. Apply Box No. 2133-W.

ENGINEER, B.SC. (E.E.), Manitoba '35. Married. Seven months mining engineering. Three years with large agricultural implement firm in all production departments, and employed by them now. Familiar with iron and steel specifications and production methods, machine design and estimating. Available with month's notice. Apply Box No. 2155-W.

INDUSTRIAL ENGINEER, M.E.I.C., P.E. Quebec and Ontario, desires permanent industrial connection. Years of extensive experience in engineering and construction of pulp and paper mills, also hydro-electric power plants; experience includes all operations in the production and manufacture of pulp and paper, maintenance and purchasing, in some of the largest mills in Canada. Apply to Box No. 2162-W.

PRELIMINARY NOTICE

(CONTINUED FROM PAGE 250)

UPTON—FRANKLIN HOWARD, of 194 Spruce St., Sudbury, Ont. Born at Southampton, England, June 11th, 1911; Educ.: Junior Cambridge Matric.; Corres. courses; 1928-34, ap'ticeship, C.N.R. shops at Stratford, Ont.; 1935-40, boilermaker, repairing mine and smelter equipment, International Nickel Company, Sudbury, Ont.

References: W. J. Ripley, J. F. Robertson, R. L. Peek, L. O. Cooper, C. O. Maddock.

FOR TRANSFER FROM THE CLASS OF STUDENT

HUNT—WILLIAM SINCLAIR, of Montreal, Que. Born at Summerside, P.E.I., Dec. 8th, 1912; Educ.: B.Eng. (Chem.), McGill Univ., 1936; 1935 (summer), asst. to chemist, Champlain Oil Company, Montreal. With the Dominion Rubber Company, Montreal, as follows: 1936-37, planning and time study dept., 1938-39, supervising material and overhead control dept., 1939-40, i/c of cost accounting, and Feb. 1940 to date, i/c of standard cost and cost estimating. (St. 1936)

References: T. M. Moran, R. Ford, J. B. Phillips, J. A. Shaw, C. M. Benett.

LUPTON—MAC JOSEPH, of 308 Niagara St., Winnipeg, Man. Born at Upper Norwood, Croyden, England, Jan. 25th, 1911; Educ.: B.Sc. (C.E.), Univ. of Man., 1934. M. Eng., McGill Univ., 1936; 1929-30 (summers), on survey parties, C.P.R.; With Dept. of Northern Development Ontario, as follows; 1931-32 & summer 1933, dftsman. & instr'man. on highway surveys, 1934-35, asst. to divnl. engr., on highway surveys, constrn. & mtce.; 1936-37, surveyor on geophysical exploration party in Nfld., Hans Lundberg Ltd., Montreal; 1937 to date, structural designer and estimator, Dominion Bridge Co. Ltd. as follows: 1937-38, Lachine office, 1938 (Jan.-Aug.), on loan to International Nickel Co., Copper Cliff, 1938-39, Lachine office, and Feb. 1939 to date, Winnipeg office.; (St. 1934).

References: F. Newell, R. S. Eadie, R. E. Jameison, D. B. Armstrong, R. M. Robertson, H. M. White, A. E. Macdonald, G. H. Herriot.

NELSON—WILLIAM ANDREW, of Montreal, Que. Born at Campbellford, Ont., July 18th, 1912; Educ.: B.Sc., Queen's Univ., 1937; 1936-37 (summers), with Falconbridge Nickel Mines, Ltd., and H.E.P.C. of Ontario; 1937-38, mech. dept., Queen's Univ., Kingston; 1938-39, cadet course at Cleveland, Ohio, and June 1939 to date, sales service engr., Montreal Office, Bailey Meter Co. Ltd., Montreal. (St. 1938)

References: L. M. Arkley, H. G. Conn, L. T. Rutledge, H. J. Muir, J. D. Young

Industrial News

Industrial development — new products — changes in personnel — special events — trade literature

GUIDE FOR WELDING THIRTY DIFFERENT METALS AND ALLOYS

A valuable guide to welding commonly used metals and alloys has recently been printed in chart form by Dominion Oxygen Company, Limited. Recommended welding method, flame adjustment, welding rod and flux for each of the 30 different metals and alloys can be determined at a glance by referring to this handy outline. Copies of this chart, Form 4464, can be obtained without cost by writing the nearest office of Dominion Oxygen Company, Limited, Toronto, Montreal and Winnipeg.

ORGANIZATION CHANGE IN MONTREAL TRAMWAYS

Retirement of A. S. Byrd, superintendent of power department, Montreal Tramways Company, after forty-four years of service, has been announced by D. E. Blair, general manager.

Effective April 1st, Mr. Byrd was succeeded by William M. Bolan, formerly assistant superintendent of power department, who is in turn succeeded by W. R. Simmons.

Born in North Cambridge, Mass., December 17th, 1870, Mr. Byrd was educated in Portland, Me., and Sherbrooke, Que. In April, 1892, he joined the Toronto Railway Company as electrician and continued this employment for four years. On February 23rd, 1896, at the request of the Montreal Street Railway Company, he was transferred to Montreal as assistant to H. R. Lockhart, electrical engineer, and upon the latter's death on January 1st, 1907, was named superintendent of power plants. This title was changed on January 6th, 1927, to that of superintendent of power department.

Mr. Bolan was born in Montreal, September 9th, 1892, attended St. Patrick's School and McGill University and joined the Montreal Tramways Company on October 6th, 1913, as an engineer on its underground distribution system. He was promoted to the post of assistant superintendent of power department on January 1st, 1927.

TURBINE MECHANICAL ELECTRIC RANGE DRIVE

Turbines have long been used for mechanical drives and to drive electric generators. On printing and soaper range drives now applied in the textile industry, Canadian General Electric Co. Limited combines these two functions. The turbine is coupled to the lead or pacemaking unit of the range and to an a-c generator. All the other units are motor driven in practical synchronism with the lead because the a-c frequency varies directly with the turbine speed.

In one application there are eight units in a soaper range, the dry cans are turbine driven and the other seven units are induction motor driven on three floors quite inaccessible for mechanical drive. With the turbine exhaust system heating the dryers, the speed is adjusted to the drying characteristics of the goods in process.

The induction motor speeds vary somewhat with loads because of normal "slip," a feature which prevents "hogging" the load by any motor and equalizes any pull that may be applied to the fabric.

The control is simple and affords ready means for jogging and for wide range of speed control. In one mill having both printing and soaper ranges driven by this method, the soaper range has been successfully operated at more than 175 yards per minute.

This dual output system offers outstanding advantages to mills having steam available, together with a process requirement for low-pressure steam.

PLYWOOD BOARD FOR OUTDOOR CONSTRUCTION

A 6-page illustrated folder, issued by British Columbia Plywoods Limited, Vancouver, B.C., illustrates and describes the company's new Sylvaply weather-board intended for outdoor purposes.

The company describes this board as resin-bonded, weather-proof plywood and the folder contains information as to grades, sizes and thickness available.

CARE OF PORTABLE ELECTRIC TOOLS

The Black & Decker Manufacturing Company, Towson, Maryland, recently published a twelve page booklet—"The Proper Care and Maintenance of Portable Electric Tools" —which gives helpful hints, not only on care and maintenance, but also methods of properly grounding to protect the operator, currents, proper sizes of extension cable and pointers on what to look for when a tool fails to operate.

TURBINE PUMPS

Bulletin 260-B11D has just been issued by the Turbine Pump Division of the Roots-Connersville Blower Corp., Connersville, Ind., covering industrial applications of these pumps which are offered in three types of construction; bronze-fitted, all-iron, and all-bronze; and are designed for handling liquids at temperatures up to 210 Fahr. Capacities range up to 185 GPM, at heads up to 600 ft., without multi-staging.

WAR PRODUCTION

The register of scientific and technical personnel is available to industrial firms engaged in the manufacture of war materials who may require the services of scientists, engineers, specialists or skilled tradesmen. Lists of names and qualifications for any specified line of work will be furnished on request to the Director, Technical Section, Voluntary Service Registration Bureau, Ottawa, Ont.

Dr. H. M. Tory,
Director.

Major G. H. McCallum,
Asst. Director.

DISCONNECTING SWITCHES AND BUS SUPPORTS

English Electric Company of Canada Limited, St. Catharines, Ontario, have issued a 12-page bulletin, No. 4,000, describing their various types of disconnecting switches and bus supports. This equipment is well illustrated with photographs and dimensional diagrams and in addition the bulletin contains tables of ratings, catalogue numbers, and dimensions.

LABOR SAVING INSTALLATIONS

Stephens-Adamson Mfg. Co. of Canada Ltd. have issued volume 185 of what they term their "Labor Saver" magazine, which contains a series of articles illustrating and describing various installations where labor materials handling equipment have been employed. The publication has 18 pages devoted to this information.

ALL-WHEEL-DRIVE VEHICLES

An 8-page broadside published by Marmon-Herrington Co., Inc., Indianapolis, Indiana, is devoted to the description of the Marmon-Herrington All-Wheel-Drive vehicles, and illustrates a number of uses where heavy-duty equipment is essential and where these vehicles have been successfully used. The Company builds 33 models of "Heavy-Duty" All-Wheel-Drive vehicles with gross load capacities up to 70,000 lbs.

THE STORY OF ASBESTOS

Known from ancient times as the "magic mineral," but possibly the least written about of all Canada's rich natural resources, asbestos now has an attractive and informative booklet all its own. Just published by Canadian Johns-Manville Company, operators of the largest asbestos mine in the world at Asbestos, Que., the new booklet, which is attractively designed and illustrated, is being widely distributed to the Canadian public.

Of interest to Canadians generally, this story of Canadian pioneering and industrial achievement is interwoven with many romantic episodes of centuries past, when asbestos was regarded as having a magic power because it could withstand the ravages of fire. It is a story that shows how Canada came to achieve the distinction of being the richest of all countries in Asbestos, producing nearly 70 per cent of the world's supply.

Keeping pace with the actual mining and processing operations, research workers have steadily pressed on to discover new and more amazing uses for asbestos which is to-day utilized in the building of homes; for brake linings; firemen's suits; industrial insulations; water, flue and sewer pipes and many other purposes.

These and a wealth of other interesting facts are chronicled in this interesting booklet, which also shows how the progressive town of Asbestos came into being in Quebec as a result of the discovery of this rare mineral in that province.

The section of the book which takes the reader "inside" Canadian Johns-Manville at the town of Asbestos graphically records how a great institution has been built by adherence to policies which have placed employer-employee relations on a basis of mutual benefit, confidence and goodwill.

Complimentary copies of "The Story of Asbestos" may be obtained from Canadian Johns-Manville Co., Ltd., Toronto 6, Ontario.

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 23 JUNE 1940 NUMBER 6

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

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PUBLISHED MONTHLY BY

THE ENGINEERING INSTITUTE OF CANADA

2050 MANSFIELD STREET - MONTREAL

Price 50 cents a copy, $3.00 a year, in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

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HYDRO-ELECTRIC CONSTRUCTION IN BOLIVIA

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Paper presented before the Montreal Branch of The Engineering Institute of Canada on January 25th, 1940

Physical Features

Bolivia comprises a large inland area in South America lying approximately between latitudes 10 and 23 deg. south. The country falls naturally into two main divisions, the high plateau land of the Andes and the low-lying tropical section on the eastern slope. The Andes pass through the country in two massive chains approximately parallel to the Pacific coast line. The western chain runs along the Chilean-Bolivian boundary line, the rise from sea level to the snow-capped peaks being very rapid. The eastern chain lies some 80 to 90 miles distant from the western one. It is a high range carrying many glaciers and snow fields, and it is the source of many streams flowing down to the Amazon. Between these two mountain chains lies the Bolivian plateau known as the Altiplano. Its average elevation is about 12,000 ft., and it has an area in Bolivia of about 6,500 sq. mi. This plateau is a rolling barren-looking tableland. Its scanty growth of bunch grass suffices to sustain the native llama, alpaca and vicuña, and the resinous tola bush provides a meagre fuel supply for the human inhabitants. It is completely treeless. At the northwestern edge of Bolivia, lake Titicaca lies in the plateau region at an elevation of about 12,500 ft.

Beyond the eastern mountain chain the country drops rapidly to the tropical levels of the Amazon and Parana drainage basins. So rapid is the descent that in a couple of days one can walk from perpetual glaciers down the valleys through progressively milder climates into regions of dense and all but impenetrable vegetation. This section of the country is hilly and precipitous and travel is difficult.

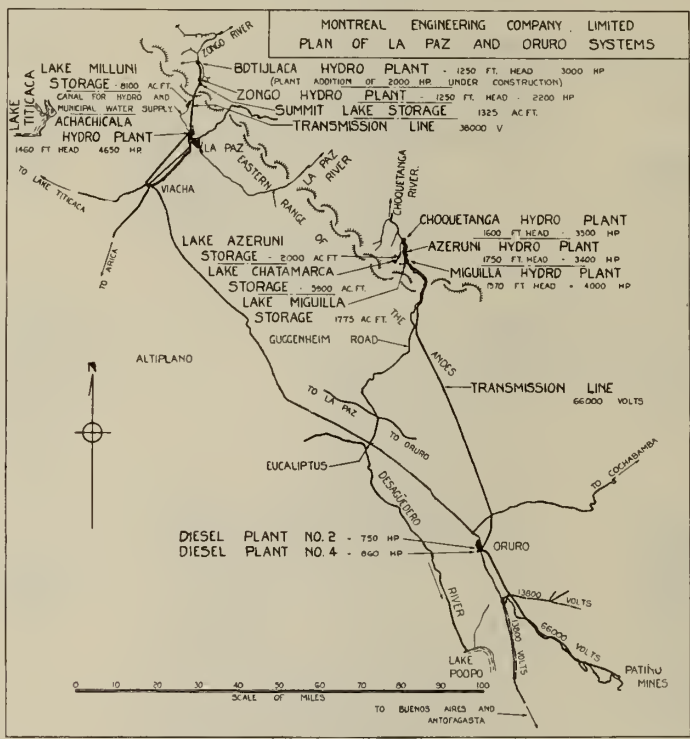

Fig. 1—Bolivian Power Company Systems.

Development of Bolivia

Most of the development of Bolivia to date has been confined to the Altiplano and the more accessible valleys of the eastern range. The railroads, roads and principal cities are to be found in these areas. La Paz, with a population approaching 200,000, is the seat of government and the largest city of the republic. It lies in a deep valley in the northern part of the Altiplano. Curiously enough, the waters of this valley originate on the western side of the eastern range, and after cutting an immense gouge out of the gravelly clay deposits of the Altiplano, they double back and pass through a gap in the mountains and so reach the Amazon basin. Oruro, the principal mining and railway centre, lies on the Altiplano to the south. It has a population of about 40,000. The Altiplano is given to haphazard agriculture. Barley and potatoes are grown, and sheep, cattle, llamas, alpacas and donkeys are raised. In some of the fertile valleys in the eastern range, such as at Cochabamba, almost all the familiar fruits and vegetables of the temperate zone are to be found. Roads are being constructed into the sub-tropical region to the northeast of La Paz, and a certain amount of development is taking place. Also, an indifferent road system has been extended to Santa Cruz in the east to bring out the tropical products of that region. Agriculture in general is in a backward condition in Bolivia, and even though it gives occupation to the majority of the population there is not enough resultant production of such things as grain, fruit, meats and dairy products to supply the needs of the country, and recourse must be had to imports. The reason for this state of affairs is that agriculture has long been over-shadowed by mining as the centre of national interest.

The mining industry has been predominant since the discovery of the famous silver mines of Potosi in 1545. Silver mining has since been replaced to a large extent by tin mining, and to-day Bolivia produces about thirty per cent. of the world's tin. The tin mines are found chiefly in the mountainous region to the south of Oruro.

Population

The country is thinly populated, the total population being estimated at slightly over three millions. About fifteen per cent of the population is of Spanish stock; about 31 per cent is of mixed blood, and the remaining 54 per cent is composed of the indigenous Indian races. The white population of Spanish ancestry naturally forms the leading class of citizens owning most of the land and occupying a predominant place in commerce and politics. The people of mixed blood are known as the Cholos. They are the artisans and tradesmen of Bolivia. The Indians are the common labourers and the tillers of the soil. Many of them live on the large farms in a state of feudal servitude. They still cling to their native language, and few of them can speak Spanish. It is interesting to note that about 80 per cent of the population lives at an altitude of over 10,000 ft. above sea level.

Access to Bolivia

Access to Bolivia is obtained by four different railroad routes. A railroad extends from the port of Mollendo, in Peru, to lake Titicaca. At the lake passengers and freight are transferred to boats and make the journey to the Bolivian side, and from there they are carried by rail to La Paz. Two railroad routes run up from the Chilean coast. One runs from the northern port of Arica directly to La Paz. The other runs from the more southern port of Antofagasta to Oruro and then on to La Paz. These three are the principal routes of the country's import and export trade. The fourth route is from Buenos Aires, on the east coast, by rail to Uyuni, which lies to the south of Oruro on the Antofagasta-La Paz line.

Systems of the Bolivian Power Company, Limited

The types of construction described in this paper are those used by the Bolivian Power Company on recent developments. The company owns and operates two distinct power systems in Bolivia, the La Paz system and the Oruro system. The La Paz system serves the city of La Paz and the railroad town of Viacha, while the Oruro system is principally concerned with supplying the needs of the mining industry of that district. Both systems are

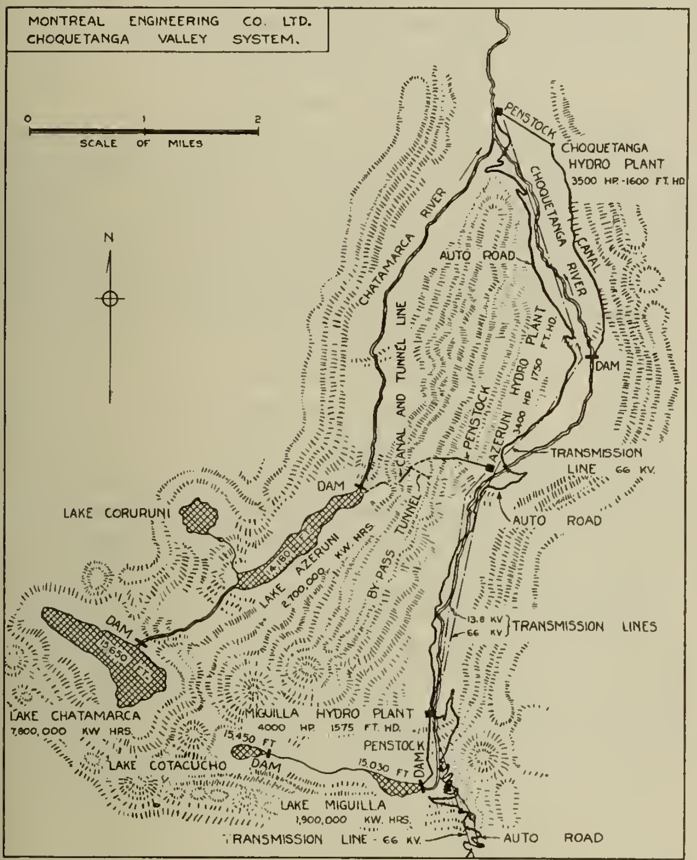

Fig. 2—Choquetanga-Chatamarca System of Hydro-Electric Plants.

dependent on high head hydro-electric developments on the streams of the eastern mountain range. This snow-capped range, with its glaciers, distributes the precipitation of the rainy season over the year and gives rise to a number of streams of the order of 10 c. f. s., which flow down into the Amazon system. These streams usually drop precipitously from their sources in the mountains and then flow in a northerly direction on about an 8 per cent grade with increasing volume. Fig. 1 shows the arrangement of plants of the two systems.

It will be noted that whilst the load centres are located on the plateau region, the sources of hydro-electric power lie on the eastern slope and the electrical energy must be transmitted over the mountains at high elevation. The highest point on the line to La Paz is about 15,300 ft. above sea level, and on the line to Oruro the highest point is about 16,000 ft. above sea level. This high altitude restricts the line voltages to a comparatively low figure if an economical type of line construction is to be maintained. In the case of the La Paz system this restriction is not particularly inconvenient, since the transmission distance from the city of La Paz to the most distant plant at Botijlaca is 20 miles. At present a transmission voltage of 38,000 is used on this system. In the case of the Oruro system, however, the distances involved are much greater, the transmission distance from the Choquetanga plant at one end of the system to Patino Mines at the other end being 136 miles. A transmission voltage of 66,000 is used. The transmission of power in small blocks over a line of this length at comparatively low voltage is abnormal in hydro-electric practice. In normal circumstances the cost would be considered prohibitive. It is only justified in this case by the fact that any competitive source of power is also very expensive. There is no coal in the country, and water is scarce, since the rivers are extremely small, so the most obvious alternative is the diesel engine. Diesel operation in Bolivia is costly, since the price of diesel fuel, due to heavy freight charges for transport from the Pacific coast, becomes of the order of $6.00 (U.S.) per barrel. Moreover, the output and efficiency of the engine is reduced at these altitudes, the reduction in output being particularly large. In the case of the Bolivian Power Company's diesel at No. 4 plant in Oruro, the sea level rating is 1050 bhp., whilst the net rating at 13,000 ft. elevation, after installation of a supercharger, is only 750 bhp., the reduction amounting to about 29 per cent. Without the addition of the supercharger, the reduction in rating would be of the order of 43 per cent. Thus the capital outlay to provide a given capacity in diesel power is greatly enhanced.

During the past five years the company has constructed three major hydro-electric developments besides smaller storage and diversion works, and is at present engaged on a fourth project. The three major developments referred to are as follows:

(1) The Azeruni development for the Oruro system, constructed in 1935-36, with an installed capacity of 3,400 hp. and using a head of 1,750 ft.

(2) The Botijlaca development for the La Paz system, constructed in 1937-38, with an installed capacity of 3,000 hp. and using a head of 1,250 ft.

(3) The Choquetanga development for the Oruro system, constructed in 1938-39, with an initial installation of 3,500 hp. and using a head of 1,600 ft.

In this paper particular reference will be made to the Choquetanga construction as being the most recent.

Fig. 3—Lakes Cotacucho and Miguilla.

The Hydro-Electric Development of the Choquetanga and Chatamarca Valleys

The hydro plants of the Oruro system are all located in the Choquetanga valley. These plants, together with the storages in the adjacent Chatamarca valley, are shown in Fig. 2. The Choquetanga river rises at lake Cotacucho, elevation 15,450 ft. and flows down a narrow glacier-rimmed valley into lake Miguilla, elevation 15,030 ft. (See

Fig. 3.) At the outlet of lake Miguilla the discharge drops precipitously down a mountain side into the Choquetanga valley. The Miguilla plant takes advantage of this initial drop from the lake and the water is passed through a penstock to a powerhouse lying below at elevation 13,460 ft. A large storage dam was erected at lake Miguilla and a smaller one at lake Cotacucho to give complete regulation of the natural flow in a normal year.

The source of the Chatamarca river is lake Chatamarca, elevation 15,650 ft., in a valley separated by a comparatively low ridge from that of lake Cotacucho. The discharge from the lake drops over two sets of falls down to lake Azeruni at elevation 14,180 ft. From the latter lake the

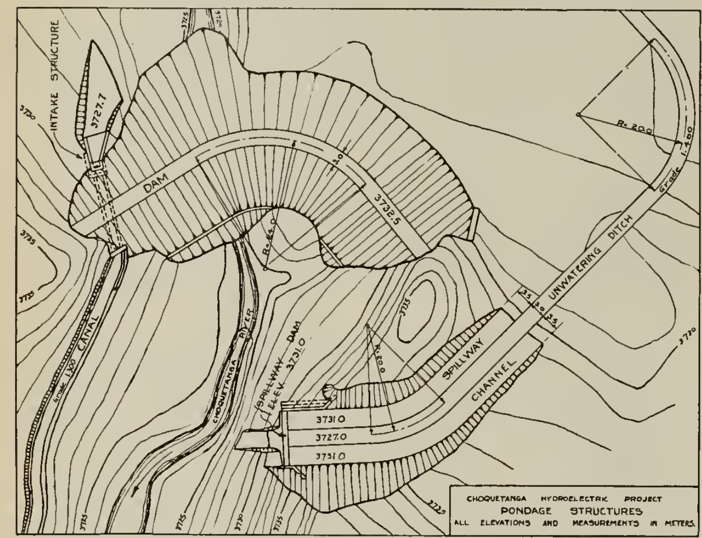

Fig. 4—Plan of the Choquetanga Pondage Structures.

water again drops precipitously before joining the Choquetanga river, some three miles downstream. At the lower end of lake Azeruni the Choquetanga and Chatamarca valleys come close together. This fact, together with the fact that lake Azeruni is considerably higher than the Choquetanga river at this point, was utilized in constructing the Azeruni development. The lake was dammed and the Chatamarca discharge was carried along the east wall of the Chatamarca valley to a long tunnel passing through the dividing rock ridge and coming out high up on the west wall of the Choquetanga valley. From the end of this last tunnel a penstock carries the water downhill to a power house on the Choquetanga river at elevation 12,400 ft. The storage dam on lake Azeruni, combined with a much larger storage development on lake Chatamarca, provides a complete regulation for the natural flow.

As a result of the Azeruni development, the water of both the Choquetanga and Chatamarca rivers is available for the Choquetanga development further downstream. The diversion dam for the Choquetanga project was constructed about a mile and a quarter below the Azeruni powerhouse at a point where a terminal moraine lying across the floor of the valley was favourable to dam construction and the formation of a regulating pondage basin. The river water was diverted into a canal at this point and carried about 2.3 miles along the east wall of the valley to a hillside forebay. A penstock takes off from the forebay and carries the water downhill to the powerhouse located at elevation 10,600 ft. on the Choquetanga river slightly below its confluence with the Chatamarca. The dependable regulated flow of the Choquetanga river at the dam site is approximately 23 c.f.s. Added to this is the dependable flow of 21 c.f.s. brought in by the Azeruni plant from the Chatamarca river, making a total dependable flow of 44 c.f.s. available for the Choquetanga plant. The gross head on the plant is 1,600 ft. and the final development calls for an installation of three impulse turbines of 3,500 hp. each. With this installation it will be possible to obtain a yearly output of 38,000,000 kw.h. from Choquetanga and a total annual output of 63,000,000 kw.h. from the three plants in the valley. In the initial Choquetanga construction just completed only one of the three 3,500 hp. units has been installed.

At the present time the flexibility of the system is being increased by drilling a bypass tunnel through the ridge above Azeruni powerhouse in order to bypass the water from lake Azeruni into the Choquetanga valley for use at the Choquetanga plant, especially during times of shutdown at the Azeruni plant. The completed tunnel will be about 360 ft. long through sedimentary rock.

Choquetanga Construction

pondage structures

Fig. 4 shows the general layout of the Choquetanga dam and its accessories. The dam is an earth-and-rock-fill with a comparatively thin core of impervious clay. It is 265 ft. long and has a maximum height of 27 ft. above the natural surface. An intake tower at the east end of the dam houses the regulating gate and connects with the canal by means of a reinforced concrete conduit running under the dam. A spillway channel 10 metres wide lies to the west of the dam.

Fig. 5 shows the various sections pertaining to these structures. All earthwork was done entirely by hand labour. Rock excavation at the spillway channel was done by hand drilling for explosives. The rock-fill and ordinary fill material for the upstream and downstream slopes of the dam was obtained chiefly from the spillway excavation. Heavy blue clay for the core was obtained from several borrow pits lying within the area to be flooded and was transported in bags and wheelbarrows to the dam by women and men. The clay was mixed in place with up to 50 per cent of pit-run gravelly material. The clay and the gravelly material were deposited in alternate thin layers, wetted and thoroughly mixed and compacted by a gang of barefooted labourers, as shown in Fig. 6.

The intake tower, the gate and the hoist are types that have now become more or less standardized for such work. The gate was fabricated locally in the company's shops using five inch timber within a rectangular framework of structural channels. This type of gate had first been used for the regulating structures at lakes Azeruni and Chatamarca and had been eminently satisfactory for such isolated sites, since it could be entirely dismantled for transport on mule back. The hoist was made in a foundry in La Paz from the same pattern that had been used for preceding jobs.

To date, the Bolivian Power Company has constructed eight dams in the Oruro and La Paz systems. Some of these are of the earth-and-rock-fill type, as at Choquetanga, and others are of the masonry gravity type. The Miguilla dam is a combined concrete and masonry structure, having been started as a concrete dam and later added to with masonry. Of these various jobs, the Choquetanga dam was among the least difficult. Foundations were reasonably good; and abundance of high-quality clay was available nearby, and transport of materials and supplies offered little difficulty, since the main road is but a few hundred feet distant. The Azeruni and Chatamarca dams, on the other hand, are examples of more difficult construction. Fig. 7 shows a section through the Azeruni dam. The Chatamarca dam is of similar type.

In these cases there was a decided scarcity of fill material, since the terrain consists of smooth, glaciated granite rock with small pockets of loose material containing gravel and some fines mixed. At Azeruni there is also a very unsatisfactory foundation condition. The lake has been formed behind a plug of rock fragments, boulders and other glacial material lodged in a narrow gorge of great depth, and the actual course of the discharge water is uncertain, being above the surface in some places and below it in others. Both these sites are in isolated localities and are accessible only to mule or llama trains over tortuous mountain trails. In order to avoid the expense of transporting such materials as cement or timber to the site, the type of dam shown in Figs. 7 and 8 was adopted. The foundation condition at the Azeruni site has given difficulty, and with the lake at full supply level, the leakage emerging from the downstream toe has been as high as 5 c.f.s. Large quantities of clay grout have been injected into the foundation under low pressure but the result has not been entirely satisfactory.

The pondage dam at Botijlaca is an earth-fill of section somewhat similar to that of the Choquetanga dam. The materials available for construction were of lower quality than those of Choquetanga, however, and the foundation consisted principally of sandy material with porous gravel strata. Leakage emerged at the downstream toe when the pond was filled, and whilst the actual amount was not very great, being of the order of one c.f.s., it soon became evident that it would have to be stopped, since it was transporting material, probably from both the body of the dam and the foundation. In this case the injecting of clay grout under a static head of about 25 ft. proved very successful and leakage was reduced to one-twentieth of a c.f.s. The grout was injected into both the foundation and the fill upstream from the core, the leakage channels being first located by injections of potassium permanganate solution.

Choquetanga Construction

canal line

The canal line running along the side hill from the dam to the forebay is 12,000 ft. long and is designed to carry 72 c.f.s. for the final development of 10,500 hp. About a third of the length of the canal has been excavated out of the sedimentary rock outcropping along the side of the valley. The remaining two-thirds lies along a grass-covered slope of earth and loose rock standing at about 35 deg. Much of the material is of glacial origin in the form of lateral moraines along the sides of the valley, and some of it is talus material that has collected from the rock summits above. The canal in earth has been built to final capacity of 72 c.f.s., whereas the canal in rock has been left with the outer wall low and providing sufficient capacity only for the initial installation of one 3,500 hp. unit. When the installation is added to, it will be necessary to raise this outer wall of the canal in rock. A good deal of the canal in earth was lined with dry masonry having side walls 30 cm. thick. This type of masonry requires a good grade of cut stone, preferably granite or quartzite, and in order to obtain such stone, it was necessary to utilize the boulders from the excavation. Accordingly it was necessary to build the entire walls at the present time or else attempt to store boulders and stone somewhere on the steep hillside for future use.

At Choquetanga it was found that although the surface material on the hillside appeared to be tight, the underlying material was extremely porous, and in order to be able to use the dry masonry lining, it was necessary to first blind the voids before laying the masonry. Where the voids were too big for this treatment, it was necessary to use the more expensive mortar masonry lining.

Before placing the canal in service, considerable time was spent in making it watertight. In the first place, all large cracks in the rock section were plastered; then water was admitted and clay was puddled in along the entire length of the canal.

The construction of the Choquetanga canal had an advantage over that of other canals built by the company in that the entire canal line was readily accessible and the contractor was able to attack the excavation along as great a length as his labour supply would permit. Some sections of the Azeruni canal could only be attacked after a small drilling crew had worked its way around cliffs cutting out a narrow trail and anchoring a hand cable to the rock. On still another job, where speed had been most urgent, the canal was opened up around an obstructing cliff by suspending drillers by means of ropes from above.

Owing to the fact that much loose ground was encountered along the Choquetanga canal line, it became necessary to build long stretches of masonry retaining walls to hold back the cut bank. Even with this precaution, it is likely that a certain amount of difficulty from slides will be

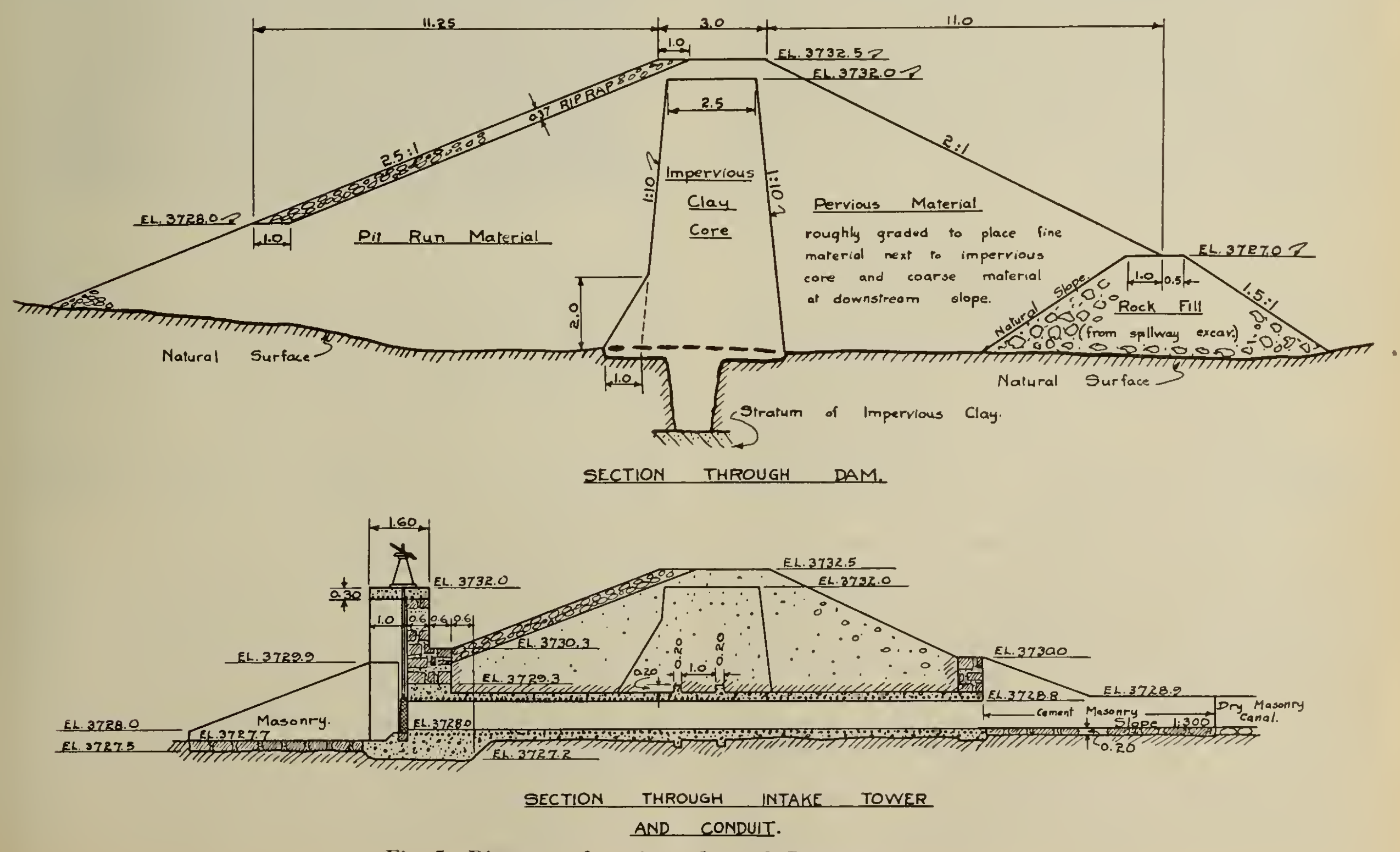

Fig. 5—Diagram of sections through Dam and Conduit.

Fig. 6—Building Choquetanga Dam.

experienced until the cut bank reaches stability. This difficulty is particularly likely to be experienced during the first rainy season after completion of construction. The treatment adopted will depend upon the nature of the ground in each case. One slide has already occurred and taken out a section of canal about 12 metres long. In this case the repair was effected by building a wooden flume across the slide on trestle bents. It is planned to keep a number of lengths of galvanized steel flume on hand to deal with similar contingencies that may arise in the future. In places where loose material tends to roll down into the canal, it is planned to put a covering of dry masonry supported on reinforced concrete beams across the canal.

It will be appreciated that, owing to the steepness of the mountain sides, it is not possible to leave the inner wall of a canal cut standing at a slope of assured stability, such as would be done under normal circumstances. To use a side slope of 1:1 or 1½:1 would mean the removal of an immense amount of material from the mountain side, if not the top of the mountain, itself. Accordingly, it has been the company's practice to leave the cut bank standing as steep as the material will hold at the time of excavation up to a maximum slope of 1:3 and to construct low retaining walls along the inside wall of the canal where needed, as shown in Fig. 9. This means that the operation staff must be prepared to undertake considerable maintenance work and to effect emergency repairs, such as that described above, until such time as the ground conditions along the canal line become stable.

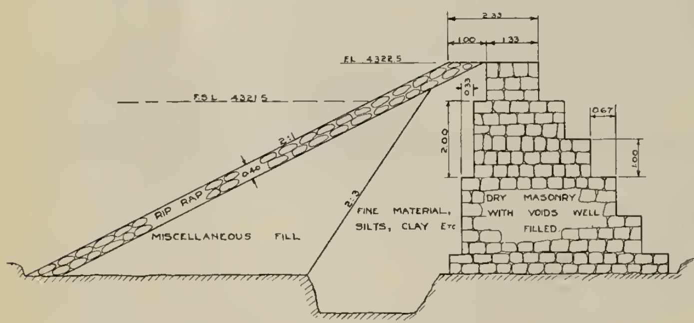

Fig. 7—Diagram of section through Azeruni Dam.

The Choquetanga canal line is one of the first major water courses built by the company that has not required the introduction of tunnels. The water course of the Azeruni development, for example, was almost equally divided in length between canals and tunnels. The introduction of short tunnels in a canal line presents little difficulty, but long tunnels are generally undesirable on account of the length of time necessary for driving. On the various developments constructed by the company to date, all excavation, including tunnel driving, has been performed by hand labour, since the cost and difficulty of transporting heavy air equipment to the site is usually prohibitive. In the case of the longer tunnels at Azeruni it required every effort to break through on schedule with hand driving. The best hammermen—men who could drill 70 in. or more per shift—were concentrated on these headings, bonuses for driving were given, continual care was taken to place holes most effectively, and an excess of dynamite was used to make sure of drawing good cuts. With these expedients it was found that with minimum size tunnel section, the headings could be advanced through granite or quartzite at an average rate of half a metre per day. This speed maintained constantly was sufficient to drive the tunnels on time.

The forebay at the downstream end of the Choquetanga canal has been constructed as a penstock intake only and has no reserve capacity. A platform was excavated out of the solid rock and was blocked off with a gravity wall of masonry to form the intake tank. A spillway and sand trap have been provided as accessories. It is planned to greatly increase the capacity of this forebay by continuing the excavation into the hillside when the turbine installation in the powerhouse is increased. However, at present there is more water available than one machine can use, so that continual spilling at the forebay is permitted and no reserve capacity is required.

Choquetanga Construction

penstock

In the initial construction that has just been completed, one penstock line has been installed and provision has been left for the addition of a second one when the final turbine installation is made. The penstock is lapwelded pipe of constant outside diameter of 21 inches. It varies in thickness from ¼ in. at the upper end to 13/16 in. at the lower end, the basis of design being a maximum allowable stress of 12,500 lb. per sq. in. on 110 per cent of the static head. The total length of penstock from the forebay to the powerhouse is 3,468 feet. Over this length there are 13 bends, each held in place by a reinforced concrete anchor block. The standard pipe length used on the job was 8 metres. This is about the maximum length for convenient transport. The pipes were divided into two classes according to the type of joint used. All the pipes of ¼ in. thickness were plain end pipes connected by means of a steel sleeve with two loose packing flanges and known as the Johnson coupling. (See Fig. 10). All other pipes had loose flanged joints of the Van Stone type. Pipes with Johnson couplings required two masonry piers per pipe, whilst pipes with Van Stone joints require but one. Smaller anchor blocks can be used with Johnson couplings, since each pipe is firmly anchored to one of its two piers and expansion and contraction are accommodated at every joint. With pipes using the Van Stone joint, an expansion joint of the bell and spigot type is located immediately below each anchor and the pipes from this joint downhill to the next anchor are held rigidly together. The pipes slide over the lubricated pier saddles and an anchor must be able to resist the thrust produced by movement of the section of penstock lying between it and the next expansion joint uphill. Judging by the experience at Choquetanga and on preceding penstock installations, the Van Stone joint would appear to be the better suited for high head penstocks.

The masonry piers and the lower half of each anchor were constructed in advance of penstock erection. The reinforcing was left projecting from the lower part of each anchor and was later bent around the pipe before the upper part was poured. Also, convenient anchor bolts were left imbedded in the lower part. After a pipe bend had been located on an anchor base and lined up, it was firmly held in place by steel collars encircling the pipe and tightened on these anchor bolts. In the erection of straight pipe with Van Stone joints the erectors proceeded uphill pipe by pipe, leaving the penstock in alignment and supported by wood and stone wedges resting on top of the masonry pier bases.

Following the erectors came a small crew of masons pouring the concrete saddle caps between the penstock and these pier bases. This job had an element of danger in it in that the men had to be continually alert to avoid falling rock that had been loosened by the erectors working higher up. The saddle caps were poured in groups of alternative piers so that the wedging might remain on every second pier to support the penstock. One difficulty in temporarily supporting such a penstock on wedges on the pier bases until the saddle caps are poured is that a long tangent length of empty penstock will undergo considerable expansion and contraction owing to the difference of day and night temperatures. The result is that wedges tend to work out and the penstock falls out of alignment. This usually necessitated a checking of line and grade immediately preceding a saddle pour.

Choquetanga Power House

The powerhouse for a high head development is a comparatively simple matter compared with that of a low head plant, since the quantity of water to be handled is small and no draft tube or elaborate substructure is required. The powerhouses built in Bolivia have been simple masonry structures on concrete footings with separate concrete foundations provided for the machines.

The Choquetanga turbine is of the impulse type with horizontal shaft and two jets, and manufactured in Kristinehamn, Sweden. It is rated at 3,500 hp, and 1,000 rpm., when operating under a net head of 1,540 feet. The generator was manufactured by the Oerlikon Company in Switzerland and is rated at 2,750 kva., 6,600 volts and 50 cycles. It is equipped with main and pilot exciters.

Fig. 8—The Azeruni Dam.

Transportation

Transportation for a construction job in Bolivia is frequently both costly and troublesome, due to the mountainous nature of the country and its lack of development. The construction of the various plants in the Choquetanga valley had been favoured in this respect in that a good all-weather road some eighty miles in length had been constructed some years previously by the Guggenheim mining interests from the railway station at Eucaliptus to the Caracoles mine located near lake Miguilla. The road leaves Eucaliptus and proceeds for many miles with easy grades over the rolling plains of the Altiplano until the steeper slopes of the eastern Andes are reached. To pass over the dividing ridge and drop down to Miguilla the road winds its way up to the top by a series of hairpin bends. This made it necessary to keep weights of separate pieces of generating equipment as low as possible. During the Azeruni construction it had been hoped to haul all heavy equipment by mule team, but when a long line of mules is used it becomes necessary to use block and tackle to take the load around the sharp bends and the time element made it necessary to turn to trucks. This, in turn, was somewhat of a problem, as it was difficult to find a truck of sufficient power at that high altitude to carry the stator of the generator over the pass leading to Miguilla. Eventually a Japanese contractor offered to do the work. This enterprising man owned a five-ton truck and a two-ton truck. He reinforced the springs of his five-ton truck with helical springs from narrow gauge railway cars and then loaded on the nine-ton stator. The two-ton truck was loaded with cement to give it a grip on the road and was used in tandem with the larger truck to help over the heavier grades. In this way the equipment arrived on the job safe and sound. Later the same contractor used the same equipment to bring in the Choquetanga machinery.

Fig. 9—The Choquetanga Canal.

The size of crate that can be hauled on this road is limited by several tunnels through which the road passes.

In the case of the work at lake Azeruni, as well as that at lake Chatamarca, all material had to be transported from the road up to the site on mule back. Owing to the small size of mule available and the steepness of the grades on the trail, any load exceeding 200 lb. presented difficulties. The two hoists for the regulating gates at lake Azeruni and lake Chatamarca caused the most trouble. They were stripped of every removable gear and bearing, but it required several days of effort to get them over the mountain, and two mules died from exhaustion under such a load.

The llama, the native beast of burden of Bolivia and Peru, has proved extremely useful in transporting such material as cement, sand, gravel and fuel. These beasts require no special feeding and sustain themselves entirely by grazing. They are capable of carrying a load of 100 lb. over good trails and somewhat smaller loads over rough mountain trails.

Fig. 11 shows llamas being loaded with washed sand near the Choquetanga dam for transport to the masonry work on the cánal line. Over 500 llamas were used on the Choquetanga construction, and the concentration of so many animals at one place in the valley resulted in attracting the wildcats from their usual haunts lower down in the wooded regions. After suffering a number of losses, the contractor found it necessary to employ watchmen to protect the grazing flocks at night. The favourite method employed by these watchmen for scaring away the cats was to set off intermittent dynamite charges at various parts of the valley all during the night. Apparently it was successful, since the losses ceased.

On the Azeruni construction the sand for masonry work along the two kilometers of canal and tunnel line had been obtained from the granite muck pulverized by the blasting in driving the first tunnel at the lake. This sand was transported along the canals and through the tunnels principally by llamas and donkeys, although Indian women were also hired for the purpose. In this case the only difficulty experienced was in training the long-necked llamas to keep their heads down when going through the tunnels.

Construction Materials and Supplies

Most construction materials can be obtained readily in the country. Such imported materials as reinforcing steel, lumber, piping and general hardware are available in the more common sizes and shapes at either Oruro or La Paz. Dynamite can be obtained locally or imported directly from the manufacturing plant in Chile. Cement is manufactured locally at a mill near La Paz and is available on short notice. Steel fabrication, machine work and foundry work, such as gate hoists, gates, railings, tunnel ventilating fans, and other equipment, can be obtained from a machine shop and foundry in La Paz. Penstock, generating and electrical equipment, and large orders for structural steel must be imported directly from the manufacturers in Europe or North America.

Fig. 10—The Choquetanga Penstock-Johnson Joint.

Whilst the procuring of construction materials has presented few difficulties, the same cannot be said for local supplies for the camp, such as food, fuel and mule feed. This was particularly difficult during the Chaco war and the period immediately following it. At the best of times the production of Bolivian agriculture is not sufficient to meet the needs of the country and foodstuffs must be imported. During the Azeruni construction, which followed directly after the Chaco war in 1935, imports were scarce and it was a difficult job to provide simple necessities for several hundred people suddenly concentrated in an out-of-the-way construction camp. The job had been in progress for a number of months before an adequate supply of beef was obtained by bringing in cattle from the distant Cochabamba valley. A regular supply of potatoes never was obtained, and to the end of the job there were weeks of scarcity and weeks of plenty. Fortunately, the supply of processed staples, such as dried mutton, dried potatoes, bread, sugar and coca leaves, was fairly reliable.

The problem of feeding the mules on the Azeruni and Chatamarca jobs was particularly acute, and from time to time the local transport was slowed down or stopped entirely for lack of feed. The feeds commonly used are barley straw and barley grain. The barley is grown on the Altiplano, and when obtainable, it would be brought over the mountains on donkey back, 100 lb. to a donkey.

The fuel supply in a Bolivian construction camp is very important during the rainy season, since the workmen will not stay unless fuel is available. Fuel is never plentiful in Bolivia, as there is no coal and the entire area from the Pacific coast to the eastern Andes does not support tree growth. Most of the Bolivian Power Company's construction has been on the eastern slope of the Andes, and it has been possible to transport wood and charcoal by llamas from the lower wooded regions. During the dry season the workmen gather their own fuel of grass, llama dung or twigs from small shrubs, but during the rainy season—particularly at the higher altitudes—it is necessary to have charcoal and kerosene for primus stoves available.

Labour

Undoubtedly the most acute problem in construction in Bolivia is that of labour. With the diversion of the country's manpower into the Chaco war a serious labour shortage was brought about and has persisted ever since. The bringing in of immigrant labour from Chile was tried by one of the mining companies and was found unsuccessful owing to the high altitude of the country and the rigorous conditions under which the Bolivian labourer works. Such labour as is available in the country for the mining and construction industries is obtained by employing professional recruiting agents to recruit labour from distant villages. To secure men, the recruiting agent usually has to advance money and also pay the travelling expenses to the work. The men so obtained come under contract to work for thirty days, although they can occasionally be persuaded by higher wages to contract for sixty days. The recruiting agent is paid so much per man for each man brought by him into camp who completes his contract. The amount paid per man varies with the classification, such as labourer, mason, driller or stonecutter. Since the natives from the villages and rural parts of Bolivia are content to eke out an existence on a small plot of ground and have little interest in money, except when a festival draws near, they see no need to work for more than thirty or, at the most, sixty days at a time. This practice gives rise to a high labour turnover and increases costs and reduces efficiency.

The labour shortage has led to the employment of women wherever possible, and it is common practice to rely on woman for such jobs as screening and washing sand and gravel, clean-up work, carrying water for concrete. During the Chaco war the Bolivian Power Company constructed a section of transmission line almost entirely with labour crews of women.

Camp accommodation for construction labour in Bolivia is a simple problem. It is customary to provide each man with three sheets of corrugated galvanized steel roofing, two or three short lengths of two by four lumber and one day's time with which to build a hut for himself. Several labourers usually get together to pool their corrugated roofing. The huts are usually about four feet high with sod or dry stone walls and the corrugated roof. Camp kitchens are not necessary, since the men bring their families with them to do the cooking or else cook for themselves.

Fig. 11—Llamas being loaded with sand at Choquetanga.

Climate

A discussion of construction in Bolivia is not complete without reference to the climate of the country. In spite of the tropical latitude, the climate of the Altiplano and the mountain regions is consistently cool, with an average temperature of 50 deg. F., owing to the high altitude. There are two main seasons of the year—the summer or rainy season lasting from about December 15 to March 15, and the dry season extending over the remainder of the year and reaching its lowest winter temperatures during June, July and August. In the winter season the country is cool, sunny and dusty, with freezing temperatures at night during the coldest months. The occasional snowstorm provides the only moisture at this season. Concrete and masonry work must be provided with some protection at night and exposed water piping is subject to freezing. During the summer or rainy season the skies are almost continually cloudy and a great deal of sleet and rain is precipitated. The dusty grey of the countryside gives way to green; lakes and rivers rise; ungravelled roads become impassable, and even the mule has difficulty in floundering over mountain trails. Owing to the abundance of water and the somewhat higher temperatures, it is preferable to do masonry and concrete work during this season. However, it is difficult to keep construction actively moving during the rainy season, since the labour shortage is felt more acutely at that time. It is the growing season of the year, and the natives prefer to stay at home and attend to their crops. Moreover, life in the hastily-erected huts of a construction camp surrounded by mud and slush, and work in the sleet and rain are anything but attractive. Sometimes it is necessary to provide canvas ponchos for the workmen, the poncho being the native form of cloak and consisting of a rectangle of material about 4 ft. by 6 ft. with a hole in the centre for the head.

On the eastern slope of the Andes there is the added inconvenience of fogs. Warm, moist air from the Amazon valley is carried up to the higher levels by the prevailing northeasterly winds, and it condenses into thick blankets of fog. This fog is present most of the time during the rainy season, and during the dry season it can be expected to appear at some time during the afternoon of almost every day. This is a continual annoyance to the field engineer, and instrument work invariably requires longer time than usual on this account. Stories are told of engineers sitting on high triangulation points for weeks trying to take a sight. The main annoyance from fog on the hydroelectric construction comes during penstock erection, the poor visibility rendering it difficult to line in the pipes to schedule. However, these difficulties are minor ones when compared with those which are encountered in a country of greater extremes of temperature, such as Canada, and on the whole the Bolivian climate may be said to be favourable. The chief influences which tend to make hydroelectric development interesting in Bolivia are the high elevation and rugged nature of the country, together with the combination of the old and the new in the customs of the people.

THE ALASKA HIGHWAY

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Some thirty years ago when we were beginning to realize that a new era in transportation had set in with the advent of the automobile, there arose the conception of a Pacific highway stretching from the southerly end of South America up the Pacific coast through Central America, United States and Canada to Alaska.

The proposed Alaska highway is only a small link in this vast highway project which is already available for use for some thousands of miles and is finally located in parts of South America, Central America, Mexico and the United States; and from the south boundary of the Yukon territory to Fairbanks, Alaska.

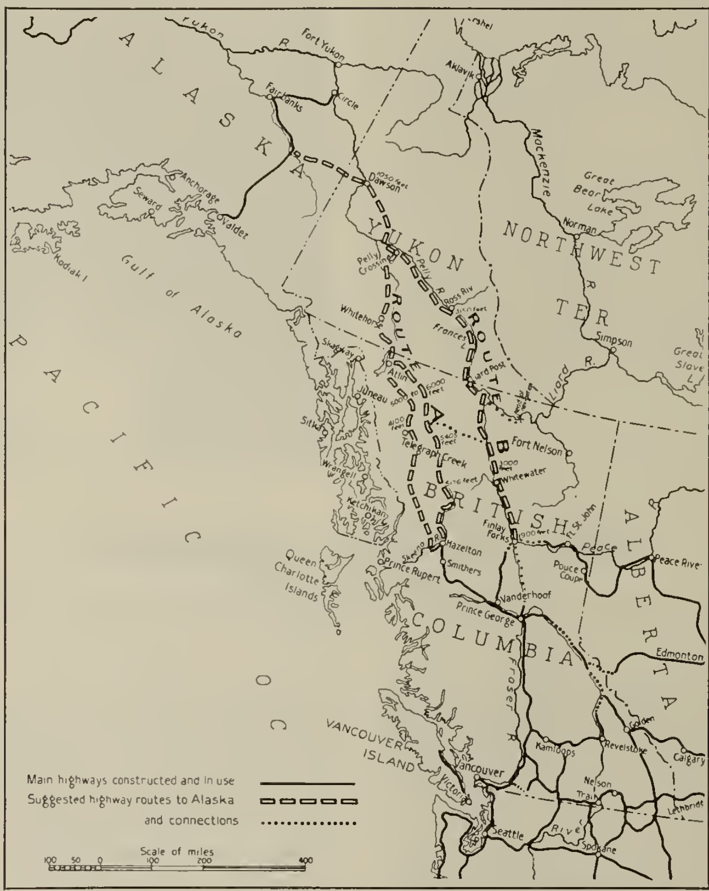
Alaska appears to be an intersecting point to a very great number of great circle routes connecting the major centres of population throughout the world with North America. It is not unreasonable to suppose that in due course a highway will finally connect the Americas with Europe via the Bering sea and it may be possible in the years to come to drive by automobile from New York to London via this route. Alaska is separated from Siberia by only some 56 miles of sea.

Alaska is the United States' greatest teriitory. The coast line along British Columbia and the American panhandle is rugged and wild. The weather is very uncertain, fogs are prevalent and the conditions of flying, generally speaking, are not desirable. A safe flying route available all the year round and of no increased length can be found inland from the coast. This aerial route would have to be served by a highway connecting with British Columbia's existing highway system and thence travelling north to the Yukon territory.

The dream of the Pacific highway gradually crystallized up until 1930 when Canada, by an agreement with the United States, appointed an International Committee to enquire into the facts of the feasibility of building a road to connect with the United States and Alaska, as to what natural resources would be tapped, as to the weather conditions likely to be met, and as to the probable cost which might be entailed. This International Committee duly met, they had certain aerial and ground reconnaissances carried out, various persons who had special knowledge of the area to be traversed were consulted, and finally the American members of the commission submitted a report to the President of the United States dated May 1st, 1933, copies of which can be obtained from the United States Government Printing Office, Superintendent of Documents, Washington.

No report was furnished by the Canadian members of the commission, probably because the country was suffering from a severe financial depression. More urgent affairs diverted attention from the construction of the road, but the idea was never lost sight of for very long. Later, upon urgent representations, Canada agreed to the appointment of a new commission and, by agreement with the United States, a United States commission was empowered to discuss with the Canadian commission the engineering, economic and financial aspects of the construction and maintenance of the projected highway. By order of the Privy Council dated 22nd December, 1938, the Hon. Charles Stewart of Ottawa was appointed as the chairman of the Canadian Commission with Brigadier General James L. Tremblay, J. M. Wardle, Arthur Dixon and J. W. Spencer as members.

As soon as was practical, the Canadian Commission held a preliminary meeting and laid down a programme of enquiry which was promptly given effect. This entailed the joint examination by the Dominion and provincial governments of all known possible routes by air and by ground reconnaissances assisted by innumerable aerial and ground photographs, the interview of many hundreds of persons comprising hunters, trappers, prospectors, mining engineers, surveyors, boards of trade and others who had an intimate knowledge of at least part of the terrain likely to be traversed. The examination of meteorological, mining, forestry reports, and natural resources reports of all kinds, enquiry into what probable tourist travel might be expected, the determination of the areas suitable for various types of agriculture, all forms of sport such as mountain climbing, hunting, fishing, ski-ing, and other forms of recreation likely to attract the tourist; the economics of construction, maintenance and the revenue likely to be derived, and generally, a detailed examination into the factors affecting a great undertaking of this nature.



Map showing Alternative Routes for the Alaska Highway.

The final report of the commission has so far not been laid before the government, and cannot be for some months yet, as revision of routes and new suggestions call for further enquiry and consideration. To date, however, it has been determined that the existing highway from Vancouver to Prince George, a distance of 525 miles, is available.

From Prince George two routes have been considered and they have been examined both from the air and on the ground, though further examination will be necessary before a final decision can be reached.

These main routes for convenience are designated as the "A" (westerly route), Prince George to Alaska boundary via Hazelton—1,442 miles, and the "B" route (easterly), Prince George to Alaska boundary—1,223 miles.

The "A" route leaves Prince George, follows the present constructed highway to Hazelton, a distance of 305 miles; thence proceeds northerly along the Skeena river, the Little Klappan and Klappan river to the Klappan-Stikine Junction, thence crossing the Stikine it proceeds via Dease lake northerly, crossing the Tuya river, down the Jennings river, crossing the south end of Teslin lake; thence westerly via Gladys and Discovery lakes to Atlin; thence northerly along the east side of Atlin lake to the B.C.-Yukon boundary, thence northerly via Tagish lake, Carcross, Whitehorse, Yukon Crossing, to the Pelley Crossing, where it connects with Route "B" and follows the same route as the said Route "B" to Dawson and the Alaska boundary.

The "B" route leaves Prince George northerly via Summit lake and Finlay Forks, along the Finlay river through the Sifton pass, along the Kechika river; thence to the Liard river; thence following the Liard to the B.C.-Yukon boundary; thence along the Liard and Frances rivers to Fort Frances on Frances lake; thence following the Pelley river to Pelley Crossing; thence to Dawson, and thence west to the Alaska boundary.

Other routes have also been suggested, and for some of these data are available from partial ground and aerial reconnaissance. One proposal submitted is to use the present Fort St. James to Manson Creek road to the crossing of the Nation river, thence along Chuchi and Tchentlo lakes, along the easterly side of Takla lake via Takla Landing, thence along the Driftwood river past Bear lake, and along the Sustut river to its junction with the Skeena river where a connection would be made with route "A" mentioned above. This alternative route goes through presently active gold mining areas.

Another suggestion has been put forward to use the Fort St. James-Manson Creek road as far as the Manson river, thence along the Manson river to Finlay Forks, where it would join route "B". This proposal has the advantage of using a considerable stretch of constructed road.

Route "B" has considerable advantage in view of the fact that the greatest elevation would be 3,100 ft. and the precipitation is light. Furthermore, it would have the advantage of opening up the Mackenzie Basin six weeks earlier than is now possible by reason of the fact that the Liard river is open for navigation six weeks earlier than the Great Slave lake, which lake is now the main artery of the water-borne commerce for the Mackenzie Basin. However, route "B" would be of no advantage to Atlin and Whitehorse.

Route "A" would traverse higher altitudes but would open up considerable timber country and would also give a direct outlet to Atlin and Whitehorse.

It would appear from the data gathered that on route "A" there is only one practicable crossing of the Stikine river, which would be at the junction of the Klappan and Stikine rivers and therefore any alternative routes to route "A" would necessarily meet at this point. From the Klappan - Stikine Crossing the only practicable route is via the Ptarmigan and Gnat Creeks to Dease lake. From Dease lake an alternative route has been suggested in a north-westerly direction to connect with the constructed highway south of Atlin, but at present sufficient data are not available for a study of this alternative.

The construction of the highway, besides giving direct access to Alaska, would open up vast areas in the Yukon and northern British Columbia known to be heavily mineralized, chiefly gold, silver, and copper, also deposits of mica and marble. These districts contain vast timber resources and considerable areas suitable for agriculture. The road would provide a life line for air transportation over these uninhabited regions. It would open up a sportsman's paradise, containing every kind of wild life found on the North American continent, together with the finest fishing. The highway would also provide unexcelled scenic attractions throughout its length.

The final location to be adopted for the construction of the highway to Alaska will no doubt depend upon the reports submitted by the two commissions and further consultation and deliberation between them.

THE BASIC OPEN HEARTH PROCESS
AT THE PLANT OF THE ALGOMA STEEL CORPORATION

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Paper presented before the Sault Ste-Marie Branch of The Engineering Institute of Canada, on February 24th, 1939

In the Algoma Steel Corporation are two open hearth shops known as Nos. 1 and 2. In the No. 1 shop are eight furnaces having a capacity of seventy-five tons (gross) each; in the No. 2 shop are four having a capacity of one hundred tons each. The furnaces in both shops are essentially the same in structure and in the process of operation. The one hundred ton furnaces of the No. 2 shop will be described in detail as they are a more standard size. Since there are eight furnaces in the No. 1 shop, more varieties of steel are made there. All the furnaces were originally constructed to use producer gas, but coke oven gas has replaced it in some of them.

Furnace Construction and Equipment

The open hearth furnace is a rectangular brick structure, supported on the ends and sides by vertical water cooled cast steel buck stays which take the form of channels bound together at their tops by tie rods, and give support against expansion of the brickwork. The general arrangement is shown diagrammatically in Fig. 1. The over-all dimensions of the furnace are about 80 ft. long, 20 ft. wide and 12 ft. high. The foundation is of concrete in the form of two large piers with an arched opening between. On top of the concrete are placed 15-in. I-beams, and across these, 10-in. I-beams surmounted by a floor plate, 9-in. layer of second quality fire brick and above this 13 inches of magnesite brick. The I-beams act as a bottom anchorage for the buck stays. Upon the magnesite bricks a bottom is made about 11 inches thick with a mixture of 75 per cent burned magnesite and 25 per cent ground basic slag, which is sintered into place. The hearth now has the form of a shallow dish, with inside dimensions about 40 by 15 ft., giving a depth of metal of about 24 inches. The back wall is pierced at its exact centre for a tapping hole. This is approximately eight inches in diameter and extends about five feet to the outside of the furnace from the lowest point in the bottom. At the outside of it there is a removable cast iron dam plate for receiving the end of the steel spout which conducts the molten steel from the furnace to the ladle when tapping. None of these furnaces has a slag hole, all the slag, due to low phosphorus and sulphur charges, being kept in the furnace until the end of the heat.

The back wall is made solid with magnesite and chrome brick, except for the tapping hole; its base is from three to four feet thick. This gives a heavy wall and gives security against having scrap steel pushed through it by the charging machine. The chrome brick of this wall is covered by a layer of lump chrome ore held in place by a chrome mud. The front wall, measuring about 13½ in. thick, starts at the slag line and is built of silica brick. The sills and doorways are placed a little above the slag line. The three doorways for charging have water-cooled cast steel frames, each being placed between two buck stays, removable to allow rebuilding of the front wall when burned out. The doors are made of cast steel, lined with fire brick. They also are water cooled and are raised by electric power. In the No. 1 shop hydraulic power is used for this purpose. A wicket, or peephole, is placed on the centre line near the bottom of each door for the convenience of the helpers when working heats, taking tests, etc.

The roof, which is built of silica brick to a thickness of 21 in., is arched from front to back. It is independent of the walls and rests on skewback brick set in skewback channels which are riveted to the buck stays. A roof lasts for about 300 heats.

Owing to the high temperatures at which the products of combustion escape from the furnaces, much of the heat generated would be carried away by the outgoing gases and wasted, unless special methods were employed for its recovery.

The hot gases are therefore used to preheat the incoming air and fuel, by means of equipment worked upon what is called the regenerative principle.

In this method the hot gases leaving the furnace are conducted through expanded portions of the horizontal flues, almost filled with open brickwork called "checkers" from the manner of laying the bricks. When one set of checkers

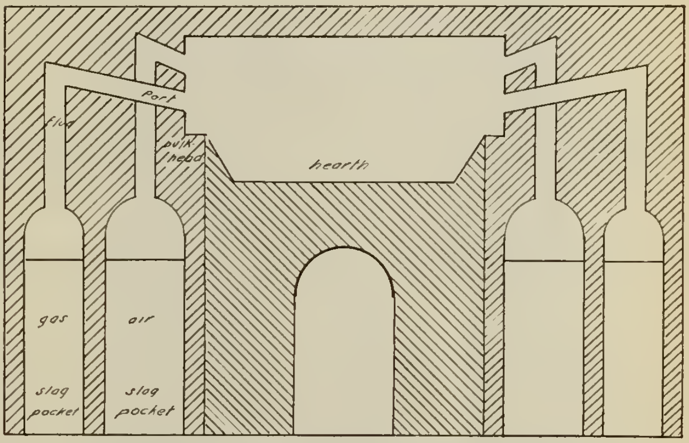

Fig. 1—Diagrammatic Longitudinal Vertical Section of Furnace showing Slag Pockets, Flues, Parts, and Hearth.

have absorbed heat sufficient to raise their temperature to nearly that of the gases, their connection to the stack is closed, and the incoming air (or air and fuel, if the latter can be preheated), is made to pass through the heated checkers on its way into the furnace, thus taking on the stored-up heat in the checkers. Meanwhile a second set of checkers is absorbing heat from the flue gases. To make the process continuous, the direction of the gases is reversed periodically at short intervals. A close check on the reversals must be made, otherwise the checkers may soon become heated to the melting point of the bricks. A Micro-Max temperature-recording instrument records the temperatures of the checkers automatically.

The checkers, or regenerators, of each furnace are in two sets of two chambers built out in front of the furnace and under the charging floor. Each set is made up of one chamber for gas and a larger one for air, the outer wall of the gas chamber being nearly in line with the end of the furnace. The total space occupied by the four chambers is from 120 to 150 cu. ft. per ton of furnace capacity. The inside measurements of a gas chamber are approximately 31 ft. long, 8 ft. wide and 16½ ft. high to the base of the roof which is further arched about 24 in. The air chambers are of the same length and height but are 11½ ft. wide and the arch rises about 34 in. above the base of the roof. The walls are built of 13½ in. of first quality fire brick on the inside. The dividing wall between a pair of checkers is built of first quality fire brick to a thickness of three feet. The checkers usually last for about 600 heats, after which time they are rebricked.

The floors of the checker chambers consist of a nine-inch layer of concrete, followed by a heavy coat of pitch as a waterproofing; on this is laid another nine-inch layer of concrete, four and a half inches of common brick and then four and a half inches of first quality fire brick. On the floor are placed nine-inch rider walls, dividing the gas and air chambers longitudinally into three and four flues, respectively, to a height of four feet. The walls are spanned by uniformly spaced fire brick tile. On this, the checker work, of first quality fire biick, is begun and continued to within about four feet of the top of the chambers. The arched roofs are built of fire brick 13½ in. thick. The checker work is separated from the flues leading to the slag pockets by a solid wall which rises to their top. This wall aids much in preventing slag and dust being carried over into the checkers

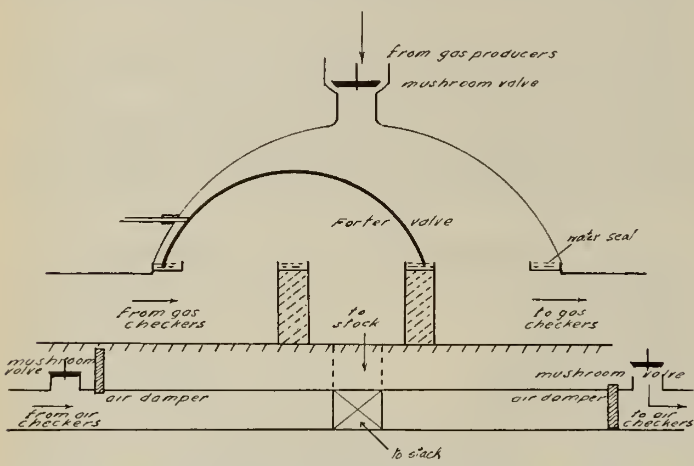

Fig. 2—Diagram showing Sectional Elevation of Valve System used to control the Temperatures of the Checkers.

and also acts as a baffle, giving full use of the checkers. The up-and-down-takes, built of silica brick, are vertical flues which connect the air and gas ports with the slag pockets and with the fan-like flues leading to the checker chambers. The slag pockets, one for air and one for gas, are placed at the bottom of the up-and-down-take flues. They conduct the gases to and from the checkers, catch any solid matter carried over with the products of combustion and take care of slag from burned brick of the end and side walls.

The air and gas ports are built at an angle to the bath in order to direct the flame to it and away from the roof. To protect the roof and promote mixing, the air enters above the gas. The bricks separating the two ports are water cooled.

The bulkheads which form the ends of the hearth below the ports are built of brickwork on a large hollow cast steel box with the ends open for air cooling. The inside surfaces of the bulkheads are made of magnesite brick.

The reversal of the flow of gas and air is effected by two systems of valves and dampers.

As regards gas, the supply from the producers to each furnace is controlled by a mushroom valve, after passing which the gas enters a water-sealed valve known as a Forter (or 'turtle back') valve. This valve can be so placed as to connect either set of gas checkers to the supply while at the same time connecting the other set to the stack; when moved over, these connections are exchanged.

To control air distribution, a mushroom valve and a damper are placed in the flue connecting each air checker to the air inlet and stack.

The arrangement is shown diagrammatically in Fig. 2 and is such that while cold air enters one set of checkers, the flue gases from the other set pass to the stack. When each mushroom valve is closed its corresponding damper is open, and vice versa.

There is also a damper at the base of the stack. All the valves and dampers are controlled from the charging floor and the reversal of the air and gas valves takes place simultaneously.

The mushroom valves on the air intake flues and in the flue from the gas producers are circular plates about three feet in diameter with a rod running through the centre. The dampers are rectangular pieces of steel about three by eight feet. The stacks, lined with first quality fire brick, are 150 ft. high above the charging floor level, with an inside diameter of five feet.

In front of the furnaces is a standard gauge railway track upon which the material to be charged into the furnaces is brought by locomotives. Steel buggies, holding four steel charging boxes with a capacity of 16 cu. ft. each, are pushed in on this track, after which the charging machines take care of them. Ore, fluxes, scrap iron, are thus brought on to the floor. Between the standard gauge track and the outside wall of the shop is a wide gauge track upon which runs the charging machine.

A hot metal mixer, to handle metal from two or more blast furnaces, is placed at one end of the floor and receives its supply from ladles from the blast furnaces. It is used for keeping a large quantity of hot metal on hand in order to supply the open hearth furnaces as required.

Overhead cranes up to 40 tons capacity are used for transferring hot metal, which comes from the blast furnace to the mixer; hot metal from the mixer to the furnaces; boxes of flux to the various furnaces, and several other jobs.

In the pit, which is about 15 ft. below the charging floor, is all the apparatus for taking care of the steel after it leaves the furnace.

The ladles are of steel lined with two courses of brick. A lining of mud is placed on the inner course of brickwork to lengthen the life of and to protect the brick in case a skull forms in the ladle from chilled steel. The ladles have a capacity of about 100 tons. An opening in the bottom is provided with a fireclay nozzle two inches in diameter. It is closed by a stopper made of clay-bonded graphite. This is mounted on a rod, protected by a fireclay sleeve brick, which reaches to the top of the ladle. Here it is connected to a sliding bar on the outside that can be raised and loweied by a lever near the base. The stopper and nozzle must be set carefully or a 'running stopper,' 'stuck stopper,' may result. The ladle, when prepared, is set on a stand at the back of the furnace ready to receive the steel. A slag pot is set on an adjacent stand and receives the overflow slag from the ladle. Below the ladle is a cement pit. This is covered to a depth of about four inches with ashes so that any overflow slag from either the slag pot or ladle can be removed easily after having cooled.

Fig. 3—The Charging Machine.

A standard gauge track runs into the pit and is used for transferring the slag pots to the dump. Railway cars are also brought in when skulls, scrap steel or other materials are to be loaded.

Overhead cranes of 100 tons capacity and less are used for transferring the ladles and slag pots from place to place.

A narrow gauge track is placed in front of the pouring stand which is built across the pit from the furnaces. On this stand is a supply of forks, rods and stopper levers used in the pouring process. A supply of oxygen is present for emergency use only, i.e., in case steel freezes in the nozzle.

The ingot moulds, which sit on stools, are run in on the narrow gauge track on small buggies. These moulds are about two feet square and six feet high; the standard ones taper from bottom to top, while the Gathman type taper from top to bottom. In the first case, the mould is stripped from the ingot; in the second the ingot is drawn from the mould.

The moulds are dipped in tar before use to lengthen their life and to improve the surface of the ingots. An overhead crane is used to carry them to and from the dipping tanks.

The stockyard is adjacent to the open hearth shops and contains the supplies of limestone, lime, fluorspar, scale, ore, pig and scrap steel. The material is loaded into charging boxes, the weight being noted. A record of the weight of each buggy load is sent to the foreman in charge of the floor.

Furnace Operation

Producer gas and coke oven gas are the fuels used in the furnaces, some using a mixture of both, others just the one type. The coke oven gas is piped from the coke ovens where it is produced by distillation of coal. Its composition is approximately 55 per cent hydrogen and 35 per cent methane. The composition of producer gas is about 25 per cent carbon monoxide, 10 per cent hydrogen and 55 per cent nitrogen. Coke oven gas, producer gas and blast furnace gas run about 590, 140 and 95 B.t.u. per cu. ft., respectively.

As regards operating staff, there are senior and junior melters who are in charge of all the furnaces on the floor and take over each furnace when the heat is ready to be tapped. The melter on duty receives notices for the kinds of steel desired, and orders the necessary stock. When the carbon approaches the desired point, he takes charge of the furnace, directs the addition of the stock and gives the order to tap. For the work on each furnace, three men are needed, called the first, second, and third helpers. The first helper has charge of working the heat, i.e., making the necessary additions of ore, pig and spar, to prepare the steel for tapping. After tapping he directs the repairing of the bottom and banks of the furnace. The second helper is responsible for keeping a supply of dolomite, lime, ore and spar on hand and weighs out the stock which is to be added near the end of the heat. He also helps to work the heat and digs the plug out of the tapping hole when the heat is ready to be tapped. Following this, he plugs the hole ready for the next heat. He helps to repair his own and other furnaces on the floor. The third helper cleans out the pit below the tapping hole and steel spout. Any overflow slag must be removed from this pit after each heat. The third helper also assists in repairing his own and other furnaces on the floor.

When a new furnace is put into operation, a wood fire is used to dry it. This takes about 48 hours. The gas is then turned on and the real heating commences and continues for a further 24 hours, with reversals of the flame about every hour. Finely ground magnesite is thrown in to cover the joints between the magnesite brick. Finely ground cinder is scattered on top of this, about twelve hours being required for these additions to fuse and become solid. The making of the bottom is then begun. A mixture of burned magnesite and basic cinder is scattered over the bottom and sides of the hearth to a depth of a quarter inch and allowed to sinter for three hours. This is repeated until a thickness of about 11 inches is reached. The tapping hole is then cut through and lined with burned dolomite which is held in place by a clay cap on the outside. About twenty tons of basic cinder is charged, melted, rabbled against the banks to make the hearth solid, and then tapped out. This is called the wash heat. The furnace is now ready to receive its first charge. The limestone and scrap are pushed on to the floor in charging boxes. These are raised from the buggies, pushed into and the material deposited in the furnace by the charging machine. This machine is one of the greatest labour and time saving devices used about the open hearths. It is electrically operated by a workman called the charger. The doors of the furnace are opened by control levers operated by the first helper. Limestone is charged first for several reasons. If it were not, it would act as an insulator and prolong the melting period; it would all go to make up a part of the first slag which would be too viscous to work well, and the benefits to be derived from the lime boil would be lost. Ore and then scrap are added and the gas, which was only partly on during charging, is now fully turned on. The melting stage now begins. A typical charge for the 100-ton furnaces is:

Limestone	20,000 lbs.
Scrap	140,000 "
Hot metal	40,000 "
Pig iron	10,000 "

A loss of 10 per cent is considered an average for such a charge. This results in the production of about 80 gross tons of steel, which amount only is produced from these furnaces at present.

Fig. 4—End of Tapping showing Slag running out of Ladle.

Since the heat is imparted largely by radiation, the fuel should burn with a long flame, reaching almost to the outlet port. The light scrap and pig melt first and trickle down to the bottom of the furnace, a considerable amount being oxidized. Hot metal may be added now if required. Reversals of the flame should take place every twenty minutes.

The purification of the molten metal takes place in three stages called the ore boil, lime boil, and the working period. About two hours after charging, practically all of the silicon and a large part of the manganese will have been oxidized. The silica formed is neutralized by limestone, whereas the ferrous oxide and manganese oxide become slag. Any sulphur that is oxidized is carried off with the products of combustion. The phosphorus is readily attacked by the ferrous oxide, which not only oxidizes it, but neutralizes the resulting oxides producing iron phosphates. Upon reaching the slag, lime replaces the iron and produces stable calcium phosphates. Carbon is being oxidized to carbon monoxide during this time, producing tiny bubbles which cause the viscous slag to foam.

When the scrap is all melted and the carbon content is decreased, the ore boil subsides and the lime boil, caused by the increased calcination of the limestone, is in the

Fig. 5—Pouring Steel into Moulds.

ascendency. The carbon dioxide formed agitates the "bath," by which term is meant the molten metal only, quite violently and exposes the molten metal to the oxidizing influence of the flame. Part of the carbon dioxide unites with the remaining carbon in the iron to produce carbon monoxide. The lime which rises to the surface now replaces iron oxide and manganese oxide in the phosphates, sulphates, and silicates, thus becoming a part of the slag. Excess lime increases the basicity of the slag. Having a highly basic slag causes the phosphoric and silicic acids to be less liable to reduction.

When all the impurities but carbon have been eliminated, the third or working period commences and aims at regulating the properties of the slag, regulating the carbon content, and raising the temperature of the bath about 300 deg. F. above its melting point. To protect the metal from contamination by sulphur from the flame, retain the impurities, especially phosphorus, and promote the elimination of carbon, the slag must have a large quantity of active oxidizing agents, except at the end of the period, and must be strongly basic at all times. The reagents used for regulating these properties are iron oxide, limestone, dolomite, and fluorspar. The carbon content is reduced to a point slightly under that required, to allow for the carbon contained in the additions; the bath is then tapped.

At the end of the lime boil, the first helper starts taking tests to find the carbon content. This is done by two methods. In one, known as a fracture test, a spoonful of steel is poured into a small rectangular mould. After solidification it is removed, nicked on both sides and plunged into a bath of cold water. It is then broken in two with a sledge hammer. From the fracture thus exposed, the carbon content can be read to 0.02 per cent. This fracture also shows the grain size and the presence of phosphorus. In the other method for testing the carbon, a spoonful of the metal is poured into a small cylindrical mould surmounted by a cone to facilitate pouring. If a hardened test is desired, i.e., if the carbon is over 0.40 per cent, the mould is immediately unclamped and the sample air cooled for a short time, then water cooled. If an unhardened test is desired, the carbon being under 0.40 per cent, the mould is not unclamped until one minute after pouring the test, after which the sample is water cooled. The test piece is now put into a carbometer, which operates on the principle of magnetism and hysteresis. The reading of the carbometer is referred to tables from which the carbon content is read to the third decimal place. This test takes but a few minutes.

In order that the temperature of the bath may be raised to a point sufficiently high for tapping by the time the carbon is reduced to the point aimed at, it is desirable that the carbon content of the bath at the end of the lime boil be about 0.50 per cent, i.e., 50 points higher than that desired for tapping. If the carbon content gets too low, hot metal, which is high in carbon, is added.

Fluorspar is added to bring about the melting of any unfused lime and to increase the fluidity of the slag. To hasten the removal of carbon, iron ore is added. The bath is also stirred with a long steel bar to reduce the carbon to the final point, the iron oxide on the rod and the exposing of the metal to the air effecting this. The melter is now notified; he takes additional tests for carbon and sees that everything is in readiness for tapping.

During the working period preliminary tests are taken by pouring a spoonful of steel into a small square mould. The steel is allowed to solidify, removed from the mould, air cooled and sent to the laboratory for analysis. If tests are to be made for phosphorus and sulphur the results are received in about 20 minutes; if for copper, nickel, molybdenum and such elements, about one hour is required to make the analysis.

The first helper judges the temperature of the bath by pouring a spoonful of steel on the floor at a slow fixed rate and noting how rapidly it flows and the thickness of skull that remains in the spoon. By long practice, he becomes expert in obtaining a suitable temperature for the steel being made. An optical pyrometer is used for taking the temperatures in the furnaces and of the steel in the open. The instrument is sighted through the wickets in the doors of the furnace to obtain the temperature of the material before it leaves the furnace, and on the open stream as it is being tapped and poured, records of these readings being kept.

Slag tests are taken to find the iron oxide content of the slag. It is very important that this be kept within a definite range for the steel being made.

Much alloy steel is being made at the present time, but only a short condensed note on this subject can be given here.

If a copper steel is to be made, copper is added in the solid form about 20 minutes before the heat is tapped. Ferro silicon is added in the ladle; nickel is added about 40 minutes before tapping. Nickel is chemically negative to iron and none is lost in the furnace. Molybdenum and chromium are also added in the furnace; the molybdenum as calcium molybdate, and the chromium as ferro chromium.

As an example of how a heat of alloy steel is finished, a nickel-molybdenum steel will be considered. Three hours before the heat is ready to be tapped, bags of calcium molybdate are thrown into the furnace, since it takes that much time for it to be reduced, and about 40 minutes before tapping, nickel is thrown in, in the form of cathode plates. Spiegeleisen is added as a wash, which cleans excess iron oxide from the steel, the manganese in the spiegeleisen performing this task, as will be described under the properties of manganese and its oxides. Ferro manganese is added 20 minutes before tapping to allow it to form a homogeneous mixture in the bath. This brings the manganese content to the desired point. The weight of the necessary additions is calculated after the results of the preliminary tests are received.

If the carbon is reduced to the point at which the heat is to be tapped, and the additions have not had time to be dissolved, silicon pig is added to 'spike' the heat. This prevents further elimination of carbon, the silicon reducing it as soon as it is oxidized. When all is in readiness, the heat may be tapped. If, however, the carbon content does decrease, coke is added in the ladle additions to adjust it.

The analyses of the first slag formed from two furnaces are given as examples in Table I, the figures denoting per cent composition.

Typical analyses of the stock added to a charge are given in Table II, the figures denoting per cent composition.

If hot top ingots are to be poured, the mould has a removable top of the McLain or Gathman type fitted into it which is supported by wooden blocks. The former are brick mouldings, the latter steel mouldings with a brick lining. When the steel reaches this, pouring is ceased to allow the steel to solidify around the edges to prevent its rising between the brick and mould. The pouring is resumed when this has been done and the brick top filled with steel. Straw is placed on top of the ingot which helps to keep it hot since it burns for a considerable time. The wooden blocks under the brick top are removed, thus allowing the top part of the ingot to contract as the ingot cools,

Table I

SiO_2	FeO	Fe_2O_3	MnO	P_2O_5	Al_2O_3	CaO	MgO	S
8.54	61.05	11.10	2.31	0.26	1.98	9.13	5.48	0.16
1.00	78.24	15.31	0.81	0.14	0.37	2.70	1.12	0.25

Table II

	Fe	C	Mn	P	S	Si	Cr	V	Ni	Cu
Ferro manganese	13.03	6.80	79.35	0.16	....	0.66	—	—	—	—
Ferro phosphorus	79.97	1.10	0.18	18.00	0.65	0.10	—	—	—	—
Ferro silicon (electric)	49.44	0.55	0.02	0.08	0.02	49.90	—	—	—	—
Ferro silicon (blast furnace)	87.47	1.52	0.42	0.08	0.02	10.50	—	—	—	—
Ferro chrome	22.05	6.36	0.35	0.01	0.08	0.48	69.96	—	—	—
Ferro vanadium	42.65	1.58	6.25	0.10	0.11	10.49	—	37.96	—	—
Spiegeleisen	75.68	4.39	19.13	0.05	0.03	0.72	—	—	—	—
Pig nickel	—	—	—	—	—	—	—	—	97.00	—
Pig copper	—	—	—	—	—	—	—	—	—	99.00
Stick sulphur	—	—	—	—	100.00	—	—	—	—	—
Pig iron	94.00	3.80	1.00	0.17	0.03	1.00	—	—	—	—

To accomplish the tapping, the second helper digs the mud cap and some of the dolomite out of the tapping hole. It is then opened by driving the rest of the dolomite out with a rod inserted through the wicket in the centre door of the furnace. If molten metal seeps through the dolomite plug at some time during the preparation of the heat and seals the opening, it must be burned out with oxygen. The steel then flows down the spout, and into the ladle. Since the tapping hole is at the bottom of the furnace, most of the steel flows out before the slag appears, thus making recarburization in the ladle possible. The tapping spout and ladle are so placed as to direct the stream of molten metal a little to one side of the centre of the ladle. This gives it a whirling motion, which aids in mixing the additions and making a homogeneous steel. Bags of coke, aluminum bars, and ferro manganese are added while the steel is tapping and lime is thrown on top of the slag when it appears, to cool it.

The slag flows out on top of the steel, keeping the heat in and protecting the steel against oxidation from the atmosphere. This occupies a considerable portion of the ladle. When full, the ladle is lifted from its stand by an overhead crane and transferred to the pouring stand. Below the nozzle at the base of the ladle is a slot which holds a small steel plate in position. This holds the clay surrounding the stopper, in the nozzle. The plate is withdrawn from the slot, the clay poked out from the nozzle, and the ladle then set over the first mould ready to have the stopper raised. This is accomplished by means of a sliding rod apparatus near the base of the ladle. When the mould is partly filled, aluminium may be added as a deoxidizer if desired. Since only about two ounces of aluminum per ton of steel is added to the ingot, it exerts no influence on the steel as an alloy. The stopper is forced into the nozzle to shut off the stream of steel when the mould is filled. The ladle is now moved over the second mould and the process repeated.

Near the end of the pouring, care is taken to watch for the appearance of the slag, which is recognized by its different colour. At this point, the stopper is again forced into the nozzle and the ladle removed to a slag pot. The ladle is now tilted and the slag poured out of the top. The technical term for letting the steel into the moulds is 'teeming,' but common usage has made teeming synonymous with pouring.

the steel in this part flowing down to fill the cavity or pipe which forms in the main body of the ingot.

In certain cases, the steel is poured by a method termed basket pouring, in which the steel is first run into a basket with two holes in the bottom. The steel runs from the holes into two adjacent moulds at the same time. This eliminates the ferro-static head and gives better control of the pouring. There is less turbulence and splashing which results in a better surface on the ingots. For similar reasons, bottom pouring is also resorted to. In this method, the steel is run into a fountain, passes along a horizontal hollow brick passageway at the base of it, and enters the moulds from openings in the brick at the centre of the mould bottoms.

Small tests are taken with a spoon during the pouring of about the third and tenth ingots. These are taken to the laboratory and the analyses recorded.

The weight of the ingots varies from three to seven tons depending on the size of the mould. The mould walls are about six inches thick, and a little thicker at the bottom to allow the top to remain molten a little longer than the bottom, the thicker wall at the bottom absorbing more heat than the thinner wall at the top. Any trapped gases and impurities are thus given an opportunity to rise to the top. Here a pipe is formed which is usually cut off after passing the first roll when it goes through the rolling mills.

After the ingots have cooled sufficiently, they are sent to a stripping shed. The stripping machine lifts the moulds from the standard size ingots, using a plunger to hold the ingots in place if necessary. The moulds are placed on adjacent cars and taken to the tar dipping tanks to be dipped and then cooled ready for use again. If the ingots have hot tops, the steel moulding is removed at the pouring stand and the moulds and ingots are run into the soaking pit building where the ingots are drawn from the moulds and put into the pits.

After being tapped, the furnace is prepared for the next charge. The steel spout is removed and any steel and slag remaining in the tapping hole is blown out with air. Any chilled steel in the hole is removed, the hole filled with dolomite and a mud cap placed on the outside to keep the dolomite in place. Any holes in the bottom of the furnace are filled with dolomite, and the banks are repaired by throwing burned dolomite on them, about three thousand

Fig. 6—The Stripping Machine.

five hundred pounds being used in a one hundred ton furnace. Then the furnace is again ready for charging.

The twelve furnaces in use at this plant are capable of producing 540,000 tons of ingots per annum, 130 different grades being made. These are rolled into various shapes: I-beams, H-beams, channels, angles, zee bars, sheet piling, merchant bars, rails, tie plates. The alloy steels contain chromium, nickel, vanadium, molybdenum, silicon, manganese, singly and in combination.

As regards the relation of the open hearth shops to the rest of the plant, it may be noted that the coke ovens are at some distance from the shops, but the gas produced can be piped quite easily to any part of the plant. Ore and limestone are unloaded on the docks and transported to bins at the calcining plant. From here the material is sent to the open hearth on buggies. The scrap yard is adjacent to the shops, the loaded buggies being pushed up a high line on to the floor of the shop. The blast furnaces are at one end of the shops. If molten iron is required to be charged into the mixer, it is brought directly to the mixer; if not, it is taken to the pig casting building where it is run into the casting apparatus. The pigs are loaded into steel cars.

The stripping machinery is placed between the two shops. From here the ingots are run into the building housing the soaking pits. They are lowered into the pits by overhead cranes and heated ready to be rolled. If there is no direct need of all the ingots of one heat, they are stored in the same building, or in adjacent yards, until orders arrive for steel of that type. The steel then leaves the open hearth department and becomes the charge of the rolling mills branch of the plant.

Acknowledgment

The author wishes to express his thanks to Mr. J. F. Nixon, assistant superintendent of the open hearths, for his constructive criticism of this paper.

CANADIAN MINING PROGRESS

Mining in Canada has made great progress during the past twenty years, the value of production advancing from $227,859,665 in 1920 to $473,107,021 in 1939, according to the Department of Mines and Resources, Ottawa. Dividend payments by Canadian mining companies have kept pace with the industry's growth, advancing from about $38,000,000 in 1929 to $105,441,265 in 1939. The mines of Canada employ in excess of 112,000 people whose salaries and wages total more than $140,000,000 annually, while the expenditures of the mining industry for supplies and equipment, including freight and electric power, amount to an estimated total of about $125,000,000 a year.

Canada now occupies a leading position among the world's mineral producers, ranking first in the production of nickel, asbestos, and platinum; third in gold, silver, and copper; and fourth in lead and zinc. She has also become one of the two principal world sources of radium. In addition the Dominion is an important source of at least fifty other metals and minerals, the list including cobalt, selenium, cadmium, coal, petroleum, natural gas, gypsum, salt, building stones, and clay products and structural materials.

Canada maintained her position as the world's leading producer of asbestos in 1939, when the output totalled 364,472 tons valued at $15,859,212 compared with 289,793 tons valued at $12,890,195 in 1938. With the exception of a small quantity from northern Ontario, the Canadian output of asbestos comes entirely from areas of serpentinized rock in the Eastern Townships of Quebec where the producing centres are Thetford Mines, Black Lake, East Broughton, Vimy Ridge, and Asbestos. According to the Department of Mines and Resources, these deposits are the largest known in the world and although production has been continuous from the Thetford District since 1878 the reserves of asbestos-bearing rock are still enormous.

In Quebec the asbestos-bearing rock is mined both in open pits and underground, and most of the asbestos production is exported in the unmanufactured state. The United States is the world's largest consumer, and Canada's proximity to this market is a distinct advantage to the industry. Other countries to which large exports are made include Japan, United Kingdom, Belgium, France, Australia and Italy.

Asbestos is used chiefly for the manufacture of automobile brake linings and clutch facings; as asbestos cloth and heat insulation materials; as packing and building materials such as roofing shingles, corrugated sheeting, tile and piping, and also for asbestos paper.

—Canadian Resources Bulletin.

DISCUSSION ON THE ECONOMIC FRONT

Paper by G. A. Gaherty, M.E.I.C.,[1] presented at the General Professional Meeting of The Engineering Institute of Canada, at Toronto, on February 8th, 1940, and published in the January 1940 issue of The Engineering Journal.

E. P. Muntz, m.e.i.c.[2]

It is becoming evident that the engineering profession is at last beginning to shake off its lethargic attitude towards public affairs. Here and there its members are showing ability to express themselves clearly and concisely on subjects outside their particular avocation. It appears that the profession is about to give that leadership to the public which the training of its members so adequately justifies. This timely paper by Mr. Gaherty indicates a long-hoped-for trend in engineering thought and action. The engineer's economic reasoning-power has been proved many times, but chiefly in connection with his every-day work, and with confidential reports on projects largely for the benefit of those in financial control of a certain situation. These reports too rarely become available to the public, and in many cases would be of no public interest. There are, of course, outstanding exceptions. A very recent one, familiar to most of us, was the report of the Chevrier Commission, for the preparation of which Professor C. R. Young, m.e.i.c., one of the members of the Commission, has been given a great deal of well-merited credit. In the citation for the award of the medal for achievement presented by the Engineering Alumni of the University of Toronto, Professor Young was referred to in one instance as "this engineer-economist."

The complex problem which Professor Young mastered indicates that the even more complex problem, the subject of Mr. Gaherty's paper, can be mastered by similar attack and dissection along engineering lines.

I take it Mr. Gaherty is a firm believer in a planned national economy, and though I may be mistaken, I think that he also believes that if wars are to be avoided in future, a nation's exports must balance a nation's imports —no more, no less. I wonder if he also believes in national control, not only of currency, but of credit.

It should be noted that such forthright, illuminating and refreshingly frank papers as Mr. Gaherty's, though they may emphatically bear on our war effort for the moment, are definitely laying the foundation for a successful solution to the world's chief basic problem, that of the distribution of goods. We now, as everyone knows, have a condition of potential plenty; that the means will be found of making our potential plenty actual, there is little doubt. That the right means will be very simple is merely following the conclusion of most analyses along engineering lines. Changes will be effected by moulding our existing institutions somewhat, not by tearing them down. That we will continue to develop new processes and new articles for our convenience and comfort, goes without saying, but a *sine qua non* for continued development is that we solve the basic problem of the distribution of goods both within the country and internationally. We, as a profession, have been largely responsible for the present-day development in productive capacity. It seems particularly our job to find a solution to the distribution problem.

Possibly the sub-heading, "Curtailing Imports from Neutrals," is not as happy as, "Curtailing Non-Essential Imports from Neutrals," which is the very timely meat of the two paragraphs under the former heading.

Mr. Gaherty's remarks under Taxation recall some of the many excellent briefs submitted to the Rowell-Sirois Commission. I have not seen the findings of the Commission, but feel confident that the reception accorded the brief of the National Construction Council, of which this Institute is a member, is an indication that some of the points raised by Mr. Gaherty have been answered in the Commission's report.

On the question of man-power, there is still a sizable amount of unemployment in the construction industry, both in the professional and contractual fields, as well as among building trade mechanics and unskilled labour. Pending the gradual absorption of men into the war effort, some work must be proceeded with if hardship and direct relief are to be avoided.

Some day Labrador and Hudson's Straits will have to be fortified, as well as our existing Atlantic and Pacific Coasts. Why not get on with it ? At least some of the necessary work can be planned now, when there are many people available, and the work executed as circumstances permit. The same is true of many public works. By utilizing private practitioners now idle, or nearly so, plans and specifications could be ready for any building programme that may be warranted, during the war, or upon the termination of hostilities.

Mr. Gaherty's conclusion is particularly good, and his reference to French Canada very happy. We have virtually a contract with French Canada. If we live up, not to the letter, but the spirit of it, proficiency in French should be a definite requirement in our educational system, and on occasion we should use it. We should strive to find and cultivate the points we have in common, that is, both sides must co-operate with the utmost tolerance, rather than sit back and be critical of one another.

No comment I can make would add anything to Mr. Gaherty's last paragraph. It expresses eloquently that conception of the very important place the profession must take which I have tried to express on a number of occasions.

Charles A. Bowman, m.e.i.c.[3]

The writer welcomes the discussion of the relationship of economics to engineering. The control and development of credit power in Canada should be the concern of The Engineering Institute no less than the use of hydro-electric power. Engineers and captains of industry in other countries were taking a leading part exploring new economic paths. In the United States, when the proposal to develop Muscle Shoals power came before a senate committee, Henry Ford and Thomas Alva Edison submitted a draft plan to finance the project as a public utility without borrowing or taxing. James H. R. Cromwell's book, "In Defence of Capitalism," had been written in collaboration with Hugo E. Czerwonky, an American engineer. In substance it advocated more scientific money. Among British leaders along this path of the new economics were similarly distinguished engineers and physicists including Lord Sempill, Sir Alliott Verdon-Roe and Professor Frederick Soddy. The report of the special committee of the London Chamber of Commerce on monetary policy as it had been submitted to the Imperial Economic Conference in Ottawa in 1932 is to be commended. It would still merit the study of The Engineering Institute.

C. R. Young, m.e.i.c.[4]

In a very few words the author has made a telling criticism of the transport situation as it exists to-day in Canada. While not themselves above reproach, the railways are undoubtedly being subjected to a very great injustice. It is not clear, however, that the charge of dishonesty and unfairness in our treatment of them has been laid at the proper doors.

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[2] President, E. P. Muntz, Limited, Hamilton, Ont.; President, National Construction Council of Canada.

[3] Editor, *The Citizen*, Ottawa, Ont.

[4] Professor of Civil Engineering, University of Toronto, Toronto, Ont.

The fault is not that of any one government. If it were, the situation might be more readily remedied. The clash of federal and provincial interests, which renders effective control of transport generally impossible, is at the root of much of the trouble. The provinces control their highways and the revenues derived from them. Since these revenues are large and, within limits, capable of being adjusted up or down to suit the financial needs of a province, it is but natural that the provinces would be loathe to yield any measure of control over highway transport. Consequently, under the Transport Act, motor traffic is exempt from control of the Board of Transport Commissioners. The railways of Canada being, therefore, generally under federal control, and the highways being under the control of the provinces, an *impasse* inevitably results. Until consistency is brought about in the contrcl of all forms of transport in Canada there will inevitably be injustice to the railways. It is to be hoped that some means of bringing this about will be indicated in the forthcoming report of the Commission on Dominion-Provincial relations.

As the author has well said, a serious aspect of the situation exists in the grip which the powerful railway brotherhoods have over the railways of this country. As was pointed out by Professor J. L. McDougall, in his evidence before the committee of the Senate inquiring into the railway situation in Canada, the rates of pay and working rules impose so great a handicap upon railway managements that it is difficult to conduct operations with that economy and relation to the general price level in the country which are necessary in a soundly-operating business.

The writer by no means holds that transport by road, water or air should be hamstrung for the benefit of the railways. No sounder statement of policy is possible than that expressed by the representatives of the railways in the report of the Conference on Rail and Road Transport, London, 1932 (the so-called Salter Report), in which they state that "they do not ask for any action which would tend to secure a different division of function than would result if a single administration, without divergence of financial interest, were solely occupied in meeting the needs of the public by the most convenient and economical arrangement of transport."

In accordance with this doctrine, there manifestly should be offered to all forms of transport an equality of opportunity but not without, at the same time, demanding an equality of present obligation. It has been represented that, since the railways of this country have been granted enormous subsidies in direct and indirect form, other transport agencies, notably motor transport, should be equally favoured. There can be little justification for this stand. Much of the aid granted to the Canadian National Railways and its constituent companies was given not to enable one transport organization to compete at a disadvantage with others but to save the national credit in a time of emergency. It was a venture in public finance rather than one in railroading. To subsidize other transport agencies in like measure would be illogical, if not suicidal. Embarcation on a disastrous transportation policy in one instance is no justification for doing it again. To the railway problem we do not wish to add a highway problem.

R. F. Legget, m.e.i.c.[5]

The note of warning, as to Mr. Gaherty's responsibility for the opinions expressed in his paper, is one of the most encouraging things which have appeared in the *Journal* in recent years. It is to be hoped that more papers on public topics will now be printed, however controversial they may be, thus enabling engineers to discuss the implications of their work and its social significance in the pages of the *Journal*, in addition to the technical aspects of engineering.

It was unfortunate that the time available for oral discussion of Mr. Gaherty's paper was so curtailed, since the paper presents so many controversial statements that could have been questioned and discussed more suitably in the presence of the author than through the more formal medium of the written word. There is, for example, the statement on page 5 about unemployed Canadians being "on the whole below average in intelligence and physique." All who know unemployed men, or who have been unemployed themselves, will question this assertion regarding intelligence; further, they will ask who is responsible for the lowered physique, remembering that not very long ago Canadian legislators were allowing single unemployed men to starve in the interests of "economy." Again, the lighter touch so graciously introduced into the discussion by Miss MacGill (to the effect that much of what Mr. Gaherty was advocating was socialism) might well be countered by the suggestion that much of the first page of the paper, and particularly the section entitled "Putting our House in Order," shows that Mr. Gaherty is not at all averse to certain features of fascist dictatorship. Finally, throughout the paper, there may be traced a conflict between a natural desire to have government intervention and public control exercised for the good of the country as a whole and the strong inclination of the engineer, as an individualist, to favour a policy of *laissez-faire* with regard to the industry with which he is associated—a conflict that must be resolved before any engineer can progress to a logical conclusion in his social thinking.

It is probable that Mr. Gaherty would like to see constructive suggestions develop from his paper in view of the present emergency. The writer wishes to present such a suggestion, one which arises from the concluding words of Mr. Gaherty's first paragraph—"we may well emerge from the war with our national economy in a stronger position than ever." Canadian economy is dependent ultimately on the husbanding of the natural resources with which the country is endowed—resources that include, in addition to the generally recognized water-power and mineral wealth, forests and all other trees, fish and animal life, and above all the soil upon which agriculture is dependent. At present, due to a variety of causes, Canada has no policy for the conservation of these resources. Leaving aside water-power and mining, the depletion of Canadian forest resources by fire, unrestricted cutting and insect blight has already assumed the proportions of a national problem; the essential measures for the conservation of animal life are recognized by many biologists but not by governments; and soil erosion —long thought of as something about which Canada need not worry—is at last attracting public notice as a real menace to the future well-being of this country.

All these and other aspects of conservation matters are closely related; one cannot be properly considered without the others. And they have direct relationship to engineering, as was demonstrated to the meeting by the paper on the Shand dam, a million-dollar river-control scheme made necessary, at least in part, by the neglect of conservation measures in the Grand River valley notably by the draining of the Luther swamp (now to have water stored in it again by a dam!).

The need for conservation measures increases with time in something more than arithmetical progression. During the war little can perhaps be done in the carrying out of constructive work. But does not the whole field provide at once a challenge and an opportunity—an opportunity to the Institute to assist in maintaining national economy by careful study and planning of engineering aspects of conservation now, with a view to their application when war is over? Conservation projects involving little capital expenditure but much man power and brain power, will provide one admirable means of off-setting the "inevitable" economic slump after the war, but only if they are planned ahead. They will have the far more important effect of stopping the waste and ruin of the natural resources upon which the whole future of this country depends.

[5] Assistant Professor of Civil Engineering, University of Toronto, Toronto, Ont.

The Canadian Society of Civil Engineers, in its later years, used to have a Committee on Conservation; could not the Institute Committee on Western Water Problems be reconstituted as a new and active Committee on Conservation?

C. M. Goodrich, M.E.I.C.[6]

The Economic Front gives a concise and well-reasoned conspectus of economic conditions in wartime in Canada. Mr. Gaherty deserves our thanks for so direct a summary, and notably for his recognition of the wastes due to lack of compact and efficient organization and to "New Deal" tendencies. This has long been a fruitful source of criticism, and one fears that it may continue, like the weather, of which Mark Twain said that many complained of it, but nobody seemed to do anything about it. Lin Yutang says, in one of his books, that one cannot determine the wisest course by counting the noses of the unintelligent.

Two suggestions may perhaps be appropriate footnotes to Mr. Gaherty's paper. First, in temporary work stresses should be increased and loads diminished. Thus in buildings, if from 25 lb. per sq. ft. (in Chicago for instance) to 40 lb. per sq. ft. is used for a rocf load in permanent peacetime work, then 20 lb. or less is appropriate in temporary wartime work; if 18,000 or 20,000 lb. per sq, in. base stress is appropriate for permanent work, then 24,000 should be adequate for wartime temporary work. In the pontoon equipage of the United States Army, adopted as standard during the World War, the writer used a stress of 3,000 lb. per sq. in. for timber not so good as douglas fir.

The second suggestion refers to packing for overseas shipment. In the writer's division, $5 per cu. ft. was used as a conservative estimate of the value of shipping space, and care in packing often showed a saving of more than the cost of the contents. Thus, for instance, the shipping cubage of the Nissen Hut was reduced through redesign by about two-thirds.

The Author

As Mr. Muntz, Professor Legget and others have rightly inferred, the author's purpose was to bring about a wider realization of the sweeping changes needed to win the war and so to further their introduction. The paper was designedly controversial as only through discussing our problems objectively can we hope to determine the proper course to adopt. We should remember that in a free country the government is the servant of the people, not its master, and in the face of military reverses we should not be too hard on our public men when our own apathy has been responsible for the lack of war effort.

I am in complete accord with most of what Mr. Muntz has to say. While I do not know just what he has in mind when he speaks of a planned national economy, I would suggest caution. Under war conditions a wide extension of government control would seem inevitable, but it should be applied with discernment. Too often it results in the building up of a huge bureaucracy usurping the functions of management and creating abuses far worse than those it was designed to correct. We can, however, work wonders merely by using a little intelligence in our public works programmes and in the levying of taxes. Our form of government, for example, with its divided and conflicting authority between the provinces and the Dominion is a relic of the horse and buggy days. What galls one is the ever-increasing exactions of the provinces and municipalities when money is so badly needed for prosecuting the war. I would suggest that Mr. Muntz elaborate his views in a paper in the *Journal*.

[6] Chief Engineer, The Canadian Bridge Company, Limited, Walkerville, Ont.

With Professor Young's comments I am in hearty agreement. It is not so much the high wages of the railway running trades that are objectionable as the working conditions imposed by the unions that force the employment of two men where one would do. This fallacious principle finds widespread adherence particularly in times of depression and among those who should know better. Pushed to its logical conclusion it would mean a reversion to the conditions existing in the Middle Ages. The powerful railway brotherhoods have a lot to answer for and a paper in the *Journal* dealing with their agreements might go far to remedy the abuses and might even lead to a more enlightened policy on the part of the unions themselves.

Unfortunately the text of Professor Jackman's contribution is not available. Without having studied the question I would be inclined to agree with his conclusions that the St. Lawrence waterway is economically unsound but I must take strong exception to the chief argument that he used to build up his case, *viz.*, that such works usually cost several times the amount estimated. The estimates in this case, I presume, were concurred in by the engineers of the Hydro-Electric Power Commission of Ontario. A company with which I am connected built a large water power plant a few years ago jointly with the Commission, and I would point out to Professor Jackman that the works were constructed for substantially less than the estimates prepared by the very same engineers. We engineers cannot be blamed if we are not given an opportunity to revise our estimates when the scope of the work is extended or when economic conditions change or if the construction is used as a vehicle for graft.

To Professor Legget and Miss MacGill I would point out that far from being a socialist I am a reactionary, although possibly an insurgent. I have little faith in the Government's ability to operate any kind of business efficiently, although I recognize that examples can be found of government undertakings that are well run, as also of companies that exploit either their employees or the public. I regard the profit motive as indispensable for advancement as only by adequate financial reward for commerce and industry can new capital be obtained for expansion of facilities. The efforts of employer and employee alike should be directed toward the more efficient use of labour as by this means wages can be increased or the selling price of the product reduced, and it is the level of wages relative to the price of goods that determines our standard of living. Co-operation should be the keynote rather than the class warfare theory of Karl Marx.

Far from having, as Professor Legget, says, "a natural desire to have government intervention and public control exercised for the good of the country as a whole," I am skeptical regarding its effectiveness for that purpose. In my view, progress comes about through a process similar to that of natural selection in the field of biology. Only those communities providing ample scope and adequate reward for individual initiative can be truly progressive, but under war conditions we must sacrifice progress for victory. The survival of the fit is then raised from the plane of the individual to that of the nation. All brands of socialism, whether it be the National Socialism of Germany, the communism of Russia or the syndicalism of Spain, imply the social organization of the ant hill. However repugnant this may be to most of us in peace time, it has obvious advantages for winning a war. Through co-operation and self-discipline we should therefore strive for that same unity of purpose and intensity of effort that totalitarian states achieve through regimentation. We cannot be half in the war and half out of it.

MINERAL DEVELOPMENT NORTH OF 54°

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Paper presented before the Calgary Branch of The Engineering Institute of Canada, February 1st, 1940

Introduction

In southern Alberta we are apt to lack a proper appreciation of the "Empire of the North"—a term frequently applied to the great northland of Canada, lying north of latitude 54 degrees, and especially to that part tributary to central Alberta. An attempt will be made to review briefly the mineral development that has occurred in this region, and to give some impressions obtained during a personal visit two years ago over a small area of some 200,000 sq. mi. between Edmonton and the Arctic ocean, where the entire population was approximately 1500 in 1937, or about one person for every one thousand square miles in the Northwest Territories.

In these days of rapid air transportation there are really no remote places on the earth. Perhaps we should revert to the Indian method of describing distance by suns or days of travel instead of miles. One can leave Montreal in the evening, have breakfast in Lethbridge, lunch in McMurray, supper at Great Bear lake and reach the Arctic coast before sunset or midnight, because there is no darkness in the north during June and July.

In July, 1937, during a return trip from Edmonton to the Arctic ocean at Coronation Gulf, our aeroplane was only twenty-nine hours off the ground and the distance was 2800 miles. All the mining centres in the north were visited. In spite of bad weather, and a forced landing in Great Slave lake the trip only took ten days. In 1789, Alexander Mackenzie had 41 days of travel from Fort Chipewyan to the mouth of the Mackenzie river. He made the return trip against the current in 61 days, therefore taking 102 days to make the complete journey. Some of our pioneer northland pilots have followed approximately the same route as that of Alexander Mackenzie, and have made the round trip in about one day. This factor—accessibility of a region—is very important when considering the future mineral development of an area like the Canadian northland.

The mineral industry in Canada is in a healthy condition. The value of Canadian mineral production recorded an all-time high in 1939, amounting to $470,179,000, or approximately $1,288,162 per day, of which the metallic minerals represent about 70 per cent. The Northwest Territories tributary to Alberta are being developed rapidly. In 1939, the value of minerals from the north, radium ores, gold, silver and petroleum from Fort Norman, amounted to approximately $18,000 per day. With the exception of petroleum practically all of the metals were brought out through Edmonton. The war situation is almost certain to affect prospecting activity for the time being, but the mining companies that have become established, and the mill installations now under way at new properties, make it likely that production will be increased during the current year. There are at present four producing mines. Three new properties are being developed and mills may be erected at these during 1940.

Canada in the last fifty years has produced minerals to the value of over six billion dollars, of which more than one-half has been from Precambrian rock and more than one-third of that value has been produced from the Canadian shield.

Physical Features of the Region

The first important geographic fact regarding the northwest territories is that the drainage of the entire area is northward into the Arctic ocean through the Mackenzie river and its tributaries. The height of land to this northern drainage occurs about 40 miles north of Edmonton, at an elevation of about 2300 ft. above sea-level. As the straight line distance to the mouth of the Mackenzie river is 1240 miles there is an average slope of about two feet to the mile. The most southerly point in this drainage is Sunwapta Pass (Elev. 6775 ft.) on the Jasper-Banff highway, 65 miles southeast of Jasper at the head of the Athabaska river drainage.

A dominant physical feature in Canada is the "Canadian Shield." This is a U-shaped area of approximately 1,825,000 sq. mi., extending around Hudson's Bay. This area is also referred to as the "Precambrian" shield because most of the rocks in this physical unit are Precambrian in age. The term "shield" refers to the shape of the area.

West of the Precambrian shield and extending west to the Mackenzie mountains is the Mackenzie lowland, which includes that part of Alberta and the Northwest Territories from the west end of lake Athabaska north to Great Slave and Great Bear lakes and to the Arctic coast. This physical unit is not much lower than the western edge of the Precambrian shield, but the surface is more regular and the lowlands are underlain by much younger rocks. The only mineral development in this lowland at present is the Fort Norman oil field which will be discussed later.

As the entire mineral development in the north has been in the Canadian shield, it is in order to indicate the importance to Canada of this great area of Precambrian rock, representing as it does one half of the whole of Canada.

Mineral Importance of Precambrian Shield

Attention was first drawn to the mineral possibilities in the Precambrian shield almost one hundred years ago by Sir William Logan, the first geologist in Canada. He organized the Geological Survey of Canada in 1842, and in his first report states "The primary (Precambrian) rocks, however, most of which are still covered with forest, will probably constitute the metalliferous portion of Canada." How true are these words, uttered ninety-eight years ago!

Since that time, only the southern margin of the Canadian shield has yet been examined in detail, and on this margin of the shield have arisen the mining centres of Sudbury, Cobalt, Porcupine, Kirkland Lake, Rouyn, Long Lac, Red Lake, Flin Flon, Goldfields, Yellowknife, Eldorado (Great Bear lake) and numerous other smaller mining centres.

The growth of this "mining empire" of the north is shown in the following:

	1928	1938	1939
Number of companies in production	1	31	36
Daily milling tonnage	150	12,505	15,675
Production	$409,571	$37,175,996	$45,000,000
Dividends paid	—	$ 7,869,385	$ 9,430,831

Canada's mining industry has passed the youthful stage and is fast growing up. Frequently it has been said that "the surface of the Canadian shield has scarcely been scratched." It must, however, be admitted that the scratching has been beneficial, since the gold recovered from the Canadian shield to date has had a value of over one billion dollars.

It is just 73 years ago, August 15th, 1866, that gold was first discovered in Ontario. In 1939, Canada produced 5,045,766 ounces of gold, and the bulk of this came from the Precambrian rock, but gold is not the only important mineral in the shield.

Real mining development in the Canadian shield may be dated from fifty-six years ago. In the autumn of 1883, a rock cut made on the location of the first transcontinental railway exposed indications of a mineral deposit in Ontario and the

Sudbury nickel deposits were discovered. This unique deposit has produced almost three-quarters of a billion dollars worth of nickel, platinum and copper metals.

The second great mineral deposit in the Canadian shield was discovered at Cobalt in 1903, and in the succeeding 28 years pure silver was produced from this deposit at the average rate of one and three-quarters tons for every working day.

Up to the end of the first decade in this century very little gold had been produced from the Precambrian shield, in fact there was no marked enthusiasm as to the gold prospects in this part of Canada. It was in 1909 that a professor in an eastern university is reported to have told his class of young budding mining engineers that "there is no gold of importance in Canada. The veins are small and of no economic importance whatever." It was later in the same year that the world-renowned Porcupine gold deposits were discovered, which in the past thirty years have produced gold to the value of nearly four hundred million dollars from mines within an area of approximately three square miles. This was the beginning of the golden era in Canada. Two years later the second great gold deposit was opened up in the Kirkland Lake district, from which two hundred million dollars in gold have been added to the wealth of Canada. Considerably over half of the gold produced annually in Canada comes from two small districts of Porcupine and Kirkland Lake.

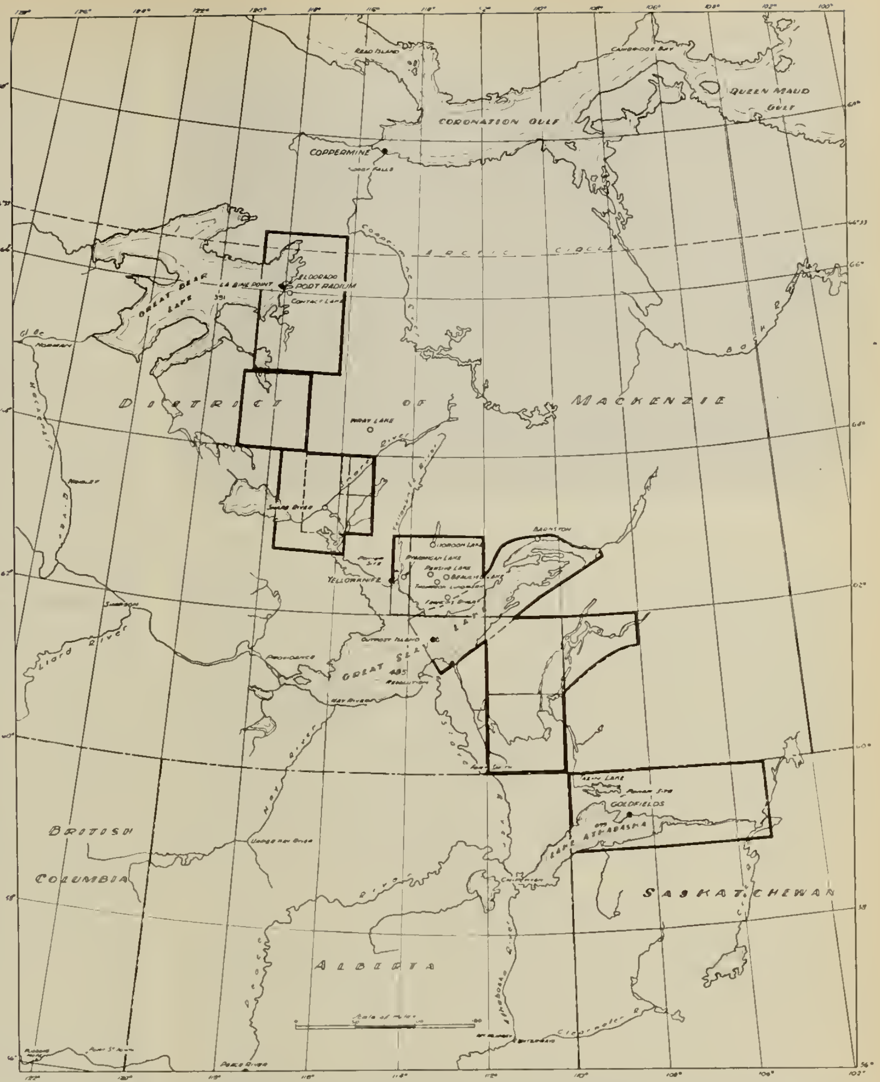

Fig. 1—Map showing the locations of mineral development and mining centres in the Northwest Territories and at Goldfields. The various areas indicated by heavy black lines have been mapped by the Geological Survey of Canada since 1931.

The national importance of the Precambrian shield is abundantly shown by the fact that considerably over one and a half billion dollars in metal wealth has been extracted from the small area in the Canadian shield, represented by the nickel-copper deposits of Sudbury, the silver ores at Cobalt, and the gold ore at Porcupine and Kirkland Lake, largely within the past third of a century. In addition to the value of the metals produced, the mines within this small area have contributed half a billion dollars in dividends, a fair portion of which remained in Canada.

Within the past fifteen years another vast natural store of gold and copper has been unlocked on the fringe of the shield in northwestern Quebec in the Rouyn district. The Noranda mine was started twelve years ago last December. Since that date this mine has paid out about twenty-five million dollars in wages and salaries. This mine has become the second largest producer of copper in Canada, with a yearly output of all metals of about twenty million dollars.

Continuing along the fringe of the Precambrian shield to the northwest across Ontario and Manitoba, scores of small mines have been opened up on deposits of unknown extent. In the Flin Flon district, on the boundary between Manitoba and Saskatchewan, an immense deposit of zinc-copper-gold ore has been proved and the first commercial mining enterprise in Manitoba, started in 1930, has become Canada's third largest metallurgical undertaking.

These brief historical notes on the mineral development in Quebec, Ontario and Manitoba are given to emphasize how logical it is that mineral deposits should exist along the corresponding southern margin of the Precambrian shield farther to the northwest, regardless of latitude.

The southern edge of the Precambrian shield extends from Flin Flon in a northwesterly trend to the west end of Lake Athabaska and then across Great Slave lake, along the north arm of the lake, passing close to the east end of Great Bear lake. This contact extends north of the Arctic circle and reaches the Arctic ocean about 150 miles east of the delta of the Mackenzie river. There is no sharp line of demarcation between the Precambrian shield and the lowlands to the west underlain by younger rocks, except in the north arm of Great Slave lake where the rocks on the east are Precambrian and those on the west are lower Palaeozoic in age. The south margin of the Precambrian shield from Lake Athabaska to the Arctic ocean is a low plain, quite irregular in profile with innumerable lakes and low rounded ridges and knobs. It is common to find hills rising abruptly as much as 300, 600, and even 800 or 1,000 feet. Even the lake levels vary in short distances. The water levels in adjoining lakes often less than half a mile apart might vary as much as 200 or 500 feet. The reason for lakes at different elevations is because the basins holding the water have been gouged out by ice action in the glacial period.

Mineral Development in the Northwest Territories

Mineral development in the north is of recent date and it has been rapid. In 1771 Samuel Hearne discovered native copper deposits on the Coppermine river. During the overland trek to the Klondike in 1898-99 placer gold was reported on the Liard river. In 1919-20 the Northwest Company, subsidiary of the Imperial Oil Company, discovered the Fort Norman oil field, and the Atlas Company found a lead-zinc deposit on the south side of Great Slave lake. It was not until the discovery of the pitchblende

Royal Canadian Air Force

Fig. 2—Mine at Goldfields.

deposits at Great Bear lake ten years later, that the real search for minerals began. In 1935, the Yellowknife, Outpost Island and Goldfields deposits were found.

The oil field 50 miles below Fort Norman has been operated by the Northwest Company, a subsidiary of the Imperial Oil. Fuel oil has been supplied to the Great Bear lake mines for several years. With the increased demand for fuel oil, the supply has been increased by drilling new wells. In 1939, No. 3 well was drilled to the oil horizon at 1,837 ft. and other wells will be drilled this year. A new refinery unit to the plant was completed in September, 1939. This most northerly oil refinery in the world, within 60 miles of the Arctic circle, is now equipped to supply a larger demand. The price of gasoline has been reduced to 37 cents per gallon, and fuel oil to 13 cents per gallon. The Dominion Government has waived the payment of royalty until January 1st, 1944. In 1939, about 20,000 barrels were produced from this field.

The petroleum possibilities in the Mackenzie basin have not yet been exhausted. There is much unprospected territory adjacent to Franklin mountains and east to Great Bear lake, and also around Great Slave lake, along the Hay river, and even in the northwest corner of Alberta. A good oil field close to water transportation in the north would to-day be as valuable as a gold mine.

The oil possibilities have not yet been determined along the new 400-mile winter highway from Grimshaw to Hay River Post on Great Slave lake, of which 325 miles are in Alberta and 75 miles in the Northwest Territories.

Mineral development in the Northwest Territories dates from May, 1930, when Gilbert Labine discovered pitchblende at the east end of Great Bear lake. While flying over this shore his attention was turned to the high coloration on the rock. This discovery was not purely accidental, because Dr. J. M. Bell in his report of 1901 mentioned that the greenstones east of McTavish bay are mineralized and the surfaces "are often stained with cobalt-bloom and copper-green." Gilbert Labine knew the relationship of cobalt-bloom and native silver, and it was to investigate this reference by Bell that Labine made his aeroplane trip into this region. In 1931 he returned to prospect the pitchblende showing.

Eldorado Mine

The Eldorado mine was opened in 1932 within a few yards of where the discovery was made. This mine is situated about 30 miles south of the Arctic circle. Production from the mine has progressed steadily since a process for the recovery of the radium and uranium salts as by-products was worked out. Production figures are not published, but according to official statements, about 8 grams per month of radium are being produced. From 1,100 tons of concentrates shipped during a twelve month period, radium and uranium salts recovered exceeded a value of $4,000,000 with radium valued at $25,000 per gram. Associated with the pitchblende are a large number of minerals including especially silver, nickel, cobalt, bismuth and copper. One of the veins carried 9,000 ounces of silver to the ton in some places. The ore occurs in three well-defined veins dipping steeply to the northwest. Their width varies from one foot to about fifty feet. In some parts of the veins 10 to 12 in. of pure pitchblende occurs. The mine is worked by an adit driven in from No. 1 to crosscut No. 2 vein, then a shaft was sunk from adit level to 800 ft. with levels driven at 125, 250, 375, 500, 650 and 800 feet. There is a No. 2 shaft about half a mile east of the mill.

The ore is hand picked for pure pitchblende and then the pure pitchblende concentrates are sacked and the silver concentrates are also sacked for shipment. The cobalt and nickel concentrates are stored. Copper is not recovered, but it is stated that the copper could be economically recovered if the price of copper is above 16 cents a pound. The pitchblende and silver concentrates are shipped across Great Bear lake, down the Bear river and up the Mackenzie to Smith, portaged to Fitzgerald, then by water to McMurray, and by rail to the Port Hope refinery, 4,000 miles from the mine. As the recovery process requires about three tons of acid to treat one ton of concentrates, it is more economical to ship the concentrates to the acid supply.

On account of the value of radium in the relief of human suffering and pain, this mine can justly be regarded as one of the most valuable in the world. It is also encouraging to know that there is no sign of depletion of this ore body, in fact the ore reserves continue to increase as development work progresses.

It is quite possible that important pitchblende deposits may be proved in other parts of the north. Pitchblende occurrences have been discovered in the vicinity of Eldorado and at Hottah lake, Yellowknife and even at Lake Athabaska. Attempts were made last summer to locate pitchblende with the Geiger counter which is a large type of the instrument used to locate small quantities of radium that have been lost. It is believed that more field tests will be made this year in the region of Great Bear lake.

Contact Lake

The second mine brought into production in the Northwest Territories was that of the Bear Exploration and Radium Company—at Contact lake, eight miles east of Eldorado. The mine has been opened up for 200 ft. below the adit level. It is a silver mine. On account of the slump in the price of silver, the mine and 25 ton mill were closed down on July 14, 1939, for an indefinite time, depending largely upon the market. However, renewed activity in silver mining in the north cannot be expected until there is an upward change in the price of silver. Some showings of pitchblende were obtained in this ore at Contact lake. A Geiger counter survey has been made to locate a larger orebody but the results have not been published.

Yellowknife Gold Area

The Yellowknife district is situated on the east side of the north arm of Great Slave lake. The name is derived from the aboriginal Indian tribe called "Yellowknives" who made their implements of the yellow colored native copper from the extensive deposits that occur near the Arctic coast adjacent to Coppermine river.

Yellowknife is the most active mining district in the Northwest Territories. There are two gold producing mines, the Con-Rycon and the Negus; three mines that will most likely start production in 1940, the Giant Yellowknife, the Ptarmigan and the Thompson-Lundmark. In addition there are several centres tributary to Yellowknife where important discoveries have been made, some of which are likely to develop into mines in the near future.

In July, 1937, there was no town at Yellowknife, just one building and a few tents. To-day there is a townsite with

246 townsite lots available by lease for five year periods. Ninety-eight lots have been taken up. On October 1st, 1939, Yellowknife was made an administrative district with a circular area of 3½ mi. radius or 38½ sq. mi., governed by five members, three appointed by the Commissioner of the Northwest Territories and two elected. A road almost half a mile in length has been constructed in the town. There are five general stores, one drug store, one liquor store, two missions, a school, an up-to-date theatre, with twice-a-week change of pictures, a sub-mining recorder's office, and four transportation company facilities. The population is about 1,000. Yellowknife is now an established mining town.

The Con gold mine, two miles south of Yellowknife, was brought into production in September, 1938, by the Consolidated Mining & Smelting Company on the completion of a 100 ton amalgamation-cyanidation mill. The first gold brick was poured in September 1938, and the mine is producing continuously. In 1939, gold to the value of approximately one million dollars was shipped. A small amount of silver is recovered with the gold. There is a three compartment shaft sunk to 520 ft. with levels at 125, 250, 375, and 500 feet. The company obtained a sixty per cent interest in the adjacent Ryan property, now known as the Rycon mine. There is underground connection on the 500 ft. level, and the Rycon ore is taken out by a 2,000 ft. drift to the main Con shaft. A crew of 145 men at the Con are employed to operate the mine, mill and the camp and about 22 men on the Rycon mine. The gold occurs in quartz veins in a volcanic series. The tenor of the ore is about an ounce in gold. A contract has been given for the development of an hydro-electric project with a capacity of 4,000 h.p. The site is 18 mi. north of the Con mine near Prosperous lake where there is a 96-ft. drop between lake "B" and Prosperous lake. When this development is completed it will reduce power costs over fifty per cent. This will be an important factor in developing properties that can not otherwise be operated at a profit.

The pouring of the first gold brick at the Con at Yellowknife marks the beginning of the gold mining industry in the Northwest Territories and the power development now being considered for the Con mine will also be a first milestone in hydro development in that region.

The second gold producer in the Territories is the Negus mine adjacent to the Con on the south. A shaft has been sunk and levels opened at 100, 200 and 300 feet. A 60 ton cyanidation mill was completed just a year ago and the first gold brick was poured in February, 1939. This mine is producing about $50,000 per month. The ore is free gold in quartz veins that extend irregularly through the same band of volcanics as on the Con and Rycon properties. The Yellowknife area is reported to be producing about $180,000 per month.

Mines Near Production

The Giant Yellowknife claims owned by the Bear Exploration and Radium Limited (B.E.A.R.) are situated three miles north of the Con and one mile north of Yellowknife. After a diamond drill survey, a shaft has been sunk 126 ft. and a level started. Some very spectacular ore occurred on the surface. About 60 tons of high grade gold ore were shipped to Trail, and the values recovered have almost met the cost of development. Another 70 tons of high grade have been cobbed, some of it reported to carry 12 ounces per ton in gold. The results have been encouraging and it now looks like a future mine. A small mill may be installed this year. Ore at Yellowknife must carry over $15 in gold per ton to be worked at a profit.

The Ptarmigan Mines Limited formed by the Consolidated Mining & Smelting Company are developing the Lily-Jack claims about eight miles northeast of Yellowknife. The shaft is 620 ft. deep and levels have been driven at 150, 300, and stations cut at 450 and 600 feet. There is a crew of 60 men employed. A well-defined vein 12 ft. wide has been

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Fig. 3—Con Mill, Yellowknife.

proved to a depth of at least 300 feet. This property is considered to be beyond the prospect stage and plans are being prepared for a 200 ton mill.

The Thompson lake discovery in 1938, 30 miles northeast of Yellowknife, has been opened up by the Thompson-Lundmark Gold Mines. The surface showing was most spectacular. Two shafts have been sunk, one on the Kim vein to a depth of 300 ft. with two levels; the other in the Fraser vein to a depth of 150 feet. There is a crew of 50 men employed. The values have not been as high at depth, but preparations are being made for the construction of a mill. The mine is closed down at present. A road has been constructed from Yellowknife bay to the mine.

Other Prospects

In 1937, rich gold quartz was discovered at Gordon lake, 50 miles north of Yellowknife. The Camlaren Mines Limited developed a gold mine to a depth of 360 feet. A 70-mile winter road was built between Yellowknife and Gordon lake. The values were not high enough and the property was closed down in December, 1938.

At Pensive lake, 40 miles northeast of Yellowknife, a gold discovery was made in 1938, and some work was done by Dome Mines, but the work was abandoned in, July 1939. Since then a small 2 ton pilot mill is being operated by Harry Ingraham. A remarkable recovery is reported which proves the value of this ore.

There is a group of about a dozen small islands forming an outpost to hundreds of islands, small and large, at the east end of Great Slave lake. This group is known as Outpost islands. This is an ideal spot for a summer vacation—good fishing, cold swimming, and lots of fresh air. At the east end of one of these small islands scarcely wider than the shaft house, is the mine. The shaft is about 425 ft. deep and levels have been developed at 50, 125, 200, 325 and 425 feet. The Timmins Corporation dropped their option on the property in March, 1938, because the gold values were not encouraging. Since that date the parent company has reopened the mine. In addition to the gold, both tungsten and tin have been discovered. According to the report of a competent mining engineer, the ore carries about one percent tungsten trioxide (valued at present prices at $25 per ton), and $19.25 in gold. The test on a 1,500 lb. sample of ore contained 1.18 percent tungsten trioxide and 0.20 percent tin in addition to the gold. The mineralization is along a 1400 ft. shear zone, but only on a short part of this zone has the ore been tested for tungsten, which is one of the important war metals in demand to-day.

At several other points north of Great Slave lake promising discoveries of gold have been made. In 1938, gold was discovered at Wray lake, 135 miles north of Yellowknife; also on Snare river 45 miles north of Fort Rae; and on Beaulieu river and François river east of Yellowknife arm.

At Snare river the vein is up to 100 ft. wide and it has been traced for 25 miles north and south. Dr. Joliffe of the Geological Survey of Canada has stated that any kind of rock, either volcanic or sedimentary, may contain gold in the Precambrian if the rock structure is suitable for mineral deposition. This is a most encouraging statement regarding the occurrence of gold in the Northwest Territories.

At Beaulieu river there is a vein 3 to 4 ft. wide forming a "hump" at the top of a fold in slate and greywacke. The vein is dipping vertically. A shaft has been sunk 350 ft. in 1938 and the gold content varies from 2.09 to 22 ounces to the ton of ore. On François river promising gold and nickel-bearing rocks have been found. Several new mineral discoveries were made in 1939. These include those at Desperation lake 70 miles east of Yellowknife, at Buckham lake,

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Fig. 4 — Eldorado experiences a building boom. The log structures are disappearing. Fuel oil tanks in background at left.

Tumpline lake, Mystery lake, and the most recent is copper ore in the form of high grade chalcopyrite ore on Barnston river close to Great Slave lake.

All of these mines, near mines, and prospects have been discovered along the fringe of the Precambrian shield, and within 75 miles of the navigable waters of Great Slave lake. The results to date have been encouraging even though it must be expected that all prospects will not be developed into mines in the future. New discoveries can be expected as intensive prospecting proceeds. Every encouragement should be given to the prospector in this northland in the way of funds and of facilities to carry on his work, because the prospector is indispensable in the opening up of this or any other mineralized part of Canada.

Goldfields

Goldfields is in the province of Saskatchewan, 120 miles east of Fort Chipewyan. The town of Goldfields has grown up on an embayment on the north side of the lake near the east end, where five years ago there stood a "dilapidated unused fish house" and a trapper's cabin occupied by Gus Nyman and his dog. The Box mine operated by the Consolidated Mining and Smelting Company is situated on the west side of a bay opposite the town. A 1,000 ton mill is in operation. The first gold brick was poured on August 15th, 1939, valued at $39,000. The mill has been in continuous operation since August, but it is not being operated at full capacity according to reports. The company has completed the hydro-power plant near Wellington lake, 22 miles west of the Box mine. The water from Tazin lake has been diverted to Charlot river drainage by means of a tunnel 1,100 ft. long. The natural head is 60 feet. The initial installation at the plant is 3,300 h.p., and the capacity of the plant can be doubled with an additional unit. The ore in the Box mine is low grade, reported to be less than $5.00 per ton. Commercial operation of this grade of ore depended upon cheap power. The hydro-electric power costs are about $50 per horsepower-year whereas Diesel power is about three times that figure. The values are in gold which occurs in quartz veinlets close to the contact of granite and quartzite. An expenditure of approximately two million dollars has been incurred in the power development and the mill. This assures continuous operation of the mine for some years, with the chance of higher grades of ore being discovered in this mine or in the district.

The Athona mine is about one mile south of Goldfields on the shore of Lake Athabaska. About 1,223,000 tons of $3.00 ore have been blocked out. The mining costs are stated to be $1.50 per ton. The 10 ton sampling plant is equipped with 310 h.p. Diesel engines, but the cost of Diesel power is too high for this grade of ore. The mine is closed down. It is possible that hydro-electric power may be supplied when surplus power is available from the Consolidated Mining and Smelting Plant. This would reduce the power costs about two-thirds.

Future Outlook

The mining activity in the north can be gauged by the number of claims. According to official reports there were 7,670 mineral claims in good standing in the Northwest Territories at the beginning of this year. There were no less than 5,000 claims in the Yellowknife alone. This indicates the attention that is being given to this part of the north.

Only a small part of the north has been surveyed geologically. It is necessary to have the area mapped before the geology can be interpreted. In this respect the Dominion Government has photographed over 165,000 sq. mi. from the air, and maps on most of this area have already been published. Until a country has been mapped geologcially, it is not possible to prospect it efficiently.

The future of the mining industry looks bright, but is not necessarily spectacular. It is only 9 years since Labine discovered pitchblende at Great Bear lake, and only 5 years since gold mining started in the Yellowknife area. But the mining development to date has proved that mining can be carried on profitably in the Northwest Territories, even within the Arctic circle. Our thanks for this northern development are due to the courage and optimism of the pioneer mining men and the prospectors, and above all, to the brave and never-tiring men of the air.

Royal Canadian Air Force

Fig. 5—Negus Mine Building, from the Bay, Yellowknife, N.W.T.

Near North Development

As regards mineral development in the near north, it may be noted that at Waterways, Alberta, adjacent to McMurray, the Industrial Minerals Limited, have proved by drilling a bed of pure salt 211 ft. thick. Considerable salt has already been produced from this basin, but the plant has been remodelled and enlarged during the past year and will be operating on a larger scale almost immediately.

The bituminous sands still remain undeveloped, but it is reported that the plant of the Abasand Oils at Waterways will be in operation early this year to supply fuel oil to Goldfields and possibly also to the Yellowknife mines.

SOME DEVELOPMENTS IN ALLOYS DURING THE LAST TWENTY YEARS

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Abstract of paper presented before the General Professional Meeting of The Engineering Institute of Canada, at Toronto, Ontario, on February 9th, 1940.

The complete paper as prepared by Dr. Ellis for the Annual Meeting, along with discussion and the author's reply, will be available in July as a technical supplement to the Journal. It may be secured by members at a price of fifty cents per copy and by non-members at seventy-five cents per copy, with a special price in lots of ten or more.

This paper makes a valuable contribution to the literature of metallurgy and the Publication Committee has decided that its unusual merit justifies this special printing.

This paper describes a few of the outstanding contributions to the art of engineering metallurgy during the past twenty years. Some of these are dealt with briefly in the introduction to the paper, which emphasizes the importance of the interaction of metallurgists and engineers in this field. It is remarked that the metallurgist has almost reached the point where he can "design" his alloy for his job.

Attention is directed to the development of age-hardening alloys, the forerunner of which—Duralumin—was developed in Germany by Wilm in 1909. Wilm was ignorant of the mechanism of the hardening of Duralumin, the original explanation of which was given by Merica and his colleagues at the U.S. Bureau of Standards just twenty years ago. They suggested that the age-hardening of Duralumin was caused by the precipitation of $CuAl_2$ in a state of high dispersion from a supersaturated solid solution of copper and aluminum. They postulated that the degree of dispersion of the precipitate was of fundamental importance, the maximum hardness being obtained at some intermediate degree of dispersion which they referred to as "critical dispersion." This theory, as it relates to sterling silver, is discussed at considerable length, the point being made that aging is not so simple a process as originally believed. The vital effect of Merica's theory upon metallurgical progress is exemplified by a number of examples of aluminum-, copper-, iron-, magnesium- and nickel base- age-hardening alloys which have been "invented" during the past two decades. The mechanical properties of these alloys in various states are tabulated, emphasis being placed upon the effect of aging. The alloys dealt with are as follows:

Aluminum Base

Aluminum Company of Canada, Alloy AC-55S.
Aluminum Company of Canada, Alloy AC-13S.

Copper Base

Beryllium Copper (The American Brass Company, Riverside Copper Company).
Cupaloy (Westinghouse Electric and Manufacturing Company).
Nickel Bronze (developed by International Nickel Company Incorporated).

Iron Base

Iron-molybdenum alloys.
Iron-tungsten alloys.
In this connection it is pointed out that some of the magnet alloys depend for their properties upon treatments involving quenching and aging.

Magnesium Base

Magnuminium 199, to meet specification D.T.D. 59A (High Duty Alloys Ltd., Slough, England).
Magnuminium 200, to meet specification D.T.D. 136A (High Duty Alloys Ltd., Slough, England).

Nickel Base

"Z" Nickel; International Nickel Company, Incorporated.

The importance of recent studies of the function of alloying elements in steel is referred to in its relation to the development of a number of relatively cheap ferrous alloys, amenable to fabrication by prevailing methods and possessed of high yield strength in the rolled or normalized condition, weldability and resistance to corrosion. Resistance to corrosion is particularly important, since it is essential that the lighter sections in which these modern steels are used shall withstand corrosive attack for longer times than the heavier sections of ordinary steel they are designed to replace. The ranges of composition and the mechanical properties of a number of high yield strength low alloy steels, as reported to Cone by a number of American producers, are given. The contributions made by Canadian metallurgists to our knowledge of these steels are dealt with at some length. It is remarked that one of the most important of earlier experiments in the use of such steels was conducted in the Dominion when silicon structural steel members were employed in the Quebec bridge.

Less than twenty years ago the term "stainless steel" described a ferrous alloy containing about 0.35 per cent of carbon and 13.5 per cent of chromium. This alloy had been successfully commercialized by the Firth Company at Sheffield some few years before. Its successful commercialization led to the introduction of a number of stainless steels which were under investigation concurrently with Brearley's alloy. These developments are considered historically with the view of stressing the fact that at least sixty different compositions of so-called stainless steels are available for practically every application requiring a heat or corrosion resistant material. Tables are given showing sixteen basic types whose value has been established as a result of extended use. Reference is also made to the purposes for which special elements, such as aluminum, columbium, molybdenum, etc., are added to these alloys. The heat resisting steels are mentioned in passing.

A section of the paper is devoted to permanent magnet alloys. Four main groups are referred to:

1. Plain alloys of iron and carbon, used in the quenched state.
2. The chromium, molybdenum and tungsten steels.
3. The high-cobalt steels.
4. The iron-nickel-aluminum alloys, with or without copper.

The gradual development of these alloys during the past twenty years is discussed and particulars are then given of the properties of some commercial magnet steels and some age-hardening magnet alloys recently developed.

The paper concludes with a review of the present situation in regard to permanent mould and die casting alloys. The aluminum-, magnesium-, and zinc-base alloys employed in this connection are discussed in some detail and information regarding their properties and uses is tabulated. Examples of the die casting art are given, which serve to support the contention that modern die-casting, particularly zinc-base, alloys are of such high quality as to merit the name 'engineering alloys.'

Abstracts of Current Literature

Contributed abstracts of articles appearing in the current technical periodicals

ESSENTIALS OF A FIGHTER

Design Requirements

By Brian Worley, *Trade and Engineering*, London, Eng., April, 1940

Fighters are all the rage now. Everybody has become expert on the relative merits of Hurricanes, Spitfires, Curtisses, Moranes, Messerschmitts, and Heinkels, and glib untruths are told about them all. Of course, it is difficult to be completely truthful when one does not know all the truth, but there are certain fundamental things which if realized would enable fairly reasonable comparisons to be made. In this article, which is a shortened form of an article which first appeared in the March issue of the monthly technical magazine *Aeronautics*, these things will be examined.

The uses of single-seat fighters are well known and are:—

1. Interception and destruction of enemy bombers.
2. Destruction of convoy fighters.
3. Destruction of enemy single-seaters, when such are used for protection of reconnaissance patrols.

To do these jobs they must be able to fly fast, climb fast, and turn fast. Speed needs first attention. An aeroplane which cannot quickly overtake the fastest bomber on the other side is useless. A high price is paid for speed when it is bought at the expense of manoeuvrability, and unfortunately that is the easiest way to get speed.

There are two ways of looking at manoeuvrability:—

1. Time to change the attitude of the aeroplane. For instance, the time to bank to a given angle.
2. Smallest radius of turn which can be flown, or the time required to make such a turn.

Both conceptions will be examined to see what they really amount to. Time to bank to a given angle depends on the rolling moment of inertia of the aeroplane, which is mainly that of the wings, on the aileron banking force and on the aileron arm. It is interesting to note that although one can bank quicker on a small fast aeroplane than on a large slow type, the distance covered during banking depends only on the size of the aeroplane and not on the airspeed. Calculation indicates that the time to bank does not change rapidly with size.

From this it is obvious that aeroplanes of similar speeds, such as the fighters now opposing each other in France, cannot vary greatly in their manoeuvrability when considered from this point of view. The little Heinkel 112 and the Hurricane are the limiting sizes, the former being about 30 ft. span and the latter 40 ft. There ought to be about half a second difference in time to bank to 90 deg., the half second being in favour of the Heinkel. That is very little difference, and shows that the time to bank is not a true measure of manoeuvrability.

Time to Turn and Radius of Turn

It is known that manoeuvrability varies considerably with speed and loading, and hence one comes to a consideration of the radius of turn, and this will be found to be a much more productive line of attack. In a constant or steady turn the control effectiveness is not decisive, for the movement is steady and no control limits are involved. The time to turn (the bank is assumed to be vertical) depends on wing loading and speed and is limited by the amount of g or acceleration the pilot (or the aeroplane, if it is weaker than the pilot) can stand.

Now it so happens that the minimum radius of turn depends on the wing loading, there being for each wing loading a definite limiting minimum radius of turn no matter how fast it is flown. The faster a turn of given radius is flown, the quicker one gets round, and the greater is the g experienced. As the g is increased the minimum speed of turn is increased, because increase of g is the same in effect as an increase in wing loading.

A severe physical limitation enters here, because a seated pilot cannot stand more than about $6g$ before blacking out and becoming ineffective as a combatant. Fig. 1, which shows how time to turn and radius of turn vary with speed and wing loading, gives a sort of map across which one can shift one's troops, and by making various combinations see how the opposition can be outmanoeuvred. But before shifting imaginary troops we ought to take a look at actuality to find the location of real aeroplanes on the map.

The heavy line on Fig. 1 shows how actual British fighters have been located, and that line may be called the factual line. An important point is that manoeuvrability has been gradually becoming worse as time has gone on. In 15 years the time to get round a turn has risen from about 7 seconds to 11 seconds. Actually the times taken from the factual

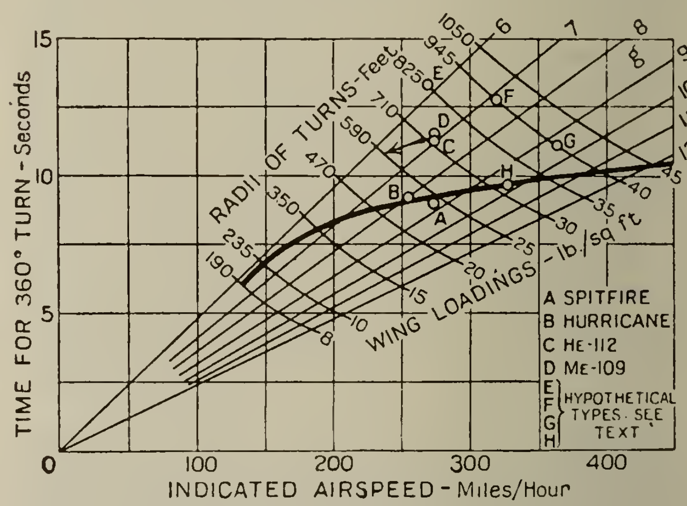

Fig. 1

curve cannot be attained because of g limitation, so the $6g$ line has to be used. The deterioration shown in Fig. 1 can be taken as the inevitable cost of speed considering our state of knowledge when the various types were built. The most striking thing about Fig. 1 is that the factual line (the heavy line) lies entirely below the $6g$ line. This means that the innate abilities of the aeroplanes cannot be used because of the limitations of the pilots' physiques. A 320 miles an hour indicated air speed machine with 30lb. per sq. ft. wing loading cannot do a turn in 9½ seconds because such a turn would produce almost $10g$. What, then, is the use of the extra speed, and why not design a slower aeroplane for a given wing loading or put up the loading for a given speed so that the curve of actual types conforms to the $6g$ curve ?

Here the opposition types, the Heinkel 112 and the Messerschmitt 109 must be considered. They have about the same speeds as the Spitfire, but owing to their higher wing loading they cannot get around a turn as fast. They are, in fact, not as good, owing to their higher wing loading. No matter how fast one can fly, if the wing loading is high, one is caught by the more lightly loaded aeroplane when manoeuvring. What the Germans should have done was to pull down their wing loadings to the British types and give away a little of their speed, moving more or less as indicated on Fig. 1 by the arrow.

These examples of the effects of increasing wing loading show that the suggestion to raise wing loadings for a given speed throws away very valuable manoeuvrability. The suggestions that the fact of the pilot being unable to withstand the *g* which the machine can produce is a reason to reduce speed is a red herring, for speed itself must be obtained. In fact the further the aeroplane lies below the 6*g* curve, the cheaper the speed has been bought. What must be had is speed, as stated at the beginning of this article, but it must not be got at the cost of too high a wing loading. Since high speed does not help manoeuvrability (as long as we are below the 6*g* line where we ought to be) and low-wing loading does help, every possible effort must be made to keep speeds up but not at the expense of wing loading.

Take-off and Landing

It is now fairly clear what is needed in regard to speed and wing loading, for we now realize the quantities involved and the effects of varing them. But there are still other points which may deeply affect design, and must be considered. For instance, the problems of take-off and landing are very important indeed. These points cannot be dealt with here in sufficient detail and it is difficult to generalize about them. What can be said is that if a fighter is designed for flight conditions, the take-off can be made quite good by the right choice of flaps and engine-airscrew combination.

The use of Fowler or Super-Fowler flaps will enable the take-off speed to be lowered to a reasonable figure and the use of contra-props and a gear shift for them can make sufficient thrust available without many secondary troubles. Another aspect of fighter performance is the climb, but if the speed is high enough for the wing loading chosen, the climb and ceiling will be quite good enough to deal with any opponents.

The necessity for a perfectly smooth surface no longer requires emphasis, but it is worth remembering that for present-day fighters the use of snap-head rivets will reduce speed by 15 miles an hour compared with a polished surface, that rough painting alone can cause 8 miles an hour drop in speed, and even badly countersunk rivets one of 5 miles an hour.

One great problem is that caused when the aeroplane speed approaches the speed of sound. At such speeds the drag begins to increase at a greater rate than the square of the speed, owing to compression effects, and exceptional care must be taken to keep local speeds over all parts of the aeroplane as low as possible. For instance, the airspeed over a sharp bump or around some corner will be much higher than the speed of the aeroplane as a whole. Bumps and corners must be minimized. One of the results is that bodies must be slim and wings thin, avoiding the sharper curves of fat shapes. Such thin sections for high speeds will be difficult to build and about all that can be said at present is that the wing must be made as thin as possible. Actual sections will probably have fairly sharp leading edges and the maximum thickness will probably lie fairly far back.

Another effect of nearing the speed of sound is a reduction of the best altitude of operation. The speed of sound is slower at altitude than at ground level, owing to the drop in temperature. Thus one gets nearer to the speed of sound for a given speed at great heights than at ground level, and so the drag increase sets in at lower speeds at altitude than at ground level. It is obvious that if one has to fly very near the speed of sound, the highest speed will be attained at ground level, where the speed of sound is highest.

These notes end with the layout of a cast fighter to be built around two engines. Let us not be optimistic or imaginative. Let us try to stick to the heavy line of Fig. 1 and ask for 450 miles an hour at 20,000 ft. That gives an indicated air speed of 328 miles an hour and a wing loading of 31 lb. per sq. ft. (H. on Fig. 1). Such an aeroplane is quite practical, but comes out rather larger than one might have expected.

It needs 2,300 b.h.p. to drive it and the weight comes to a little over 11,000 lb. Before going further it must be pointed out that the size of this aeroplane depends to a considerable extent on how clean it is. In this case, in an effort not to be optimistic, it has been assumed to be no cleaner than the existing standard Spitfire according to published figures. The bigness of the aeroplane is absolutely necessary unless one could cut down the structure, the load, and the engine weight per horse-power. Structure and power weight cannot be cut down at present without seriously sacrificing safety and reliability, and it is necessary to carry a reasonable load so that the aeroplane is a real fighter and not a racer. In spite of its size this aeroplane is almost 100 miles an hour faster than the present German fighters and equally manoeuvrable.

The proposed aeroplane takes full advantage of twin-engined reliability and contraprops. The long nose also gives a reasonably long wheelbase for the use of a tricycle chassis, and is an advantage over the relatively short nose of the normal single-engined tractor type.

The conclusions one may draw from the above notes are:

1. The real manoeuvrability of an aeroplane depends not on size but on wing loading, and the lower the wing loading the better. The small aeroplane is not necessarily very manoeuvrable.
2. For the last 15 years our aeroplanes have become less and less manoeuvrable because of the urge for speed. This deterioration will continue but must be watched.
3. By means of the manoeuvrability graph (Fig. 1) we can compare the manoeuvrability of different types.
4. Our present trend of design appears to be sound and capable of being continued, but at the expense of faster aeroplanes being rather large.
5. If means are found of increasing the bearable acceleration (such as using a prone pilot) the size of aeroplane for a given speed and manoeuvrability can be reduced considerably. The smaller aeroplane would be cheaper.
6. The wing loadings of present German fighters are higher than they ought to be, and they are thus inferior to our fighters in manoeuvrability.
7. At high speeds, apart from smoothness of surface, we must strive for thin wings of low aspect ratio and long slim bodies.

BRITAIN'S 400 CLOSED COAL PITS

May Be Opened Up by World Demand

From Robert Williamson, London, Eng.

One half of the miners of Great Britain who were unemployed at the outbreak of war are now at work as a result of the Government drive to increase the peace time output of 240,000,000 tons a year by 40,000,000 tons.

Lord Portal, chairman of the Coal Production Council, is now touring British coalfields to speed production up to the full 280,000,000 tons required to meet the enormous world demand created by the blockade of German exports. When war began Germany was selling abroad some 24,000,000 tons a year and Poland 14,000,000 tons, almost half of which trade, it is estimated, has now been cut off by the British Navy.

France, Italy, the South American countries and overseas bunkering stations are all clamouring for supplies and inquiries are also coming in from Canada, Portugal, Greece, Egypt and Algeria. Italy lost 2,000,000 tons of coal when shipments from Rotterdam were held up: now she is second only to France as a buyer of South Wales coal and there is no doubt that she would take far more if it were available.

It is possible that the Government will now help to re-open many of the 400 mines which for economic reasons have been shut down since 1929. These and other measures are now being discussed with the coal owners and miners' leaders by the Coal Production Council.

ELECTRIFICATION OF THE GLION-ROCHERS DE NAYE RACK-RAILWAY

From *Swiss Technics*, Lausanne, March, 1940

Everybody knows, at least by its name, Montreux, the famous resort on lake Leman's shore. It is not only remarkably located as regards fine scenery but it also is a most important touring centre from which many excursions can be made in the surrounding Alps. Montreux and its vicinity are in fact the starting point of several mountain railways.

In 1883, for instance, took place opening to the public of a cable-railway from Territet (elevation 1,300 ft. above sea-level) to Glion (elevation 2,300 ft.)—first railway in the world having a 57 per cent gradient. So great proved to be its success that the company were induced to extend the track from Glion up to the Rochers de Naye (elevation 6,550 ft.). This rack-railway section was brought in operation in 1892. Steam locomotives hauled trains. Track length from Glion to Rochers de Naye is nearly five miles, maximum gradient reaches 22 per cent, curve radius is 88 yards, falling exceptionally to 55 yards at points. Rack is of blade Abt model. The gauge is 2 ft. 7½ in.

Since 1909, Glion is also linked to Montreux Central Station by an electric rack-railway Montreux-Glion. Total track length from Montreux station to Rochers de Naye is thus over six miles and a half. Maximum gradient of Montreux-Glion section is 13 per cent.

However, steam haulage from Glion to Rochers de Naye had serious drawbacks. It was expensive, lacked comfort and did not allow for winter running up to the Rochers de Naye summit, which has now become quite necessary, winter sports having developed to an extent unknown in past days. After 36 years of service, steam locomotives were worn out and it was decided to electrify the line with light rack rail-cars running on same 800 volts pressure as that of Montreux-Glion section, thus enabling passengers to reach Rochers de Naye direct from Montreux without unnecessary shuntings or transfers. Following data are best summing up of progress effected.

	Steam running	*Electric running*
Loaded train weight...	30 tons	22 tons
Number of passengers.	66	80
Dead-weight per passenger............	835 lbs.	440 lbs.
Running speed.......	5 to 5.5 m.p.h.	7.2 to 8.1 m.p.h.
Time of Montreux-Naye run.........	90 minutes	51 to 52 mins.
Train crew..........	3	1
Yearly coal or electric power expenditure (Swiss francs)......	40,000 to 45,000	16,000 to 17,000

The five rail-cars supplied by Swiss Locomotive Manufacture at Winterthur and Messrs. Brown, Bovery & Company Limited at Baden have an overall length of 49½ ft. and a height of 9½ ft. without trolley and without starting and resistance boxes fitted on car roof. While present steam locomotives dead-weight varies from 16.5 to 17 tons and total dead-weight of steam-locomotive plus one passenger car is about 23 tons, total weight of an electric rail-car is about 15.5 tons only. The car body is slightly streamlined. In addition to two entrance platforms, there are electrically heated and lighted second and third class compartments. The many high and wide windows can be opened or closed by means of handles. Electric radiators are switched on the 800 volt circuit. Their output is about 6 watts per cubic foot. Electric current for lighting and for secondary controlling circuits is supplied by a 24 volts 60 amp.-hr. battery combined with a direct current generator. At both ends of car is a booth for the wattman who also acts as conductor. The driver is sitting on a moveable seat. From his place he can watch entering or leaving passengers, track, overhead contact-line and instruments, operate controller, electric rheostatic brake, two mechanical brakes, windshield-wiper, horn, dead-man safety device and auxiliary relay for applying safety brake in case of car backing, as well as operate button for electric tripping of automatic brake and control double-panel doors. Rail-car rests on two trucks, each truck having two axles, one of which bearing the driving and braking gear wheel set to rack. Each truck has its series-motor. Aggregate power of the two series-switched motors amount to two hundred and ten horse-power. Total gear ratio (one spring cylindrical gear and one conical gear) is one to 18.25. Controllers have thirteen drive or brake steps. Rail-cars run very smoohtly, being fitted with triple springs and intermediary rubber plates.

Special care has been given to safety devices and brakes in view of one-man driving. On descending run, driver uses only rheostatic brake. In addition, there are two independent mechanical brakes controlled by driver. Of these two mechanical brakes, the one fitted on gear-driven axle is designed as ratchet-brake. It remains permanently set during ascending run. The other safety mechanical brake operates on intermediary transmission shafts and can also be applied by hand. On descending run, it is automatically applied in case of driver failing to press over dead-man pedal, in case of rheostatic brake current failure, in case of speed exceeding 11.5 m.p.h. or in case of a passenger pulling alarm handles inside of car, or, lastly, in case of driver pushing the electric tripping button. If, on ascending run, alarm handles or push-button are operated, or if dead-man device or speed centrifugal governor comes in operation, automatic brake is not actuated but current is cut off. Car stops and is blocked by ratchet-brake. Casual loosening of ratchet-brake would switch on a backing device, thus tripping automatic brake. In case of overhead contact-line current failure on ascending run, rail-car is topped by ratchet-brake without any backing. Everything has therefore been done for increasing passenger safety in comparison with that offered by present-day steam locomotives.

REDUCING DIESEL SPECIFIC WEIGHT

By Prof. C. E. Lucke, Columbia University, N.Y.

From *The Journal of The Society of Automotive Engineers*, April, 1940

For any given engine, the weight per horsepower will be least when the ratio of maximum to mean pressure is least. How many of the existing automotive diesel engines have the least possible ratio of maximum to mean pressure? Very few, perhaps none, and so it must be concluded that they are heavier than is necessary, and that they can be made lighter by whatever means will lower the maximum pressure without decrease of the mean. This raises the question of how low can the maximum be made, and the answer was given by Rudolf Diesel himself. In fact, in that answer is to be found one of the elements of an injection engine that makes it a diesel engine and, without which, it is not a diesel engine.

In his book *The Rational Heat Motor*, Diesel, in 1894, reported superior results to be expected from operation of an internal-combustion engine by feeding fuel into air after enough compression to produce a temperature higher than needed for ignition, and then graduating the fuel feed so that the combustion pressure would not rise above the compression value. The compression pressure would thus be the maximum pressure, and this need be no higher than necessary to produce ignition, though it might be made higher than ignition requirements if a higher efficiency were desired. Graduated introduction of fuel to effect such pressure control was stated to be an essential element of Diesel's idea. This is the means whereby the maximum pressure is to be controlled to not exceed the compression value.

AIR PROPAGANDA

American and British Machines

From *Trade and Engineering*, London, Eng., April, 1940

A great deal of information has come from the United States recently concerning the merits of the latest types of American aeroplane. A number of single-seat fighters in particular have been described in messages emanating from New York, and their performances have been painted in glowing colours. Meanwhile nothing is said about any new types of aeroplane which may be in the course of development in this country. The reason for our reticence is plain. It is to prevent the enemy from obtaining information which might be useful to him and enable him to assess with some accuracy our air strength now and in the future.

It is true, however, that the publication of facts and figures concerning American aircraft and the withholding of facts and figures concerning new British aircraft tend to give a false impression of the actual position. It is difficult to see how this can be remedied. Perhaps one way would be to ensure that the public is aware of the different conditions which apply and govern the publication of the details of new aeroplanes built in this country and in the United States.

American Claims

The United States is under no ban on publication. Individual aircraft manufacturers can, if they wish, issue to the press all the figures relating to their new types of aeroplanes as soon as they like. Only if they believe that they may secure army or navy contracts will these companies normally fail to indicate in general terms what they believe are the performance figures of their new aircraft.

Thus the figures for the new Lockheed, Curtis and Bell single-seat fighting aeroplanes have been repeated many times. The implications of all the publicity which has accompanied these machines is that they are much faster and much better than any previous aeroplanes. It is to be remembered that they are not yet in quantity production, so that they will have to be a great deal better if they are to have much chance of acceptance in the leading air forces of the world—and certainly in the air forces which are at war.

If, however, the figures which have been issued are examined it will be found that they are, in fact, disappointing. In the House of Commons recently Sir Kingsley Wood, the Secretary of State for Air, mentioned that the top speed of the British Supermarine Spitfire single-seat fighter had been increased by a further 10 per cent since the machine had come into service. Now exactly what Sir Kingsley meant is open to doubt. He said "a further" increase, and if that was his precise meaning it would bring the speed of the Spitfire up to more than 400 miles an hour, for the previous top speed, as established at Martlesham Heath, was 367 miles an hour. It may be, however, that his meaning was that the top speed of the Spitfire had been increased by an aggregate of 10 per cent since the machine first came into the squadrons. This would make it more difficult to determine exactly what the speed is now, for there is no figure to go by, but it may be guessed that the Spitfire speed is now somewhere near 400 miles an hour. That, of course, is the true air speed, after all the appropriate corrections have been made. It is not the air speed indicator reading.

No Marked Improvement

Now the speeds of the new American machines are said to be over 400 miles an hour. The Spitfire is many years old as a design, and consequently new designs whose prototypes have only recently been built and flown might be expected to show a marked improvement. But these American machines do not show a marked improvement. On the contrary, they seem to perform in about the same way as the Spitfire. Nor is their armament very much heavier. Indeed, in some instances it seems that their armament is, in effect, less than that of the Spitfire, for the use of machine-guns synchronized to fire through the airscrew field is fairly common and considerably reduces the effective rate of fire.

No one would for one moment deny the genius of the Americans for the production of good aircraft. In their commercial aeroplanes they have exhibited this genius on many occasions. Their new military machines are, with some exceptions, promising, but in performance their single-seat fighters must be looked upon as a little disappointing. With the genius of a race of engineers behind it, one might have thought that the American industry would have been able to produce aircraft showing a much bigger increase on our own relatively old types.

It may be—and the point must be kept in mind—that in the matter of speed increases a stage is being reached at which further increases will become more and more difficult. In that event it may be expected that British aeroplanes of the future will show no greater advances than the American. But information is that this is not so. In the future, no doubt, there will come a period when every speed increase will be a matter of extreme difficulty, but everything tends to show that that stage will not be reached until the speed is somewhere within the 500 miles an hour region.

Superior British Design

Great Britain's new aeroplanes, therefore, may be expected to show a substantial increase in performance over the types which are now in use in the squadrons. Indeed, it has been stated in the House of Commons many times over that the new machines will show that substantial increase. But existing types already in use in the squadrons are showing speeds comparable with the American prototypes which are not yet in production. The inference is that British design, so far as the high performance type of aeroplane is concerned, is in advance of American. As has already been stated, it is impossible to verify this while the present conditions exist, for no statement of the actual figures for British machines has been made. It seems, however, that the new British types of aeroplane, at any rate in the single-seat fighter class, must be greatly in advance of the American. It is a point that should be constantly borne in mind when news comes from America of the performance of the new American machines. That America can produce good aeroplanes is beyond doubt, but that she can yet produce military aeroplanes of the high-performance type which come up to the standards of the comparable British machines is questionable.

REPAIR OF B.E.F. TRANSPORT

From *Civil Engineering and Public Works Review*, London, Eng., March, 1940

Motor vehicles from the B.E.F. requiring repair are now coming back to this country and are being sent, under the scheme arranged by the Ministry of Supply in co-operation with motor trade organizations, for repair in civilian garages.

So far most of these returned vehicles are those impressed, as a temporary measure, from civilian sources at the beginning of the war. They are being replaced in France by new, specially built Ministry of Supply vehicles.

It is, however, the intention of the Ministry that not only impressed vehicles, but all vehicles which can be repaired in this way shall be sent to trade garages in this country as the war proceeds.

In the war of 1914-1918, although mechanization was not developed to anything approaching the present degree, it was necessary to purchase large numbers of motor vehicles abroad for use with the British forces.

So well has the British motor industry responded to present heavy demands that it has not been necessary for the Ministry of Supply or the Air Ministry to purchase any vehicles abroad for use in France since the outbreak of war, and it is confidently expected that all future requirements will be provided from works in this country.

From Month to Month

News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

"ASSOCIATE MEMBERSHIP" IS NO MORE

Not many changes have been made to the by-laws of the Institute that are as far reaching as the one recently adopted abolishing the classification of "Associate Member" (reported on this page), and no ballot submitted to the corporate membership was ever carried with such a favourable majority. Only 83 negative votes were received out of a total of 1,423.

This latest change is significant. It indicates an almost unanimous desire to simplify professional nomenclature, to do away with meaningless divisions within the Institute, and, indirectly, within the profession, to establish a practice more comparable to that in use by other professions, and to make simpler the conditions for co-operation with other professional bodies.

The success of the ballot indicates that the Institute has come a long way since simplification and co-operation were first discussed. Had this proposal been submitted only a few years ago it probably would have been defeated by a majority as substantial as that which now supports it. It is encouraging to see such evidence of a widening outlook on professional affairs. It augurs well for the future.

With the passing of this amendment all former Associate Members become Members. Approximately two thousand three hundred persons are thus affected. The accompanying small adjustment in fees will date from 1941, and will be indicated on next year's accounts. New applications will be classified and accounts rendered on the basis of the new by-laws.

It is interesting to observe the large number of votes received. It is within a very few of being the greatest number ever polled within the Institute. Even the "consolidation" proposals which were discussed at such great length and were given such prolonged publicity, received only thirty more responses. This sign of increasing interest in Institute affairs will be well received by everyone.

PAST-PRESIDENTS

The sustained interest in and support of Institute affairs by past-presidents has long been recognized by officers and members, but it is doubtful if a better example has ever been given than that shown on the occasion of the recent visit of the president to the Montreal Branch.

Previous to the meeting a dinner was given at the University Club by the executive of the branch, to which all past-presidents resident in the city—seven in number—were invited. Without a single exception they attended both the dinner and the meeting. In the order of seniority the list is as follows:

G. H. Duggan	1916
H. H. Vaughan	1918
J. M. R. Fairbairn	1921
Arthur Surveyer	1924–25
O. O. Lefebvre	1933
F. P. Shearwood	1934
J. B. Challies	1938

Some comment was made on the fact that one city should have had so many presidents, but an equally interesting observation was recorded to the effect that three of them had come from other provinces and were graduates of the University of Toronto. In any event it was a happy and unusual occasion—a tribute to the president and to the Institute itself.

COVER PICTURES

Some response has been received to the request voiced in the May issue for photographs suitable for use on the Journal cover, but there is still a need, and additional submissions will be very welcome. In order to provide variety and to include all branches of engineering, a large supply is required from which appropriate selections may be made from month to month.

Pictures showing "close-ups" at interesting angles of pieces of new equipment, action "shots" of moving machines in the shop or in the field, unusual photos of new construction either under way or recently finished, laboratory experiments and so on, are what is required.

Many members are interested in photography. Here is an opportunity to share your interest with your fellow-members, and at the same time make a contribution to the publications of the Institute. You may not have the right picture now, but under normal circumstances the demand will be permanent, and you may, at a later date, see something that exactly meets the requirements. Keep this purpose in mind and make your contributions, when and as often as you can.

ADDED INTEREST

Readers' attention is called to the branch report for Hamilton in this number. Some enterprising member of that branch has devised a method of increasing interest in technical meetings by submitting to the audience a "quiz" based on the material given in the papers. It looks like a good idea. It doesn't seem to be copyrighted, so perhaps other branches would like to try it.

RESULTS OF BALLOTS FOR AMENDMENTS OF BY-LAWS

We, the undersigned, beg to report as follows on the voting with reference to the proposed changes in Sections 2, 3, 4, 7, 8, 32, 34 and 39, abolishing the classification of Associate Member (ballot A), and in Sections 12, 13, 64 and 67, giving Ontario two vice-presidents (ballot B):

Total ballots received		1,469
Rejected ballots	46	
Valid ballots		1,423
Ballot A		
Yes	1,338	
No	83	
		1,421
Ballot B		
Yes	1,167	
No	201	
		1,368

Respectfully submitted,

John G. Hall, M.E.I.C.
Huet Massue, M.E.I.C.
E. A. Ryan, M.E.I.C.
Scrutineers.

CORRESPONDENCE

The following communication has been submitted by Mr. J. A. Vance in accordance with a request made by Council at the May meeting. He will be glad to have comments or suggestions from any members who wish to discuss this report. Letters may be sent to Headquarters or direct to Mr. Vance at Woodstock, Ontario.—*Editor.*

Woodstock, Ontario, May 29th, 1940.

The Engineering Institute of Canada,
Montreal, Quebec.

Gentlemen:

In connection with the activities of the Papers Committee which were referred to at the Windsor meeting of Council, I would like to make a few suggestions on behalf of the committee. In my contact with branch secretaries and members generally I seem to gain a certain point of view.

The branches, particularly the more isolated ones, are very eager to have engineers when travelling attend their meetings, or if this is not convenient, to call upon the executives of the branch. I wonder how many branches have a register for visiting engineers similar to what is at Headquarters. This in my opinion should be advocated. When our members start on a trip they might be reminded to take with them the list of branch executives from the front of the Journal and the last list of members. They would then be in a position to look up members of the Institute wherever they might be. I am sure that any member who will make a little effort in looking up and calling on engineers in his travels will be more than repaid by the kindness and courtesy extended to him.

Most of the branches are eager to have a good speaker, an interesting engineering film, or a good general paper for their programmes. It appears to me that if branch executives would communicate with a large number of other branches to discuss programmes and exchange ideas in general they would be of great assistance to one another. I have been strongly advocating that each branch send notice-of-meeting cards to a large number of other branches and to other engineering societies with a cordial invitation to attend. I believe that in most cases if a branch is invited by another branch to organize and present the programme at their meetings, they would be very happy to do so and make a good job of it. From results I have seen I would also like to strongly urge joint branch meetings, joint trips to engineering works, and all possible get-together meetings. In this way we would develop better branch meetings with increased attendance and promote co-operation among engineers which we consider so important.

There are a large number of corporations in Canada whose products are designed and produced by engineers. Such firms frequently have a number of very excellent films which show the technical and engineering features of their plant, equipment, and products. As a result, these companies are quite willing to have their engineers or executives address groups of engineers. There are many of these speakers available for our branch meetings but our difficulty is have a clearing house with all the available information concerning these corporations and arranging for their representative to visit the branches. This might be accomplished in part if branch executives would advise other branches of such corporations and speakers from their own area as well as advise the General Secretary or the chairman of the Papers Committee.

At this time I am in favour of arranging for some of our engineers to visit our more distant branches upon a prearranged itinerary, with headquarters paying the general travelling expenses. This in my opinion would have to be done only for a short period of time until we could promote in our membership, the desire to visit other engineers and branches.

A large number of our members are isolated. They work individually as far as their profession is concerned and they do not mix enough with other engineers.

It might not be the function of the Papers Committee to promote co-operation and inter-branch meetings but it does appear that such co-operation would be of great assistance to branch programmes and meetings.

In my opinion, the Papers Committee at its best can promote inter-branch meetings, the assistance of one branch to another in its programmes, act as a clearing house for papers, speakers, and films, and generally promote the will to co-operate with all other engineers.

James A. Vance,
Chairman, Papers Committee.

The following letter was received in answer to an open letter addressed to the Editor of the *Canadian Motorist* and published in the May issue of the *Journal.—Ed.*

Toronto, May 8th, 1940.

Mr. G. A. Gaherty, Montreal, Que.

Dear Mr. Gaherty:

Your letter of May 7th has been read with interest. The crux of our difference of opinion appears to be on the effectiveness of the means you propose to the ends of conserving Canada's U.S. funds and improving the economic state of this Dominion. The means you propose is the rationing of gasoline. You agree that it would be detrimental if such rationing resulted in the curtailment of our greatest single source of U.S. funds—tourist traffic. To avert such a deplorable result you state the "Government can be counted upon to exempt American tourists from any such restrictions."

Our leading tourist authorities have pointed out, time and again, that enemy propaganda in the United States, alleging the imposition of restrictions on U.S. motor tourists in Canada, has resulted in diverting much tourist traffic from this country. These authorities have expended much time and energy in counteracting this propaganda. Gasoline rationing in Canada would make the front pages of the press of the United States. The exemption you propose would be given no such feature display headings as the rationing and therefore the said exemption would receive relatively subordinate attention. That it would be exploited by members of the Nazi fifth column in the United States as lending the colour of truth to their propaganda, designed to deflect U.S. tourist traffic dollars from Canada, is no less certain.

Gasoline rationing, even with the exemption you propose, not only would greatly reduce the flow of U.S. funds to Canada but also would greatly increase the flow of U.S. funds from Canada. In normal times the proportion of Canadian motorists who tour in the United States is much greater than that of U.S. motorists who tour in Canada. Rationing of gasoline would greatly increase this disparity. Prohibition of Canadians touring in the United States might have repercussions in kind and otherwise that no administration short of desperation would care to contemplate, let alone to risk.

Gasoline rationing would disrupt the greatest manufacturing industry in Canada. The automotive industry with the industries tributary to and dependent on it—gasoline, oil, tires, parts, etc.—is this Dominion's greatest manufacturing industry. Rationing of gasoline could not do other, in the circumstances, than very adversely affect the national economy. It would also deprive the federal and provincial governments of many tens of millions of dollars of revenue annually. From a third to a fifth of the taxation income of the provinces is derived from motorists, as such.

Sincerely,

Canadian Motorist,
W. B. Hastings, *Editor and Manager.*

MEETING OF COUNCIL

A regional meeting of the Council was held at the Prince Edward Hotel, Windsor, Ontario, on Saturday, May 11th, 1940, at nine o'clock a.m.

There were present: President T. H. Hogg in the chair; Past-President J. B. Challies; Vice-Presidents McNeely DuBose (Province of Quebec) and J. Clark Keith (Province of Ontario); Councillors A. B.Gates (Peterborough), J. G. Hall (Montreal), T. H. Jenkins (Border Cities),

Officers of the Ontario Association meet with officers of the Institute. Front row: J. Clark Keith, vice-pres. E.I.C. and councillor of the Association; T. H. Hogg, president E.I.C.; J. W. Rawlins, president of the Association. Back row: Austin Wright, general secretary, E.I.C., Barry Watson, registrar of the Association.

W. L. McFaul (Hamilton), A. U. Sanderson (Toronto), C. E. Sisson (Toronto), J. A. Vance (London), and General Secretary L. Austin Wright. The following were also present by invitation: Past-President A. J. Grant; Past Vice-Presidents H. G. Acres, E. V. Buchanan and R. L. Dobbin; Past-Councillors C. G. R. Armstrong, E. P. Muntz, J. E. Porter and O. Rolfson; the following members of the Bordei Cities Branch: J. F. Bridge, chairman; G. E. Medler, vice-chairman, H. L. Johnston, secretary-treasurer; E. M. Krebser, member of executive; A. H. Pask, branch news editor; G. A. McCubbin, C. E. Carson and J. J. Newman; Alex. Love and H. F. Bennett, chairmen of the Hamilton and London branches; J. W. Rawlins, President, and M. Barry Watson, Registrar, of the Association of Professional Engineers of Ontario; Colonel R. E. Smythe, Director of the Technical Service Council, Toronto.

The President welcomed all members of Council and guests, and asked everyone to feel perfectly free to take part in all the discussions.

The Secretary presented a revised draft of the rearrangement and rewording of the Institute by-laws, prepared by Mr. Durley, which included the amendments to various sections approved on the recent ballot. It was unanimously RESOLVED that the draft be approved, and the Secretary was authorized to proceed under the provisions of Section 75 of the by-laws. Accordingly, the draft will be submitted to members of Council, branch executive committees, published in the Journal, and finally presented to the next annual general meeting of the Institute.

Council meets in Windsor with past officers, past councillors and others as guests, and with President Hogg in the chair.

After receiving a message from the Winnipeg Branch that it was felt they were not in a position to invite the Institute there for the annual meeting next year, it was decided to accept the invitation from the Hamilton Branch and hold the 1941 meeting in that city.

Under the terms of the recently completed co-operative agreement, Messrs. J. R. Kaye and I. P. Macnab were appointed as the Institute's representatives on the joint Finance Committee in Nova Scotia.

Mr. Harry Bennett, chairman of the Institute's Committee on the Training and Welfare of the Young Engineer, gave a progress report on the work of the committee. Considerable discussion followed, and Council expressed its appreciation of the progress which had been made, and assured Mr. Bennett that they would support him in his recommendations.

The membership of the Leonard Medal Committee, as submitted by the chairman, was noted and approved.

The report of the scrutineers on the proposed amendments to the by-laws was accepted, and showed that both

Past-President A. J. Grant explains the situation to R. M. Coleman, councillor of the Association, left; McNeely Dubose of Arvida, Que., vice-pres. of the Institute; and Mr. T. B. Harrison of Saskatoon.

amendments had carried by a substantial majority. Accordingly, the classification of Associate Member has been abolished, and two vice-presidents will now be elected in Ontario. Mr. E. P. Muntz, M.E.I.C., of Hamilton, was appointed as the additional vice-president to serve until the next annual election.

A communication was presented frcm the Committee on International Relations recommending that Council apply to the Engineers' Council for Professional Development (E.C.P.D.) for corporate membership. A report was also presented from the Finance Committee approving of the recommendation. After considerable discussion, the recommendation of the Committee on International Relations was approved.

Past-President Challies, as chairman of the

Institute's Committe on Professional Interests, gave a resumé of conditions and developments in all the provinces, with particular reference to the recent developments in Alberta and in New Brunswick. He also reported that in the province of Nova Scotia over ninety per cent of the members of the provincial professional association had applied for membership in the Institute under the terms of the new co-operative agreement.

Eight resignations were accepted, one member was reinstated, one Life Membership was granted and a number of special cases were considered.

The Secretary was directed to extend the thanks and appreciation of Council to Mrs. H. W. McKiel for the gift of one of her own paintings which had recently been presented to the Institute.

Mr. E. P. Muntz, with Mr. A. H. Harkness as alternate, was reappointed to represent the Institute on the National Construction Council of Canada.

It was unanimously resolved that the greetings of the Institute be sent to the Earl of Athlone, the newly appointed Governor General of Canada.

Mr. Vance, chairman of the Papers Committee, gave a progress report in which he mentioned the survey which had been made to obtain a list of moving pictures that might be suitable for branch meetings. He also suggested that members of the Institute, whose business took them to different parts of Canada, might make excellent speakers at the meetings of the various branches.

A report was made by Major Barry Watson, registrar of the Association of Professional Engineers of Ontario, and secretary of the Dominion Council of Professional Engineers, with reference to the use of the words "engineer" and "engineering" in the titles of firms applying for letters patent or charters. Mr. Muntz, a member of the Executive of the Dominion Council, reported on the work which had been done by that body.

The President assured Major Watson and Mr. Muntz that their respective associations would certainly have the hearty support and co-operation of the Institute in these objectives. He requested that the general secretary be kept informed of what was proposed, so that Council could co-operate. He suggested that Mr. Clark Keith and Past-President O. O. Lefebvre would make appropriate representatives of the Institute on the Dominion Council's committee or delegation.

Major Watson pointed out that professional engineers in the Active Service Forces were not getting the professional pay allowance that was made to the doctors, dentists and to veterinary surgeons. After some discussion it was decided that the Institute would take some action in full co-operation with the Dominion Council, and the president was given full power to organize a small committee to follow up.

Colonel R. E. Smythe was present to continue discussions of the proposal for closer co-operation between all the engineering bodies on the matter of a national employment service. Council expressed itself as much interested in anything that would improve the employment service, but did not feel that this was an appropriate time to reorganize on the proposed basis. Considerable discussion ensued, and ultimately the matter was left in abeyance until the policy of the government towards the Voluntary Service Registration Bureau was determined.

A number of applications were considered, and the following elections and transfers were effected:

ELECTIONS

Members	13
Juniors	5
Affiliates	2
Students admitted	10

While the Council of the Institute was meeting in one room, the Council of the Association of Professional Engineers of Ontario, shown in this photograph, was meeting in the next room under the chairmanship of President Rawlins.

TRANSFERS

Associate Member to Member	1
Junior to Member	5
Student to Member	3
Student to Junior	8

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

ELECTIONS AND TRANSFERS

At the meeting of Council held on May 11th, 1940, the following elections and transfers were effected:

Members

Archer, John Edward, B.A.Sc., (Univ. of Toronto), instr'man., Dept. of Transport, Nakina, Ont.

Bailey, Alexandre, B.A.Sc., C.E., (Ecole Polytechnique, Montreal), librarian-in-charge and professor, Montreal Technical School, Montreal, Que.

Beique, Jean, B.Sc. (Civil), (Mass. Inst. Tech.), consltg. engr. and surveyor, 69 Courcelette Ave., Outremont, Que.

Cantin, L. Arthur, B.Sc. (E.E.), (Tri-State Coll. of Engrg.), foreman-assistant on substation constrn. & mtce., elect'l dept., Aluminum Company of Canada, Arvida, Que.

Craik, Oliver Stanley, B.Sc. (Elec.), (McGill Univ.), elect'l supt., Canadian International Paper Company, Gatineau Mills, Que.

Fanset, George R., B.Sc. (Civil), (Univ. of Man.), chief engr., Ducks Unlimited (Canada), Charleswood, Man.

Frisch, John, Mech. Engr., (Technical Institute of Horten), mech. supt., Price Bros. & Co. Ltd., Riverbend, Que.

Granich, Joseph Edward, supervisor, printer and ticker services, C.P. Communications, Winnipeg, Man.

Jasen, Henry, D.Eng., (Berlin Univ.), 2054 Claremont Ave., Montreal, Que.

Keenan, John Stephen, B.Sc. (E.E.), (Mass. Inst. Tech.), mgr., appliance and merchandise dept., Canadian General Electric Co. Ltd., Toronto, Ont.

Lindsay, Thomas Alfred, B.Sc. (E.E.), (Univ. of Man.), branch mgr., Canadian Telephone and Supplies Ltd., Regina, Sask.

Stevens, Stephen S., B.Sc. (E.E.), (Univ. of So. Calif.), supt. of communications, Trans Canada Airlines, Winnipeg, Man.

Treadgold, William Manton, B.A., 1903, Grad., Fac. App. Sci. and Engrg., Univ. of Toronto, 1905; professor of civil engineering, University of Toronto, Toronto, Ont.

Juniors

Crowe, John Murray Allen, B.A.Sc. (Civil), (Univ. of Toronto), demonstrator in hydraulics, dept. of mechanical engrg., University of Toronto, Toronto, Ont.

Ford, John Norman, B.Sc. (Elec.), (Univ. of Alta.), junior engr., Calgary Power Company, Calgary, Alta.

Gale, Frederic Tyner, B.Sc. (Elec.), (Univ. of Alta.), junior engr., Calgary Power Company, Calgary, Alta.

MacCallum, Peter Malcolm, B.Eng. (Elec.), (McGill Univ.), engr., plant dept., Bell Telephone Company of Canada, Montreal, Que.

Ritchie, Christopher, B.Sc. (Elec.), (Univ. of Alta.), junior engr., Calgary Power Company, Calgary, Alta.

Affiliates

Lancaster, Gerald Nelson, sales mgr., Vancouver Iron Works Ltd., Vancouver, B.C.

Teasdale, Joseph Ephrem, Warrant Officer, Royal Canadian Engineers, Quebec, Que.

Transferred from the class of Associate Member to that of Member

Lynn, Harold Riviere, Major, O.C., 5th Army Troops Co'y, R.C.E., C.A.S.F., Toronto, Ont.

(CONTINUED AT BOTTOM OF PAGE 301)

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

Eric P. Muntz, M.E.I.C., has been appointed by Council as a vice-president of the Institute to fill the vacancy resulting from the recent amendment to the by-laws giving Ontario two vice-presidents. He was born at Toronto, Ont., in 1892, and was educated at the University of Toronto, where he was graduated in 1914, with the degree of bachelor of applied science. From 1916 to 1919, he was in active service in France and Palestine. From 1920 to 1922, he was construction manager and engineer with J. B. Nicholson, Limited, Hamilton. In 1923, he became president and chief engineer of E. P. Muntz, Inc., and E. P. Muntz Engineering Company Limited. Mr. Muntz has been connected with many large engineering projects. At one time, he was consulting engineer to the Lehigh Valley Coal Sales Company, Buffalo, N.Y.

Mr. Muntz, who has been president of the National Construction Council of Canada last year, was re-elected at the annual meeting held in Toronto last month.

Past-President Dr. J. M. R. Fairbairn, M.E.I.C., was re-elected first vice-president of the National Construction Council of Canada.

A. Ross Robertson, M.E.I.C., manager of the Ontario division of the Dominion Bridge Company, Limited, Toronto, represents the Canadian Manufacturers Association this year on the Executive of the National Construction Council of Canada.

F. V. Siebert, M.E.I.C., has been appointed industrial commissioner by the Canadian National Railways for the western region, with headquarters in Winnipeg, Man. Formerly, superintendent of development and natural resources, he will continue the work of this department in taking over his new duties.

Mr. Seibert has been associated with mining and metallurgy for many years and is an authority on natural resources in western Canada. It is the intention of the company that his department will offer every assistance to industrial organizations proposing to locate in western Canada. He will also devote his time to the encouragement of industries to establish branches in the west.

Immediately after graduating from the University of Toronto, in 1912, Mr. Seibert spent some years in survey work in northern Alberta, with the Department of Interior and later took over the duties of natural resources investigator for the department. He joined the Canadian National Railways in 1929.

Dr. R. W. Boyle, M.E.I.C., director, Division of Physics and Electrical Engineering, National Research Council, Ottawa, Ont., received the Flavelle Medal of the Royal Society of Canada at the annual meeting held last month in London, Ont. Dr. Boyle was graduated in electrical engineering at McGill University in 1905. He worked under Lord Rutherford in Montreal and in Manchester where he held an "1851 Exhibition" scholarship. He did important research on radio-activity and ultrasonics. His ability as a student and a research worker was recognized by the university which granted him both M.Sc. and Ph.D. degrees.

At the close of the first great war, he was in charge of the development of asdics, working in the anti-submarine division of the Admiralty Board of Inventions and Research. His achievements in this field aided the spectacular success of the British Navy in meeting the submarine menace. Modern submarine detection methods are a straight evolution of that early work. Dr. Boyle was assistant professor of physics at McGill University in 1912. He was then appointed professor of physics at the University of Alberta. He was overseas for three years and after his return was made dean of the faculty of applied science in Alberta. He was appointed to his present post in 1929.

C. H. McL. Burns, M.E.I.C., manager, Canada Foundries and Forgings, Limited, Welland, Ont., has been a patient since May 1st, at the Private Patients Pavilion, Toronto General Hospital, where he is undergoing treatment previous to an eye operation.

G. G. M. Carr-Harris, M.E.I.C., has been promoted recently to Major in the Royal Canadian Ordnance Corps. Major Carr-Harris was educated at Toronto Military College, where he was graduated in 1916. From 1916 to 1927, he served in the British Regular Army as a royal engineer officer. Upon returning to this country in 1927, he became instructor of engineering at the Royal Military College at Kingston. In 1933, he became assistant professor of engineering, and in full charge of the department of mechanical engineering, a position which he occupied until the outbreak of war last fall. He is, at present, stationed at the R.C.O.C. training centre at Petawawa, Ont.

C. H. Gordon, M.E.I.C., vice-president of the Atlas Construction Company, in Montreal, is with the Department of Munitions and Supply, as inspecting engineer on the construction of the Nobel project at Parry Sound, Ont. Mr. Gordon was educated at the Royal Military College, Kingston, and at McGill University, Montreal, where he was graduated in 1924. He joined the Atlas Construction Company, Limited, in Montreal, in 1925 as an assistant engineer. He has been, since, engineer and superintendent on many large engineering projects.

L. D. H. Sutherland, M.E.I.C., president of the Sutherland Construction Company, has been appointed as vice-president of the Builders Exchange, Inc., to replace C. H. Gordon, who resigned.

F. H. Barnes, M.E.I.C., has accepted a position with Canadian Industries Limited at Brownsburg, Que. He was graduated from McGill University in mechanical engineering, in 1912, and until 1914, was employed with the Canadian Pacific Railway. During the first great war, he was at the Dominion Arsenal at Quebec, first as a foreman on shell manufacture, and later as superintendent of all departments. From 1920 until 1926, he was employed successively with the Laurentide Company, at Grand'Mere, Que., Canadian Brill Company, at Preston, Ont., Thomas Watson Limited, at Woodstock, Ont., and Charles Walmsley & Company, Limited, Longueuil, Que. From 1926 to 1935, he acted as chief engineer and general superintendent of the Northern Foundry & Machine Company at Sault Ste. Marie, Ont. From 1931, until last fall he was in the engineering department of Mathews Conveyor Company, Limited. Since last fall and until his recent appointment, he had been with the British Supply Board on inspection work.

Jean Bouchard, M.E.I.C., has recently been appointed assistant district engineer for the province of Quebec, in the Civil Aviation Division of the Department of Transport of Canada. After graduation from the Ecole Polytechnique in 1931, as a bachelor of applied sciences, he went for some time with the Quebec Roads Department, and in 1932 he was appointed city engineer of St-Hyacinthe, Que. In that capacity, he was closely connected with the installation of the municipal Diesel plant for the generation of electricity and with the construction of the distribution system.

G. P. Wilbur, M.E.I.C., was elected president of the Canadian Institute of Steel Construction, and chairman of its central division, at the annual meeting held in Montreal last month. Mr. Wilbur, who is the sales manager for the

Ontario division of the Dominion Bridge Company, Limited, was president of the same Institute in 1938.

Omer Boucher, Jr.E.I.C., has accepted a position as assistant engineer with the city of Outremont, Que. He was graduated from the Ecole Polytechnique in 1937 and worked for a year with the Department of Trade and Industry of Quebec, and later with the Roads Department and the Public Works Department of the Province.

D. W. Miller, Jr.E.I.C., has accepted a position with the Aluminum Company of Canada, Limited, at Arvida, Que. Mr. Miller was graduated in civil engineering from the University of Manitoba in 1935. Upon graduation, he engaged in mining, and was connected with various concerns in Ontario and Manitoba until 1937, when he became assistant mine engineer with the Island Mountain Mines Company, Limited, at Wells, B.C. Mr. Miller came to Montreal last fall to take post-graduate work in mining at McGill University.

Oswald Barry, S.E.I.C., formerly located at Montreal, with the Canadian Pacific Railway, has recently been transferred to Toronto. He was graduated from McGill University in 1936.

E. B. Pearce, S.E.I.C., has accepted a position with the Horton Steel Works, Limited, at Fort Erie, Ont. He was graduated in mechanical engineering from Queen's University last month.

Roger Hamelin, S.E.I.C., has accepted a position with the Viau Limitée, biscuits and candy manufacturers, in Montreal. He was graduated from the Ecole Polytechnique last month.

D. L. Rigsby, S.E.I.C., has accepted a position with Sheldon's Limited, at Galt, Ont. He was graduated in mechanical engineering from Queen's University last April.

VISITORS TO HEADQUARTERS

J. F. Lynch, Jr.E.I.C., from Moncton, N.B., on April 29th.

F. O. Condon, M.E.I.C., chairman of the Moncton Branch, on May 2nd.

Harry J. Crudge, M.E.I.C., building engineer, Canadian National Railways, from Moncton, N.B., on May 2nd.

O. N. Mann, Jr.E.I.C., assistant to manager and plant superintendent, Eagle Pencil Company of Canada, Limited, from Drummondville, Que., on May 4th.

Col. Frank Chappell, M.E.I.C., Industrial and Public Relations Manager, General Motors of Canada, Limited, from Oshawa, Ont., on May 6th.

J. H. Bradley, M.E.I.C., engineer, Holcroft & Company, from Detroit, Mich., on May 8th.

G. E. Booker, M.E.I.C., from Bathurst, N.B., on May 11th.

E. B. Horton, M.E.I.C., Price Brothers & Company Limited, from Riverbend, Que., on May 11th.

Professor R. W. Angus, M.E.I.C., professor of mechanical engineering and head of the department, University of Toronto, from Toronto, Ont., on May 13th.

W. E. Cornish, M.E.I.C., assistant professor, department of electrical engineering, University of Alberta, from Edmonton, Alta., on May 13th.

Norman W. Brittain, M.E.I.C., from Minto, N.B., on May 13th.

Sam Fromson, Jr.E.I.C., mechanic and draughtsman, Howey Gold Mines, Limited, from Red Lake, Ont., on May 14th.

J. N. deStein, M.E.I.C., from Regina, Sask., on May 15th.

R. O. King, formerly of the research staff of the Air Ministry, from London, Eng., on May 15th.

G. T. Perry, S.E.I.C., department of mechanical engineering, National Research Council, from Ottawa, Ont., on May 16th.

Robert Chambers, S.E.I.C., of the Shawinigan Engineering Company, from LaTuque, Que., on May 18th.

W. A. B. Saunders, S.E.I.C., from Fredericton, N.B., on May 21st.

G. G. Murdoch, M.E.I.C., representative on the Dominion Council of Professional Engineers of the Association of Professional Engineers of New Brunswick, from Saint John, N.B., on May 25th.

E. M. Nason, S.E.I.C., from Welsford, N.B., on May 25th.

Obituaries

Howard Archibald Mackenzie, M.E.I.C., died suddenly in Montreal, on May 13th, 1940. He was born at Sorel, Que., on October 29th, 1872. He served a five-year apprenticeship with J. R. Weir, Montreal, from 1888 to 1893. He then became connected with the Laurie Engine Company, and later with the Montreal Harbour Commissioners. In 1896, he joined the Quebec Steamships Company, and in 1907, became chief engineer. A few months later, he went to India as assistant superintendent of dredging for the Jammu and Kashmir Government; he was made superintendent in 1909, and in 1928, became chief engineer of the mechanical engineering department, at Baramulla, India. In 1930, he went with the Paterson Engineering Company (India) Limited, at Calcutta, India. He returned to Canada in 1931, and became superintendent of the Canadian Lift Truck Company, Limited, Montreal, in 1934.

Mr. Mackenzie joined the Institute as an Associate Member in 1909, and was transferred to Member in 1914.

Frederick Bridges, M.E.I.C., died suddenly in Montreal, on May 18th, 1940. He was born at London, England, on March 1st, 1868. He was educated at private schools, and at King's College in London. He was an articled pupil with Samuda Brothers, shipbuilders and engineers, from 1884 to 1889, when he became draughtsman. From 1892 to 1894, he was sea-going engineer with the same firm. He joined Edwards & Company, shipbuilders and engineers at Millwall, in 1889, as chief draughtsman. He later became assistant manager, and manager. He came to this country in 1908, as chief hull draughtsman at the government shipyards at Sorel, Que. In 1918, he joined the Leclaire Shipbuilding Company of Sorel, as manager and naval architect. From 1922 to 1924, he was an independent ship surveyor at Montreal. In 1924, he became steamship inspector for the Dominion government and in 1928, was appointed superintendent of the government shipyards, at Sorel, Que. In 1937, he became port warden at Sorel, a position which he occupied until his death.

Mr. Bridges joined the Institute as a Member in 1930.

Major Stuart Howard, M.E.I.C., a member of the Institute since its inception in 1887, died in Montreal, on May 18th, 1940. He was born at Plymouth, England, in October, 1849 and was educated at Guilford and Queenstown Colleges. In 1866, he entered the Public Works Department of the British Admiralty, serving under officers of the Royal Engineers and later became identified with the construction of the extension of Portsmouth dockyard, the building of the forts at Spithead and the Marine Artillery Barracks at Wastway.

He came to Canada in 1870, as engineer of the Northern Railway Company, and took charge of the construction of the North Grey Railway. In 1872, he was appointed first engineer of the Toronto Waterworks and in 1883, he was superintendent on the Allenburg branch of the Great Western Railway and the remodelling of the suspension bridge.

In 1874, he was appointed chief engineer of the construction of waterworks at St. Catharines, Ont., and for the plans he designed and made for the Welland canal he was awarded first prize at the World's Fair in Paris.

From 1876 to 1879, he was in private practice in Toronto. He then came to Montreal as resident engineer of the Quebec, Montreal, Ottawa and Occidental Railway. Not long after, he became chief assistant engineer of the Canadian Pacific Railway. This post he held until 1889, designing

Major Stuart Howard
M.E.I.C.

and constructing viaducts, grain elevators and stockyards. For three years, he engaged in private practice in Montreal, while he supervised the construction of the Adirondack Railway.

In 1892, Major Howard was appointed by the City of Montreal to take charge of the design and construction of the Ontario Street subway, the St. Catherine Street bridge, the Berri Street subway, Beaudry Street tunnel and Notre Dame Street bridge. For a paper on these works, he was awarded the Gzowski Medal of the Institute. He was then appointed deputy surveyor of the City of Montreal, in charge of sewage works, bridges and tunnels.

In 1917, he took up active military service as major in No. 4 Company, Royal Canadian Engineers. Returning to civil life, he entered the technical service of the city of Montreal, and remained there until his retirement in 1934.

He was a charter member of the Engineers Club of Montreal and was one of three Honorary Life Members of that institution. He was also a life member of the St. George Snow Shoe Club and the Pointe Claire Yacht Club. He joined the Corporation of Professional Engineers of the Province of Quebec in 1922 and was a non-active member at the time of his death.

John Baylor Barnum, M.E.I.C., died suddenly at Valleyfield, Que., on May 19th, 1940. He was born at Birmingham, Alabama, U.S.A., on December 29th, 1889. His early engineering experience was with J. Pierce, O.L.S., D.L.S., on subdivision work in Saskatchewan, in 1911. He later became connected with W. S. and R. S. Lea, of Montreal, as instrumentman on sewer construction. He was on active service from July, 1917 up to April, 1919. In 1920, he joined the Riordon Company, Limited. From then on, he became connected with many engineering projects with various firms, Foundation Company of Canada, Limited, Gatineau Power Company and Canadian International Paper Company. For the last four years, he had been employed by Beauharnois Light, Heat & Power Company, and was still with them at the time of his death.

Mr. Barnum joined the Institute as an Associate Member in 1921.

Andrew Lake McCulloch, M.E.I.C., died on May 1st, 1940, at Lajolla, Calif., U.S.A., where he spent the winter. He was born at Galt, Ont., on April 18th, 1865, and he received his education at the University of Toronto, where he was graduated in civil engineering, in 1887. He practised his profession in Galt from 1887 to 1890, and was employed from 1890 to 1897 as resident engineer on construction of the Galt waterworks, Kincardine waterworks, Petrolia waterworks, Barrie sewerage and flood improvements works and Toronto Junction sewerage works, and built the electric railway system connecting Galt, Preston and Hespeler. This railway system was later taken over by the Canadian Pacific Railway. In 1897, he went west to British Columbia, locating in Nelson, as the first city engineer. There, he laid out the city's main streets, designed and built the city waterworks and sewage systems; he selected the site, planned and built the municipal hydro-electric plant at Bonnington Falls. He retired as city engineer in 1907, and entered private practice, specializing as a hydraulics engineer.

He prepared plans, specifications and estimates on hydroelectric developments and reports on waterworks. He did considerable pioneering survey work in British Columbia, including that for the first town site at Fort George. A dozen or more waterworks or irrigation projects in the upper country were designed and carried out by him. As a surveyor, he had a wide acquaintance with the entire Kootenay district, from Kimberley in the east to Lardeau in the north. After the war, he was engaged by the Nelson Board of Trade to report on the pulp and paper possibilities of this district, and prepared a plan based on utilizing at Nelson the pulpwood supplies of the Lardeau-Duncan valley with the aid of Kootenay river hydro-electric power.

Mr. McCulloch took an interest in mining development. He was personally interested chiefly in the Cambourne mining area. In later years, he was again identified with Nelson's civic affairs as consulting engineer for the Five-Mile Creek intake and pipe line, which he designed.

Mr. McCulloch joined the Institute as an Associate Member in 1891, and was transferred to Member in 1909. He was made a Life Member in 1936.

COMING MEETINGS

American Institute of Electrical Engineers—Summer Convention, Toronto, Ontario, June 16-20.

American Society of Mechanical Engineers—Semi-annual Meeting, Milwaukee, June 17-20.

American Society for Testing Materials—Forty-third Annual Meeting at Chalfonte-Haddon Hall, Atlantic City, N.J., June 24-28.

Society for the Promotion of Engineering Education—Annual Meeting, University of California, Berkeley, June 24-28.

Canadian Electrical Association—Fiftieth Annual (Golden Jubilee) Convention at the Seigniory Club, P.Q., June 25-28.

American Society of Civil Engineers—Annual Convention, Denver, Colo., July 24-26.

The Canadian Good Roads Association—Annual Meeting—definite dates not set—Quebec City, Que., in September.

The Society for the Promotion of Engineering Education—Conference on Soil Mechanics and its Applications. Purdue University, Lafayette, Indiana, September 2-6.

American Society of Mechanical Engineers—Fall Meeting, Spokane, September 3-5.

Electrochemical Society, Inc.—Fall Meeting, Ottawa, Ont., October 2-5.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

BORDER CITIES BRANCH

H. L. Johnston, m.e.i.c. - *Secretary-Treasurer*
A. H. Pask, Jr.,e.i.c. - *Branch News Editor*

A junior meeting was held by the Border Cities Branch on April 12, 1940. Following a dinner at 6.30 p.m., in the Prince Edward Hotel, the branch chairman, Mr. J. F. Bridge, turned the meeting over to Mr. D. S. B. Waters.

After a brief business meeting, Mr. Waters introduced the first speaker of the evening, Mr. J. A. Ferrier, who is in charge of boiler control maintenance at the Ford Motor Company in Windsor.

Mr. Ferrier spoke on **Fundamental Principles and Maintenance of Boiler Control.** He began by defining boiler control and gave conditions that must be satisfied, as the relations of the fuel and air supply, and the balance of the forced and induced drafts.

The speaker stressed the importance of boiler control for modern boilers owing to their relatively small water capacity, and gave examples of stationary and mobile plants equipped with complete automatic controls.

Routine maintenance is repeated, checking temperatures, pressures and rates of flow. Maintenance does not require a great deal of attention but the human element in this is important in securing the best results.

Following a question period, Mr. Waters introduced the second speaker, Mr. A. H. Pask, who is an engineer in the Canadian Industries Limited plant at Windsor.

The subject of this paper was **The History, Production and Uses of Salt.** The speaker remarked on the salt resources of the earth and how they were deposited.

Salt is recovered by evaporation of sea water in pools, by mining of rock salt, or from wells. When the wells penetrate rock salt, fresh water is pumped down and returned to the surface as brine. It is evaporated by either grainers or vacuum evaporators. The former is simply an open tank heated by steam coils and produces coarse salt. The latter is often used in several effects and so is more efficient. It produces a fine salt. The salt is separated from the brine by a filter or centrifuge and dried. Any special ingredients are then added and the salt packaged or bagged by automatic machines.

There followed a question period, after which a vote of thanks to the speakers was moved by Mr. E. W. Driedger and seconded by Mr. J. G. Turnbull. The meeting was then turned back to Mr. Bridge and Mr. T. H. Jenkins moved a special vote of thanks to Mr. Waters for his past work with the branch on the eve of his leaving to take a new position in Cleveland. This was seconded by G. E. Medlar. The meeting then adjourned.

EDMONTON BRANCH

B. W. Pitfield, m.e.i.c. - *Secretary-Treasurer*
J. W. Porteous, Jr.e.i.c. - *Branch News Editor*

The last meeting of the Edmonton Branch for the 1939-40 season was held in the Macdonald Hotel on Monday, May 13. The speaker of the evening was Mr. W. G. Worcester, professor of ceramic engineering at the University of Saskatchewan.

After being introduced by Mr. Garnett, Professor Worcester explained the difference between a ceramic artist who designs and makes pottery and a ceramic engineer who compounds the clays, glazes, etc., for the use of the artist. Having made the distinction clear the speaker went on to outline the course which is given in Saskatchewan to prepare students for ceramic engineering. Following this, a number of slides were produced showing various test equipment used and then some of clay deposits in Saskatchewan and Alberta. Professor Worcester also gave an outline of the ramifications of the science illustrating the various branches in which graduates might obtain positions.

There was a very lively discussion following the talk and the meeting adjourned after a vote of thanks had been extended to Mr. Worcester.

HALIFAX BRANCH

L. C. Young, m.e.i.c. - *Secretary-Treasurer*
A. G. Mahon, m.e.i.c. - *Branch News Editor*

The Halifax Branch was pleased to have as guest speakers during their regular April meeting, Past-President Dr. J. B. Challies, Mr. G. A. Gaherty and Mr. Austin Wright, General Secretary of the Institute, all from Montreal. The meeting was held on April 22, in the St. Julien Room of the Halifax Hotel, and a number of the local members availed themselves of the opportunity to meet personally the three guests, who, in some cases, had been known only through their very active association with the Institute. The Halifax Branch was also pleased to have a number of members of the Association of Professional Engineers of Nova Scotia in attendance.

Branch Chairman, Charles Scrymgeour, acted as chairman of the meeting and asked Mr. Ira P. MacNab to introduce the guest speakers.

Dr. Challies spoke about the progress which is being made throughout the Dominion in bringing the various professional engineering associations into close co-operation with the Institute. He outlined the difficulties which were encountered and lauded the fact that Nova Scotia and Saskatchewan had shown the way whereby a satisfactory co-operative agreement could be reached.

Mr. Gaherty, in his address, heartily endorsed Dr. Challies' remarks. He paid high tribute to Dean H. W. McKiel for his work in bringing closer together the engineering bodies of Canada. He pointed out that Dean McKiel's trans-Canada tour, in the interests of the Institute, had been particularly fruitful in this respect.

Mr. Austin Wright remarked that co-ordination, in addition to co-operation, was of paramount importance for the success and effectiveness of organizations which banded themselves together for betterment. He also outlined the advantages of the employment services which the Institute extends to its members, and enumerated cases where a number of members had availed themselves of these services. It was very pleasing to hear that the Institute was so well organized in this respect and enjoyed the prestige to be effective not only in Canada but in different parts of the world.

Dr. Challies, Mr. Gaherty and Mr. Wright spent several days in Halifax, discussing with the officials of the Association of Professional Engineers of Nova Scotia various matters concerning the co-operative agreement between the Institute and the Association, which was signed last January.

HAMILTON BRANCH

A. R. Hannaford, m.e.i.c. - *Secretary-Treasurer*
W. E. Brown, Jr.e.i.c. - - *Branch News Editor*

The regular meeting of the branch was held at McMaster University on May 14th, when Mr. T. P. Buckley, service manager of the Canadian Gypsum Company Limited spoke on the subject of **Gypsum and Lime and Their Uses.** The speaker added interest to his remarks by his frequent reference to his collection of exhibits of gypsum and fossils by which he demonstrated the origin of limestone.

Gypsum in its rock state is a non-metallic mineral. It is known chemically as hydrous calcium sulphate. Deposits of gypsum are found in many localities in the United States and Canada.

Gypsum is secured in much the same manner as coal—it is either quarried or mined, depending on the location of the strata to the surface of the earth. Pure gypsum has 20.9 per cent combined water and calcination removes part of this and gives a product commonly known as plaster of Paris. After gypsum has been calcined, it is ready to be manufactured.

It is a well-known fact that all materials will fail in fire if the temperature is high enough and the duration long enough. Gypsum behaves in a fire unlike any building material, because it possesses a characteristic found in no other material. When fire strikes a material made of gypsum, and the heat is above 212 deg. F., calcination begins—that is, the water of crystallization is evaporated and the walls automatically sweat. This action retards fire and keeps the temperature of the wall at a limit of 212 deg., which heat is not sufficiently high to ignite wood. In addition to fire protection, gypsum products have several other important characteristics, mainly early strength and quick set. A gypsum plaster develops half its strength in a few hours and full strength in a few days.

Lime, as well as gypsum, has been used for nearly 5,000 years as a construction material. Limestone deposits are to be found in practically all parts of the United States and Canada and limestone rock is divided mainly into two types, high calcium lime, formed from calcium carbonate, and high magnesium lime, formed from a mixture of calcium carbonate and magnesium carbonate.

The application of heat to limestone will drive off the carbon dioxide and also any water in it. The result of this burning will be quicklime. Hydrating this quicklime by slaking it with sufficient water changes it to a hydrated lime which does not boil when used on a job as a quicklime does. After lime plaster has been applied to the wall, it takes up carbon dioxide from the air, to cause it to return to its original rock or carbonate form. Lime plaster, therefore, does not set as does a gypsum plaster, but slowly hardens as it absorbs carbon dioxide from the air. The rate of hardening in lime plaster is extremely slow and this accounts for the almost universal use of gypsum. In other words, gypsum can meet the speed of modern construction, whereas lime to be satisfactory, must be allowed sufficient time for hardening.

T. S. Glover, chairman of the Papers Committee, has devised the idea of an educational Quiz contest on the subject of the speaker. The two best answers were presented with a copy of a novel by the late John Buchan. The winners were L. S. Collison and W. J. W. Reid.

Gypsum "Quiz"

How much do you know about gypsum ? Correct answer (approximate only in some questions) is among the three alternatives in each question. Underline your choice. Prize will be awarded for the most correct set of answers before meeting adjourns.

1. How long has gypsum been known and used as a construction material ? (a) 100 years. (b) 1,000 years, (c) 5,000 years.
2. What is the chief property that gypsum materials give to a building ? (a) strength, (b) fire protection, (c) Insulation.
3. Why has gypsum replaced lime as a plastering material ? (a) Because it is cheaper, (b) because it requires less time; (c) because it has been advertised.
4. Which is heavier ? (a) A cubic foot of dry sand, (b) A cubic foot of wet sand.
5. Express in pounds of water the fire protection offered by gypsum lath and plaster products in an ordinary six-room house. (a) 100 lbs., (b) 1,000 lbs., (c) 2,700 lbs.
6. In connection with quicklime, what does hydration mean ? (a) Slaking, (b) mixing, (c) burning.
7. How soon is it safe to paint a lime putty finish ? (a) Two weeks, (b) two months, (c) one year.
8. What is the maximum compressive strength of gypsum plaster per square inch ? (a) 100 lbs., (b) 2,000 lbs., (c) 10,000 lbs.
9. The time required to burn quicklime is: (a) one hour, (b) three hours, (c) six hours.
10. In the chemical field, lime is a cheap source of: (a) sodium, (b) calcium, (c) magnesium.

The speaker was introduced by T. S. Glover and a vote of appreciation was moved by W. J. W. Reid. Our chairman, Alex Love, gave a brief report on the meeting of Council which had been held in Windsor three days previous to this meeting. The usual refreshments were served after the lecture.

LONDON BRANCH

D. S. Scrymgeour, m.e.i.c. - *Secretary-Treasurer*
J. R. Roston, m.e.i.c. - *Branch News Editor*

John S. Cutler, regional conservator of the U.S. Department of Agriculture, addressed the May meeting of the branch in the City Hall Auditorium on the evening of May 1st. His subject was **Engineering Science as Applied to Soil Conservation.** H. F. Bennett, branch chairman, occupied the chair and introduced the speaker.

Mr. Cutler said that three acres of every five in the United States, seeded to crops, are economically headed downhill unless a radical change in farming methods is introduced. All of the 350 million acres suitable for agriculture production in the United States are affected to some degree by erosion. Of special interest to his audience was a warning that western Ontario, though it might appear prosperous and immune to soil erosion dangers, was in reality definitely susceptible.

The loss of topsoil forces farmers into subsoil farming and hence the cost of production is increased to a point where the farmer cannot meet the costs of his operations, much less make a profit. The subsoil from the sloping land settles on the richer bottom lands, eventually ruining those also.

A description of the method used is now given to the farmers, and the demonstration programme is conducted on a voluntary basis. Co-operative five-year agreements are made with interested individual farmers who reside within the area of the project. A farm plan is worked out by the farmer with the help of the technicians,—a plan designed to conserve soil and water, and put every acre to its proper use. At the same time the plan should provide the income needed by the farmer and his family.

The keynote is the control of the water run-off. Some of the practices that have been found effective in making water walk, rather than run, off cultivated fields are terracing; contour cultivation, which is cultivating along the natural contour of the slope or around the hill instead of up and down slope; contour strip cropping, which consists of a series of alternate bands of row crops and close growing vegetation such as grasses or small grains; grassed drainage ways and buffer strips, and many others, or a combination of two or more of the practices mentioned.

Generally speaking, the average farm plan works out about like this. The steepest most erosive lands are converted to protected woods, the lands of lesser slope are converted to improved pasture or meadow, the flattest and least eroded fields are set aside for the production of cash crops with the addition of one or more of the conservation tillage practices mentioned.

About 33 members and guests were present and the discussion was interesting and very general.

A meeting of the London Branch was held on the evening of Friday, May 3rd, when the members were guests of the Military Institute, M.D. No. 1, in the Officers' Mess rooms of the Dundas Street Armouries.

Brigadier E. J. C. Schmidlin, Director of Engineer Services and Acting Quartermaster General, addressed the meeting on **The Work of Engineer Units in Modern Warfare.** He explained how mechanization had broadened and deepened their work, and only in one phase had their former activities been reduced, and that is in the quantity of water necessary for the supply of horses.

The full text of Brigadier Schmidlin's paper will be found in the January number of the **Journal.**

About 100 military and guest members were present. H. F. Bennett, chairman of the London Branch of the Institute, thanked the Military Institute for extending the invitation to hear the address to the Branch.

MONTREAL BRANCH

L. A. Duchastel, m.e.i.c. - *Secretary-Treasurer*

The subject of **Power System Communications** was treated by Mr. H. W. Haberl on March 21st in a paper which covered the progress from the more primitive forms of communication up to and including the modern application of radio. A demonstration of two-way radio communication was given with the assistance of Mr. J. D. Altimas.

The Automobile Industry in Canada was the subject of an address by Colonel Frank Chappell on March 28th who described the development of that industry in Canada during the past twenty-five years. The talk was followed by a sound film portraying a tour through the plant of the General Motors Corporation at Oshawa, Ont. A courtesy dinner was held at the Windsor Hotel before the meeting.

On April 4th, Mr. John Schofield, m.r.a.i.c. gave an inteiesting and detailed description of the **Hotel Vancouver,** stressing its architectural and engineering features. The address was illustrated throughout with slides. The members of the Province of Quebec Association of Architects were invited to attend the lecture.

The Mathematics of Management were discussed on April 11th by Mr. Paul Kellogg who dealt with the influence of the structure of business on the determination of policy.

Mr. Ernest Gohier, chief engineer of the Department of Roads of the Province of Quebec gave a very illuminating address on **Planning Quebec Highways,** on April 18th. A courtesy dinner was held at the Windsor Hotel, previous to the meeting.

On April 25th the branch visited the wire mill of the Steel Company of Canada and saw a plant equipped with the most modern wire machinery. Visitors were then very kindly offered refreshments by the Steel Company.

The branch was honored on May 2nd by the official visit of the president of the Institute, Dr. T. H. Hogg, who after addressing the members, showed some very interesting films and slides on the construction of a power line during winter in northern Ontario. Refreshments were served and all members present were introduced personally to the president.

Previous to the general meeting, an informal dinner was offered by the Executive Committee to Dr. Hogg, at the University Club. All past-presidents of the Institute residing in Montreal were invited and it was noted that all seven past-presidents were in attendance. In addition, the treasurer of the Institute, Mr. de Gaspé Beaubien, the general secretary, L. Austin Wright, and the secretary emeritus, R. J. Durley were present.

The chairman of the Montreal Branch, Mr. H. J. Vennes, welcomed the president and professor R. E. Jamieson of McGill University thanked Dr. Hogg for his visit.

NIAGARA PENINSULA BRANCH

Geo. E. Griffiths, m.e.i.c. - *Secretary-Treasurer*
J. G. Welsh, s.e.i.c. - *Branch News Editor*

On Tuesday evening, April 16th, the member societies of the Niagara District Council held a joint dinner meeting at the Leonard Hotel, St. Catharines, Ont. The guest speaker, Mr. R. M. Slipp of the Plastics Department, Technical Sales Service, of the E.I. du Pont de Nemours & Co., Inc., spoke on **Plastics.**

Mr. Slipp briefly introduced the subject of plastics, following which a motion picture film "The Wonder World of Chemistry" illustrated the importance of chemistry in every day life. The speaker then pointed out that plastics were perhaps overpublicized, but due to low cost, and wide application in existing and new fields were of vast importance.

Plastics are divided into two groups—thermo-setting compounds and thermo-plastic compounds.

Thermo-setting compounds are those which soften, melt and cure on the original heating and on re-heating remain rigid. Examples of these type materials are: phenolic formaldehyde materials such as bakelite and urea formaldehyde materials such as plaskon.

Thermo-plastic compounds are those which, on heating, soften and melt and on re-heating soften and on re-cooling become rigid again. Examples of these are: cellulose nitrate such as celluloid and pyralin; cellulose acetate such as plastacele and tenite, styrene; polyvinyl acetate such as butacite; methyl methacrylate such as lucite and nylon.

These materials, which are used for moulding either by the compression or injection method, are, as a rule, sold in powder form. Samples of these coloured granular materials were shown.

In compression moulding, a metal mould is filled with moulding material and closed in a press and heated. The material softens and melts together and under pressure assumes the shape of the mould.

The thermo-setting material is usually ejected hot while the thermo-plastic material must be cooled before ejection.

Injection moulding, which is only adaptable to thermoplastic materials, is more rapid than compression moulding and is replacing it in many cases. In injection moulding the granular material is fed gradually into the melting cylinder which has an electrically heated jacket. The injection piston compresses the material, and forces it through the heated cylinder which holds about 20 "shots," to the cylinder nozzle, by which time the granular flakes have melted and become a liquid of the consistency of thick molasses. This liquid is quickly forced into the moulds, these being cooled, and after the material sets, the moulded objects are removed and the moulds replaced for recharging. The cycle is very fast and for this operation is usually between 6 and 60 seconds.

This injection moulding operation produces finished pieces that require no machining, facing, polishing, or painting. These pieces may be produced in any color. They are very light in weight, are very poor conductors of heat and electricity and many have excellent moisture and weather resisting properties. Practically all will withstand heat up to 160 deg. F., and in a few new special cases as high as 500 deg. F.

Some of the injection materials have remarkable impact strength and are, therefore, very desirable for certain uses where the thermo-setting materials do not fill the need.

In general, the thermo-setting materials are used where heat resistance is very important and where colour and impact strength are not too important.

Thermo-plastics are generally used where colour, toughness and light transmission are essential.

It was explained that the cellulose nitrate and cellulose acetate materials were made from either wood pulp or a cotton linters base, while the methyl methacrylate and nylon were made from a coal, air and water base.

In conclusion, a motion picture of the Du Pont Exhibition at the World's Fair in New York last summer was shown which brought the evening to a close.

OTTAWA BRANCH

R. K. Odell, m.e.i.c. - *Secretary-Treasurer*

The use of the metal spraying gun for coating surfaces uniformly much as automobiles are sprayed with paint was demonstrated on the evening of April 25 at the National Research Laboratories by A. Van Winsen, m.e., of that institution, in the course of his address, **Metal Spraying and its Industrial Applications,** before the Ottawa branch. W. H. Munro was chairman and the meeting was largely attended by local engineers and representatives of various industries in Ottawa.

The gun operates by compressed air and through the heat generated by burning acetylene or other gas converts the metal, fed through the gun in the form of a wire, into atomized particles that are air sprayed on to the surface to be covered.

By the use of slides and by actual demonstration Mr. Van Winsen illustrated how the method may be used to spray aluminum, zinc and other metal coatings upon other metals, upon wood, glass, and even cloth.

The speaker, in listing the applications of the process, included the following: as corrosion protection against atmospheric, sea water and chemical effects, to build up worn parts as on metal shafts, to produce a slightly porous coat on shafts or bearings so as to take up oil, to repair pin holes in a casting, in architectural work, in aircraft industry, for non-slip surfaces as on catwalks in aircraft, for coating the edges of glass windows on electric meters so they may take solder, and for numerous other purposes.

Noon luncheon at the Ottawa Technical High School, music by the Boys' Band and Choir, and a trip through the building on Thursday, May 9, constituted the closing function of the regular spring programme of the Ottawa branch of the Institute. About 85 members attended, with W. H. Munro, chairman of the branch, presiding at the luncheon.

H. R. Welch, b.sc., m.e.i.c., chairman of the Advisory Vocational Committee of the Ottawa Collegiate Institute Board, and W. B. Wallen, b.a., b.paed., principal of the school, spoke briefly at the luncheon outlining the work of the school. Other head table guests included: Mrs. C. H. Thorburn, chairman of the Collegiate Institute Board; L. S. Beattie, Inspector of Vocational Education of the Ontario Department of Education, Toronto; J. J. Slattery, vice-chairman of the Advisory Vocational Committee of the Ottawa Collegiate Institute Board; and George T. Green, chairman of the building and Shops Committee.

The orchestra was directed by Ross Hunter of the school staff and short talks on the organization and equipment of the school were given in the Auditorium by Ken Ward and Roy Patterson, fifth year students. Members and their guests were conducted through the school in small groups by students acting as guides who explained all features of interest.

SAINT JOHN BRANCH

F. L. Black, m.e.i.c. - *Secretary-Treasurer*

Commending the achievements of engineers in the Great War and the present conflict, T. C. Macnabb, general superintendent, New Brunswick district, Canadian Pacific Railway, speaking at the annual dinner of the Saint John branch of the Institute at the Admiral Beatty Hotel on May 8th, declared the world could look for new weapons to be brought out in the present war. His subject was **The Uncivil Engineer.**

The dinner was preceded by the annual business meeting at 6 o'clock resulting in the election of John P. Mooney as chairman for the ensuing year. He succeeds, as chairman, H. F. Morrisey who presided. Also elected were: Vice-Chairman, J. T. Turnbull; Secretary-Treasurer, F. L. Black (re-elected), and Executive, David R. Smith (re-elected), F. A. Patriquen and A. O. Wolff.

Reports submitted showed an increase of 12 in the total membership to 105, while the employment situation was regarded as "good." Through the Institute's headquarters in Montreal, the employment service bureau had taken care of 16 local engineering placements. Engineers laid off highway jobs had been absorbed into other fields of the profession, notably airport work.

"Once more we are depending for our lives upon the engineer," stated the guest speaker of the evening. "In this war, courage must be aided by trained minds or we shall go under. This has been so since forts were built and engineers were asked to show how to conquer them." He cited cases in point down through the days that followed Caesar's Perfectus Fabricum and Waldivus of William the Conqueror.

There was a hearty expression of thanks to the speaker by the many present. Besides members several guests attended. Three members were in khaki. Several others spoke briefly, including E. G. Cameron, Ottawa, chief engineer of the National Harbors Board, who helped establish the local branch a quarter of a century ago, as an original member.

The President at Quebec—This photograph shows officers and members attending the dinner meeting at the Chateau Frontenac.

QUEBEC BRANCH

PAUL VINCENT, M.E.I.C. - *Secrétaire-Trésorier*

Le lundi soir, 15 avril, nous avions une réunion à la salle des promotions de l'Université Laval de Québec, sous la présidence de Monsieur Philippe Méthé. A cette soirée, la section québecoise continuait ses innovations en invitant les ingénieurs et leurs amis en compagnie de leurs épouses et de leurs amies. La séance eut un succès important, plus de 300 personnes y assistaient.

Monsieur Methé, président de la section, présenta Monsieur de Lotbinière Harwood, chef publiciste du Téléphone Bell à Québec. Après une courte allocution de Monsieur Harwood la Compagnie Bell nous présentait une série de films sonores où **Les Communications Téléphoniques** nous furent expliquées en français .Débutant par un court historique du téléphone, ces films nous renseignèrent sur la construction, l'entretien et l'exploitation des divers genres de réseaux téléphoniques présentement en usage sur terre, sur mer et dans l'air.

Comme intermède, Monsieur Roger Morin de Radio-Canada CBV Québec nous montra un merveilleux film en couleurs de toutes les principales attractions de **l'Exposition Universelle de New-York,** de jour et de nuit.

Revenant à l'écran, Monsieur Louis Chartier nous explique à l'aide de dessins animés et de photographies l'action des ondes émises par les divers modèles d'antennes de radio-téléphonie: l'antenne d'émission, l'antenne à rideau réfléchissant, l'antenne rhombique et l'antenne à ondes courtes. Une communication téléphonique de Vancouver à Plymouth, Angleterre, au moyen d'une ligne animée nous montrait le trajet suivi par les ondes dans les deux sens. Dans cette excursion imagée, nous avons visité les postes radiophoniques, émetteurs et récepteurs, les amplificateurs et l'outillage des bureaux de Montréal, Drummondville, Yamachiche, Baldock, Rugby et Londres.

Monsieur Chartier nous expose ensuite à l'écran les facilités téléphoniques reliant les continents aux paquebots en mer, sur le *Queen Mary* par exemple. Et toujours par le film, Monsieur Desbaillets nous montre comment l'aviation est devenue plus sûre pour le public par la radiotéléphonie qui guide les aéroplanes. Nous voyons aussi que les communications téléphoniques sont possibles entre avions en plein vol et avec les postes terrestres.

En conclusion, un court film nous renseignait sur la provenance et de la constitution de chaque pièce d'un téléphone combiné (dit français). Nous avons alors assisté à l'assemblage des 274 pièces qui constituent l'appareil.

Monsieur Jean Marie Paquet remercia Monsieur Roger Morin pour son merveilleux film sur l'Exposition ainsi que la Compagnie Bell pour la gracieuse présentation de ses films et ses experts pour leurs commentaires.

Tout le monde est parti enchanté de cette soirée et convaincu que les dames sont très intéressées aux représentations cinématographiques qui vulgarisent la technique dans les domaines variés du génie.

THE PRESIDENT'S OFFICIAL VISIT

On Tuesday, April 30th, a dinner was held at the Château Frontenac in honour of Dr. Thomas H. Hogg, president of the Institute.

The chairman of the branch, Philippe Méthé, and 45 members cordially welcomed the president at this meeting, on his official visit to Quebec.

In a short after-dinner address, Dr. Hogg expressed the hope to have the full support of all Canadian engineers in these troubled times of war when commerce, industry and finance are undergoing considerable strain. "All our Canadian engineers," he stressed, "must strive together and form a united group in the interests of our country and our profession, in an attempt to solve the problems likely to result from the European conflict."

Mr. McNeely DuBose, vice-president, praised the president and mentioned that, in wartime, it was necessary for Canada to maintain a high rate of production in order to save our economic life.

Mr. L. Austin Wright, general secretary, paid tribute to Dr. Hogg who, he said, was continuing the Institute's tradition of being represented by presidents of outstanding reputation and internationally recognized for their authority and competence.

Messrs R. B. McDunnough and Hector Cimon, respectively in English and in French, thanked the president, Dr. Hogg, on behalf of the members.

After dinner, the secretary presented the members to the president, who was pleased to meet and talk with every one.

SASKATCHEWAN BRANCH

J. J. WHITE, M.E.I.C. - *Secretary-Treasurer*

On April 15th, Major M. A. MacPherson, K.C., of Regina, addressed the Saskatchewan Branch on **The Middle East and the War.**

Mr. MacPherson's address was very interesting and provocative of a great deal of discussion during the question period which followed.

The meeting was under the chairmanship of Mr. P. C. Perry and was preceded by a dinner at the Kitchener Hotel, at which sixty members and friends were present.

On April 23rd, the Saskatchewan Branch was favoured by a visit from Dr. Norman McLeod, research engineer of Imperial Oil Limited. The meeting was held in the Science Theatre of the Regina College and was attended by seventy persons under the chairmanship of Mr. P. C. Perry. Mr. McLeod's discussion was on **The Development of Airport Runways.**

SAULT STE. MARIE BRANCH

O. A. EVANS, Jr.E.I.C. - - - *Secretary-Treasurer*
W. C. COWIE, Jr.E.I.C. - - - *Branch News Editor*

The fourth general meeting for the year 1940 was held in the Windsor Hotel on Friday, April 26th, 1940, when 18 members and guests sat down to dinner at 6.45 p.m. The business portion of the meeting began at 8.00 p.m. The minutes of the previous meeting were read and adopted on motion by K. G. Ross and J. L. Lang. H. J. Leitch and N. C. Cowie moved the bills be paid.

Chairman H. J. Leitch then introduced the speaker of the evening, Mr. G. W. MacLeod, who had for his topic **The Mining and Treatment of Siderite at the Helen Mine.** He illustrated several features of the process with samples and pictures.

Mr. J. S. MacLeod, then moved a vote of thanks to the speaker. K. G. Ross, moved that the meeting be adjourned.

ST. MAURICE VALLEY BRANCH

GORDON B. BAXTER, Jr.E.I.C. - *Secretary-Treasurer*

The Branch held a dinner on May 1st at the Chateau de Blois, at Three Rivers, to welcome the president of the Institute on his official visit. Guests assembled in the lobby at 7.00 and cocktails were served to all in the hotel lounge. At 7.45, dinner was served. The guests at head table were as follows: Guest of Honour, Dr. Thomas H. Hogg; General Secretary, L. Austin Wright; Branch Chairman, C. H. Champion; Branch Secretary, G. B. Baxter; H. O. Keay, Dr. A. H. Heatley, F. W. Bradshaw, E. B. Wardle, H. K. Wyman; Quebec Branch: H. Cimon, A. Larivière.

The chairman introduced the principal speaker. Dr. Hogg then explained why he had accepted the presidency of the Institute, and thanked all those who had assisted in conferring this signal honour upon him. He mentioned in passing that if he had known that war would be upon us this year with its consequences, and heavy duties, it was possible he would have hesitated to accept the presidency, but since he had accepted, he would do his best to carry on the task in a manner worthy of his predecessors.

The President visits the St. Maurice Valley Branch at Three Rivers. Head table guests from right to left are: Gordon B. Baxter, Alex Larivière, E. B. Wardle, Dr. A. H. Heatley, Dr. T. H. Hogg, C. H. Champion, L. A. Wright, H. O. Keay. Not shown on the photograph were: F. W. Bradshaw, Hector Cimon and W. K. Wyman.

He complimented the work of individual branches, saying that it was due principally to their efforts that the Institute was forging ahead. The problems facing engineers from coast to coast are very diversified and it is only by grouping together under one head that these problems become known to engineers as a whole, thus The Engineering Institute is doing valuable work for the country in trying to solve our many national problems. He mentioned that the services of the Institute had been placed at the Government's disposal, and that it was expected advantage would be taken of the offer.

He spoke of engineering as being an exact science and said that when comparisons were drawn between doctors, engineers, lawyers, the engineer was at a disadvantage since he had to be absolutely correct to win distinction. Nevertheless, he was called upon to organize our transportation systems by land, sea and air, to develop and transmit power for our industries. It is a fact that there are fewer monuments to the work of engineers than to other professions.

He passed remarks about the improvements to our Journal, giving credit for this to our General Secretary, Mr. L. A. Wright.

He also mentioned the good work being done by the Bennett Committee in charge of the welfare of our young engineers.

In mentioning the war effort of our Institute he remarked that full advantage of the Institute and its members as a whole had not been taken to the extent that it could be but he expected that this situation would be altered in the near future.

The chairman thanked Dr. Hogg for coming and addressing the Branch and called upon Mr. L. A. Wright to say a few words. He spoke briefly of the value of belonging to the Institute and the prestige attached to this body, mentioning several cases of its value to members both in securing employment, and the services it rendered its members both in this and foreign lands. He also spoke of the Voluntary Registration Bureau and of the great work done in compiling the records of all who have volunteered to serve in war-time occupations should they be called upon. He stated that it was expected some further announcement on this would be forthcoming shortly.

Mr. Cimon spoke briefly of the Quebec Branch and expressed his pleasure at being able to attend our meeting here. He stated that both branches should get together oftener and try and hold joint meetings, thus encouraging good fellowship and promoting the welfare of the Institute.

Mr. Wyman was then called upon by the chairman to express the Branch's thanks to our honoured guest.

Mr. Wyman spoke very briefly, thanking Dr. Hogg for his visit and hoping that he would be able to repeat this again. Said that members should have more get-togethers, and heartily endorsed the sentiments of Mr. Cimon.

Library Notes

Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

BOOK REVIEW

Soil Mechanics and Foundations

By Plummer and Dore, Pitman Publishing Corporation, New York, 1940; 484 pp., 6 x 9 in., $4.50.

Reviewed by Prof. I. F. Morrison*

The mechanics of granular masses is not of recent origin. It has been developed over a considerable period. One might say, however, that up to 1914 the growth was limited in its scope to such items as the familiar Coulomb's theory of earth pressure, Rankine's theory of conjugate pressures and some related topics. In the early part of this century, new interest was aroused by the stimulating and inspired researches of Dr. Charles Terzaghi, the ultimate value of which can not yet be fully assessed and certainly not be overestimated at present. He is to be credited with the first successful attempt at a thorough study leading to a rational and systematic investigation of the underlying causes of the complex phenomena which often make their appearance in engineering works in which soils are involved. His first book, the foundations for which he laid in 1917, *Erdbaumechanik*, was published in 1925. The fact that this book contains no less than 400 odd references to previous work bearing on the subject is an indication, not only of the thoroughness with which the author dealt with his subject, but that a considerable body of knowledge related to the physics of granular masses was already at hand; and furthermore that this body of knowledge was in need of critical examination and intelligent correlation. Since that time an enormous amount of experimental work, much of it of a higher order, has been done and published at widely scattered sources. It would seem, perhaps, again time to gather together the important items of the new knowledge, so recently acquired, into a single volume in order that those who are engaged either in teaching or in practice may have a ready means of becoming informed of these later developments in the field of earthwork engineering. This, the writer takes it, is the object of the present volume by Plummer and Dore on *Soil Mechanics and Foundations*.

The authors do not claim to be specialists in the subject and perhaps it is well to have a book written by those who are not specialists but who are, nevertheless, in close touch with the subject from the point of view of practical application.

For the most part the material has been drawn from many different sources as is shown by the excellent bibliography at the end of the book. This lacks references to the European literature, however, where much valuable work has been done, so that the bibliography can hardly pretend to be very comprehensive. The task of gathering the material and of sorting and selecting the essential parts of it, to say nothing of presenting it in comprehensive language, is indeed not a small one. It is upon the quality of the authors' judgment in selection that the value of a book of this sort lies.

The book, although not actually so divided, consists of three more or less distinctive parts. These are: a descriptive section on the origin, classification, physical testing and properties of soils; a section on the mechanics of granular masses; and a final section which is perhaps best described briefly as the engineering or technical application in practice of the subject matter of the preceding parts.

There are in all twenty-nine short chapters, one very brief appendix of symbols, several pages of problems and a bibliography. Of these, the first eleven chapters of 140 pages constitute the first section in which soils, their origin and physical properties are briefly described along with the tests which are carried out for the purposes of determining the characteristics and classification of soils. The authors have adopted an attitude of direct statement or description, rather than one of the development of ideas or of critical discussion of the scientific principles involved. Following a somewhat too short chapter on the geology of soils, soil properties in general and the usual soil tests are

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discussed in detail. As an example, no attempt is made to develop the formulae on which the theory of consolidation is based. The fundamental equations and resulting formulae are merely stated and discussed very briefly, the settlement of structures based on this theory is disposed of in a single page, and a quite short, well-known example as an application presented.

The second section embraces chapters twelve to seventeen inclusive and contains 91 pages. These chapters deal briefly with the distribution of stresses in soils and their actions and reactions against walls and foundations. Here also the method adopted is to state results rather than to develop ideas. For example, a number of valuable formulae are stated for various cases of surface loading but no process is given to show the methods by which these were obtained. The rather outstanding work of Kögler and Scheidig on the distribution of stresses in building ground is disposed of on a single page. On the other hand, six and one-half pages are devoted to the interesting and important, but nevertheless rather special, topic of the bedding of rigid pipes or conduits. The bearing capacity of soils is discussed from several points of view but mainly attention is given to the methods of Krey and of Bell with too little perhaps devoted to the interpretation of actual field loading tests. The carrying capacity of a soil is, however, only one part of the foundation design problem. The amount of settlement, both total and differential, receives but scant attention from the point of view of actual computations or examples.

In the third section, the authors deal with the compaction of soils and the handling of water in foundation construction. This is followed by four short descriptive chapters on foundations for buildings, bridges, highways and dams, respectively, which are in turn followed by two chapters on the design and construction of earth dams.

The chapters on foundations are descriptive in character and actual computations, such as, for the proportioning of building footings, are not presented nor is any rational basis for this procedure discussed. Extensive excerpts from the new Boston Building Code on the classification and allowable bearing values of soils and on pile foundations form a valuable part of this section and should be of special interest to those who, at present, are engaged in the revision of building ordinances. Certain paragraphs of this new code afford an interesting example of the influence of the recent progress in soil mechanics and in the reluctance to depart from traditional practice.

A number of examples of deep excavations for dam foundations have been gathered and presented in condensed form. This is followed by two good chapters on the design and construction of earth dams with a considerable preponderance of information on the Quabbin dams. The book closes with two very short chapters on engineering and organization in construction work.

A series of problems pertaining to some of the chapters is given at the back of the book. These are of good quality and will be of considerable value for class work.

It is plain from what has been said above that the book is of elementary character. It is not one for the specialist or research worker but should be of value to students and young engineers who approach the subject for the first time with a desire to find out, in an elementary way at least, what it is all about.

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

Canadian Trade Index:

Compiled and published by the Canadian Manufacturers' Association, Toronto, 1940. 842 pp., 6½ by 9¼ in., $6.00.

Fuel Burning and Steam Generation:

By Otto de Lorenzi, Montreal, Combustion Engineering Corporation Limited, c1939. 265 pp., 8¾ by 11¼ in., $3.25.

National Reference Book on Canadian Men and Women:

Published by Canadian Newspaper Service, 1940. 5 by 7½ in.

Public Works Engineers' Year-book 1940:

American Public Works Association, Chicago, c1940. 338 pp., 5½ by 8¾ in., $3.50.

PROCEEDINGS, TRANSACTIONS, ETC.

American Institute of Electrical Engineers:

Year-book, 1940.

American Society for Testing Materials:

Proceedings of the Forty-second Annual Meeting, Volume 39, 1940.

American Society for Testing Materials:

Index to A.S.T.M. Standards including Tentative Standards, 1940.

Canadian Institute of Mining and Metallurgy:

Transactions, Volume 42, 1939.

Institution of Civil Engineers:

List of Members, 1940.

Institution of Mechanical Engineers:

Proceedings, Volume 142, 1939.

Society of Mechanical Engineers Japan:

Volume 5, No. 21, 1939.

Society of Naval Architects and Marine Engineers:

Transactions, Volume 47, 1939.

REPORTS

American Institute of Mining and Metallurgical Engineers:

Technical Publication No. 131—Electrical prospecting applied to foundation problems, by Irving B. Crosby and E. G. Leonardon.

American Public Works Association:

Preparation of refuse for collection. Bulletin No. 9, c1940.

American Society of Civil Engineers:

Engineering Geology Problems at Conchas Dam, New Mexico, by Irving B. Crosby. Reprinted from Proceedings, January 1939.

Canada Department of Labour:

Wages and hours of labour in Canada, 1929, 1938 and 1939. Ottawa, 1940; Prices in Canada and other countries 1939, Ottawa, 1940; Strikes and lockouts in Canada and other countries. Ottawa, 1940; Labour legislation in Canada, 1939. Ottawa, 1940.

Canada Department of Mines and Resources—Mines and Geology Branch:

Comparative tests of various fuels when burned in a domestic hot-water boiler, 1935 to 1938. Ottawa, 1940; Test on the liquefaction of Canadian coals by hydrogenation, Ottawa, 1940.

Canada Department of Mines and Resources:

Report of the department of mines and resources including report of soldier settlement of Canada, 1939. Ottawa, 1940.

Canada Censorship Co-ordination Committee:

Handbook, press and radio broadcasting censorship. Ottawa, 1940.

Canadian Department of Mines and Resources—Surveys and Engineering Branch:

Precise levelling in Ontario south of Parry Sound. Publication No. 19. Ottawa, 1940; Bench marks in Quebec north of St. Lawrence. Publication No. 63. Ottawa, 1940.

Canadian Government Purchasing Standards Committee:

Specification for Linseed oil, raw, unrefined; Linseed oil, boiled; Turpentine for pain, type 1; Priming paint for steel; Zinc chromate-oil varnish type; Primer, zinc, chromate, for light alloys, semi-paste with thinner; Linen hose, forestry type.

Electrochemical Society:

Present status of the electric arc furnace in industry; Theory of the potential and the technical practice of electrodeposition; Electric furnace alloy steels for forgings; Some new developments in corrosion resistant steel. Preprints Nos. 77-27 to 77-30.

Institution of Structural Engineers:

Revised code of practice for the use of structural steel in buildings. Based on the final report of the Steel Structure research committee, 1936; Report on reinforced concrete for buildings and structures, part 3. London, 1940.

Mémoires de la Société des Ingénieurs Civils de France:

Mémoires, 1939.

New Brunswick Electric Power Commission:

Twentieth Annual Report, 1939.

New England Water Works Association:

Relation of geology to the groundwater supplies of New England by Irving B. Crosby, 1933; Ground water in the Pre-Glacial buried valleys of Massachusetts by Irving B. Crosby, c1939.

Ohio State University—Engineering Experiment Station:

A study of the fire resistance of building materials by Harry D. Foster. Bulletin No. 104, January, 1940.

Quebec:

An act respecting information concerning companies. Chapter 228 of the revised statutes of Quebec, 1925, Quebec, 1937.

Quebec Bureau des Statistiques:

Caisses populaires et sociétés coopératives agricoles, 1937, Quebec, 1939.

U.S. Department of Commerce—Building Materials and Structures Reports:

Structural properties of wood-framewall and partition constructions with "Celotex" insulating boards sponsored by the Celotex corporation, BMS42; Structural properties of a wall construction of "Knap concrete wall units" sponsored by Knap America Inc. BMS40.

U.S. Department of the Interior—Bureau of Mines:

Some information on Timbering Bituminous-Coal Mines, 1939; Accidents from falls of rock or ore in metal mines, 1940.

U.S. Department of the Interior—Geological Survey Bulletin:

Transit traverse in Missouri, part 3, East-Central Missouri 1903-37, No. 916-C. Spirit levelling in Utah 1897-1938, No. 912.

U.S. Department of the Interior—Geological Survey Water-Supply Paper:

Flood of December 1937 in Northern California, No. 843; Geology and Groundwater resources of the Harney Basin, Oregon, No. 841.

U.S. Department of the Interior—Bureau of Mines:

Technical paper No. 607.

SPECIFICATIONS

Canadian Engineering Standards Association:

Hard Drawn Aluminum Wire, Aluminum Cable and Aluminum Cable Steel Reinforced, C49-1940. Portland Cement and high early strength portland cement, A5-1940, A57-1940.

GIFTS*

Canada at the Universal Exhibition of 1855:

Toronto, John Lovell, 1856.

Ensamples of Railway Making:

London, Architectural Library, 1843.

Practical Treatise on Rail-Roads and Interior Communication:

By Nicholas Wood. Has original experiments and tables of the comparative value of Canals and Rail-Roads. London, Knight and Lacey, 1825.

*Presented to the Library by W. H. Breithaupt, M.E.I.C., Kitchener, Ontario.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

ALTERNATING-CURRENT CIRCUITS

By K. Y. Tang. International Textbook Co., Scranton, Pa., 1940. 438 pp., diagrs., charts, tables, 9½ x 6 in., cloth, $4.00.

Intended as an introductory course in the study of circuit analysis, the material here presented should precede the study of alternating-current machinery, power, and communication networks. The physical nature of circuit elements and the principles and laws of electric circuits are covered, with emphasis on the effects of the circuit elements on the flow of current and the relations of instantaneous values. Problems accompany each chapter.

AMERICAN PLANNING AND CIVIC ANNUAL

Edited by H. James. American Planning and Civic Association, Washington, D.C., 1939. 288 pp., illus., 9 x 6 in., cloth, $3.00.

The papers included in this volume have been presented at various national and regional conferences, and are grouped under the headings of community reclamation, industrial migration, man-made obstacles to planning, rural problems, national income, public works, state and national parks. They constitute a survey of current work in these fields, leading toward the improvement of living and working conditions.

CHEMISTS' YEAR BOOK, 1940

Founded by F. W. Atack, edited by E. Hope. Chemical Publishing Co., New York, 1940. 1,257 pp., illus., diagrs., charts, tables, 6 x 4 in., fabrikoid, $6.00.

This well-known pocketbook contains a careful selection of numerical data, analytical methods, glossaries of trade names and other information frequently needed by chemists. Many editions have appeared. This one has been thoroughly revised and brought up to date.

E.Q.A., ENGINEERING QUESTIONS AND ANSWERS. 2 Vols.

Emmott & Co., London and Manchester, England, 1936-1939. Illus., diagrs., charts, tables, 10 x 7 in., paper. Vol. 1, 176 pp., 6s.; Vol. 2, 176 pp., 6s.

These volumes contain a selection of the questions and answers which have appeared in the "Mechanical World" during the years 1934 to 1938. These questions deal with a great variety of difficulties and problems which have arisen in shops and mines, in construction work and manufactories. The answers are full and the volumes will be useful for reference.

ÉLASTICITÉ ET PHOTO-ÉLASTICIMÉTRIE

By H. Le Boiteux and R. Boussard, preface by M. P. Langevin. Hermann & Co., Paris, 1940. 361 pp., illus., diagrs., charts, tables, 10 x 7 in., paper, 180 frs.

This treatise is the first French work to provide a complete exposition of the photoelastic methods of studying stresses in materials. The first section gives the fundamental mathematical theory of elasticity; the second, the principles of optics involved; Part three discusses photoelastic principles, apparatus and methods; and Part four, the determination of stresses by photoelastic studies.

ELECTRIC DISTRIBUTION FUNDAMENTALS

By F. Sanford. McGraw-Hill Book Co., New York and London, 1940. 242 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $2.50.

Written from a non-engineering viewpoint, this book gives the perspective, development and economic background of electric distribution as a part of the general system of electric supply. The author outlines features of both the utility distribution, and the industrial and inside wiring branches of service to the outlet. Practical design problems are included, with solutions based on graphical methods rather than on engineering mathematics.

ELECTRICAL METERMEN'S HANDBOOK, 5th ed., 1940.

Edited and published by Edison Electric Institute, New York. 354 pp., illus., diagrs., charts, tables, 10 x 8 in., cloth, $3.60.

This is a completely revised edition of the "Handbook for Electrical Metermen," the fourth edition of which appeared in 1923. It is prepared primarily for the practical meterman and the meter engineer confronted with the day-to-day problems of measuring customer loads. It contains the basic principles, diagrams of the usual connections for all types of metering, descriptions of laboratory equipment and procedure, full descriptions of all American meters of modern types and complete tables of constants for all types of meters that are in current use.

ENGINEERING REORGANIZATION

By J. J. Gillespie, with a foreword by D. Brown. Pitman Publishing Corp., New York, 1940. 258 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $4.00.

This book is written for engineering companies not engaged on continuous or mass production. The general subjects of planning, material and quality control, time study and job analysis, costing and sales methods are discussed, together with many specific examples and applications to particular shops and departments.

FUEL FLUE GASES, the Application and Interpretation of Gas Analyses and Tests

American Gas Association, New York, 1940. 198 pp., illus., diagrs., charts, tables, 11 x 8½ in., cloth, $5.00.

This book has been prepared under the auspices of the Chemical section of the American Gas Association, as a summary of the manner in which chemical work can be practically and usefully applied to the everyday problems of the gas industry. The first five chapters are devoted to fuel gases and discuss their analysis, physical testing, the application of gas analyses and the specific constituents of fuel gases. The sixth chapter is on the chemistry of the distribution system and its problems; the seventh considers atmospheres other than those composed of combustion products. The final two chapters, on the gases that result from combustion, discuss furnace atmospheres and flue-gas analysis. Throughout, attention is directed to the application and interpretation of analysis. Numerous bibliographic footnotes are included.

Great Britain. Scientific and Industrial Research Dept.:

METHODS FOR THE DETECTION OF TOXIC GASES IN INDUSTRY

Leaflet No. 8. Phosgene. 7 pp., $0.75.
Leaflet No. 9. Arsine. 6 pp., $0.75.
Leaflet No. 10. Chlorine. 7 pp., $0.10.
Leaflet No. 11. Aniline Vapour. 9 pp., $0.10.

His Majesty's Stationery Office, London, 1939, charts, diagrs., tables, 10 x 6 in., paper, (obtainable from British Library of Information, 50 Rockefeller Plaza, New York).

These pamphlets give detailed directions for determining the presence of dangerous gases or fumes in factories. The methods are simple and the directions sufficiently explicit to be used by comparatively unskilled persons.

(The) HISTORY OF PHOTOGRAPHY, Its Relation to Civilization and Practice

By E. Stenger, translation and footnotes by E. Epstean. Mack Printing Co., Easton, Pa., 1939. 204 pp., illus., 9½ x 6 in., cloth, $5.00.

In this translation from the German a brief general history of the origin of photography is followed by a section on photographic apparatus, in which are described the various types of cameras, old and new, the sensitive film and its treatment, and photographic printing papers. The next section contains brief descriptions of the development of many applications of photography. Photography is also discussed as a profession and a hobby in civilization and as an economic asset. There is a brief bibliography, a group of portraits, and a list of quotations concerning photography. The work overemphasizes German contributions, but is a useful contribution to the question.

HISTORY OF THE KODAK AND ITS CONTINUATIONS, the First Folding and Panoramic Cameras, Magic Lantern, Kodak, Movie

By M. F. Hammer. House of Little Books, 156 Fifth Ave., New York, 1940. 95 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $2.00.

The purpose of this book is to call attention to the contributions of David Henderson Houston to the development of the roll-film and folding cameras. The early history of photography is sketched, Houston's patents are presented, his relations with George W. Eastman described and a brief biography given. The invention of the name "kodak" is claimed for him, as a derivative from the word Dakota, where Houston lived.

MANUAL OF WATER QUALITY AND TREATMENT

Prepared and published by the American Water Works Association, 22 East 40th St., New York, 1940. 294 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $3.00.

This manual is intended to represent, as adequately as possible, the prevailing views of water works managers and specialists concerning the quality and treatment of water supplies. A thorough review of the organisms that occur in water, the methods of removal in use, treatments to remove tastes and odors and methods of conditioning water chemically are discussed in a practical, up-to-date way. There is a bibliography.

MECHANICS APPLIED TO VIBRATIONS AND BALANCING

By D. L. Thornton. John Wiley & Sons, New York, 1940. 529 pp., illus., diagrs., charts, tables, 10 x 6 in., cloth, $7.50.

The purpose of this book is to present the general theory of vibrations in its various aspects. While written primarily for engineers, it should also be of use to students of physics. The subjects discussed include the balancing of locomotives and engines, the theory of vibrations, the propagation of stress in elastic materials, and vibrations in beams and plates and in rotating shafts and disks. A final chapter gives a general survey of the subject and of its applications to the testing of materials, to ships, bridges, traffic, geophysical surveying, etc.

MODERN ELECTRIC AND GAS REFRIGERATION

By A. D. Althouse and C. H. Turnquist. 3rd rev. and enl. ed. Goodheart-Willcox Co., Chicago, 1939. 858 pp., illus., diagrs., charts, tables, 8 x 5 in., lea., $5.00.

This practical textbook for school use and home study covers both domestic and commercial refrigeration. Fundamental physical principles are discussed in the introductory material. Installation and servicing are treated, and there are chapters on refrigerants and air conditioning. Domestic refrigerator specifications are given, and each chapter has review questions with answers.

(The) NEW TECHNIQUES FOR SUPERVISORS AND FOREMEN

By A. Walton. McGraw-Hill Book Co., New York and London, 1940. 233 pp., 9 x 6 in., cloth, $2.50.

The psychological methods available for the selection, encouragement and improvement of workers are considered, following a general discussion of the theory behind such methods. Suggestive notes discussing fundamental psychological factors are appended.

PETROLEUM REFINING AND MANUFACTURING PROCESSES

By M. J. Japour. Wetzel Publishing Co., Los Angeles, Calif., 1939. 310 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $5.00.

This book is intended to present the fundamentals of refinery practice and to supply a general account of the products and their industrial uses. A large part of the book is devoted to lubricants and to recommended specifications and formulas for specific purposes. A chapter is devoted to the significance of tests. The work brings together, in convenient form for reference, a large amount of commercial and practical information.

(The) PHILOSOPHY OF PHYSICAL SCIENCE (Tarner Lectures 1938)

By Sir A. Eddington. The University Press, Cambridge, England; The Macmillan Co., New York, 1939. 230 pp., 9 x 6 in., cloth, $2.50.

A distinguished scientist presents a companion volume to his previous works. This time he examines the nature of physical knowledge and demonstrates how it is applied to the physical universe. In the two final chapters he presents an outline of a general philosophical outlook which he believes a scientist can accept without inconsistency.

(The) PRINCIPLES OF ECONOMIC GEOLOGY

By W. H. Emmons. 2 ed. McGraw-Hill Book Co., New York and London, 1940. 529 pp., illus., diagrs., maps, charts, 9½ x 6 in., cloth, $4.00.

The aim of this work is to provide the advanced student of geology with a concise, but completely rounded knowledge of the science of metalliferous and non-metalliferous deposits. The first part of the book is a general treatment of mineral deposits. The second part treats each of the metals and the more valuable non-metallic minerals. Many mining districts and their deposits are described. This edition has been completely rewritten and brought up to date. Many bibliographic footnotes are included.

PRODUCTION AND UTILIZATION OF COKE

By F. M. H. Taylor. Walter King, Ltd. ("Gas Journal" Offices), London, E.C. 4, England, 1939. 278 pp., illus., diagrs., charts, tables, 9 x 5½ in., fabrikoid, 21s.

This work is specifically concerned with the utilization of coke and is intended as a guide to its combustion and use for heating dwellings and for raising steam, for gas production and other purposes. The production and properties of coke, its preparation for the market are discussed briefly. Considerable space is given to the design and construction of coke-burning appliances.

QUANTITATIVE SPECTROGRAPHIC ANALYSIS WITH THE MICROPHOTOMETER

Pt. 1. A Review of Published Work, by D. M. Smith. Research Report, Association Series, No. 524. November, 1939. British Non-Ferrous Metals Research Association, London, N.W.1. 24 pp., tables, 10 x 6 in., paper, 2s.

The work published in the last fifteen years on quantitative spectrographic analysis with the microphotometer is listed and reviewed briefly in this pamphlet. A tabular summary is given of data for the analysis of non-ferrous alloys, and the present position of the method is summarized.

QUARTZ OSCILLATORS AND THEIR APPLICATIONS

By P. Vigoureux. Great Britain, Department of Scientific and Industrial Research; His Majesty's Stationery Office, London, 1939. 131 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, 4s. 6d. (obtainable from British Library of Information, 50 Rockefeller Plaza, New York, $1.35).

The purpose of this monograph "is to present in a systematic manner a short account of the information now available concerning the construction, basic properties, and practical applications of piezo-electric resonators. The discussion will be confined mainly to quartz crystals." The book appears under the auspices of the Department of Scientific and Industrial Research of Great Britain, and is a completely rewritten edition of one published in 1928 under the title, "Quartz Resonators and Oscillators." There is a bibliography.

RAILROAD TIE DECAY

By C. J. Humphrey and C. A. Richards. American Wood-Preservers' Association, Washington, D.C., 1939. 54 pp., illus., diagrs., tables, 9 x 6 in., cloth, $2.00.

Two papers by pathologists of the Bureau of Plant Industry which have appeared in the Cross Tie Bulletin are now made available in book form. The first paper, by C. J. Humphrey, deals with the more common fungi that attack ties in storage and with their control. The second paper, by C. A. Richards, discusses the defects produced by fungi. Both papers are illustrated by many photographs.

(The) ROAD TO MODERN SCIENCE

By H. A. Reason. D. Appleton-Century Co., New York and London, 1940. 297 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $3.00.

Important scientific achievements from the earliest recorded times to the present day are described in a concise, simple manner. Some account is given of the contemporary background and the lives of the men connected with the various discoveries. A chronology arrangement carries Part I up to the time of Newton. Part II, 1600 to date, takes up each science separately, closing with a chapter on modern investigations.

(The) STORY OF FLYING

By A. Black. McGraw-Hill Book Co. (Whittlesey House), New York, 1940. 267 pp., illus., 9½ x 6 in., cloth, $2.75.

The history of men's conquest of the air is related from the earliest recorded attempts to the modern airplane, including the balloon, rigid airship and glider. Air mail and transport are covered, the development of various aircraft parts, instruments and functions is described, and the final chapter sketches some probable future developments.

TEXT-BOOK OF HEAT, Pt. 1

By H. S. Allen and R. S. Maxwell. Macmillan & Co., London; Macmillan Co., New York, 1939. 527 pp., diagrs., charts, maps, tables, 9 x 6 in., cloth, $3.25.

The present part of this two-volume work is mainly descriptive and experimental, and the mathematical treatment has been kept as simple as possible. The development of the science has been traced, with full explanation of each step from the earliest notions to modern theories. Brief biographical notes have been included and questions accompany each chapter. The book aims to occupy the place between the elementary textbook and the comprehensive treatise.

THEORY AND DESIGN OF SPRINGS

By F. M. Cousins. Edwards Brothers, Ann Arbor, Mich., 1940. 99 pp., diagrs., charts, tables, 11 x 8 in., cloth, $2.50.

The more general types of springs, helical, spiral, conical, leaf, ring and disk, are analyzed for the purpose of establishing a mathematical basis for spring design. Problems connected with the surging characteristics of valve springs and other types subject to dynamic action are investigated. A bibliography is included.

TRAVAUX MARITIMES, Vol. 3.

Ouvrages Interiéurs et Outillage des Ports

By G. de Joly, P. H. Watier, Ch. Laroche and A. de Rouville. Dunod, Paris, 1940. 703 pp., diagrs., charts, maps, tables, 10 x 7 in., paper, 169.95 frs.; bound, 190.55 frs.

This third volume of a series of four on maritime works covers the arrangement and management of harbors; the construction of quays and docks of various types; equipment for building, launching and maintaining ships; harbor bridges, locks and sluices; dredging and cargo handling equipment; and the administration of commercial seaports. The treatment is comprehensive and detailed and there are many illustrations.

TWENTIETH CENTURY WARFARE, How Modern Battles Are Won and Lost

By L. M. Limpus. E. P. Dutton & Co., New York, 1940. 205 pp., 8½ x 5½ in., cloth, $1.75.

The theory, mechanics and tools of war are clearly and concisely explained. Keeping to fundamentals, the author emphasizes the basic lines of offensive and defensive strategy and tactics, discusses the functions and cooperation within a military organization, and describes not only the guns but also the mechanized equipment so important in modern warfare. There is a bibliography.

(The) ULTRACENTRIFUGE

By T. Svedberg and K. O. Pedersen, and others. Clarendon Press, Oxford, England; Oxford University Press, New York, 1940. 478 pp., illus., diagrs., charts, tables, 9½ x 6½ in., cloth, $12.50.

All features of the problem of the ultracentrifuge are discussed at length by various authorities: its design and construction as an engineering problem in which the material used is stressed to the limit of its strength; the theory of sedimentation; methods of operation; the technique of measurement for recording rates of sedimentation and the steady state ultimately obtained; the interpretation of results. There is a large bibliography.

PRELIMINARY NOTICE

of Application for Admission and for Transfer

May 25th, 1940

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

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

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

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

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

The Council will consider the applications herein described in July, 1940.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

A 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 attainment 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

COUILLARD—JOSEPH OVIDE, of 44 Marie Rollet St., Quebec, Que. Born at St. Charles sur Richelieu, Que., June 6th, 1902; Educ.: 1923-26, Bell Telephone Company course in principles of electricity & trans. of speech. Cert. Oct. 1926. Private study; 1918-21, gen. telephone work, Manitoba Govt.; 1922 to date, with the Bell Telephone Company of Canada, work includes outside plant constrn., cable splicing and testing, instructor at plant school, first aid instructor, chief assigner, tester, equipment and outside plant, from 1929-31 and Jan. 1935 to date, field engineer.

References: D. Rhodes, J. Saint Jacques, C. Boisvert, P. Vincent.

HARDING—LAURENZ FOSTER, of 152 Watson St., Saint John, N.B. Born at Saint John, Feb. 28th, 1896; Educ.: 1930-31, Bliss Electrical School, Washington, D.C.; 1915-16, sugar refinery, power house, Atlantic Sugar Refinery; 1916-19, 11th Field Co., Can. Engrs.; 1919-22, refinery, mech. mtce., Atlantic Sugar Refinery; 1922-23, city surveys, with G. G. Murdoch, M.E.I.C.; 1926-30, trade school electrical instructor; 1933-39, i/c West Saint John Hydro System, and at present, city electrician, Saint John, N.B.

References: G. N. Hatfield, F. P. Vaughan, J. T. Turnbull, D. R. Smith, G. G. Murdoch.

HENDERSON—CHARLES, of 4497 Notre Dame St. E., Maisonneuve, Que. Born at Dundee, Scotland, June 13th, 1900; Educ.: I.C.S. Course in mech. engrg., evening study. 1916-21, five years apprenticeship with Canadian Vickers Limited, Montreal, two years gen. and deck machine shops, and three years mech, drawing office; 1921-25, mech. dftsman., and 1925-33, chief dftsman. and asst. to chief engr., Peacock Bros. Ltd., Montreal; 1933-35, lubricating engr. i/c of installns., Climax Co. (Industrial Lubrication Divn. of Stewart-Warner Alemite Corpn.); 1935 to date, engr. in charge of design and plant installns., Reavell & Co. (Canada) Ltd., Montreal.

References: F. T. Peacock, J. H. Hunter, G. H. Midgley, H. Milliken, R. Ramsay, D. Giles.

HOCH—NORMAN FREDERICK, of Kapuskasing, Ont. Born at Killaloe, Ont., Jan. 21st, 1912; Educ.: B.Sc. (Mech.), Queen's Univ., 1936; 1937-date, dfting, checking, designing & estimating, Spruce Falls Power & Paper Company, Kapuskasing, Ont.

References: C. W. Boast, D. N. McCormack, R. S. Walker, J. G. Gilchrist, L. T. Rutledge.

KELLOGG—PAUL, of 5580 Queen Mary Road, Hampstead, Que. Born at Buffalo, N.Y., Oct. 10th, 1888; Educ.: B.Sc., Mass. Inst. Tech., 1911; R.P.E. of Quebec; 1924-28, factory manager, Kalamazoo Stationery Company, Kalamazoo, Mich.; 1930-33, member, research staff, National Industrial Conference Board, New York—Conducted research in management problems & prepared reports thereon; 1933-36, senior member, engrg. staff, Stevenson, Jordan & Harrison, New York—entire charge of various projects in field of management engrg.; 1936 to date, President, Stevenson and Kellogg, Ltd., Management Engineers, Montreal.

References: L. J. Scott, R. L. Weldon, T. M. Moran, R. E. Heartz, J. Stadler, W. B. Scott.

LEACH—TRONSON ALFRED JAMES, of Swift Current, Sask. Born at Kamsack, Sask., Nov. 11th, 1915; Educ.: B.Sc. (Civil), Univ. of Sask., 1938; 1938 (summer), student asst. on topog'l. survey; Sept. 1938 to date, instr'man., Water Rights Br., Prairie Farm Rehabilitation Board.

References: C. J. Mackenzie, C. J. McGavin, I. M. Fraser, E. K. Phillips, R. A. Spencer, W. E. Lovell, S. H. Hawkins.

ROUSSEAU—FRANCOIS PAUL, of Cadillac, Que. Born at Montreal, Oct. 11th, 1904; Educ.: B.Sc., Mass. Inst. Tech., 1927; R.P.E. of Quebec; 1929 to date, asst. resident engineer, for the Dufresne Construction Co. Ltd. (now Dufresne Engineering Co. Ltd.), on various projects.

References: J. B. D'Aeth, O. O. Lefebvre, G. O. Vogan, L. J. Leroux, L. A. Dubreuil, S. A. Baulne, E. S. Holloway, A. B. Normandin, A. Duperron.

SCOTT—ROBERT CLARK, of Kapuskasing, Ont. Born at Isabella, Man., Nov. 28th, 1914; Educ: B.Sc. (Mech.), Univ. of Sask., 1936; 1937 to date, dfting., designing, checking & instrument work, Spruce Falls Power & Paper Co. Ltd., Kapuskasing, Ont.

References: C. W. Boast, R. S. Walker, D. N. McCormack, J. G. Gilchrist, I. M. Fraser, W. E. Lovell, C. J. Mackenzie.

WADSWORTH—WILLIAM JAMES GORDON, of 34 Ardagh St., Toronto, Ont., Born at Toronto, Jan. 21st, 1909; Educ.: 1928-29 and 1930-31, civil engrg. course, Univ. of Toronto; O.L.S. 1937; 1930 (Jan.-Oct.), dftsman. & instr'man, C.P.R. Toronto Terminal; 1931 (June-Aug.), i/c field survey party, township surveys, Nor. Ontario; 1931 to date, surveyor in city planning & surveying dept., City Hall, Toronto, Ont.

References: A. G. Dalzell, T. A. S. Munford, J. M. Walker, W. L. Shelden, R. W. Emery, D. C. Beam

FOR TRANSFER FROM JUNIOR

CAPELLE—WILLIAM ABRAM, of 409 Broadway Court, Winnipeg, Man. Born at Winnipeg, Dec. 8th, 1910; Educ.: B.Sc. (Civil), Univ. of Man., 1932; 1926-31 (summers), rodman, instr'man., etc., C.N.R.; 1936-37, dftsman., constrn. dept., T. Eaton Co. Ltd.; 1937-38, engrg. dept., T. Eaton Co. Ltd.; Winnipeg; 1939, junior engr., Dept. of Public Works of Canada; 1939 to date, Major, R.C.E., Officer Commanding, 1st Corps Field Park Coy., R.C.E., Winnipeg. (St. 1929, Jr. 1937).

References: H. A. Dixon, E. P. Fetherstonhaugh, J. H. Edgar, A. M. Kirkpatrick, W. J. Johnston.

FOR TRANSFER FROM STUDENT

ARMSTRONG—JOHN LLOYD, of 5265 Cote St. Luc Road, Montreal, Que. Born at Shawville, Que., Jan. 29th, 1913; Educ.: B.Eng. (Elec.), McGill Univ., 1936; 1936-40, engr. in office of dial apparatus engr., and at present, engr. in office of manual operator engr., Northern Electric Co. Ltd., Montreal, Que. (St. 1936).

References: H. Miller, H. C. Spencer, W. C. M. Cropper, R. H. Yeomans, C. A. Peachey.

ELFORD—WESLEY FRED, of 95 Jameson Ave., Toronto, Ont. Born at Cogswell, North Dakota, U.S.A., July 28th, 1909; Educ.: B.Sc. (Elec.), Univ. of Alta., 1937; 1928-36, managed field work on 1500 acres of land in Alberta; 1937-38, plant study, and 1938 to date, asst. chief inspr., Toronto factory, Massey Harris Co. Ltd. (St. 1937).

References: R. S. L. Wilson, W. E. Cornish, C. A. Robb, R. M. Hardy, R. E. Smythe, J. S. Campbell.

Employment Service Bureau

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

SITUATIONS VACANT

ENGINEER. Excellent opportunity for young engineering graduate, preferably mechanical, with several years' industrial experience. Work involves analysis of plant operations. Offers wide scope for initiative and ingenuity. Describe briefly education, training and experience with special reference to specific accomplishments. Apply to Box No. 2070.

PRODUCTION ENGINEER thoroughly experienced in manufacture of plows, harrows, cultivators and other light agricultural implements. Must be competent to organize and lay out new factory on the most economical, modern lines. Good salary and excellent prospects for the right man. Travelling expenses paid to new position. Apply giving full particulars to Box No. 2078-V.

MECHANICAL ENGINEER, not over 35 years of age, for a Winnipeg firm dealing in well-known lines of mechanical and electrical equipment. Preference will be given to a man with experience in sale of contractors' equipment, conveying equipment and mining machinery. Apply to Box No. 2088-V.

YOUNG MECHANICAL ENGINEERING graduate, single, with a couple of years draughting experience wanted for Pulp Mill in Eastern Canada. Please give full particulars in first letter. Apply to Box No. 2091-V.

ASSISTANT to the ELECTRICAL SUPERINTENDENT of a paper mill. Electrical graduate with two to six years' experience preferred. Salary approximately $175.00 a month to start. Apply to Box No. 2097-V.

MECHANICAL and CIVIL ENGINEERS. See advertisement on page 302.

EMPLOYERS!

The Institute's Employment Service has on file the records of many young men graduated this spring in all the branches of engineering. Most of these graduates have had some early engineering experience during their vacations.

In recent weeks the demand for engineers has risen to a point where a scarcity has developed; therefore, we strongly recommend that employers arrange now for any extra help that they may require permanently or for the summer.

SITUATIONS WANTED

INDUSTRIAL EXECUTIVE, technically trained, 16 years experience in engineering, purchasing, production, manufacturing, technical sales, merchandise, general administration, and industrial relations. Box No. 185-W.

CIVIL ENGINEER, age 52, married, open for engagement. Experience includes 3 years at railway construction, 12 years at highway reconstruction work and asphalt paving, 8 years at municipal work. Will go anywhere required. Apply Box No. 216-W.

MECHANICAL ENGINEER, B.Sc., A.M.E.I.C., age 32, married. Ten years experience field erection; and in the preparation of plans, specifications, and estimates on various structural and mechanical projects pertaining to manufacturing plants. Desires change to position of responsibility in assisting a plant manager in problems of plant extension, new construction or maintenance. Apply Box No. 1054-W.

CIVIL ENGINEER, B.Sc., E.C. (U.N.B. '32) A.M.E.I.C. P.E. of N.B. Age 34. Married. Experience, general construction, mining, surveying, reinforced concrete, railroad, water and sewerage layouts. Apply to Box No. 1562-W.

CHEMICAL ENGINEER, Toronto '31; nine years experience in paper and board industry as assistant chief chemist; successfully worked on pitch elimination, waste reduction and steam saving. Anxious to join up with progressive company. Bilingual. Apply Box No. 1768-W.

ELECTRICAL ENGINEER, B.Sc. (Queen's Univ., 1938). Jr.E.I.C. Canadian, age 27, single. Experience includes 3 mos. testing transmitters and associated equipment with Canadian Marconi Co.; 4 mos. draughting, designing and redesigning, with the Northern Petroleum Corp.; 4 mos. assembly, testing and research on electric fence controllers with The W. C. Wood Electric Co.; on spare time radio servicing and generator rewinding. Wishes to take an apprenticeship course with radio engineering firm or power transmission company. Good references are available, will consider any location. Available on about one week's notice. Apply to Box No. 1969-W.

ENGINEERING STUDENT, S.E.I.C., graduating in civil engineering this spring; age 23; single; Canadian; eighteen months with large structural firm, draughting and detailing; interested in all phases of civil engineering; does not believe a graduate is entitled to a sinecure; location immaterial; good references. Apply Box No. 2133-W.

ENGINEER, B.Sc. (E.E.), Manitoba '35. Married. Seven months mining engineering. Three years with large agricultural implement firm in all production departments, and employed by them now. Familiar with iron and steel specifications and production methods, machine design and estimating. Available with month's notice. Apply Box No. 2155-W.

INDUSTRIAL ENGINEER, M.E.I.C., P.E. Quebec and Ontario, desires permanent industrial connection. Years of extensive experience in engineering and construction of pulp and paper mills, also hydro-electric power plants; experience includes all operations in the production and manufacture of pulp and paper, maintenance and purchasing, in some of the largest mills in Canada. Apply to Box No. 2162-W.

SAFETY ENGINEER, Affil. E.I.C., age 24; single; bilingual; presently employed; Canadian; 40 months with large industrial firm. Familiar with all phases of accident prevention and editing of bilingual company organ. Interested in industrial relations, safety, personnel and employment work. Location immaterial. Available with month's notice. Apply to Box No. 2187-W.

INDUSTRIAL EXECUTIVE, Canadian, M.E.I.C., presently associated in an executive capacity with an outstanding firm producing quality communications equipment, actively engaged for past twelve years in directing manufacture, development of new processes, design and provision of production facilities and cost control, will consider, if possible, position in the production or sales organization of other industrial enterprises. Apply to Box No. 2188-W.

ELECTIONS AND TRANSFERS

(CONTINUED FROM PAGE 287)

Transferred from the class of Junior to that of Member

Addison, John Hillock, B.A.Sc. (Civil), (Univ. of Toronto), topog'l engr., Tropical Oil Company, Barranca Bermeja, Colombia, South America.

MacCarthy, Henry Blair, B.Sc. (Chem.), (McGill Univ.), senior asst. engr., Dept. of National Defence (E.S. Branch), Ottawa, Ont.

Orr, William Winston, B.Sc. (Queen's Univ.), power transformer design engr., Can. Gen. Elec. Co. Ltd., Toronto, Ont.

Pottinger, Alexander, B.A.Sc., (Univ. of B.C.), engr., Canadian Westinghouse Co. Ltd., Hamilton, Ont.

Scott, Lloyd George, B.Sc. (Elec.), (Univ. of Man.), supt. of bldgs. office, Hudson's Bay Company, Winnipeg, Man.

Transferred from the class of Student to that of Member

Bolduc, Armand, B.A.Sc., C.E. (Ecole Polytechnique, Montreal), res. engr., Quebec Dept. of Roads, Montreal, Que.

Klotz, Carl Otto Paul, B.Sc. (Civil), (Queen's Univ.), junior research engr., National Research Council of Canada, Ottawa, Ont.

Moseley, Shirley Charles Tilton, B.Eng. (Mech.), (McGill Univ.), sand engr., Canadian Car and Foundry Co. Ltd., Montreal, Que.

Transferred from the class of Student to that of Junior

Desormeaux, Dollard, B.A.Sc., C.E., (Ecole Polytechnique, Montreal), technical service, City of Montreal, Que.

Doucet, Jean, B.A.Sc., C.E., (Ecole Polytechnique, Montreal), supt., Plessisville Foundry, Plessisville, Que.

Elliott, Clarence W., B.Sc. (Elec.), (Univ. of Alta.), junior engr., Calgary Power Company, Calgary, Alta.

Harvey, Ernest Allan, B.Sc. (Elec.), (Univ. of Man.), Toronto, manager, The Maytag Co. Ltd., Toronto, Ont.

Hastie, Frank James, B.Sc. (Elec.), (Univ. of Alta.), shift engr., Canada Packers Ltd., Edmonton, Alta.

Hyman, Ernest Roy, (Grad., R.M.C.), B.Sc., (Univ. of Man.), S.M. (Civil), (Mass. Inst. Tech.), asst. engr., Trinidad Leaseholds Ltd., Pointe à Pierre, Trinidad, B.W.I.

Northover, Arthur Beverley Clinton, B.A.Sc. (Civil), (Univ. of Toronto), junior research engr., Toronto Transportation Commission, Toronto, Ont.

Rowan, John James, B.A.Sc., C.E., (Ecole Polytechnique), B.Sc., (Mass. Inst. Tech.), design engr., Montreal East Refinery, Imperial Oil Limited, Montreal, Que.

Students Admitted

Blanchard, John Rust, (McGill Univ.), 180 Ballantyne Ave. So., Montreal West, Que.

Duquette, Roland C., (McGill Univ.), 753 St. Catherine Road, Outremont, Que.

Holli, Sulo A., (Detroit Inst. Tech.), power house office, Canadian Industries Limited, Windsor, Ont.

Kane, Redmond John, (McGill Univ.), 653 Grosvenor Ave., Westmount, Que.

Lee, John Wilson, (Univ. of Toronto), R.R. No. 4, St. Catharines, Ont.

Logan, George Robertson, (Univ. of N.B.), 254 St. James St., Saint John, N.B.

Patterson, Dan William, (Mount Allison Univ.), elect'l dftsman., Aluminum Co. of Canada, Montreal, Que.

Phillips, Roy Alexander, B.A.Sc., (Univ. of B.C.), test student, Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

Pumple, Francis Gerard, B.Eng. (Civil), (N.S. Tech. Coll.), 76 Kennedy St., Saint John, N.B.

Waller, Milford John, (Univ. of Toronto), Glen Cross, Ont.

Industrial News

Industrial development — new products — changes in personnel — special events — trade literature

LOADER AND PILER

Bulletin No. 240, issued by Stephens-Adamson Mfg. Co. of Canada Ltd., covers the company's line of box car loaders and pilers used for loading box cars with practically no loose bulk material. This and other applications are illustrated in the 4-page bulletin.

HAND AND MOTOR WINCHES

Another 4-page bulletin, No. 340, has been published by Stephens-Adamson Mfg. Co. of Canada Ltd., describing and illustrating the complete line of S-A hand and motor winches. Photographs, dimensional drawings, specifications and other data are included.

CHAIN LINK FENCE

The many uses of Stelco chain link fence are described in a 4-page illustrated bulletin recently distributed by the Fence Sales Division of the Steel Company of Canada, Limited, Montreal, Que., and Hamilton, Ont. In addition to the general description of various applications, the bulletin gives specifications in each case and a guide to the information required when ordering fence for a specific purpose.

HIGH TEMPERATURE CEMENT

Quigley Company of Canada, Limited, Lachine, Que., have issued a 20-page catalogue, No. H.G. 501, devoted to their product "Hytempite" plastic air-setting, high temperature cement. The catalogue which is being distributed by Canadian Fairbanks-Morse Co. Ltd., Montreal, deals with the use of "Hytempite" in a wide variety of industrial works.

SELF-PROPELLED RAILCAR

Schramm Inc., West Chester, Pa., have announced through a bulletin, No. 4015-4, the production of a new and larger size self-propelled railcar compressor. Specifications, illustrations and a general description are contained in the bulletin.

SHOW CASE LIGHTING

A 6-page folder, issued by Conduits National Co., Limited, Toronto, features the applications of "Wiremold" show case lighting. The advantages of this equipment and the method of installation, and other details are given in the folder.

ONTARIO SECTION, A.S.M.E., MEETING

The May meeting of the Ontario Section, The American Society of Mechanical Engineers, meeting at Hart House, Toronto, was addressed on the subject of "Hydraulic Presses, Their Industrial Applications for the Production of Human Needs" by J. C. Graf, of Baldwin-Southwark Corporation, Philadelphia, Pa., whose hydraulic presses are manufactured in Canada by United Steel Corporation of Canada, Limited. Mr. Graf's talk covered the design, application and service requirements of presses in such manufacturing and processing industries as transportation, plastics, asbestos products, presses for piercing, drawing, nosing and testing of shells, cartridge case presses and hydraulic testing machines.

RUSTPROOF METALS

Issued in pocket size as a quick guide to the best known family of rustproof metals, "7 Minutes with 7 Metals," The International Nickel Company of Canada Limited, 25 King St. W., Toronto, summarizes characteristics and uses of rolling mill and foundry products including special alloys as well as Monel and nickel. The publication is a handy synopsis, from the viewpoint of industry generally, of development to date in the field of these corrosion-resisting alloys with high physical strength and it includes much very recent material.

PORTABLE DYNAMIC BALANCING EQUIPMENT

Vibration in heavy rotating machinery is a serious matter which may involve considerable expense for repairs to the vibrating machine and nearby equipment. To combat this expense, Canadian General Electric Co. Limited has produced a portable dynamic balancing equipment for use wherever rotating masses require balancing to eliminate vibration.

The new device is a self-contained precision instrument capable of measuring the amount and phase angle of unbalance vibration present in the bearing pedestals of a rotating machine running in its own or substitute bearings at any speed between about 600 and 5,000 r.p.m.

BRAIDED PACKING

A new development in braided packing has been announced by The Garlock Packing Co. of Canada Ltd., Montreal, in a 12-page booklet entitled "Garlock Lattice-Braid" which fully describes and illustrates this new product. The booklet contains reference information for the purchaser and can be obtained on application to the company.

SPIRAL END MILLS

Brown & Sharpe Mfg. Co., Providence, R.I., have featured their spiral end mills in a 4-page bulletin recently made available for distribution. The Canadian Fairbanks-Morse Mfg. Co., Montreal, are the Canadian representatives.

FORTESCUE FELLOWSHIP WON BY QUEENS SENIOR

Selection of Norman Z. Alcock, of Kingston, Ontario, Canada, as the first successful candidate for the Charles LeGeyt Fortescue Fellowship was announced by the American Institute of Electrical Engineers.

Mr. Alcock will enter the Graduate Schoo of Electrical Engineering at California Institute of Technology next fall, specializing in the field of communications under Professor R. W. Sorensen. Born in Edmonton, Canada, in 1918, he is now a senior in electrical engineering at Queens University, Kingston.

The fellowship committee of the A.I.E.E., administering the income from a $25,000 trust fund, stated that Mr. Alcock has maintained the highest grades in his class since entering Queens University in 1936 on the Sir Sandford Fleming scholarship. He has won six scholarships and prizes.

The graduate fellowship, established by the Westinghouse Electric & Manufacturing Company" in recognition of the valuable contributions to the electric power industry" made by the late Dr. Fortescue during his 38 years with the Company, carries with it a minimum award of $500 a year.

Dr. Fortescue graduated from Queens University in 1898 as the school's first electrical engineer. Prior to his death in 1936 he had received 185 patents for electrical inventions. He is particularly noted in his profession for the development of a new mathematical tool—the method of symmetrical co-ordinates used in the solution of unbalanced polyphase circuits, for his analysis of the fundamentals of transmission circuit stability, and for his theories of lightning behavior and the resulting principles of lightning protection.

DUPLEX RECORDER

A new duplex recorder for recording simultaneously kilowatts and kva or kilowatts and frequency, or volts and amperes is announced by Canadian General Electric Co. Limited. Designed originally for cement mills to record kiln speed and temperature simultaneously on a single chart, the new instrument may be had with any two of the elements formerly available singly in the Type CD instruments. It is expected to have a wide use wherever it is desirable to obtain synchronism between two separate records, or where space economy makes it necessary to place two separate recording mechanisms in a single case.

ELECTRIC WELDERS

A new organ entitled, "The Weld-It," is being issued by the Taylor-Winfield Corp., Warren, Ohio, and will be mailed to anyone interested upon application to Commonwealth Electric Corp. Ltd., Welland, Ont., which company is the Canadian licensee of the Taylor-Winfield Corp., Warren, Ohio.

PORTABLE ELECTRIC NIBBLER

A small, portable electric "Nibbler" for cutting all kinds of sheet metal has just been introduced by the Independent Pneumatic Tool Company of Chicago. Only nine inches long and weighing but 3¾ pounds, it is a compact tool with a yoke type front head incorporating a punch and die that "nibbles" out a rectangular shaving of metal at each upward stroke of the punch. The "Thor Nibbler" will cut up to No. 18 gauge (.049 in.)—in steel and up to No. 15 gauge (0.72 in.) in aluminum. Information of the uses and construction of the "Thor Nibbler" may be had by writing to the company for Bulletin No. E-31.

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 23 | JULY 1940 | NUMBER 7

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

★ ★ ★

PUBLISHED MONTHLY BY

THE ENGINEERING INSTITUTE OF CANADA

2050 MANSFIELD STREET - MONTREAL

Price 50 cents a copy, $3.00 a year, in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

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FACTORS AFFECTING THE MASS PRODUCTION OF AEROPLANES

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Paper presented before the Lakehead Branch of The Engineering Institute of Canada, at Fort William, Ont., April 18th, 1940

SUMMARY—Figures are cited showing the universally small output of aeroplanes, despite the insatiable demand for military machines. The factors governing mass production of any commodity are stated to be, that tooling shall be undertaken on a rapidly-expanding market, that the commodity shall be designed for cost and production primarily, and that the basic design of the commodity shall be stabilized. The automobile and freight car are cited as examples of successfully mass-produced commodities, and the applicability of the factors mentioned is shown. Their applicability to the aeroplane industry is discussed. It is shown that the aeroplane is designed for performance, and that the ultimate basic pattern of the aeroplane is uncertain. The effect on performance of the stabilization of the basic pattern is discussed. A number of patterns are noted—the braced biplane, the semi-monocoque monoplane, the geodetic monoplane and the monocoque monoplane. The pattern commonly accepted to-day is stated to be the semi-monocoque monoplane. Production methods of this pattern are outlined. Mass production methods are outlined. The conclusion is reached that the semi-monocoque cannot be produced *en masse*.

War in Europe has created a tremendous demand for military and training aircraft, a demand so great that aeroplane factories the world over are busy striving to satisfy it. To increase production is the immediate concern of the whole industry. This concern, however, is not limited to the aircraft companies. So pressing is the need, that aeroplane production has become a matter of national interest and national urgency for neutral and belligerent countries alike. The drive for production is such as the industry never before experienced; yet the accomplishment falls far short of the demand and the output of aeroplane factories the world over is comparatively small.

National production figures for aeroplanes would undoubtedly substantiate this last statement. It is difficult, however, to obtain actual figures, especially those for the belligerent nations. However, experts have prepared estimates of probable outputs. Thus T. P. Wright (Reference 1) places the output of military aeroplanes in 1939 at about 22,000 for Germany, 3,600 for the United States, 7,600 for Great Britain, 4,100 for France, or, say, 12,000 for the Allies[1] (including purchases from the United States). Another estimate (Reference 2) of the total number of aeroplanes (all types) produced during the same period gives 4,775 for the United States, 17,475 for Great Britain, 5,550 for France, 22,550 for Germany, 5,450 for Italy and 9,410 for Russia. That mass production has not hit the aircraft industry is very apparent.

That mass production methods can be applied at will to aeroplane manufacture has been accepted without question by the general public. A production engineer can put anything on a mass production basis, they say, whether it is aeroplanes or baby carriages; it is assumed that there is a close parallel between the automobile and aeroplane industries.

If these statements are true, why then is not the industry on a mass production basis now? Why does aeroplane manufacture lag so far behind automobile manufacture? Three million automobiles were produced last year in the United States in the time it took to turn out five thousand areoplanes there. Mr. Wright's figures for 1941 show that he does not expect the gap between cars and 'planes to close in the near future, no matter how great the demand. Thus, if the popular conception of the ready applicability of mass production methods to aeroplanes is correct, governments and the public are entitled to an explanation of the delay.

The delay is due to no negligence on the part of the aeroplane manufacturers. Some mass production features have been introduced into the industry. But before the full range of manufacturing technique which transforms quantity production into mass production can be introduced successfully, certain fundamental factors which govern the production *en masse* of all commodities must obtain in the aeroplane industry.

Factors Governing Mass Production, and Examples

Mass production may be defined as the rapid manufacturing of a commodity in large quantities at a decreasing cost per unit produced (within reason). Before mass production techniques can be introduced successfully in an industry, the following factors must govern:

1. Tooling for mass production must be undertaken when the market for the commodity is expanding rapidly.
2. The commodity must be designed for cost and production.
3. The basic design of the commodity must be stabilized.

The automobile and railway freight car are excellent examples of mass-produced commodities and of the operation of the factors listed above.

Some thirty or forty years ago, when the railways were building, there was a growing demand for freight cars, and at that time tooling for mass production was undertaken. A production order for freight cars in those days averaged about 10,000 units, to be completed in a year's time. Similarly, when the demand for automobiles was growing, the motor car companies introduced mass production methods and tools, with the result that from 10,000 to 20,000 units of a single model could be turned out annually. In all industries once the change is made and the cost of it absorbed, production remains on that basis, even though the demand no longer provides work to plant capacity.

Twenty or thirty years ago when mass production methods were introduced in the automobile and freight car industries, the design of these two commodities was primarily for cost and production. Design for performance, design for beauty, design for comfort, design for any other specific requirement was given but secondary consideration. Until the emphasis was placed on cost and production, mass production in the two industries was unknown. To elaborate this point—one important step in the design for production is the reduction to a minimum of the number of separate and different parts of the commodity. Comparison of the early automobiles and those of to-day show what has been accomplished along this line. The first motor car bodies were assembled from many different frames, angles, brackets and built-up panels. The modern automobile body is made from four steel pressings. Even though the scope of the automobile has increased, the separate parts of a modern car number only between 500 and 2,000.

When the engineering approach to the problem of the design of a commodity is crystallized, the basic design of the commodity remains stable and unchanging. Stabilized basic design does not imply, however, a similarity of detail design, materials or methods of construction throughout the industry or down the years. These matters must keep

[1] He estimates that in 1941 the Allies will catch up with German production (which is still growing) and each side will produce about 40,000 aeroplanes annually—providing that bombing of aeroplane factories does not occur.

abreast of the times, taking advantage of increased engineering skill, new materials developed and new manufacturing processes evolved, even though the fundamental pattern of the commodity to which they are applied remains unchanged. Only when basic design is stagnant can the production engineer function effectively. The basic patterns of the automobile and the freight car were stabilized over twenty-five years ago. Since that time there has been no fundamental change in the design of these two commodities and this has enabled the production engineer in these two industries to solve his problems with some degree of finality.

Having established the factors governing the successful introduction of mass production methods, we will use them as a yardstick to gauge the feasibility of the mass production of aeroplanes. If these factors obtain now in the industry, we might consider it an indication that mass production of aeroplanes was just around the corner.

Aeroplane Orders and the Expanding Market

That the aeroplane market is undergoing a period of rapid expansion at this time is very apparent. Thus it is astonishing to learn that purchasing orders and production orders are rather limited. Mr. Wright, in his analysis, assumes the average production order for an all-metal aeroplane of modern type to be 400 in the United States, 800 in Germany. Another investigator places the English figure at 1,000. Such production orders result from limited purchasing orders, and that the latter should be restricted appears extraordinary in these times. The paradox of almost insatiable demand and restricted orders may be explained by the facts that production is slow, obsolescence rapid and the demand of uncertain duration. The expanding market so necessary and attractive to the introduction of mass production methods is at hand, yet wholesale tooling for mass production is not undertaken. The reason for this is the absence of the design factors which govern mass production.

Performance—the Basis of Aeroplane Design

"The commodity must be designed for cost and production." The aeroplane is designed for performance. The design of a new aeroplane is a failure if the performance does not better that of existing machines of the same power and duty. Thus the aeroplane designer faces a dilemma. To insure the marketability of his product,—perhaps, too, the supremacy in flight of his nation's Air Arm—he must design for the ultimate in performance. To insure production *en masse*—and perhaps the numerical superiority of his nation's Air Force—he must design to speed up manufacturing. How antithetical these design aims are at present, is shown by the following examples.

To facilitiate production the designer is called upon to depart from the streamlined form. This may result in a serious decrease in the speed of his machine[2]. To reduce the number of different parts and thereby simplify production, he must adopt certain standard parts throughout with a resultant increase in the gross weight of the machine. An increase in gross weight of five per cent of the gross weight may seriously impair the rate of climb (the important characteristic if the machine is an interceptor); or the useful load (fuel, ammunition, bombs), a reduction which would destroy the aeroplane's potency if it were a bomber. Thus under present conditions of design, performance and production are opposed as design aims. Before mass production can be entered upon they must be reconciled, and design for cost and production must assume priority.

Stabilization of Basic Design

The goal of the aeroplane designer is improved performance—particularly increased top speed. This he can achieve efficiently in two ways—by refinement of the basic pattern and by changing the basic pattern. Refinement of the basic pattern is carried out by incorporating aerodynamic improvements, employing the most improved materials, devising cunning means of saving structural weight, and streamlining the external form to reduce air resistance. Changing the basic pattern implies a fundamental change in the engineering approach. Attempts at crystallization of aeroplane design pattern are foiled by a change in the basic pattern of the aeroplane, not by refinement of this pattern.

Attempts have been made to crystallize the aeroplane pattern. Seven or eight years ago there was a very general attempt to stabilize design in the form of the braced biplane[3]. This pattern had been followed for years, and its general acceptance (with consequent stabilizing of its design, stress analysis and manufacturing techniques) had resulted in continuous development of refinements to performance and production. This highly satisfactory state of affairs changed as the result of the drive for better performance. The braced biplane became obsolete from the standpoint of performance because the aeroplane designer evolved more efficient patterns which gave greater speed with increased cubical content and load-carrying capacity.

The most popular of these modern design patterns is the semi-monocoque[4] monoplane—the reigning design of to-day. A growing rival is the geodetic[5] monoplane; a promising pattern for the future is the monocoque[6] monoplane. (No such aeroplane has been built yet, owing to lack of suitable material, although development work on promising materials is being carried out.

The difference between "basic pattern" and "refinement of pattern" now becomes very clear. To each of the four basic patterns mentioned, the common "refinements" of retractable undercarriage and wing flaps are applicable, but this in no way lessens the basic differences between the four patterns. Each pattern approaches the design problem from a different engineering standpoint. Each pattern must develop techniques of its own for design, stress analysis and manufacturing. Many of the engineering techniques of one pattern are inapplicable to the others. The obsolescence of plant equipment and stabilized techniques, and the cost of the new development work are part of the price we pay when we change from one basic pattern to another.

At the present time three of these basic patterns are in use and under construction. The braced biplane is still being built, although its aerodynamic efficiency is inherently less than that of the semi-monocoque monoplane. The semi-monocoque monoplane is the reigning pattern and the one upon which the industry is concentrating. The geodetic monoplane is an interesting dark horse in the race for performance. The monocoque monoplane looms an imminent possibility—one to raise doubts regarding the advisability of standardizing upon one of the other types. Since, by the nature of things, some one pattern will possess greater all-round efficiency than the others, the concurrent building of a number of patterns may be considered a transient phase.

[2] Speaking generally, and considering the effect on performance only, changes in external form affect flying speeds and rate of climb, while changes in gross weight affect rate of climb, ceiling, take-off and landing speeds.

[3] A biplane with externally braced wings, the fuselage of which is a rectangular frame of built-up trusses, faired with wooden stringers and covered with doped fabric, the frame, not the fabric, carrying the load.

[4] A monoplane of which the reinforced covering (skin) of the wings and fuselage takes the loads. The skin is reinforced by internal stiffeners capable of taking compression. Examples: Lockheed and Douglas Transports.

[5] A monoplane the wings and fuselage of which are built of curved "lattices," braced internally and covered with doped fabric. The "lattices" carry the load. Example: Vickers-Armstrong "Wellington" Bomber.

[6] A monoplane the wings and fuselage of which are each hollow "shells" made of light-weight, rigid material, which takes the loads, requiring no internal bracing.

What is the ultimate design pattern for the aeroplane[7]? No one can answer such a question authoritatively. But since mass production has become so necessary in the eyes of the world, the industry as a whole is crossing its fingers, accepting the semi-monocoque monoplane as the ultimate (for now), stabilizing on that design pattern and attempting to produce it *en masse*.

Stabilization of Performance and of Design Technique

In accepting a basic pattern as the ultimate, we accept simultaneously an ultimate in performance. To clarify this latter statement, let us consider the most important single performance characteristic of the aeroplane—level top speed. Had the aeroplane designer accepted the braced biplane as the final pattern (as the industry at one time was prepared to do) aeroplane speeds would have been limited to the maximum that could be obtained by extreme refinement of that pattern—i.e., a limiting level speed of approximately 250 miles an hour[8]. Similarly, when we now accept the semi-monocoque monoplane as the ultimate design pattern we limit the level top speed of aeroplanes to the optimum that can be obtained by extreme refinement of this pattern. This, according to Flader and Child (Reference 3), is a level speed of 650 miles on hour[9].

Such a deduction can be pushed further. Crystallizing the basic design has not only set a limiting value on the level top speed of aeroplanes, it has set an ultimate in performance for each combination of wing loading and power loading[10]. Thus, assuming the happiest design proportions and the utmost in design refinements, 480 miles an hour, say, may be the maximum speed and 5,000 ft. per min., say, the maximum initial rate of climb possible for a semi-monocoque monoplane of wing loading 50 lb. per sq. ft. of wing area and power loading 5 lb. per hp. These figures would then represent 100 per cent efficiency for that wing loading and power loading.

This conclusion provides us with a means (undeveloped as yet, so far as the author has seen) of determining at the outset of the design of a prototype the performance limitations which our preliminary decisions place upon the machine. By a series of calculations carried out perhaps as in Reference 3, charts of wing loading, power loading and level top speed, and wing loading, power loading and maximum initial rate of climb could be prepared from which the ultimate values of top speed and maximum climb could be obtained[11]. Conversely, having chosen a desired value for the top speed and maximum rate of climb, the wing loadings and power loadings required to give them could be read from the curves. The efficiency of the prototype designed to such wing and power loadings would be gauged by the approach of its performance to these limiting values.

Incidentally, the importance of the preliminary decisions regarding the design of a prototype become immediately apparent. At the same instant that the basic pattern is chosen, the ultimate performance is determined. Combining two basic patterns results in limiting the performance to a value dictated by the weighted mean of the effects. Thus a monoplane with a fabric-covered fuselage of the open girder type, and a biplane with semi-monocoque fuselage are both inherently slower than a semi-monocoque monoplane. Similarly, the instant that the decision regarding wing loading and power loading is made, the ultimate values of performance are determined. An important part of the designer's job is to make these decisions correctly.

The evolution of routine design techniques is made possible by the crystallization of the design pattern. Such routines (of which the one suggested above is a poor example) will clarify the designer's problems by showing him exactly where the limits are set, and what steps he must take to obtain the performance desired. Equipped with routine procedures which, while requiring judgment, experience and knowledge to use most advantageously, will assist him to grind out specifications for the prototype, he will be able to shift the emphasis from design for performance to design for production.

Thus, stabilizing the basic pattern stabilizes performance, which, in turn, encourages crystallization of engineering design techniques, permitting design for production to be the primary aim. On such terms, mass production methods can be introduced successfully into the industry.

Feasibility of Mass Production Now

Using the yardstick of factors governing the successful introduction of mass production methods, we can gauge the present feasibility of producing aeroplanes *en masse*. A rapidly expanding market—the sound incentive for tooling for mass production—is at hand; there is a general but possibly premature attempt at stabilizing the design pattern in favour of the semi-monocoque monoplane; there is a very limited attempt to design minor parts for cost and production, with the primary design aim for performance.

Obviously the industry is not ready for the successful introduction of mass production methods, but due to the tremendous demand, the pressure of public opinion and the financial gains, it is being driven to introduce mass production techniques wherever possible. While this is doubtless the only immediate solution to the war requirements, it will not necessarily succeed in vastly increasing the number of machines built, due to the limitations set upon the introduction of such methods by the aeroplane pattern chosen. Assuredly, more aeroplanes will be manufactured within a given period of time. But production cannot be on an efficient basis, as gauged by quantity and cost, due to the fact that the aeroplane is designed for performance and not for production. To tool to produce aeroplanes as they are designed now is as great an engineering folly as it would have been to tool for the first automobiles as they were designed originally. Modern aeroplane design is still very much in the "bits and pieces" stage that motor car design was formerly before designing for cost and production was undertaken. However, "needs must when the devil drives" and the industry the world over has no alternative but to do what is immediately possible to increase production.

It has been stated above that the present design aim is for performance and that this is responsible for the present manufacturing techniques which, it is claimed here, in general are not mass production methods. To support this contention, it is necessary to outline the present methods of manufacturing adopted universally by the industry and to demonstrate the practical impossibility of producing aeroplanes *en masse* by such methods. Also it is necessary to outline mass production techniques and to demonstrate the impossibility of introducing them unless the machine is designed for production.

Present Production Methods

To appreciate why the present methods of producing the semi-monocoque monoplane are employed, we must recall the methods used in building the earlier pattern. Components of the braced biplane were built separately, and to

[7] The basic pattern for the aeroplane only is being considered here. This does not bar the possibility that drastic design changes in the other heavier-than-air craft, such as helicopters and rotating-wing machines (autogyros, gyroplanes, etc.), may lead them to supersede the aeroplane.

[8] Increasing speed by using more powerful engines is at present inefficient due to the attendant increase in weight and dimensions.

[9] Some of the further refinements considered necessary to obtain this speed are: use of new improved wing sections, further reduction in wing area, counter-rotating propellers and increased thrust by recovery and utilization of waste energy from the exhaust and radiator heat.

[10] Wing loading is the gross weight of the aeroplane divided by the wing area. Power loading is the gross weight divided by the rated horsepower. These factors define numerically the characteristics of sustentation and propulsion of each aeroplane.

[11] Adjustment for altitude would be carried out separately.

obtain fitment of components, the essential points of attachment were jigged. Commonly, the fuselage, wings, tailplane, elevator, rudder, fin, ailerons, landing gear and engine mount were built on individual jigs. The usual construction of the plane was a girder-type fuselage of wooden struts and wire bracing, or of steel tubular members throughout, wings with two wooden or metal spars, ribs of wood or metal, and internal bracing of wire and wood or metal members; control surfaces, landing gear and engine mount of metal tubular members. Permanent connections between metal members were made by welding, riveting or bolting; between wooden parts by glueing and nailing. Fittings were of welded plates.

With the stabilization of the braced biplane pattern, attempts were made to produce the machine in quantity. In many cases, metal superseded wood as the material of construction due to the ease with which metal parts are reproduced and because of metal's greater uniformity and inertness to moisture changes. Attempts were made to design or redesign minor parts for production: manufacturing techniques were developed and adapted to the job on hand. Thus rib templates were introduced on which wooden or metal ribs were constructed rapidly from parts previously cut and formed; ribs were cut from plywood; ribs were stamped from metal sheets. Steel plates were stacked and cut in batches for fittings. Piping, cables and control wires were cut to length and arranged before final assembly. But the great body of work was still carried on on the principal jigs, and in time-consuming fitting work on the final assembly. Thus multiplication of output could only be obtained by multiplication of jigs, men and floor space. Hence, while the construction is simple, and the machine could be and still is produced in quantities, the pattern does not lend itself to mass production.

From experience with the construction of the braced biplane, the industry learned that jigging provided two further advantages aside from insuring fitment of components. It insured the interchangeability of components, which was a particular boon to replacement and maintenance in the field, and, in comparison with former methods, it speeded up the production of machines. It was but natural then that when, over a period of time, the popular basic design pattern changed to that of the semi-monocoque monoplane, jigs were accepted as the proper manufacturing technique for the new design. This practice is universally accepted in building the semi-monocoque monoplane, although now it is commonly believed that jigs were introduced to provide quantity production!

The construction of the semi-monocoque monoplane is a fuselage composed of transverse hoops and longitudinal stringers to which the load-bearing skin or metal or plywood is attached by riveting or other means. The wings and control surfaces are of single-, two-or multi-spar construction (the spars being built from formed sections), with tubular internal bracing and metal or plywood covering. The landing gear and engine mount are of tubular metal construction, the former being retractable. This construction is complicated. Intricate sections require a multiplicity of forming operations; closed skin structures present difficult riveting problems. Due to the closed-skin wing and fuselage construction and to the increased intricacy of operating systems the assembly of the "plumbing"[12] is vastly more complicated, and time-absorbing. With the increased size of machines, fuselage jigs and wing jigs have become veritable mastodons upon which are assembled huge components whose time of assembly runs into days and weeks. The semi-monocoque monoplane, with its increased size and complexity and new problems of manufacture, takes longer and is more difficult to build than the braced biplane.

The industry seeks to overcome these difficulties by putting minor parts on a mass production basis and by tackling the various "bottlenecks" in the assembly line. Drop hammers and presses are commonly used, especially for small surfaces of double curvature, to speed up production, gain cheapness and meet interchangeability requirements. Obviously, it is quicker, more accurate, and cheaper, if quantity is required, to press out the door of a gun bay than to build it up from separate parts on a jig. Complicated fittings are made from stampings to avoid excessive machining. Castings provide rapid and cheap reproduction of non-structural parts. Time spent on the assembly of components is reduced by breaking down their manufacture into a number of stages. Individual parts are gathered together to form subcomponents which are joined into sub-assemblies before being brought together on the main component. The stressed-skin structures are broken into sections for construction. Thus wings are built in sections—a centre section, outer panels and wing tips; or panels are made by constructing the main portion complete with spars, building the leading and trailing edges separately, and bringing the lot toegther at the final wing assembly. Fuselages are made in halves longitudinally, or in short barrel-like units, the plumbing being completed in each portion before uniting them in the final assembly.

In general the result of such methods is to increase the structural weight of the aeroplane, with attendant reduction of flight performance, and to produce more aeroplanes in a given time than have ever been produced before. But except for the production of minor parts, the technique of mass production has not been introduced into the industry.

Jigs Not Mass Production Tools

Manufacturing by use of jigs is not a mass production technique. Whether the final product is a braced biplane or a semi-monocoque monoplane, manufacturing by use of jigs is limited and multiplication of output can be obtained only by multiplication of the number of jigs with their complement of men and floor space. Thus the element of decreasing cost with increasing output is lacking, while, to make the system even more impracticable, the size, cost of construction and overhead expense of the jigs increase with the size of the aeroplane. Mass production implies getting more products from one tool or jig, not getting more products by increasing the number of tools or jigs. A multiplication of the number of jigs is not a change to mass production methods. The capacity of the jig is so limited that, while it may be considered as a tool to provide fitment and interchangeability, it cannot be considered as a tool to provide rapidity of production. Since the jig is not a mass production tool, the production of aeroplanes *en masse* using the present manufacturing system is a practical impossibility.

The immediate difficulty then is that the present system of manufacturing is wrong from a production standpoint. But the system is the result of aeroplane design. This brings us right back to the basic difficulty which is the lack of the fundamental factor governing successful mass production of a commodity—the commodity must be designed for cost and production.

Mass Production Methods

Mass production signifies rapid, cheap production.

To gain rapidity the work must be kept flowing through the factory as exemplified by the conveyor-belt system of automobile construction and the track system of the railway car industry. To provide this, the work must move from small components to the finished article in a large number of easy steps, each operation being a simple, short-time routine. The bottleneck of final assembly does not exist because the final assembly stage is eliminated in favour of a large number of operations the completion of which is rated in minutes, not hours or days.

To afford cheapness and rapid reproduction the majority of parts must be manufactured by machines. Presses must supplant jigs. Manual labour, skilled and unskilled, must be reduced to a minimum. Differences in parts must be eliminated by standardization of a few parts, and the number of separate parts must be reduced to a minimum.

[12]Controls, hydraulic lines, electrical cables and piping.

Similarly, standardization of semi-finished components such as extruded sections, rolled sections, etc., must be undertaken. For further saving, gauge sizes and approved material specifications must be standardized.

Conclusions

There is nothing new in the mass production techniques outlined above, but they are obviously different from the production methods now in vogue, except as regards the manufacturing of minor parts. Before aeroplanes can be produced *en masse* the proper techniques must be introduced. But the aeroplane built by these mass production methods will be different in construction from to-day's aeroplane. Like the first automobile, the semi-monocoque monoplane is all "bits and pieces," being composed of between 3,000 and 20,000 separate parts. Like the first automobiles, the semi-monocoque monoplane is slow and difficult to assemble. Design for production automatically eliminates the semi-monocoque monoplane as the ultimate design pattern.

Before the ultimate pattern for the aeroplane emerges, a great deal more work must be carried out. The basic patterns mentioned previously—the geodetic and monocoque monoplanes—present promising solutions, and are doubtless being explored. As for the present emergency, since we, our allies and the enemy, are all concentrating upon the same discredited pattern, using the same discredited technique, we will suffer disappointment jointly where production *en masse* is concerned.

The production engineer cannot, at will, put any commodity on a mass production basis. Aeroplanes are not like baby carriages. The easy acceptance of the applicability of mass production methods to aeroplane construction arises from sad ignorance of the problems involved.

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COATED ELECTRODES IN ELECTRIC ARC WELDING

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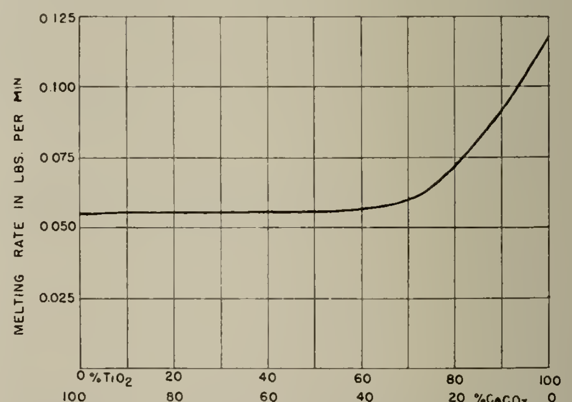
Paper presented before the Montreal Branch of the Engineering Institute of Canada on February 8th, 1940

Revolutionary improvements in welding equipment have been made during recent years and have very greatly broadened the field of application of electric arc welding. The development of better welding rods or electrodes is not the least important contribution to this process and it is intended in this paper to present some of the technical problems involved in their manufacture and application. Attention will be confined to electrodes for welding mild steel.

Electric arc welding is a process in which the intense heat liberated when a stream of electricity of high current density, bridging a gap between two conductors, is utilized to melt momentarily localized masses of metal, which, on re-solidification will, in general, join structures which were previously apart. A welding machine or generator furnishes a current of proper electrical characteristics which is led by suitable connections to the welding rod or electrode and the parts to be welded. To begin welding the circuit is momentarily closed by touching one end of the electrode to the spot where a joint is required and then withdrawing it again to a distance of approximately 1/8″. The current will continue to flow across the gap so produced and will thereby form an electric arc, a source of very intense heat and light. This heat melts the electrode which flows on to the parts being welded and it is fed continuously into the arc in such a way as to maintain a constant arc length. The arc also melts a small amount of the parts to be welded in its immediate vicinity and this, together with the melted electrode, forms a pool of liquid metal known as the crater. This metal quickly re-solidifies and forms a continuous metallic bond between the parts being welded.

In the arc, about which the whole process of electric welding revolves, complex chemical and electrical phenomena occur. According to the present conception of electricity, it is impossible for an electrical discharge to take place unless matter in some form is present to act as a carrier or conductor. Although metals in the solid and liquid state form excellent conductors, it appears that this is by no means true of their vapours; consequently an arc struck between two polished masses of metal does not flow freely and there is hesitance and sputtering. If, however, certain metallic oxides are present, even though only in relatively minute quantities, at the high arc temperature they readily produce current carriers and the arc flows freely and smoothly, its electrical resistance being much decreased.

This lowering of the electrical resistance results in a decrease of the voltage drop across the arc, according to Ohm's Law, a factor which, in turn, affects the welding characteristics of the electrode. The substances present in



Effect of Titanium Dioxide & Calcium Carbonate on the Speed of Burning of a 3/16 inch diameter Electrode Current-190 amp

Fig. 1

the arc also influence the point in the arc at which the conversion of electrical energy into heat is most intense, a state of affairs which plays an important rôle in the operation of covered rods. The arc characteristics, in particular the voltage drop across the arc, depend, too, upon the chemical composition of the atmosphere in which the arc exists; an arc in pure hydrogen, for example, requires a higher voltage to keep it flowing than one in the ordinary atmosphere.

To understand modern covered electrodes, consideration of the earlier types which preceded and led up to them, will be very helpful. These are two in number: (1) The bare or sul-coated electrode; (2) The lightly flux-coated electrode.

(1) In the case of bare or sul-coated electrodes, a thin film of iron oxide or rust known as a sul-coat is drawn into the surface of the wire and this is the sole agent promoting arc conduction and stability.

(2) A smoother and steadier arc may be secured by applying light coatings of materials other than iron oxide. These vary in composition, but generally contain some lime, and are applied simply by dipping the rods in a suitable liquid solution or suspension and allowing them to dry. These coatings are of the order of one-thousandth of an inch thick and serve not only to quieten the arc but, also by modification of its electrical characteristics, to regulate the speed of burning of the electrode and to control the penetration of the deposit. Different materials impart different speeds of burning to the electrode; titanium dioxide, for example, when applied as a thin coating, will produce a higher rate of burning than will calcium carbonate. See Fig. 1.

What happens when we weld with either of these types of practically bare electrodes ? The metal as it travels across the arc from the electrode to the work, is exposed to the atmosphere. At the very high temperature attained it picks up oxygen and nitrogen, both of which are highly deleterious in the weld metal, while the surface of the metal has a dull, semi-burnt appearance. Although steel members can be successfully joined by the material, the great susceptibility to corrosion of the weld metal, and the element of uncertainty regarding its soundness have resulted in wide adoption of coated electrodes.

The main purposes of the different coatings may be grouped under three headings: 1. The control of the physical

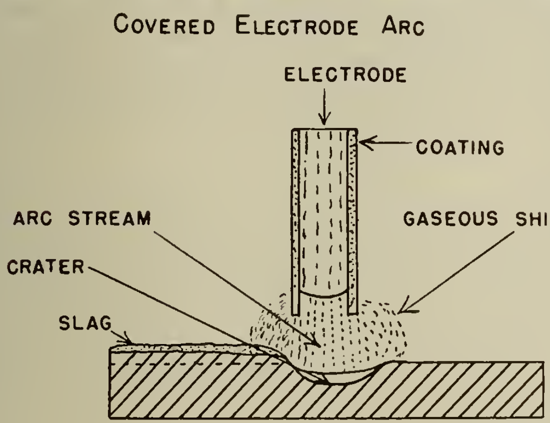


Fig 2

and chemical characteristics of the weld metal; 2. The control of the shape of the weld metal and its ability to be deposited in different positions; 3. The control of the speed of deposition of the weld metal.

1. The control of the physical and chemical characteristics of the weld metal is achieved, principally, by three methods:

(a) The exclusion of the harmful elements (oxygen and nitrogen) of the atmosphere, from the molten or vaporous metal as it crosses the arc, and the prevention thereby of these elements from being dissolved in the weld metal. This effect, in turn, is achieved by two methods; often both are simultaneously employed, as shown in Fig. 2.

  (*a*) The production by the burning of the coating of a large volume of reducing gases, which surrounds the arc and thereby encases it in a beneficial, reducing atmosphere.

  (*b*) The enclosure of the molten drops of metal as they cross the arc, by a film of slag. This is more or less effective with all covered rods.

(b) The fluxing action of the slag. The slag as it is formed from the fusion of the coating comes into intimate contact with the depositing metal and, if it is of suitable composition, reacts with non-metallic impurities in this metal, and removes them. The process may well be likened to that of an open-hearth furnace, where steel undergoes a similar treatment, although in this case the slag has several hours in which to purify the steel; here only a fraction of a second.

(c) The addition of such alloying elements as manganese by the incorporation of ferro-alloys in the coating.

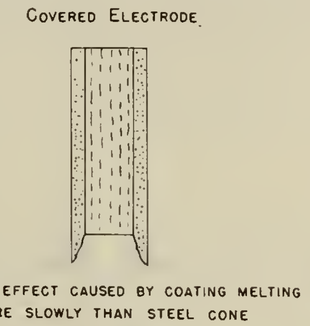


Fig. 3

2. The control of the shape of the weld metal and its ability to be deposited in different positions. This is achieved principally by two methods:

(a) The control of the physical characteristics of the slag, such as melting point, surface tension and viscosity. These factors, affecting the shape of the deposit, act in a somewhat complicated manner, and in such a way that it is often difficult to separate one cause from another. However, as an example, it can be readily understood that a rod whose slag has a low melting point and high fluidity, will be unsuitable for welding in the vertical plane, as instead of helping to support the metal, the slag will run down and drag the molten metal with it.

(b) The penetration of the deposit, by which is meant the depth to which the zone of fusion extends into the parts being welded. This factor is controlled by the electrical characteristics of the arc and depends upon the coating thickness, the elements present in the coating and the composition of the gases surrounding the arc.

3. The control of the speed of deposition of the weld metal. It is, of course, for the sake of economy, desirable to deposit as many pounds of weld metal per hour as possible. For the three following reasons, covered wires have a faster rate of deposition than bare ones:

(a) The coating enables higher currents to be employed by promoting smoothness of arc operation, and reducing spatter loss.

(b) The arc is rendered more efficient thermally by the coating, which melts more slowly than the steel, forming a cup-shaped sheath about the arc, which confines the radiation. See Fig. 3.

(c) The higher electrical conductivity in the arc afforded by the ingredients of the coating which results in an increase of the efficiency of the transfer of the metal across the arc.

It may thus be understood that not only can covered electrodes be made which produce welds vastly superior to those made from bare wire, but, by varying the coatings, widely different operational characteristics can be imparted to them.

Types of Welds

Before dealing with the applications of electrodes, it will be well to consider the different types and shapes of metal deposits which are usually employed in joining steel members. Fundamentally, the great majority of welds fall into one of a very limited number of types, which are shown in Fig. 4: the bead weld, the fillet weld, the butt weld.

A bead weld is a layer of weld metal deposited usually to build up a surface, not to join two parts. It is the simplest type of deposit. The term "bead" is generally used to denote a single layer of weld metal laid in any position.

A fillet weld is an approximately triangular or convex section of metal joining two surfaces not in the same plane.

A butt weld is one joining two plates or sections in which the plate or section is reproduced or replaced by weld metal.

These types of welds may be made in any position, downhand, vertical or overhead and they vary a good deal in

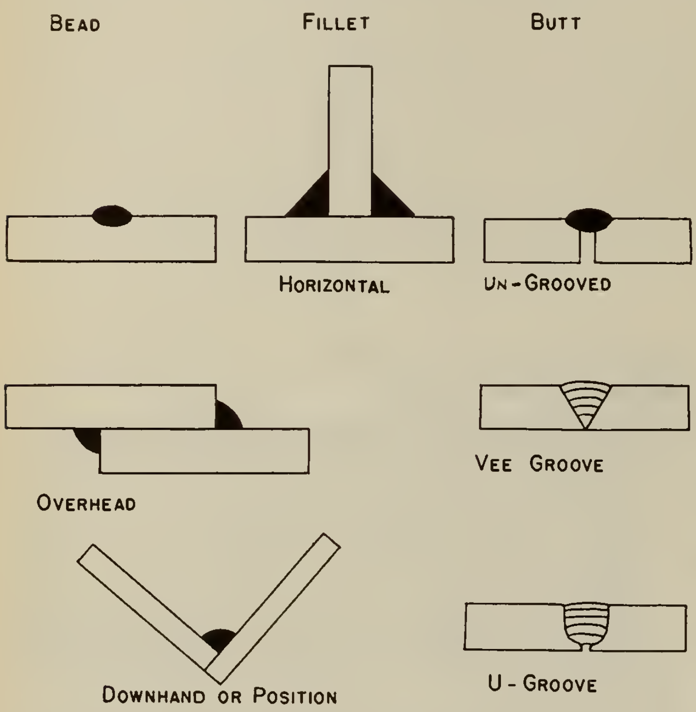


Fig. 4—Types of Welds

actual shape, depending upon the type of members being joined. It will be understood then, that the welder has an infinite number of different conditions under which he has to apply his electrodes.

It is unfortunate for the welding industry that no single rod has as yet been devised which can accomplish all these types of joints with a maximum efficiency, neither does it appear likely that such a rod ever will be designed. The slag and arc conditions necessary to make, for example, a vertical weld and a deep groove weld are so different that any attempt at a compromise would seriously detract from the excellence of the rod for either use. Consequently, manufacturers of covered electrodes appear to be agreed upon the necessity of offering to the market several types of rods each specially adapted to a certain class of work.

Types of Electrodes

There are four types of mild steel covered rods at present in general use. This does not mean that there are four distinct and definite brands of electrodes on the market, for of all the kinds of rods, and their name is legion, there are probably no two exactly alike. In general, however, most brands may be identified with one of the four following types:

(1) General purpose.
(2) Vertical and overhead.
(3) Fillet and downhand.
(4) A.S.M.E. Class 1, downhand.

Type 1—General Purpose

The slag from this rod has a high melting point and freezes quickly to a hard non-plastic solid, in contrast to the slags resulting from types three and four which remain soft and plastic until quite low temperatures are reached. This rapid freezing of the slag helps to prevent the metal from running down and holds it in place. The rod usually has a fast burning rate and produces a deposit which is convex in contour and lacks the depth of fusion of type 2. It is a general purpose rod and can be used for practically all kinds of welding.

Type 1, however, is especially recommended for the following kinds of welds:

FILLET WELDS IN THE HORIZONTAL POSITION

The rapid freezing of the bead lessens the tendency of the weld metal to run down and form a fillet with a short vertical leg. If the weld metal in such a joint remained liquid for very long, it would give rise to a phenomenon known as under-cutting in which the weld metal melts and carries away part of the vertical plate leaving in it a reduced and weakened section. The contour of the fillet is convex. See Fig. 5.

POOR "FIT-UP" WELDS

Very often parts must be welded together in which it is impracticable or uneconomical to get the adjacent surfaces quite flush, or the edges may be irregular. If a rod with deep penetration were used, at the spots where there were gaps between the plates, the depth of fusion might become so excessive as to burn a hole completely through the parts being joined. Consequently type 1 should be used for this class of work.

WELDS ON LIGHT GAUGE PLATE

For similar reasons when welding 16 gauge or lighter material this type of rod is usually employed. It is possible, by skilful manipulation to weld 20 gauge sheets by using a 3/32 in. diameter electrode of this type. Surprisingly enough, the best results on very light gauge work are obtained not by using unusually low currents, but rather by keeping the current up to normal values and travelling very fast.

Before leaving type 1, it will be interesting to consider briefly the quality and physical characteristics of the weld metal it deposits. As the coating on such rods is, in general, thinner than on the other types, protection of the arc from the atmosphere is not so complete and consequently there are apt to be more impurities in the weld metal than with the other types. The deposit has a higher tensile strength and lower ductility than with the other types and its resistance to corrosion is less; consequently, if deposits of the highest physical characteristics are necessary, it is advisable to use rods other than those of type 1. It may be well to note that manufacturers are constantly improving the quality of the weld metal from rods of this type, so that for most classes of welding it is now of sufficiently high quality.

Type 2—Vertical and Overhead

This type operates on reverse polarity and is designed to make high quality welds in the vertical and overhead positions. It can be used in the downhand position, but, for most types of joints, not so efficiently as types 3 or 4. Its coating is quite different from that of type 1, being largely composed of organic material, which, on being burned, gives off much gas; it forms, therefore, a relatively small quantity of slag. Atmospheric shielding is brought about almost entirely, then, by these evolved gases, which, as explained before, form an envelope about the arc. The depth of fusion of the deposit is considerably greater than in the case of type 1, and the surface of the bead apt to be rough and ridged. A factor which in some shops, discourages the general use of this type, is its unusually high spatter loss, unless fairly low, and therefore uneconomical currents are used.

VERTICAL AND OVERHEAD WELDS

Vertical welds may be made either by starting at the bottom and working up, or vice-versa. The former method, which is the sounder one to use where possible, consists essentially of building a ledge of metal outward from the vertical parts, depositing metal on this ledge, and so progressively extending it up the plate to form a vertical bead. For this type of weld, the coating must produce only a small volume of slag, and this should not be too fluid, or

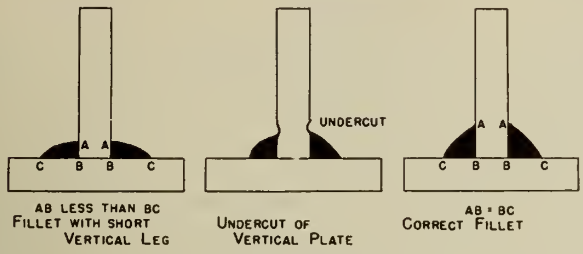


Fig. 5

else it will obstruct the arc and tend to run down taking the metal with it. The coating of type 2 fulfils these conditions, and furthermore, the penetration of the rod makes fusion into the apex of a vertical fillet weld possible, which is often not the case with type 1. Coming down from top to bottom produces a very different kind of weld. To keep ahead of the flowing slag, the welder must travel fast and consequently only a very light, thin bead is deposited. With rod types 3 and 4, this kind of weld is virtually impossible, as the slag immediately runs down and extinguishes the arc; downward vertical welds may be made with type 1, though only a very weak bond is obtained since the inherently small degree of penetration is accentuated by the necessarily fast rate of travel. Thus type 2 invariably should be chosen for making downward vertical welds. Similar considerations will show that this rod is well suited to overhead welding.

BUTT WELDS ON SQUARE EDGED PLATES, DOWNHAND POSITION

This is one kind of downhand weld for which type 2 is sometimes better than types 3 and 4 as it has somewhat deeper penetration. With no gap between the plates, welds having a depth of fusion of 3/16 in. can be made with a ¼ in. rod, so that by welding from both sides, plates as thick as ⅜ in. can be joined in complete fusion without any previous machining operation.

The uses of this type of rod should be confined almost entirely to welding which is not in the downhand position, as many welds which are at present being made with it could be done more neatly and efficiently with the next type of rod under consideration. The physical properties of the deposit are good. The metal has a tensile strength ranging generally from 60,000 to 65,000 lb. per sq. in. with an elongation of from 25 to 30 per cent in 2 inches. Its resistance to corrosion, as is the case with deposits of all types, except possibly No. 1, is greater than that of the surrounding parent metal.

Type 3—Downhand and Fillet

The coating of type 3 is very different from that of types 1 or 2, being almost entirely mineral in composition and forming a heavy, though very brittle, slag. This slag can be very easily and completely removed by light brushing, or raking with a chisel, a fact resulting in a considerable saving of labour. The metal surface is more pleasing in appearance than with types 1 and 2 being very even and lustrous. These facts, coupled with a smoothly flowing arc, and an absence of spatter, make it very attractive to the welder. In spite of the fact that the slag formed is large in volume, its viscosity and surface tension can, and should be adjusted, so that it does not render welding difficult by following the arc too closely and obstructing it. The penetration of the metal is much greater than with type 1, although it is not as great as with type 2.

Type 3 is suitable for the following kinds of welds:

FILLET WELDS IN THE HORIZONTAL POSITION

When fillet welds are to be made on heavy sections, or even on lighter ones which are well set up and accurately assembled, type 3 will make deposits which are neater, and of a metal quality superior to type 1, as shown in Fig. 6. Due to the greater penetration and heavier slag, the shape of the fillet, though still equally inclined to the vertical and horizontal plates, is much flatter, and less convex than type 1. Greater care must be exercised in handling this rod for fillet welds, as unskilled or careless procedure will result in a deposit with a short vertical leg, and an under-cutting of the vertical plate. The same defects will occur if the work is poorly prepared or inaccurately fitted.

MULTI-LAYER, DOWNHAND WELDS

For making groove welds, or any downhand multi-layer welds, it is excellent, as the slag comes away completely and freely and also the metal shape is smooth and concave, and forms a continuous surface with the adjacent parts. These facts enable successive layers to be deposited with a minimum both of delay and of danger of slag inclusions. Positioned fillet welds, in which the plates to be joined both make angles of 45 deg. with the vertical can be made neatly and easily with this rod. Butt welds on ungrooved plates can also be made with type 3, although sometimes type 2 is preferable.

VERTICAL AND OVERHEAD WELDS

Although not primarily designed for this purpose, it has been found that some rods of this type in the smaller sizes can be used to make very neat upward vertical welds, and overhead welds. Probably on the whole it is better to keep to types 1 or 2 for vertical welding, although on certain classes of work it can conveniently be used.

For general welding in small shops, type 3 should be used with reserve; No. 1 or No. 2 will probably be more suitable. For reasons shortly to be given, it is considered less safe for class 1 groove welding of plates over 1 in. thick than type 4.

If this rod is used properly, metal with excellent physical characteristics, even better than type 2, is obtained. From

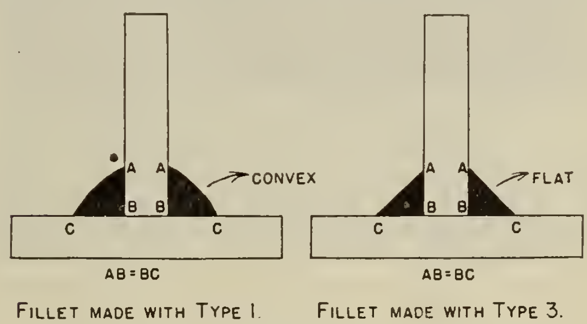


Fig. 6

all weld metal specimens, an elongation of as high as 36 per cent in 2 in. and a reduction of area of 64 per cent are sometimes reached. It does, however, require more care and judgment on the part of the welder to bring out the best results. It may be summed up by saying that while it is more sensitive and critical than types 1 or 2, it is capable of a higher quality of work when used correctly.

Type 4—A.S.M.E. Class 1

Type 4 is designed for Class 1 pressure vessel work where welds must be capable of passing X-ray examination, although it is recommended for any downhand work on heavy sections. In general the coating of this rod resembles that of type 3 quite closely, although it is somewhat heavier and produces a larger quantity of fluid slag. The production of welds which show no defects at all on an X-ray film requires not only the greatest care and skill on the part of the operator, but also a very carefully designed and well balanced rod.

TABLE I

Distributors	Type 1	Type 2	Type 3	Type 4
G. D. Peters	Wilson No. 107	Wilson No. 98	Wilson No. 851	Wilson No. 105, 851
Frost Steel & Wire	No. 2500	No. 3100	No. 3300	No. 3200
Lincoln Electric	Fleetweld No. 7 Fleetweld No. 5	Fleetweld No. 5	Fleetweld No. 8	Fleetweld No. 9
General Electric	W-20	W-22, W-25	W-24, W-22	W-23
Dom. Welding Eng.	No. 46, 66	No. 44, 74	No. 48, 62	No. 42, 72
Canadian Liquid Air	Alflex C-48 Alflex L-45	Alflex L-45	Alflex C-50	
Hollup Corporation	Sureweld N	Sureweld B	Sureweld F	Sureweld A
Steel Co. of Canada	No. 604	No. 704	No. 804	No. 904

The penetration of the metal from this rod is generally less than of that from type 3, and, as a result, the contour of the bead is not so concave. This is so in spite of the fact that the rod, as a rule, requires a higher current and is due to the effects of the ingredients in the coating. Probably the most common cause of rejection of Class 1 deep groove welds is the formation of gas pockets, as shown in Fig. 7. The factors governing the production of these defects are not clearly understood, but they are evidently quite numerous and complicated. It is found, and indeed might be expected, that the deeper the layer of metal in a given pass, the harder is it for gas to escape, and the greater is the likelihood for gas holes to appear. There are other factors, too, which enter the case. If type 3 is used a deeper

Fig. 7—X-Ray of Weld showing Defects—Porosity

layer of metal is melted, and sometimes the gas has not time to rise from the bottom of this molten layer to the top and escape; hence type 4 is less likely to make porous welds. Another way in which type 4 tends to produce only a thin layer of molten metal is through the characteristics of its slag. This has a relatively low surface tension and is very fluid, so that it follows the arc more closely than with type 3, forcing the welder to travel more quickly, and, therefore, to make a thinner deposit of metal. The appearance of the bead is very pleasing, being similar to that from type 3.

On account of the plentiful fluid slag, it is quite impossible to weld in the vertical or overhead positions with this rod, attempts to do so resulting merely in a shower of molten slag and metal to the floor. It is not suitable for horizontal fillet welding, as the fluid slag gives the metal no support against the vertical member, which is likely to be badly undercut. In fact it must be emphasized that welds other than those strictly in the downhand position should not be attempted with this rod.

The metal produced by type 4 is of the highest quality. Excellent ductility, impact strength and resistance to corrosion are combined with a tensile strength of from 60,000 to 65,000 lb. per sq. in., resulting in a deposit of first class steel. With regard to its design and manufacture it requires more careful control and greater uniformity of composition than the other types. All in all, it is an exacting product, designed to perform exacting work.

Table I includes some of the commonest covered mild steel electrodes now in use in Canada.

The above summarizes briefly the four types of mild steel covered electrodes manufactured on this continent. While it is not desirable to lay down hard and fast rules on this subject, it is the author's earnest belief that were welding supervisors more familiar with the broad and general characteristics of these types and could they appreciate the advantages to be gained from using the right one for a given job, not only would the quality of their welding improve, but their costs would decline. Small concerns will, naturally, be reluctant to keep large stocks of material and will want to limit the number of the types and sizes which they use as much as possible. Firms for whom welding is only a means of performing minor repair work can doubtless do very well with type 1, in perhaps two sizes. Companies for whom welding is a process of major consideration in either repair or construction work should combine either type 2 or type 3 with type 1. For large construction and boiler making companies, there is no doubt that by judiciously employing three or even four types, not only can a better quality of work be obtained, but the resulting increase in welding efficiency will be the means of reducing welding costs.

PRESERVATIVE TREATMENT OF POLES BY END-BORING

J. F. HARKOM, M.E.I.C.

Chief, Division of Wood Preservation, Forest Products Laboratories of Canada, Department of Mines and Resources, Ottawa, Ont.

There is a demand in Canada for a cheap preservative treatment for the butts of spruce and pine poles on lines erected in remote districts where cedar is not available. Work was started on this problem in 1928, and at that time it was considered that the chief application would be for telephone lines on forest reserves. In recent years, however, the development of the mining industry in Canada has brought about a demand for a cheap treatment for poles in power and telephone lines serving communities in the far north. In some districts the use of creosoted poles, either butt-treated cedar or full length treated pine, is out of the question because of the uncertainty as to the life required or the prohibitive cost of transportation.

On studying the question of a suitable method of treatment, it appeared that in a standing pole there must be an evaporation of moisture from the top with a consequent travel up the sapwood of moisture entering below the ground line. To prove this, copper sulphate was placed in tin cans which had been coated with paraffin; the cans were nailed to the butts of pole stubs, and the stubs were set in the ground. On the green poles used, the preservative appeared at the ground line in three weeks' time. This was very promising, but on removing one of the poles after a year's service, it was found that in sections cut at the butt, six inches below the ground line, and three feet above the ground line, the amount of preservative, by analysis, was 0.15, 0.22 and 1.4 lb., respectively, of dry salt per cu. ft. of wood[1]. It was considered, therefore, that in a few years' time practically all the water-soluble salts would be found above the ground line and the butt would be left with insufficient preservative to inhibit decay. This proved to be the case in the test in Ottawa. In a very dry location the results might differ considerably.

The problem of holding some of the preservative below the ground line was, therefore, approached in the following manner[2].

Holes were bored longitudinally in the sapwood at the butt and alternate holes were filled with a water-soluble salt which could combine with another salt placed in the adjacent holes to precipitate a slightly soluble toxic salt below the ground line, by a fanning out or diffusion of the salts during the climb up the sapwood. Owing to the comparatively limited tangential diffusion of the salts compared with the movement up the pole, the holes had to be placed fairly close together to permit this to occur. The climb and tangential diffusion will vary with climatic and ground conditions.

In 1933 at the Petawawa Forest Experiment Station at Chalk River, Ontario, 80 jack pine and spruce stubs, 8 in. to 10 in. in diameter by 12 ft. in length, were treated and installed with the butts 4 ft. in the ground. The bark was left on the stubs up to the ground line and the total number of holes bored in the sapwood at the butts varied from 6 to 16. The following treatments were used:

1. Copper sulphate and potassium ferrocyanide to precipitate copper ferrocyanide.
2. Zinc chloride and potassium ferrocyanide to precipitate zinc ferrocyanide.
3. Copper sulphate and sodium arsenite to precipitate cupric arsenite.
4. Zinc chloride and sodium arsenite to precipitate zinc arsenite.

The preservatives were mixed in a flour paste and the mixture placed in the holes with a grease gun.

Out of four combinations of chemicals tested it has been found that the copper sulphate-sodium arsenite combination is perhaps slightly better than the zinc chloride-sodium arsenite, and that the copper and zinc combinations with potassium ferrocyanide are unsatisfactory. The information obtained showed that, apparently, if a sufficient number of holes are used with a sufficient quantity of chemicals, jack pine and spruce poles so treated will, under similar conditions of service, show an increase in life of at least six years over untreated poles. The advice at the present time, therefore, is to treat poles in accordance with Table I, using dry salts in the holes instead of a flour paste as formerly.

TABLE I

Diameter of pole	Total number of holes 1⅛" dia. x 8¼" deep	Lbs. of $CuSO_4 \cdot 5H_2O$ in one-half the holes	Lbs. of sodium arsenate in one-half the holes	Cost of copper sulphate at 8c–lb. $	Cost of sodium arsenate at 8c–lb. $	Cost of preservative per pole $
8	10	1.75	2.50	.140	.200	0.34
9	12	2.10	3.00	.168	.240	0.41
10	14	2.45	3.50	.196	.280	0.48
11	16	2.80	4.00	.224	.320	0.54
12	16	2.80	4.00	.224	.320	0.54
13	18	3.15	4.50	.252	.360	0.61
14	18	3.15	4.50	.252	.360	0.61
15	20	3.50	5.00	.280	.400	0.68
16	20	3.50	5.00	.280	.400	0.68
17	22	3.85	5.50	.308	.440	0.75
18	22	3.85	5.50	.308	.440	0.75

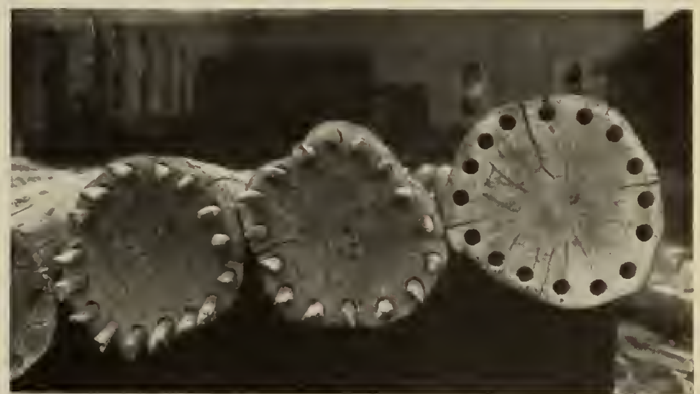


Fig. 1—Preservatives in paper bags are placed in holes in the butt. The holes are then plugged with a short cork.

It is impossible at the present time to state more definitely the average increase in life to be expected from the butts of poles treated according to the above table. The installation of some test pole lines by commercial companies would provide an excellent opportunity to obtain further information on the effectiveness of the treatment under different conditions of soil and climate.

If it is permissible to say that the pole in place treats itself, it will be easier to realize that conditions of soil and climate will necessarily affect the distribution of the preservative salts. It is possible, however, that the treatment will be effective over quite a wide range of service conditions.

The following is a detailed description of the method of treatment, applied to jackpine and spruce poles.

[1] "Preservative Treatment for Poles," by J. F. Harkom. *Canada Lumberman*, January 15, 1931.

[2] "Wood Preservation in Relation to the Attacks of Fungi and Insects" by J. F. Harkom. *Proceedings of the 5th Pacific Science Congress*, Canada, 1933.

1. Leave bark on up to the ground line.
   If the bark is not left on up to the ground line, moisture will enter the outer sapwood below the ground line. This will prevent the "draw" of moisture and preservative from the butt, and consequently the outer ¼ in. or ½ in. of the sapwood will not be treated.
2. Treat while green before checks develop in the butt.
3. Trim the butt with a saw at right angles to the pole axis.
4. Mark off the required number of holes and bore them 1⅛ in. in diameter by 8¼ in. deep, entirely in the sapwood, if possible, or at least one-third into the sapwood. To facilitate marking off the required number of holes, plywood discs of proper diameter, divided according to the table, will be found useful.
5. Fill alternate holes with copper sulphate and sodium arsenite.
6. Plug the holes with a short cork.

In addition to the holes in the sapwood, it may be advisable to bore a few holes in the heartwood, about 4 in. deep, and fill the alternate holes with copper sulphate and sodium arsenite. This is to seal the exposed heartwood at the butt against decay in light sandy soil. The salts in these shorter holes will not climb the heartwood to any extent but will diffuse radially.

A method for filling the holes that has been used at the laboratories, and which permits the use of larger quantities of preservatives than the pastes used in the first experiments, is described below. It is pointed out, however, that copper sulphate and sodium arsenite are poisons and this method should be entrusted only to careful and experienced workmen.

Roll a paper cylinder 11 in. in length on a 1-in. diameter wood dowel, using a sheet of paper 11 by 8½ in. Crimp one end at the lap and slide the paper cylinder to within 2 in. of the end of the dowel. Holding the paper tight at the end of the dowel, fill the cylinder with a small scoop. Still holding the paper cylinder tightly at the end of the dowel, insert the filled paper cylinder in the hole giving a slight twist, and tamp and cork, leaving the paper in the hole. Do not use a waterproof paper.

Copper sulphate "snow" can be purchased from any chemical supply house. Lump copper sulphate has to be ground before use, but the "snow" brand is already ground. The sodium arsenite can be obtained in England. It is not manufactured at present in Canada or the United States.

As far as is known, the only study of the possibility of using this method of treatment on a commercial scale has been made by the engineers of the Hydro-Electric Power Commission of Ontario. A very useful development of this study was the practice of using green and red paper bags for the copper sulphate and sodium arsenite. The bags are slipped into the holes and consequently poles may be cut, treated, and installed during the winter months.

WORLD'S LARGEST CASTING

Recently an unusual piece of metal work was completed at Rockefeller Centre, New York. It is a stainless steel plaque in bas relief, done in heroic proportions that establish it as the largest casting of its kind in the world. It has been mounted on the facade of the Associated Press Building. From a generous supply of publicity material, the following facts have been selected for the readers of the Engineering Journal—*Editor.*

Over-all dimensions are 18 by 24 ft.; the weight is 10 tons. At some points the thickness is not more than ½ in. New methods of design, manufacture, transportation and erection were used throughout, making the undertaking unusually interesting and unique.

The pattern from which this plaque was cast was the full scale, 18 x 24 ft. plaster model, enlarged from the original quarter size model, which won the Rockefeller award. The plaque was eventually made in nine sections, the largest one weighing over two tons, and the smallest approximately 1,200 lbs.

The design required many loose cores. These and the entire moulds were made in synthetic sand, baked in ovens. Each core or separate piece of sand had a steel armature or reinforcing arbor, especially designed as a skeleton to support the sand against the high pressure of the metal, and to locate it precisely in position and to permit hollow construction for gas outlet.

Because of the cutting action of large quantities of molten metal at the terrifically high pouring temperatures (approximately 3,000 deg. F.) it was desired to avoid pouring the molten metal over any large area from any one inlet. Therefore, as many as eighty different "gates" or inlets,—in some sections as many as one to the square foot—were employed. Molten metal was fed into these gates from reservoirs on top of the moulds, equipped with plug valves that provided instant and simultaneous release of metal in all the "gates," so that the mould was filled in one second by a terrible surge of metal, thus avoiding molten metal wandering over the surface, cutting into the sand, and cooling ununiformly. Gates were removed with diamond-toothed saws, which bite through the metal like cheese.

The most remarkable part of this job was the meticulous care employed in calculating the shrinkages and strains over widely varied angles and contours so that it was possible to cast different sections at different times, entirely different in form, except for their matching edges, and have them match to a precision of less than ⅛ in.

The shrinkages of the metals, from molten to cold state is over a quarter of an inch to the foot, and some of the contoured edges totalled more than 25 ft.

The secret of the shrinkage control was absolutely uniform temperatures of each square foot of the metal in the moulds, which is an entirely new approach to foundry problems.

Because the high temperature of welding would result in excessive warpage it was deemed inadvisable to attempt to join such complex forms by welding so the sections were joined by machining them to match to 2/1000 of an inch, forming a practically invisible line.

Finishing is not merely buffing and polishing in the sense that soft metals are polished, but actually requires the removal of the surface of the metal with high-powered grinders turning at exceptionally high speeds made possible by special "high-cycle" generators, having 240 cycles as compared to the 60 cycles of regular alternating current.

Special grinding wheels were employed which were matched as to grits with various sized wheels on different grinders, and the speeds of the grinders were adjusted to give the same surface speed per minute, on wheels of widely varying diameter—using speeds from 5,000 to 25,000 rpm.

After disassembly for shipping the plaque was "passivated" with a special hot solution containing nitric acid to remove all traces of abrasives—iron contamination from tools and other foreign materials. Two hundred gallons of hot acid solution were used—and more than two hundred gallons of ammonia sprayed at 200 lb. pressure to neutralize the acid. It was then washed with several thousand gallons of hot water.

The plaque was designed by Isamu Noguchi, and was engineered and built by the General Alloys Company of Boston.

THE NEW HYDRAULIC LABORATORY OF THE NATIONAL RESEARCH COUNCIL

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AND
K. F. TUPPER,
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Introduction

The National Research Council has recently provided in Ottawa facilities for hydraulic structures research. A laboratory has been established under the guidance of a committee composed of technical representatives from four Dominion Government departments.

The new laboratory has been planned to supplement the limited facilities which are at present available in Canada. Space and equipment have been provided for model research on many classes of hydraulic structure to a scale, which will ensure correct flow conditions and freedom from uncertainty regarding "scale effect." The design of structures such as canal locks, dams, spillways, gates and power plant details can be investigated and work may be undertaken on river hydraulic problems of limited extent. Many pipe-flow problems also are within the scope of the laboratory. A feature of the laboratory is the large flow of water available which will be adequate for the largest models that can be accommodated.

The equipment of the laboratory has been selected to ensure that the class of work most likely to be submitted can be handled properly. To this end the interdepartmental committee conducted a Dominion-wide survey for the purpose of ascertaining specifically the problems which had arisen in the past, which seemed likely to occur in the future, and which might be sent to a national hydraulic laboratory for solution. The analysis of the returns from this survey showed that the majority of such problems involved hydraulic structures and that these problems could best be solved by the employment of suitable geometrically similar models.

Description of the Laboratory

location and layout

The hydraulic structure laboratory is located at the National Research Laboratories Annex, John and Sussex Streets, Ottawa, where it comprises a part of the laboratories belonging to the Division of Mechanical Engineering. The present location of the hydraulic equipment is temporary, and the equipment has been designed for more commodious quarters.

The laboratory is located on the ground floor of an existing building. The general layout is shown in Fig. 1. With the exception of the overhead tank the whole of the laboratory is contained in one large room.

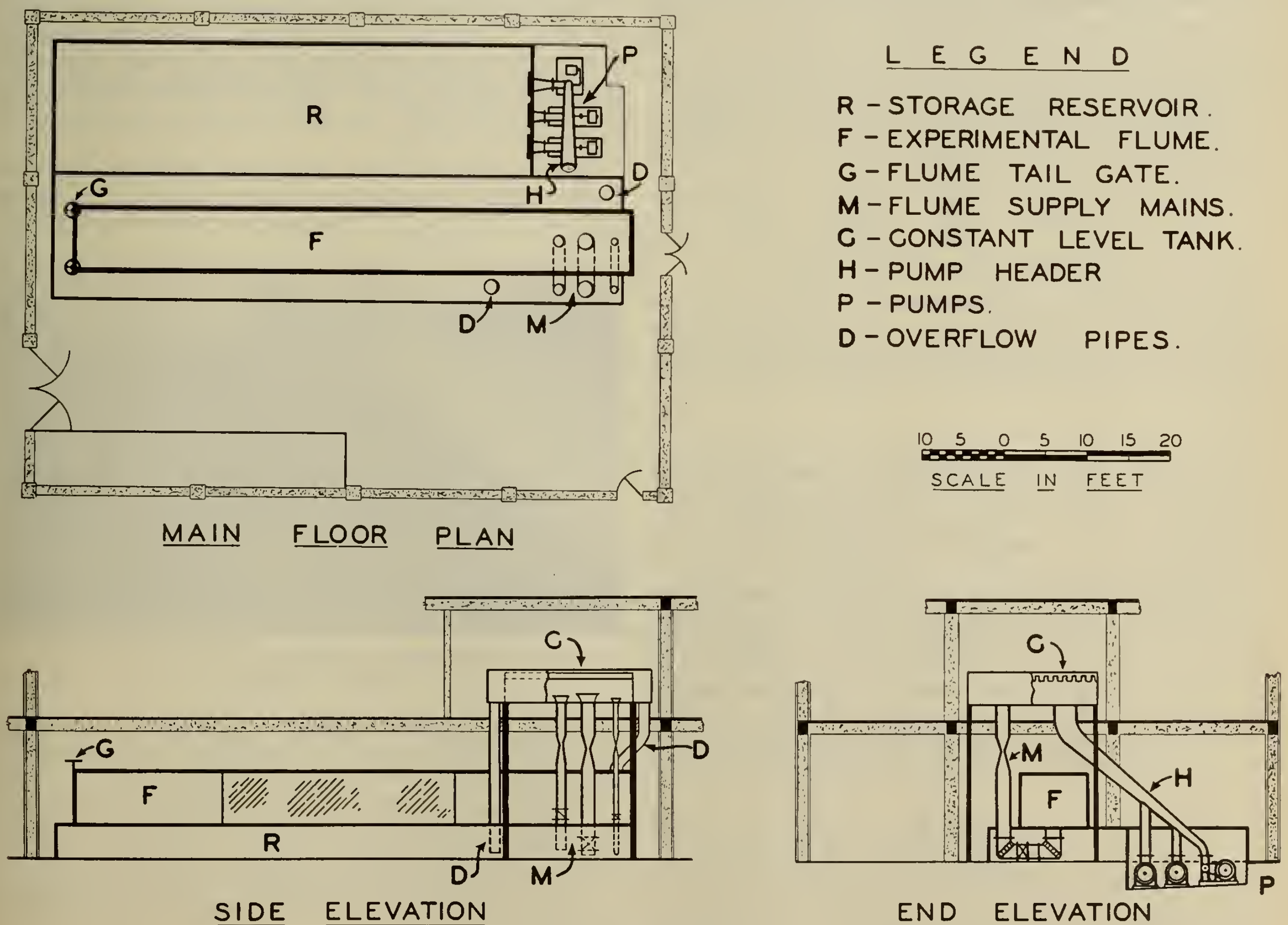

Fig. 1—General layout.

STORAGE POND AND PUMPING EQUIPMENT

The water used in the laboratory for experimental purposes is obtained initially from the city mains, and is stored in a shallow reinforced concrete reservoir. This reservoir is built on the ground floor of the building, and has a surface area of 1,900 sq. ft.; when filled to the normal depth of 3.5 ft. it has a capacity of 6,650 cu. ft. The top of the reservoir is open except where covered by the experimental flume.

The pumping equipment is located in a pit beside the head end of the experimental flume, and is shown in Fig. 2. There are three axial flow pumps which may be operated either singly or in parallel. These give a combined capacity of 26.7 cu. ft. per sec. (=10,000 Imp. g.p.m.). The details of the pumps are given in Table I.

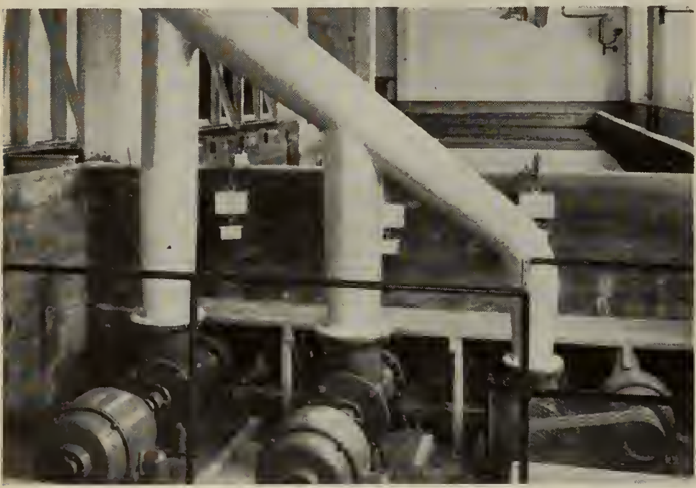

Fig. 2—Pumping installation and header, with storage reservoir in background.

Table I

Pump						Motor*	
No.	Size of Discharge	Speed r.p.m.	Head ft.	Discharge Imp.g.p.m	Drive	H.P.	Speed r.p.m.
1	12	1760	25	4000	Direct	40	1760
2	12	1760	25	4000	Direct	40	1760
3	8	2290	25	2000	Vee-belt	20	1760

*The pump motors are all 550 volt, 3 phase, 60 cycle.

The intakes for the pumps consist of conical pipes expanding to 18 in. diameter at the reservoir where there are intake gates. A common header receives the discharge from all the pumps and connects to the overhead constant level tank.

CONSTANT LEVEL TANK

The constant level tank is designed to maintain, within narrow limits, a constant head on the mains supplying the experimental flume, irrespective of changes in flow. The tank is 20 by 16 ft. in plan and 4 ft. deep, and is of welded steel construction.

Running horizontally in the top of the tank are 24 overflow troughs, 4 in. wide, 9 in. deep and 4 in. apart. These provide a total of 736 ft. of spillway crest to accommodate changes in the quantity of overflow with a very small change in tank level. These troughs connect to two compartments, one at each end of the tank, which are in turn provided with downpipes leading to the storage reservoir below. The top view of the constant level tank is shown in Fig. 3.

SUPPLY MAINS

Three separate mains supply water to the experimental flume. These are respectively 18 in., 12 in., and 8 in. diameter, and lead downward from the constant level tank through the venturi meters, then after passing horizontally under it finally discharge vertically upwards into the bottom of the experimental flume. Each line is equipped with a standard low pressure gate valve which is used for controlling the flow. The corners in the 8 in. pipe consist of long radius segmental bends, while those in the 18 in. and 12 in. lines consist of abrupt corners fitted with vanes.

At the entrance to the supply mains are located bell-mouthed intakes to which are joined conical reducers. At the junction of supply mains with the experimental flume conical expanding sections are fitted to reduce the loss at exit, and minimize the disturbance produced in the flume.

VENTURI METERS

The laboratory is equipped with five venturi meters. Two of these are permanently installed in the 18 in. and 12 in. supply lines. Any one of the other three can be placed in the 8 in. supply line. The meters are installed in the vertical parts of the supply mains approximately 6 ft. below the bottom of the constant level tank. The particulars of these meters are given in Table II.

Table II

Designation	Upstream Diameter	Throat Diameter	Down-stream Diameter	Contraction Ratio	Style
A	22	11	18	.5	short
B	12	6.5	12	.542	"
C	8	4	8	.5	"
D	5	2.5	5	.5	"
E	3	1.75	3	.583	long

Discharges ranging from 0.25 to 27 cu. ft. per sec. can be measured with accuracy by the venturi meters. The four short type meters were individually calibrated in the hydraulic laboratory of the University of Pennsylvania. The long type meter was calibrated at the National Research Laboratories. The calibration constant of each meter is believed to be accurate to within ¼ of 1 per cent.

Three precision mercury manometers are provided for use with the venturi meters. These manometers are of the direct reading type and have been individually calibrated. An adding machine is provided for recording and averaging manometer readings.

EXPERIMENTAL FLUME

The experimental flume is designed to accommodate the various hydraulic models upon which the work of the laboratory is to be done. To provide the maximum flexibility with respect to size and shape of models, the walls of the flume are constructed of movable panels. In this way it is possible to provide a maximum width of 10 ft.

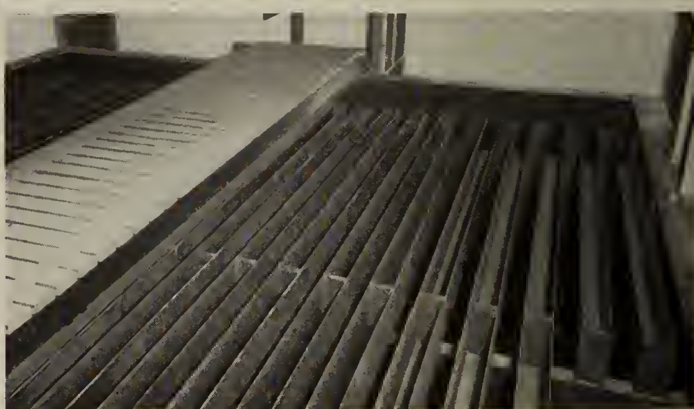

Fig. 3—Top view of constant level tank showing spillover troughs.

The flume is located above the storage reservoirs with the bottom 4.5 ft. above the room floor level. The length is 67.29 ft. and the height is 6.5 ft. It consists of three parts, the head end including supply inlets and stilling racks, the central portion with glass walls to permit of observation, and the tail end with a regulating gate. Fig. 4 shows a general view of the flume.

Fig. 4—General view of flume.

With the exception of the glass, the flume is constructed entirely of steel plate. The floor is bolted to supporting I-beams and the joints are caulked with lead. The walls are made in 7 ft. long panels and are supported with knee braces and with tie rods across the top. The glass panels occupy 28 ft. of length in each wall. The glass is held in steel frames and is provided with support along all four edges. Tempered glass is used and the necessary thickness for the 42 by 72 in. plates is ¾ in.

The tail gate is for the purpose of regulating the water level in the downstream portion of the flume. It is arranged with hand operated lifting screws and has a range of travel of 4 ft. The water passing over the tail gate falls directly into the storage reservoir.

SHOP FACILITIES AND ADDITIONAL APPARATUS

A small well equipped work shop has been provided in the laboratory. This contains a range of hand tools for wood and metal work and for model construction. In addition to this shop the facilities of the main instrument and model shop of the National Research Laboratories are available.

The laboratory is equipped with a variety of instruments such as hook gauges and manometers, current meters, calculating machine, camera and similar apparatus. In addition apparatus is provided for working with transportable materials such as are required for bed-erosion and scouring studies.

FUNCTION OF THE LABORATORY

This hydraulic laboratory provides the engineering profession with a useful tool not hitherto available in Canada for the solution of many problems in hydraulic design. Like all of the facilities of the National Research Council, the new laboratory is provided to serve the needs of the country, and its facilities are available not only for investigations of national interest but also for the solution of those specific problems which arise in private industrial development.

TECHNICAL SUPPLEMENT OF "THE ENGINEERING JOURNAL"

The paper presented before the General Professional Meeting of the Institute at Toronto, on February 9th, 1940, by Mr. O. W. Ellis, Director of the Department of Engineering and Metallurgy, Ontario Research Foundation, on the subject of "Some Developments in Alloys During the Last Twenty Years," is now available as a technical supplement to *The Engineering Journal*.

This paper makes a valuable contribution to the literature of metallurgy and the Publication Committee of the Institute has decided that its unusual merit justifies this special printing.

The supplement may be secured at The Engineering Institute, 2050 Mansfield Street, Montreal. The price is fifty cents per copy for members and seventy-five cents per copy for non-members. There are special prices in lots of ten or more copies.

Abstracts of Current Literature

Contributed abstracts of articles appearing in the current technical periodicals

AERIAL WARFARE IN THE POLISH-GERMAN CAMPAIGN

Extracted from a paper by S. Rogalski read before the Royal Aeronautical Society, April 19th

From *The Engineer* (London, Eng.), April 26th, 1940

Poland's vital industrial centres are all in or near Upper Silesia, close to the German frontier. The weakness of this situation was sought to be remedied by the development of new centres of industrial activity in the so-called C.O.P., or Central Industrial District, in the fork between the rivers Vistula and San. This district, though possessing a few large industrial plants, had always been considered an agricultural one. A number of modern plants had been completed or were under construction in it just before the present war. Roughly, Silesia was responsible for all the steel and iron production, as well as for practically all the zinc, lead, copper, and light alloys manufacture. C.O.P., the new industrial district, was under development with large steel and heavy armament works, synthetic rubber, cellulose, explosives, ammonia and other plants, as well as two air frame and aero engine plants. The aircraft industry was concentrated in Warsaw, Lublin, Biala, Podlaska, Rzeszow, and Mielec.

The following provisions were made for the protection of industrial plants and in order to enable their working in war time to be carried on. Each plant was protected by two to four A.A. guns and a number of machine guns, situated on the roofs of the factory building or camouflaged near the plant. This armament was manned by factory personnel, who had undergone special training under the supervision of military authorities. In the light of actual experience in Poland, such protection should be considered as being inadequate, not only as to its equipment and power of fire, but as to its principle. Manning the guns by factory personnel does not seem to be the best solution, as these neither have the necessary training and experience, nor can they be expected to perform their duties in the shops in case of emergency. For the protection of men during air raids, trenches were dug outside the factory premises close to the gates. This also did not prove to be efficient, especially when raid warnings were sounded on sight of the approaching aircraft.

The Warsaw factories, frame and engine, are situated on the eastern and western outskirts, respectively, of the civil and military airport, over which the German reconnaissance and bombing machines made their first appearance at about 7.30 a.m. on September 1st, a few hours after the outbreak of the undeclared war. After that, air raids were carried on, several times each day, from about 6 a.m. till about 5 p.m., each bombardment being followed by observation planes, taking pictures. The marksmanship was, at the beginning, not very good, but improved quickly. The generally clear weather with some clouds that prevailed during the whole of September over Poland greatly aided the attacking air force.

The first three bombs that fell on airframe factory No. 1 at about 4.30 p.m. on September 1st did little material damage. It had been decided by the management to continue working in two shifts, but on the next morning only about 60 per cent of the workers appeared. This, however, was accounted for by the disorganization in railway transport and damage done to Warsaw suburbs, bombed on the previous day, where the majority of workers had their dwellings. There was little organized work on that day in the factory, though no bombs were dropped. On September 3rd, at about noon, nine bombs were dropped, three of which hit the main building, two of them exploding and considerably damaging the building and machines. On this day the whole of the Warsaw aerodrome was heavily bombed, and considerable damage done to the Air Force hangars, landing field, and railway branch line leading to the airframe factory. Warsaw suburbs were also heavily bombed and many fires occurred. On September 4th, the airframe factory ceased practically to exist after severe bombing, during which dive bombing with Ju 87 bombers had been carried on and many fires started. It should be noted that actual work had been practically stopped on the second day, because of frequent evacuation of personnel to the trenches on approach of enemy aircraft.

In order to be able to carry the work on in the shops in spite of very frequent disorganization, it had been necessary to abandon the day shift and to resort to a night one of ten hours. Only a small shift, that could be herded in the factory main bombproof shelter, was left for the day. This scheme worked quite smoothly, and all nervousness on the part of the personnel, that was felt on the first two days, gradually faded.

Observation of events in Poland allows two conclusions to be drawn. First of all, it appears that a high precision production plant, such as an aero engine factory, can be easily upset by comparatively little material damage, owing to its complexity and dependence on a large amount of special equipment in the form of jigs, tools, and gauges, as well as heat treatment furnaces and similar equipment. Even without actual damage, through frequent raids only, its normal functioning and output is greatly hampered.

The second conclusion is that local protection by artillery and machine guns, however strong and diversified, to cope with different forms of attacking craft and their tactics, will not be able either to ensure an uninterrupted running of a plant, or to prevent a determined enemy from carrying out its destructive task. The balloon barrage, viewed from this point is, probably, a still less effective protection. The object of a really effective defence should be to keep the enemy at such a distance from such plants that no air raid warnings will be necessary. This can, apparently, be only done by a strong and efficient intercepting organization on the ground and in the air, at a reasonable distance from the areas concerned.

Air force operations undoubtedly played an important part in bringing speedy and complete victory to the German Command in the Polish campaign. The numerical superiority of its Luftwaffe was so overwhelming that what was left of the Polish air force, after the surprise attack on the early morning of September 1st, could not be expected to bear appreciably on the issue of the campaign. The only, though bitter, consolation is that its results cannot be regarded as a proof of the quality and efficiency of the German air force.

The German tactics were to strike at as many as possible of the airports and landing fields known to exist in Poland on the first morning of the undeclared war, and thus destroy on the spot the units of the Polish air force. This was generally carried out as a surprise attack from low altitude. Bombing with explosive and incendiary bombs and machine gun fire were extensively used. The damage inflicted was in some places heavy, in others slight. The marksmanship on the average was poor. The effect on the morale of the troops and civil population must, however, be considered to have been great. Railway centres and lines were also bombed at many points, upsetting to a great extent the mobilization of the Polish army, and practically preventing its completion. Vital industrial plants, mostly those placed far inside the country, were raided and bombed. Their work was upset and the rate of production fell sharply in consequence of incessant raids. German bombers were observed bombing apparently empty roads inside the country, thus not only destroying them, but telephone and telegraph lines running along them. It was not a question of concentrated raids on some of the military important centres, but a powerful attack on the whole of the strategic organization of the country, which prepared a way for the comparatively easy invasion by the ground forces. The constant presence of the Luftwaffe over Poland was of very great advantage to the German High Command, without which it would have been much more difficult for it to achieve a speedy victory.

SOIL MECHANICS IN GREAT BRITAIN

Note by Robert F. Legget, m.e.i.c.

In view of the exceedingly cautious manner in which British engineers have taken up the study of soil mechanics, it is encouraging to read of the progress that is described in Report on Soil-Mechanics Research, received from the Building Research Station (*Journal of the Institution of Civil Engineers*, Vol. 14, April, 1940, pp. 241-244). During the past year, as a result of co-operation between the Institution's Committee on Earth Pressures and the Building Research Station, nine young engineers from various organizations have spent at the Station a period of study ranging from two to six weeks. Five British engineering organizations have already formed soil-testing laboratories and have installed apparatus of designs similar to those in use at the Building Research Station and the Road Research Laboratory. In addition a number of universities now have soil testing apparatus.

Work carried out by the staff of the Station during the past year has been mainly directed towards establishing co-operation between soil-research and practical engineering work. Sixteen investigations were carried out to study the soil properties and site conditions at sites where engineering works were either contemplated or where difficulties had been encountered during construction. In the course of these investigations valuable data and experience on a variety of problems were gained, and in many cases it proved practicable to correlate laboratory test results and larger-scale field tests. Three typical investigations are described in general terms.

Special attention has been given to the development of a field method of estimating the degree of variation in soils over any site being investigated. For this purpose, the Station has evolved a comparatively simple and inexpensive technique, based on field tests of the compressive strength of small "undisturbed" cylinders of soil, obtained from the ground in their natural state in special sampling tubes. The tests are carried out with a portable and relatively inexpensive testing device which has recently been described in another publication (Cooling, L. F., and Golder, H. Q., "Portable Apparatus for Compression Tests on Clay Soils," *Engineering*, Vol. 149, (1940), pp. 57 and 58, 19 January, 1940). After being thus tested in the field, the soil cylinders are taken in sealed jars to the laboratory for determinations of their natural moisture content and Atterberg limits. Comparisons between test results for different samples then permit the degree of variation to be ascertained, and indicate the positions from which representative samples for detailed examination may be taken.

The Report concludes with the following outline of the position of soil mechanics in Great Britain to-day: firstly, that, in the development of research close co-operation is being maintained between the soils-laboratory and the practising engineer; and, secondly, that in the civil engineering profession in general there is a developing interest in this new branch of science and in the possibilities presented by its application to practical engineering problems.

WORLD BUYING MORE BRITISH COAL

AND HALF THE UNEMPLOYED MINERS ARE NOW AT WORK

From Robert Williamson, London, Eng.

Lord Portal, chairman of the Coal Production Council, is now touring the British coalfields to discuss with owners and miners' leaders the measures to be taken to speed up production and satisfy the enormous overseas demand caused by the stoppage of German exports.

Already the drive for greater production has halved the figures of coal-mining unemployment since war began, when total production was about 240 million tons a year. The industry's object is to increase this tonnage by 30-40 million tons annually, and up to the present the mine-owners' efforts have concentrated on intensifying work at seams already in operation.

In addition to the work being done in this direction there are 400 mines which have been shut down for economic reasons since 1929, and the possibility of re-opening a number of these is now under consideration.

In many cases considerable expenditure will be required before this can be done, and it may be that Lord Portal and his Council will recommend some form of Government assistance. Other measures may include the exemption of all miners from military service, and the extension of working hours with increased wages.

Germany and Poland

Up to the war, Germany was exporting about 24 million tons and Poland 14 million tons annually. It is reliably estimated that almost half of this trade, 19 million tons a year, is now blockaded. Yet her former customers must have coal from somewhere.

Chief among the countries now urgently demanding British coal for industrial purposes are the South American countries and overseas bunkering stations. Meanwhile inquiries have been coming from Canada, Portugal, Greece, Egypt, and Algeria.

All these countries are cut off from their former German supplies and now depend on Britain and the United States. Italy lost 2,000,000 tons when shipments from Rotterdam were suspended; she was second only to France as a buyer of South Wales coal, and would have taken more had it been available.

Under the present priority system the War Office and Admiralty have first call on coal supplies, and after other essential home requirements, including those of France, have been met, the balance is being distributed according to the need and urgency of the customers concerned.

EXPANSION OF TURKEY'S COAL INDUSTRY

From Robert Williamson, London, Eng.

A contract of the approximate value of £1,500,000 has been placed by the Turkish Government institution, the Eti Bank, with the Metropolitan-Vickers Electrical Export Co. Ltd., London, England, for the construction of an electrical power station at Catal Agzi.

One of the main objects of the station is to furnish electric power for the modernization and expansion of the Turkish coal industry. Catal Agzi, on the Anatolian coast of the Black Sea, has been chosen as the site because it is near the Zonguldak coal basin from which the station will get its fuel.

The contract was obtained in face of international competition and the first instalment of plant totals 60,000 kw. and comprises three 20,000 kw. turbo generator sets, the requisite steam boilers, electrical switchgear, transformers, overhead transmission line and sub-stations.

Provision is to be made for the extension of the power station at some future date.

FRANKENSTEIN AND THE ENGINEER

By C. S. Jeffrey, M.I.E.E., M.I.E. Aust.

From *The Journal of the Institution of Engineers of Australia*

I am tired of Frankenstein. In trade depression and in war the question is repeated, has the engineer created a Frankenstein monster which will destroy our civilization? I do not know the answer. I do not know how much of our civilization is worth keeping, and how much should be destroyed, but I do know that most of our questioners do not have any clear idea what they mean by the question. Frankenstein's monster has become a figure of speech, it has achieved the permanence of the dictionary, but it originated in one of the strangest bits of unreason that ever claimed public attention. Mrs. Shelley's novel is now seldom read, and I venture to suggest it is not really worth reading. It is one of those books which depend on the literary quality of atmosphere, but in *Frankenstein* the atmosphere is so thick as to constitute a fog. Many who have not read the book do not distinguish between Frankenstein and the monster he created. The author, at least, is clear on that point, but I do not agree with her. The real monster of the book is Frankenstein himself, not his preposterous creation.

My sympathies in this story are entirely with the monster. In liquidating Frankenstein he did the right thing, although that is not wholly the moral I wish to convey here.

That is enough of Frankenstein in person, but Frankenstein as a figure of speech is another matter. Here I would urge our critics to turn to worthier writers than Mrs. Shelley. There is a very fine chapter on the engineer as a creator of forces which he cannot control in Samuel Butler's *Erehwon.*

Unfortunately, Butler was not in earnest, but was only poking fun at Darwin. But from Swift to A. P. Herbert, English literature contains many criticisms of engineering works. The following characteristic explosion from Ruskin is among the more reasonable.

"Civilization," says the Baron, "is the economy of power, and English power is coal." Not altogether so, my chemical friend. Civilization is the making of civil persons, which is a kind of distillation of which alembics are incapable, and does not at all imply the turning of a small company of gentlemen into a large company of ironmongers. Have we then in our modern armaments created forces which have destroyed or will destroy real civilization?

There is a temptation to-day to argue that the honours of war come not to those who possess modern weapons but to those who do not. We may say that the strength in defence has exceeded that in attack. We may go on to imagine warfare in which more and more machinery is operated by fewer and fewer men until at last wars are lost and won by national exhaustion of machine power and not of man power; but, unhappily, that pretty theory may be exploded with devastating thoroughness at any moment. I, therefore, shall not attempt to justify modern machine armaments and must accept their use, but not their creation, as the negation of civilization.

I shall not enter into familiar details of how science has made leisure, and so has given man the opportunity to become civilized, time to cultivate his soul. All people, perhaps most of us, have not done so. Leisure has gone sour and turned to the nasty mess we call unemployment. Power to build has become power to destroy. Is that the fault of the scientist and engineer?

In past times man has not lacked weapons of destruction. We may even say that modern weapons only facilitate the work of our old enemies fire and water. The incendiary bomb destroys by fire; the torpedo gives the sea its victims. We have not so much created new forces as organized the old ones and handed the control over to evil men. But be it noted that the soul cf man has rebelled against some old uses of fire and water. Burning at the stake is now one of the things that is really not done, and we even frown on the gangster who applies the persuasion of a match to the soles of his victim's feet. Slow motion drowning at the stake by means of the rising tide is not now encouraged anywhere.

We may use poison gas to-day, but we don't poison the soup of our guests as did the Borgias. We could to-day manufacture those simple mechanical devices, the thumbscrew and the rack, in large quantities at very small cost. That we no longer use them, I can only attribute to the growth of the human soul. The point I want to make is that if we try to deprive belligerent inhumanity of its weapons we cannot stop until we have prohibited the manufacture of false teeth to prevent people biting each other. There is only one way to get rid of bombs and poison gas and that is to cultivate the human soul. We have outgrown many evil things, but all mankind must grow, not only the scientist and engineer.

We will now, if you please, turn to Kipling's *MacAndrew.* MacAndrew's engines sang to him of "Law, order, duty and restraint, obedience, discipline." These are the virtues of the good engineer, as an engineer. As a man he has the usual vices. Without the virtues sung by MacAndrew, machinery will not function. They are only a part of civilization, but an important part. Machinery is the child of man's brain. Undisciplined and lawless men can never use it effectively. Law and order cannot be destroyed by a machine which depends on law and order for its operation, any more than the Kilkenny cats can really eat each other. The aviator to-day probably lives by faith more than any man, faith in his fellow-man to do his duty. The life of every man in the machine age is in some other man's keeping all the time. There is no work in which neglect of duty brings such quick retribution as in the application of science.

Law, order, duty, obedience and discipline may exist in the kind of civilization we believe to be utterly bad. The civilization all good men want has other elements—charity, justice, mercy, unselfishness and humility in its true sense, but these do not enter into engineering calculations. They have their part in our dealings with men not with machines. There is, of course, no such person as the scientist or engineer who has no human contacts, but those contacts are not engineering. Long ago, some wise old owl classified certain subjects of study in Scottish universities as "the humanities," but these do not form part of engineering training. It is the humanities that make the difference between a good and a bad civilization. In past times men built cathedrals as well as castle dungeons. They built the cathedrals to the glory of God. The engineer to-day builds, in the words of Tredgold in the constitution of The Institution of Civil Engineers, "for the use and service of man." Men still build temples to false gods, and engineers build machines for evil men.

Let me come back to Frankenstein. My object is to do to that figure of speech what the monster did to the man, choke it. Let us rather bring the devil back into public life. If I am told that the engineer has sold his soul to the devil I will at least admit that the gas mask has turned man into the image of the devil. If one could travel through eighteenth century England with motor cycle and gas mask, I think the churches would fill up very quickly. But if you unmask that grotesque figure to-day as likely as not you will find a genial clergyman, so that things are not always what they seem. There are still amongst us elderly people who throw salt over the shoulder to keep the devil away. It is quite a good practice really, if only to remind us that the devil is not yet dead.

GOVERNMENT TRAINING CENTRES

From *The Engineer* (London, Eng.), April 26th, 1940

For several years the Government has maintained a number of centres in different parts of the country in which unemployed men are given a practical training in the engineering and other trades. With the outbreak of war this scheme has now become a national asset for the training of large numbers of men for the engineering industry. Although the 30,000 men trained each year at the fourteen centres will not by any means satisfy the demand, they will make a valuable contribution to the national effort. It will be recognized that these men with a good practical training behind them will be capable of a higher class of work than those who enter the trade with no knowledge and are only fitted for simple repetition work which can be rapidly and easily taught under actual factory conditions.

The Government training scheme was originally established with a view to helping the younger type of unemployed men in distressed areas who had little or no opportunity of getting local work. It was intended to teach them a trade in order that they might take up employment in some other part of the country where industry was in a better state. At present training is mainly concentrated on the engineering trades and the courses include draughtsmanship, fitting, turning, instrument making, machine operating, sheet metal working, and electric and oxy-acetylene welding. As a rule, each course lasts about six months and the draughtsmanship course three months longer. The instructors at the centres are men with years of practical experience in their trades and have a special ability for teaching. Training is carried out under conditions closely approaching those of ordinary workshops and the practical work is supplemented by lectures on typical problems and general workshop knowledge. The work done is generally for instructional purposes only and includes the maintenance of machines and replacement of parts for the centres themselves.

At present, admission to the centres is restricted to men aged eighteen and nineteen and those between twenty-five and forty-five, although under specified conditions men of the intermediate ages are admitted. During training, men receive the various unemployment and other benefits to which they are entitled together with supplementary sums for living expenses, fares, etc.

The actual training syllabus followed by the men at each centre is largely left to the discretion of the manager, who adapts the system to the current requirements of the industry, and he generally keeps in close touch with the latest workshop practice in order that the trainees should enter industry with the advantage of completely up-to-date knowledge.

THE CREEP OF CONCRETE UNDER LOAD

From *Civil Engineering and Public Works Review*, London, Eng., March, 1940

The Department of Scientific and Industrial Research has issued a further paper (*Building Research Technical Paper No. 21*, published by H. M. Stationery Office, price 1s. net) in the series of studies on reinforced concrete, which deals with an investigation at the Building Research Station on the creep or flow of concrete under load. Much of the work described was done in co-operation with the Reinforced Concrete Association.

The subject was first considered in *Building Research Technical Paper No. 12*, published in 1930. Since that time, the scope of the investigation, which originally related to the longitudinal movements resulting from loading in compression, has been widened to include creep in pure tension, lateral movements under compression and the effect of creep on the deformation and ultimate strength of reinforced concrete beams.

Some of the test results now published relate to specimens which have been maintained under load for over seven years. Those for Portland cement concretes indicate in all cases that the creep is proceeding at a steadily decreasing rate, and, for each concrete, is tending to a limiting value. Thus the increase in creep from one to five years under load is only about one-fifth of the movement during the first year for specimens loaded at the age of one month.

A series of simple tests showed that at stresses higher than the normal working values, the creep cannot be assumed to be proportionate to the applied stress, but the results indicated that the mechanics of the deformation were similar for all stresses. Tests have been carried out to discover the effect of the water content of the concrete, the fineness of the cements, the sharpness of the aggregate, and the preliminary storage on creep. A section of the paper deals with the redistribution of stress in reinforced concrete columns and beams.

To provide an example of the movements that occur in practice as the result of the shrinkage and creep of concrete, measurements were made periodically for over eight years of the vertical and horizontal deformation of one of the reinforced concrete arches of a large hall in London. An analysis of these measurements is included in the paper.

COMPACTION OF SOIL BY EXPLOSIVES

By Col. A. K. B. Lyman, M.Am. Soc. C.E., in *Civil Engineering*, April, 1940

Abstracted by A. C. D. Blanchard, m.e.i.c.

A new method of consolidation of loose soil has been developed by Col. Lyman in the preparation of the foundation for Franklin Falls dam in New Hampshire. His description of the methods used is prefaced by a discussion of soil characteristics and a review of the various commonly-employed methods of treatment, including piles, piers, spread footings, grillages and the like; and compaction by artificial means. It is pointed out that in many cases the treatment applied results in an expensive foundation, the cost of which is disproportionately large compared to that of the superstructure.

The author classifies stresses acting on foundations as gravitational loads, hydrostatic pressures and dynamic forces. Gravity loads slowly increase as construction proceeds, and reduction in void spaces in loose, cohesionless soils may result in substantial settlement of the structure. Ground water or seepage is of major importance when the flow emerges at ground surface at a velocity to cause flotation of the soil grains; this quicksand condition is, of course, unstable. Vibration in an earth mass may be induced by earthquake shocks, explosives or operation of heavy machinery on the surface; on loose soils the action of vibratory forces is quite pronounced.

The treatment applied by the author (compaction by dynamite) is stated to effectively compact fine and medium sands, including those having an appreciable silt content.

At the Franklin Falls dam site, where the process was used, soil samples were taken from an unwatered test pit prior to blasting. After blasting, a similar test pit was excavated adjacent to the first, and a comparison of the two pits made. The effect of dynamiting is illustrated by a chart included with the text. A compaction scale, taking 0 per cent for the loosest and 100 per cent for the most compact states obtainable in a laboratory was utilized as a means of comparing field samples.

In the case under review, the degree of compaction was changed approximately from 20 to 60 per cent and was effective both downward and laterally. Field pumping tests indicated also a great difference in permeability.

The action of the explosive is described as producing a ball of gas which is squeezed out to the surface and the lateral flow of soil seals the cavity. Subsequently small boils of water break out; the liquefied soil bleeds surplus water, settles and rearranges its grain structure.

The action of explosives on loose soils is also under study in connection with hydraulic fills.

THE DAM AT GÉNISSIAT ON THE RHÔNE

From *Civil Engineering and Public Works Review*, London, Eng., March, 1940

In *Foreign Notes*, December, 1937, a brief account was given of the organisation and preliminary investigations for the great national undertaking for the development of the River Rhone from the lake of Geneva to the sea. In *Génie Civil*, 116, 22, Mr. P. Calfas describes the actual state of the work which, started in 1937 at Génissiat, has not so far been interrupted by the war. The main features of this work are the concrete gravity dam 328 ft. high curved in plan, which will contain 600,000 cu yds. of concrete and will store about 1,863,000,000 cu. ft. of water.

This dam will, according to the modified design, contain the power station, protected by a roof which will form the continuation of the downstream face of the dam and over which, if necessary, exceptional floods will pass. The idea of two power houses, one on either side of the valley, as at the Boulder dam, has been abandoned. The distribution station at 220,000 volts will be on the right bank.

Special attention has had to be given to the enormous flood discharge, but with the main discharge channel on the right bank, the turbines, a provisional discharge on the left and the safety scour on the right bank there will be a total discharge of nearly 180,000 cusecs, so that it is most unlikely that the river will ever flow over the crest of the dam. Finally, means for dewatering the site of the dam between the two temporary dams and the navigation canal are noted.

The construction of the tunnels on either side of the site to by-pass the waters of the Rhône has been carried out without special difficulty. Their lengths were about 1,980 ft., and they have curved roofs, side-walls and invert, being about 37½ ft. by 28½ ft. high.

It was judged best to line them with concrete which, mixed at two stations on the right bank plateau, was brought in shoots to the four entries. From these points compressed air injectors forced it through 6 in. tubing. The pressure was necessarily high, 113 lb. per sq. in., and the granular analysis had to be kept constant, the gravel being smaller than 1.65 in. diameter. In this way the concrete was transported through a length of about 1,300 ft. These tunnels were finished in May, 1938.

Serious difficulties were encountered in cutting the Rhône. In other recent important hydro-electric plants similar operations could be carried out at low water, often when the flow was only a few cusecs. At Génissiat, on the contrary, the flow of the Rhône was never less than 5,400 cusecs. Also the slope of the river at the site is very flat, and consequently the upstream inlets cut into the river above low water level.

Many observations were made with various mixes of the materials for the earthen dams, and it was found that if the mix was made with large and smaller materials the slope of the mass tends to approach to that which obtains when the smaller materials alone were used.

Also an economy of material was obtained by constructing two masses instead of one, and the downstream mass should be made first. A special quarry was opened for the material giving stone weighing between 25 lb. and 1,000 lb. Experiments showed that one could not depend (with this material) on a downstream slope of more than 4 per cent, and since the downstream dam required a height of at least 29 ft. it was impossible to build it by merely tipping these stones on the bed of the river.

To get over this difficulty steel tetrahedral frames, 6.6 ft. wide, were constructed of 3-in. angles and launched in the stream, forming an obstacle to the movement of the tipped material. These frames being moored by cables, the slope of the mass was increased from 4 to 20 per cent, allowing the dam to be placed with a length of about 200 ft. Begun in March, 1939, the two dams were successfully completed by tipping about 53,000 cu. yds. of stone.

Two rigidly constructed service gangways have been built above these upper and lower dams. They are reinforced concrete arches with top deck, and have been useful in tipping the dam material, and also in the construction of sheet piling screens to prevent infiltration through the dams. Since the maximum length of steel sheet piling in France is 66 ft., in one case a second screen of 21½ ft. piling was spliced to the top of the first set of piles driven.

As even then the lower sheeting did not penetrate the deepest part of the alluvial bed of the river, it was decided to inject the alluvium below the piles. Cement having given uncertain results, silicate of soda injected between two injected layers of clay was used. At the lower dam some of the sheet piles are welded before driving.

Attention has been paid to the aesthetic treatment of this great work, and as the result of a competition, Mr. Laprade has been appointed consulting architect to the whole scheme. In a further article, *Génie Civil*, 116, 45, the author discusses the amelioration of the stable river channel. In 1938, the channel for a width of 230 ft. had a depth of 5¼ ft., with a maximum depth of 6.6 ft. below low water. In March, 1939, there was a maximum depth of 12½ ft., and the width of the 5½ ft. channel was 462 ft. It is also noted that irrigation, especially in the regions of the Camargue and Crau on either side of the Rhône south of Arles, is being much developed.

VINYON

From *Mechanical Engineering* (New York), May, 1940

Similar in some ways to nylon, a new textile fibre, called vinyon, is now being made from coke, lime, water, and salt, according to F. Bonnet, American Viscose Corporation, in a paper published in the March 4, 1940, issue of the *American Dyestuff Reporter*. Vinyon is produced by the polymerization of two well-known plastics, vinyl chloride and vinyl acetate. The former is a rubber-like material which can be moulded or pressed into any desired shape, such as sheets, rods, tubes, and belts to take the place of rubber ones. The latter plastic easily wets or clings to surfaces, acting as an excellent bonding material. In fact it is used as a binder in composition wood moulding; as an adhesive for sealing fibre cartons; for making milk-bottle caps; and for gumming tapes. Of the various copolymers or compositions of the two plastics investigated only those containing 85 per cent or more of vinyl chloride seem to have particular industrial interest.

In making the multifilament yarn of vinyon, the raw copolymer in the form of a white powder is dispersed in acetone to get a dope containing 23 per cent of the copolymer by weight. After filtering and deaerating the dope is spun the same as acetate rayon by the dry or air-spinning process. After conditioning on the take-up bobbins the yarn is twisted wet to avoid static with six turns per inch, whereupon it is given a stretch of over 100 per cent of its original length. As in the case of nylon, this stretching is a vital part in producing a good yarn so as to give it high tensile strength and true elasticity. The stretched yarn is then set by immersion in water at 150 deg. F. for several hours, after which it is ready to be wound to cones or skeins as the case may be.

The ordinary yarn is bright but may be dulled by incorporating finely ground pigments in the spinning dope just as is done in the case of viscose or acetate rayons. The tenacity or tensile strength may be controlled within a range of 1 to 4 grams per denier (19,300 to 77,200 p.s.i.) and the elongation correspondingly from 120 per cent to 18 per cent, the higher strength corresponding to the lower extensibility and vice versa. Being extremely water-repellent the tenacity and extensibility of the dry and wet yarn are the same. Although it is thermoplastic and softens at temperatures above 150 deg. F., it does not support combustion.

During textile processing it is customary to run with rather high humidity because of the static which develops. The knitting properties are good since vinyon, due to its high strength and elasticity, can be knit under higher tension, thus producing a tighter stitch than is possible with other fibres. Both the yarn and fabrics are in no way affected by water and are exceptionally resistant to acids and alkalies. In contact with ether or the lower aromatic hydrocarbons it tends to swell, but it is unaffected by alcohol, gasoline, and other similar hydrocarbons. Vinyon is not attacked by bacteria, moulds, or fungi, and will not support their growth. It does not conduct electricity and, as water does not affect it, is an excellent insulator. The staple fibre of vinyon blended with natural fibres like cotton or wool, or with rayon, can be made into fabrics which will retain a pressed shape, fold, or crease.

Uses suggested for the new textile fibre include filter fabrics, fishlines, nets, seines, electric insulation, shower curtains, bathing suits, waterproof clothing, acid- and alkali-resisting clothing, fireproof awnings and curtains, upholstery, fabrics, and hosiery.

A DUTCH AMPHIBIAN

From *The Royal Engineers Journal*, March, 1940

The following abstract, which was prepared before Germany's assault on Holland, is of particular interest now. It is tragic that "fifth column" activities rendered such protective measures ineffective.—Editor.

The inundation areas which form Holland's chief line of resistance would, as is believed, constitute an effective barrage against all known motorized land units, including tanks. A certain amount of activity would, of course, be possible with pontoons, rafts or other flat-bottomed boats, but the Dutch military force, naturally foreseeing this eventually, has developed a particular type of armoured amphibian which is capable of moving freely on firm or swampy ground as well as over flooded areas.

The vehicle is manufactured by the D.A.F. concern at Eindhoven. It has an overall length of 11½ ft., an overall width of 5½ ft., and overall height of 5 ft. 3 in. The wheelbase is 8 ft. 3 in., and the weight is 24½ cwt. It is a small but remarkable vehicle, as it is capable of travelling at speeds as high as 45 m.p.h. in either direction.

The vehicle is fitted with one or two machine-guns and is manned by four men, seated in opposed directions, of whom two are drivers, each operating in one direction, while the other two serve the weapons.

As Holland has no motor-car works of its own, clever use has been made of Citroën components. The engine, gear box, clutch, the two complete front wheel assemblies, and many parts of minor importance are, in fact, of French manufacture. Suspension is, therefore, identical with that of the Citroën cars, by torsion bars. The engine is mounted transversely in the middle of the vehicle, with the gear box in front of the differential. The driving shafts, leading to both the front and rear axles, are provided with two universal joints and terminate in pinions of two supplementary differentials, interposed between the driving shafts of the wheels.

The vehicle has constant four-wheel drive, but the steering of the two axles is entirely independent. Under normal conditions the steering of one axle can be locked, but if necessary the second steering system can be applied assuring then a degree of manoeuverability unprecedented on normal vehicles.

Being independently sprung on all wheels, the D.A.F. is of a thoroughly cross-country type when used on land. With a gear ratio of 20.50 in first, 11.30 in second and 6.8 in third, the steepest gradient negotiable is 51.5 per cent, which is certainly remarkable for a three-speed car and an engine of only 48 b.h.p. (78 mm. bore and 100 mm. stroke). Two independent brakes are fitted, the foot brake being of the Lockheed type.

Referring now to the capacities of the vehicle over flooded territory, propulsion is effected by a screw, driven from a supplementary bevel pinion from one of the two interposed differentials between the oscillating half axles. It is worth mentioning that provision has been made for all four wheels to revolve also when the vehicle is passing through water. This is an important feature when, owing to shallowness of the water, the wheels come into contact with the ground, for, so far from interfering with the propulsion, they assist it. The wheels have also proved to be quite adequate as rudders, thus serving a double purpose and minimizing further complications.

A careful weight distribution and a self-contained design of bodywork are the external features of this vehicle, of which more details have, for obvious reasons, not yet been released.

THE TOOL MAKER

From *Trade and Engineering*, London, Eng., April, 1940

The tool maker is among the most highly skilled of all metal-workers, and a long period of training is necessary before he is fully qualified for his task. It will be apparent, therefore, that when a sudden increase in output is demanded throughout the metal-working industries, it is the shortage of tool-makers which is felt most acutely and is the most difficult to remedy. In these circumstances it is essential to ensure that the work of tool-rooms is mechanized to the greatest possible extent so that the output of each skilled man is increased to a maximum.

To-day many special types of tool-room machines can be obtained, which in the hands of trained operators enable work to be performed in a period of hours that would otherwise require days or even months for its completion. Most important of all is the jig-boring machine, by which holes can be located and machined to a remarkable degree of accuracy. In view of the precision necessary in such machines and the quality of the workmanship involved in their construction, the supply is necessarily limited, but as two British firms are now producing them, deliveries from the Continent and from the United States of America can be augmented.

Other equipment developed to aid the tool maker and eliminate much tedious and exacting hand work includes form milling machines, automatic die-sinking machines, contour sawing machines, profile grinding machines, and engraving machines. Even with the best plant obtainable, an appreciable amount of hand-finishing is frequently necessary, but the object should be to ensure that the facilities are available for performing every possible operation by machine.

SALVAGING WASTE PAPER

From *Trade and Engineering*, London, Eng., April, 1940

For the manufacture of paper board for essential industrial and war purposes, more than 10,000 tons of waste paper is needed in this country every week. The board is made into tubes to hold ammunition, cartons for rifles, and containers for food, medical and chemical supplies. It thus saves wood and metal. On the occasion of a visit last month to a paper board mill—the largest in the British Empire—an appeal was made by Colonel J. J. Llewelin, Parliamentary Secretary to the Ministry of Supply, that all clean waste paper should be saved and strict economy exercised in the use of paper generally. It was also urged that more councils and boroughs should organize the collection of waste paper, of which 1,000,000 tons is estimated to be available in the homes of Great Britain. Half of this quantity was required urgently by the paper board industry. Meanwhile it was necessary to take up valuable shipping space to bring old newspapers from Sweden.

From Month to Month

News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

CANADIAN ENGINEERS ABROAD

The demand for engineers by governmental departments and by industry has become so great that a real problem is developing. There are not many men in Canada actually out of work to-day, although several are still interested in changing from their present occupation to one more closely related to the war effort.

One firm with large war orders has suggested that Canadian engineers in other parts of the world might wish to return to Canada if they thought their services here would contribute to the prosecution of the war. In fact the Institute has received many letters from Canadians now out of the country, asking for information along these lines.

It is impossible to guarantee anything, but it does appear as if such persons would be valuable back in their native land. There must be many hundreds of them happily and gainfully employed in other countries. If even a small percentage returned they would add greatly to the momentum of production of the necessities of war.

If any of these persons are ready to consider such a move, Headquarters will be glad to hear from them. It should be possible to give an accurate account of conditions in Canada, and also to advise them on specific openings that have been recorded with the employment department.

It is not the purpose of these comments to have men quit their posts and rush to Canada, but rather to inform interested parties that it is possible they can assist greatly in this time of stress. The Institute desires to aid to its utmost in bringing to Canadian industry an adequate supply of technical men. Inquiries from employers in Canada and engineers in all parts of the world will be welcomed. In times like these such a service is not limited to members of the Institute.

ANNUAL MEETING OF THE DOMINION COUNCIL

The annual meeting of the Dominion Council of Professional Engineers was held at the Fort Garry Hotel, Winnipeg, on May 27th, 28th, 29th, 1940. The president of the Council, D. A. R. McCannel, M.E.I.C., of Regina (representing the Saskatchewan Association) occupied the chair. Other members present included Hector Cimon, M.E.I.C., Quebec, vice-president; Colonel F. W. W. Doane, M.E.I.C., Nova Scotia; G. G. Murdoch, M.E.I.C., New Brunswick; E. P. Muntz, M.E.I.C., Ontario; P. Burke-Gaffney, Manitoba; J. B. de Hart, M.E.I.C., Alberta; E. Redpath, British Columbia and Major M. Barry Watson, M.E.I.C., secretary-treasurer of the Council.

The greetings of the Association of Professional Engineers of Manitoba were extended to the Council by their president, Mr. F. S. Adamson, who also tendered a cordial invitation for the Council to attend the 20th anniversary banquet of the Manitoba Association on the evening of May 27th, which invitation was accepted.

The president, in his opening remarks, expressed his appreciation of the honour to himself and to the Saskatchewan Association for his election to that office. He also presented his greetings to the new councillors and expressed regret at the enforced absence of the honorary president, Mr. Kirby, who had forwarded his own regrets through his alternate.

Mr. J. B. de Hart, chairman of the Committee on admission of Foreign Engineers, reported on the activities of his committee. He requested that all Dominion councillors and registrars of the various associations report cases concerning the entry of foreign engineers into Canada to this committee, especially in cases of foreign engineers doing work in Canada while in the country as "tourists." It was recommended that each provincial association make contact periodically with the local immigration authorities with a view to seeing that all foreign engineers doing work in Canada are properly licensed.

Mr. Redpath, chairman of the special Committee on the Training of Young Engineers, presented a brief report on the work of his committee. It was decided that this committee should collaborate as fully as possible with the similar committee of the Engineering Institute of Canada, under the chairmanship of Mr. H. F. Bennett, for the purpose of arriving at a policy which may be acceptable to all engineering bodies. Suggestions were presented regarding methods of guidance of secondary school students in the choosing of a career and the representatives reported on the scholarships which their respective associations had inaugurated in the engineering colleges.

Mr. Muntz presented a verbal report on the activities of the National Construction Council. The general opinion expressed was that the activities of this Council were a valuable means of keeping the engineering profession before the construction industry and was worthy of support. Mr. Frank R. Ewart, M.E.I.C., of Toronto was re-appointed representative of the Dominion Council on the National Construction Council for the year 1940.

It was RESOLVED that the Dominion Council of Professional Engineers offer on behalf of its component associations in the various provinces, any service to the government of Canada which may be of assistance in furthering its war effort.

Mr. McCannel reported on the working out of the co-operative agreement with the Engineering Institute of Canada in Saskatchewan. The opinion was then freely expressed that while the Dominion Council is in "an advisory co-ordinating capacity" to the provincial associations and while under section 6, subsection 5 of the constitution it may "negotiate with other organizations whereby the common interests of the engineering profession would be advanced," the principle was recognized that the consummation of co-operative agreements was a provincial matter and that no action of the Council should tend to take away from the autonomy of the provincial associations.

It was RESOLVED that the Dominion Council as the co-ordinating body for the provincial associations in the interests of unity in the profession requests the associations to embrace every opportunity of giving sympathetic consideration to concrete proposals for co-operation with any or all engineering bodies in their respective spheres with the end in view that, when all bodies are in accord, full co-operation will be attained; so that the profession will have one front to the public and to the government.

To assist in obtaining this objective, the Dominion Council appointed Mr. E. P. Muntz as chairman of a special committee, to explore ways and means by which the above end may be reached. Mr. Redpath was appointed vice-chairman of this committee.

It was reported that all the associations which have the power to do so in their act, have made provision for the remission of fees of their members who are serving outside of Canada on active service.

It was RESOLVED that all steps possible should be taken to influence the various governments to see that a registered engineer is included in the personnel of all government commissions dealing with engineering topics.

Minor changes were made in the constitution necessitated by the setting up of a permanent secretariat.

(*Continued on page 327 right column*)

CORRESPONDENCE

2050 Mansfield Street, Montreal, Que.,

June 20th, 1940.

Your Excellency,

It is my privilege to comply with the directions of the President and Council of The Engineering Institute of Canada—the senior representative professional engineering society of the country—to express to Your Excellency the pleasure which your appointment as Governor General has given to the Institute's membership of nearly five thousand Canadian engineers.

All are confident that in performing the duties of the high position which you are about to assume, you will be adding another notable achievement to the long list of your distinguished services to the State and to the Empire.

The President and Council of the Institute venture to hope that your residence in Canada as His Majesty's representative will be a time of agreeable experiences, both for Her Royal Highness the Princess Alice and yourself.

I have the honour to remain, my Lord,

Your Excellency's Obedient Servant,

(*Signed*) L. Austin Wright, *General Secretary,*

The Engineering Institute of Canada.

His Excellency The Right Honourable the Earl of Athlone, K.G., P.C., G.C.B., C.M.M.G., G.C.V.O., D.S.O., Governor General and Commander-in-Chief of the Dominion of Canada.

Government House

Ottawa

June 25th, 1940.

Office of the Secretary to the Governor-General

Dear Sir,

I am desired by the Governor General to acknowledge the receipt of your letter of June 20th, and to request you to be good enough to convey to the President and Council of the Engineering Institute of Canada, an expression of His Excellency's sincere appreciation of their kind message of welcome.

Yours sincerely,

(*Signed*) Sir Shuldham Redfern,
Secretary to the Governor-General.

L. Austin Wright, Esq., *General Secretary,*

The Engineering Institute of Canada,
2050 Mansfield Street, Montreal, P.Q.

June 12th, 1940.

Members of Council,
The Engineering Institute of Canada.

Gentlemen:—

As I will not be able to attend the meeting of Council on Saturday, June 5th, I wish to submit a report of the activities of the Papers Committee which was requested at the Windsor meeting.

During the past couple of months, communications with lists of films and other information that was available concerning papers and speakers have been sent to all the western branches, the maritime branches, and a number of

(*Continued in column at right*)

(*Continued from left column*)

the Ontario branches. The maritime branches have been advised that Mr. H. F. Bennett is proposing to spend his holidays in the East about the end of August and has agreed to address their meetings. Dr. A. E. Berry and Mr. William Storrie of Toronto have signified their willingness to address some of the Ontario branches and some of these branches have been advised accordingly. In a discussion with Mr. McNeely DuBose, vice-president for Quebec, it was considered that Dr. Berry, past chairman of the Toronto Branch, would be an excellent speaker for the Quebec branches. This matter has been taken up with Dr. Berry but his final acceptance has not as yet been received. If Dr. Berry will agree the branches will be advised.

The question of eastern speakers visiting western branches is always to the fore. Professor Legget, on his trip to the West, is visiting the branches where possible. He addressed a meeting of the Calgary Branch on June 10th. Another speaker who may be induced to visit the western branches late in the year is Mr. E. V. Buchanan of London. If Mr. Buchanan were agreeable to making this trip on his holiday time, he would make an excellent representative.

Mr. H. E. Brandon, vice-chairman of the Toronto Branch, is in charge of programmes for the year and if any member of Council knows of a suitable speaker or paper for the Toronto Branch, Mr. Brandon would appreciate being advised.

The Committee is most anxious that members call upon branch executives and members on every occasion in their travels.

The Committee would be very pleased to receive suggestions from members of Council as to ways and means of assisting the branches.

Yours very truly,

(*Signed*) James A. Vance,
Chairman, Papers Committee.

(*Continued from page 326*)

The following officers were elected for the ensuing year: honorary president—C. C. Kirby, M.E.I.C., of New Brunswick; president—D. A. R. McCannel, M.E.I.C., of Saskatchewan; vice-president—Hector Cimon, M.E.I.C., of Quebec; 3rd member of executive committee—E. P. Muntz, M.E.I.C., of Ontario; secretary-treasurer—Major M. Barry Watson, M.E.I.C., of Toronto.

It was decided to hold the next meeting of the Dominion Council in Ontario.

Executive of the Dominion Council of Professional Engineers in session at Winnipeg Left to right—Major Watson, Mr Redpath, Mr Muntz, Mr. de Hart, Mr. McCannel, Mr. Cimon, Mr. Murdoch, Mr. Burke-Gaffney and Col. Doane.

MEETING OF COUNCIL

A meeting of Council was held at Headquarters on Saturday, June 15th, 1940, at ten thirty a.m., with Vice-President E. P. Muntz in the chair and ten other members of Council present.

The secretary read communications from the chairman of the Engineers' Council for Professional Development acknowledging receipt of the Institute's application for membership, and outlining the procedure which is being followed for its consideration. A special committee has been set up to study the proposal and to make a recommendation at the annual meeting of the Council next September.

A report was presented from Mr. Vance, chairman of the Papers Committee, outlining the recent activities of that committee.

In view of the changes in membership classifications and the increase in the price of metals, the schedule of badges of the Institute had been reviewed, and it was decided to retain the bronze badge for Students at the same price, $1.50; to use the silver badge for Juniors at the same price, $2.25, and to raise the price of the gold badge for Members from $3.75 to $4.00. These prices include engraving.

In response to a request from the chairman of the Papers Committee for the next Annual Meeting, the following topics were suggested: (a) The work of Mr. Bennett's Committee on the Training and Welfare of the Young Engineer, particularly as it affects the young graduate; (b) the work of the Engineers' Council for Professional Development and the Institute's membership therein (if granted); and (c) the work of engineers in relationship to the war effort.

The secretary reported that the Institute had been co-operating with other national organizations in making representations to the government regarding the projected Unemployment Insurance Bill. Councillor W. F. M. Bryce, of Ottawa, had represented the Institute on a delegation which had presented the following resolution to the Minister of Labour and the Minister of Agriculture at Ottawa. This had been followed up by letters from the general secretary to the Minister of Labour and to our Member of Parliament.

> WHEREAS it has been intimated that an Unemployment Insurance bill will be introduced at the coming session of Parliament;
>
> BE IT RESOLVED that, if any bill is introduced, it should not be proceeded with at the coming session of Parliament, but that an opportunity should be given for consideration of the bill by all interested persons and groups, so that all approved suggestions may be incorporated in any bill which may be proceeded with at a subsequent session.

The general secretary was instructed to express to Vice-President J. Clark Keith, Council's appreciation of his action in presenting to the Institute at the Windsor meeting a bronze replica of the Institute crest.

Two resignations were accepted; two members were reinstated, and the names of three members were removed from the membership list.

A number of applications were considered, and the following elections and transfers were effected:

ELECTIONS

Members	6
Juniors	4
Affiliates	4
Students admitted	8

TRANSFERS

Student to Junior	3

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

THE ENGINEERING INSTITUTE OF CANADA PRIZE AWARDS 1940

Eleven prizes known as "The Engineeiing Institute of Canada Prizes" are offered annually for competition among the registered students in the year prior to the graduating year in the engineering schools and applied science faculties of universities giving a degree course throughout Canada.

Each prize consists of twenty-five dollars in cash, and having in view that one of the objects of the Institute is to facilitate the acquirement and interchange of professional knowledge among its members, it has been the desire of the Institute that the method of award should be determined by the appropriate authority in each school or university so that the prize may be given to the student who, in the year prior to his graduating year, in any department of engineering has proved himself most deserving as disclosed by the examination results of the year in combination with his activities in the students' engineering organization, or in the local branch of a recognized engineering society.

The following are the prize awards for 1939:

Nova Scotia Technical College	W. A. MacCallum
University of New Brunswick	Ivan Frederick Ronalds
McGill University	William Crocker Brown
Ecole Polytechnique	Aubry Gérard, S.E.I.C.
Queen's University	J. M. Courtright
University of Toronto	B. K. Smith
University of Manitoba	John Alexander Hopps
University of Saskatchewan	Ronald Henry Hall
University of Alberta	Charles A. Stollery
University of British Columbia	Charles V. Ryder
Royal Military College of Canada	No award—regular course discontinued during the war

RECENT GRADUATES IN ENGINEERING

Congratulations are in order to the following Juniors and Students of The Institute who have completed their courses at the various Universities:—

NOVA SCOTIA TECHNICAL COLLEGE

DEGREE OF BACHELOR OF ENGINEERING

Dean, Maurice Ferguson, Halifax, N.S., B.E. (Ci.).
Pumple, Francis Gerard, Saint John, N.B., B.E. (Ci.).

THE UNIVERSITY OF NEW BRUNSWICK

HONOURS, MEDALS AND PRIZES

Dineen, James Own, Hampton, N.B., B.Sc. (Elec.); Rhodes Scholarship; Brydone-Jack Memorial Scholarship for the highest standing in Electrical Engineering—(tied).
Geary, Bertram Harman, Fredericton, N.B., B.Sc. (Elec.); Brydone-Jack Memorial Scholarship for the highest standing in Electrical Engineering—(tied).
Ring, Alfred Jackson, Nashwaaksis, N.B., B.Sc. (Ci.); Ketchum Silver Medal for the highest standing in Civil Engineering.

DEGREE OF BACHELOR OF SCIENCE

Hughes, Gerald Francis George, Montreal, Que., B.Sc. (Elec.).
Logan, George Robertson, Saint John, N.B., B.Sc. (Elec.).
Logie, Richard Bucknam, Fredericton, N.B., B.Sc. (Ci.).
Manuel, Oliver Hemphill, Truro, N.S., B.Sc. (Ci.).

McGILL UNIVERSITY

HONOURS, MEDALS AND PRIZE AWARDS

French, John Kenneth, Montreal, Que., B.Eng. (Mech.); Honours in Mechanical Engineering; British Association Medal.
Webb, Earle Lester Robert, Montreal, Que., B.Eng. (Elec.); Honours in Electrical Engineering; Montreal Light, Heat and Power Consolidated First Prize.

DEGREE OF BACHELOR OF ENGINEERING

Balcom, Alfred Burpee, Jr., Wolfville, N.S., B.Eng. (Mech.).
Brown, George Cameron, Montreal, Que., B.Eng. (Elec.).
Dickson, William Leslie, Moncton, N.B., Jr.E.I.C., B.Sc., Nova Scotia Technical College '29; B.Eng. (Mech.).
Dodd, Geoffrey Johnstone, Jr., Montreal, Que., B.Eng. (Mech.).
Doehler, Rolf John, Montreal, Que., B.Eng. (Ci.).
Duncan, Frederick Robert, Fort William, Ont., B.Eng. (Elec.).
Duquette, Roland Charles, Montreal, Que., B.Eng. (Elec.).
Fish, Abe., Montreal, Que., B.Eng. (Mech.).
Graham, Richard James, St. Lambert, Que., B.Eng. (Elec.).
Hamilton, Alexander Daniel, Montreal, Que., B.Eng. (Chem.).

Hilton, Thomas Bradford, Mount Vernon, N.Y., B.Eng. (Mech.).
Jarry, Aurel Gaston, Montreal, Que., B.Eng. (Ci.).
Lamb, Hugh, Jr., Montreal, Que., B.Eng. (Ci.).
Leroux, George G., Montreal, Que., B.Eng. (Ci.).
McDunnough, William Ralph, Quebec, Que., B.Eng. (Elec.).
MacInnes, Thomas Robert Lampman Malcolm, Ottawa, Ont., B.Eng. (Elec.).
Merson, Lawrence Nelson, Montreal, Que., B.Eng. (Elec.).
Russell, Harold George, Montreal, Que., B.Eng. (Chem.).
Schofield, William Douglas, Montreal, Que., B.Eng. (Mech.).
Tuttle, Paul Douglas, Montreal, Que., B.Eng. (Elec.).
Vaughan, Robert Polk, Montreal, Que., B.Eng. (Mech.).
Walker, Howard James, Victoriaville, Que., B.Eng. (Elec.).
Watson, John Crittenden, Washington, D.C., B.Eng. (Mech.).
Wills, Nicholas James, Ottawa, Ont., B.Eng. (Ci.).

DEGREE OF MASTER OF SCIENCE

Brossard, Léo, Montreal, Que., B.A.Sc., C.E. (Ecole Polytechnique '36); M.Sc. '40.

MASTER OF ENGINEERING

Leblanc, Raymond Forte, Montreal, Que., B.A.Sc., C.E. (Ecole Polytechnique '37); B.Eng. (McGill '39); M.Eng. '40.

ECOLE POLYTECHNIQUE

DISTINCTIONS ET PRIX

Trudeau, Marc R., Montréal, Qué., B.Sc.A., I.C.; avec grande distinction; Médaille du Lieutenant-Gouverneur; Médaille d'argent de l'Association des Anciens Elèves de l'Ecole Polytechnique; Prix Augustin Frigon; Prix Ernest Cormier.
Brien, François, Montréal, Qué., B.Sc.A., I.C.; avec distinction; Médaille de bronze de l'Association des Anciens Elèves de l'Ecole Polytechnique.
Carrière, Paul, Montréal, Qué., B.Sc.A., I.C.; avec distinction.
Deslauriers, Charles-Edouard, Montréal, Qué., B.Sc.A., I.C.; avec distinction; Médaille d'or de l'Association des Anciens Elèves de l'Ecole Polytechnique.
Hamelin, Roger, Montréal, Qué., B.Sc.A., I.C., avec distinction.
Marchand, Fernand, Montréal, Qué., B.Sc.A., I.C., avec distinction.
Bourgeois, Claude, Montréal, Qué., B.Sc.A., I.C.,; Prix Mgr Gauthier.
Papineau, Marcel, Montréal, Qué.; B.Sc.A., I.C.; Prix de la Cinquantième Promotion de l'Ecole Polytechnique; Prix Paul d'Aragon.

DEGRÉS

Baril, Romain, Montréal, Qué., B.Sc.A., I.C.
Beaudry, Marcel, Montréal, Qué., B.Sc.A., I.C.
Caron, Clément, Montréal, Qué., B.Sc.A., I.C.
Coupienne, Gilbert, Montréal, Qué., B.Sc.A., I.C.
Dessaulles, Jean, Montréal, Qué., B.Sc.A., I.C.
Fréchette, Gaston, Montréal, Qué., B.ScA., I.C.
Frigon, Raymond A., Montréal, Qué., B.Sc.A., I.C.
Gravel, Georges, Montréal, Qué., B.Sc.A., I.C.
Lamarche, Marcel, Montréal, Qué., B.Sc.A., I.C.
Lecavalier, Gabriel, Montréal, Qué., B.Sc.A., I.C.
L'Homme, Louis-Philippe, Farnham, Qué., B.Sc.A., I.C.
Lord, Roger, Montréal, Qué., B.Sc.A., I.C.
Malo, Gérard, Montréal, Qué., B.Sc.A., I.C.
Mercier, Jules M., Montréal, Qué., B.Sc.A., I.C.
Nadeau, Yvon, Montréal, Qué., B.Sc.A., I.C.
Richard, Adrien, Montréal, Qué., B.Sc.A., I.C.
Sicotte, Jean, Montréal, Qué., B.Sc.A., I.C.
Tétreault, Armand, Montréal, Qué., B.Sc.A., I.C.
Vaillancourt, Jean-Louis, Montréal, Qué., B.Sc.A., I.C.
Valiquette, Francis, Montréal, Qué., B.Sc.A., I.C.

QUEEN'S UNIVERSITY

HONOURS AND MEDAL AWARD

Askwith, Francis Lloyd George, Ottawa, Ont., B.Sc. (Elec.); Honours in Electrical Engineering.
Campbell, John Graham, Windsor, Ont., B.Sc. (Met.); Honours in Metallurgical Engineering.
Davis, Robert Andrew, Ottawa, Ont., B.Sc. (Mech.); Honours in Mechanical Engineering.
Lee, John Douglas, Brantford, Ont., B.Sc. (Ci.); Honours in Civil Engineering.
Lockeberg, Rolf Sigurd, Ottawa, Ont., B.Sc. (Mech); Honours in Mechanical Engineering.
Newby, William Murray, Woodstock, Ont. B.Sc. (Mech.); Honours in Mechanical Engineering.
Simpson, Charles Norman, Port Arthur, Ont., B.Sc. (Ci.); Honours in Civil Engineering; Departmental Medal.

DEGREE OF BACHELOR OF SCIENCE

Asquith, Alfred Reginald, Auburn, Ont., B.Sc. (Mech.).
Binks, Wyman Rodger, Ottawa, Ont., B.Sc. (Ci.).
Conlin, Gerard Herbert, Toronto, Ont., B.Sc. (Ci.).
Denovan, John James, Asbestos, Que., B.Sc. (Mech.).
Hall, Gordon Hudson, Peterborough, Ont., B.Sc. (Elec.).
Hoba, Joseph G., Thorold, Ont., B.Sc. (Mech.).
Hunt, Frederic Alvin, Brantford, Ont., B.Sc. (Ci.).
Main, Hardy Lawrence, Dundas, Ont., B.Sc. (Ci.).
McGeachy, Duncan Donald Cameron, Vanderhoof, B.C., B.Sc. (Mech.).
McIntyre, Donald James, Chatham, Ont., B.Sc. (Ci.).
Mackenzie, Robert Kenneth, Owen Sound, Ont., B.Sc. (Ci.).
Neil, Charles Hamilton, Pembroke, Ont., B.Sc. (Mech.).
Paithouski, Nicholas Joseph, Sarnia, Ont., B.Sc. (Ci.).
Rowan, Russell Gillespie, Peterborough, Ont., B.Sc. (Ci.).
Shisko, Nicholas, Ansonville, Ont., B.Sc. (Mech.).
Smiley, Donald Charles, Ottawa, Ont., B.Sc. (Mech.).
Taylor, Charles Gray, Arnprior, Ont., B.Sc. (Ci.).

UNIVERSITY OF TORONTO

HONOURS

Howard, Henry Mervin Killins, Toronto, Ont., B.A.Sc. (Mi.); Honours in Mining Engineering.

DEGREE OF BACHELOR OF APPLIED SCIENCE

Dunn, Sydney Mewburn Secord, Ridgeway, Ont., B.A.Sc. (Met.).
Forrester, Robert Andrew, Toronto, Ont., B.A.Sc. (Ci.).
Hart, Erwin Edward, Toronto, Ont., B.A.Sc. (Ci.).
Kennedy, Dorwin Elmore, Toronto, Ont., B.A.Sc. (Ci.).
Levine, Samuel Dave, Lethbridge, Alta., B.A.Sc. (Chem.).
McArthur, Duncan Robert Baly, Toronto, Ont., B.A.Sc. (Elec.).
Murphy, Herbert John, South River, Ont., B.A.Sc. (Elec.).
Potter, Edward Bullivant, St. Catharines, Ont., B.A.Sc. (Chem.).
Simons, Samuel John, Toronto, Ont., B.A.Sc. (Ci.).

UNIVERSITY OF MANITOBA

HONOURS AND MEDAL AWARD

Morris, Ronald William, Winnipeg, Man., B.Sc. (Elec.); Honours in Electrical Engineering; University Gold Medal.

DEGREE OF BACHELOR OF SCIENCE

Adams, Jack Lindley, Newdale, Man., B.Sc. (Ci.).
Baker, Benjamin, Winnipeg, Man., B.Sc. (Elec.).
Barkwell, Stewart, Winnipeg, Man., B.Sc. (Elec.).
Bestwick, Frank Sheldon, Norwood, Man., B.Sc. (Elec.).
Cook, Charles Henry, Winnipeg, Man., B.Sc. (Elec.).
Curtis, George Louis, Moose Jaw, Sask., B.Sc. (Elec.).
Dixson, George Wilbert, Stettler, Alta., B.Sc. (Elec.).
Macnabb, Thomas Creighton, Rothesay, N.B., B.Sc. (Ci.).
Milhausen, William James, Morden, Man., B.Sc. (Ci.).
Morris, Ronald William, Winnipeg, Man., B.Sc. (Elec.).
Sutherland, Eric Sinclair, Winnipeg, Man., B.Sc. (Ci.).
Venables, William Norman, Winnipeg, Man., B.Sc. (Elec.).

UNIVERSITY OF SASKATCHEWAN

DEGREE OF BACHELOR OF SCIENCE

Goodfellow, Hodgson, Climax, Sask. B.Sc. (Mech.).
Mortin, Arthur Kenneth, Dilke, Sask., B.Sc. (Mech.).
Wiebe, Leslie, Herbert, Sask., B.Sc. (Mech.).

UNIVERSITY OF ALBERTA

HONOURS AND PRIZE AWARDS

Schulte, Theodore Milne, Strathmore, Alta., B.Sc. (Ci.); High Distinction with First Class General Standing in Civil Engineering; First Class General Standing in Applied Science; Association of Professional Engineers of Alberta Prize in Civil Engineering.
Monkman, Beverley Andrew, Medicine Hat, Alta., B.Sc. (Ci.); Honours in Civil Engineering.
Peck, Robert Cartwright, Edmonton, Alta., B.Sc. (Ci.); Honours in Civil Engineering.
Ross, Donald, Edmonton, Alta., B.Sc. (Ci); Honours in Civil Engineering.
Stanley, Donald Russell, Edmonton, Alta., B.Sc. (Ci.); Honours in Civil Engineering.

DEGREE OF BACHELOR OF SCIENCE

Corey, Bert Hatfield, Calgary, Alta., B.Sc. (Mi.).
Findlay, Stewart McIver, Edmonton, Alta., B.Sc. (Elec.).
Frick, David William, Edmonton, Alta., B.Sc. (Elec).
Hoar, Charles Richard, Knee Hill Valley, Alta., B.Sc. (Elec.).
Madill, Floyd Alexander, Edmonton, Alta., B.Sc. (Ci.).
Pegler, William Arthur, Edmonton, Alta., B.Sc. (Elec.).
Ripley, Herbert Angus, Edmonton, Alta., B.Sc. (Ci.).

DEGREE OF MASTER OF SCIENCE

Hugill, John Templeton, Edmonton, Alta., B.Sc. (Chem.) '39; M.Sc. '40.

UNIVERSITY OF BRITISH COLUMBIA

DEGREE OF BACHELOR OF APPLIED SCIENCE

Laird, Alan Douglas Kenneth, Montreal, Que., B.A.Sc. (Mech.).

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

De Gaspé Beaubien, M.E.I.C., treasurer of the Institute, is joint chairman of the War Savings Committee recently created by the Dominion Government. Mr. Beaubien has also been elected president of the Rotary Club of Montreal for the current year.

A. L. Bishop, M.E.I.C., has been made president of Consumers Gas Company, of Toronto. Col. Bishop is also president of the Coniagas Mines Limited and honorary treasurer of the Canadian Red Cross Society of Canada.

Harold J. A. Chambers
M.E.I.C.

Harold J. A. Chambers, M.E.I.C., has been appointed chief engineer of the Hamilton Bridge Company, Limited. After graduating from the School of Applied Science, University of Toronto, in 1924, Mr. Chambers received his master's degree in engineering in 1925. He has been associated, in various engineering capacities, with the Canadian Bridge Company since 1925, and resigned his position as chief designing engineer with that company to accept his new position.

W. F. Drysdale, M.E.I.C., vice-president of the Montreal Locomotive Works since 1932, has been appointed director of munitions of the Department of Munitions and Supply, at Ottawa. Before the first Great War, he was the mechanical engineer and superintendent of motive power of the United Fruit Company and Northern Railway of Costa Rica, and when war broke out, he was appointed assistant works manager of the Steel Company of Canada.

In 1916, he went to France in charge of the locomotive work undertaken by the American Locomotive Company and the Montreal Locomotive Works. Following the war, he was managing director of the Worthington Pump and Machinery Company interests in Europe, and in 1923, he founded the Brazilian Portland Cement Company in Sao Paulo, Brazil.

Charles H. Jackson, M.E.I.C., formerly production manager of the Ammunition Division of Canadian Industries Limited, has been made manager of the same division.

Lt.-Col. C. R. S. Stein, M.E.I.C., of Halifax, has been appointed officer commanding the Canadian Engineers' training centre, as Adjutant and Quartermaster-General of Military District No. 7, at Saint John, N.B.

A. B. Normandin, M.E.I.C., is the vice-chairman of the new Public Service Board of the Province of Quebec, which was created to replace the Provincial Electricity Board and the Transportation and Communications Board. Mr. Normandin, who is a graduate of Ecole Polytechnique, has been in the service of his province for many years past, having been assistant chief engineer, and more recently, chief engineer of the Hydraulic Service in the Department of Lands and Forests. Mr. Normandin is a past chairman of the Quebec Branch, and was on the Council from 1924 to 1929.

Alex. Larivière, M.E.I.C., is a member of the new Public Service Board of the Province of Quebec. He was previously a member of the Transportation and Communications Board. Mr. Larivière has also been a member and the chief engineer of the former Public Service Commission.

J. W. McCammon, M.E.I.C., is also a member of the recently established Public Service Board of the Province of Quebec. Since 1935, he has been a member of the Quebec Electricity Commission, which was replaced, in 1938, by the Provincial Electricity Board. Mr. McCammon, who is a graduate of McGill University, has been connected with the Beauharnois Light, Heat & Power Company for a number of years, as assistant to the general manager.

C. O. Whitman, M.E.I.C., is now employed with the Beauharnois Light, Heat & Power Company, at Beauharnois, on extension to the plant.

James Breakey, M.E.I.C., who has been, for the last year, in the industrial sales department of Imperial Oil, Limited, in Toronto, has now been transferred to Cobourg, Ont. Mr. Breakey, who was educated at Sheffield University, in England, served his apprenticeship with Metropolitan-Vickers Electrical Company, Limited, at Manchester. From 1925 to 1927, he was erection engineer with the same firm, in England. In 1927, he went with A. Holt & Company, owners of the Blue Funnel Line, and served for two years as sea-going engineer. He came to this country in 1929, as a draughtsman with Canadian Vickers, Limited. A few months later, he became connected with McLean Publishing Company, at Toronto, and remained with them until last year, when he went with Imperial Oil.

W. S. Bowles, M.E.I.C., has accepted a position with Foundation Company of Canada, Limited, at Arvida, Que. A graduate of McGill University in 1930, he became connected with the Lamella Trussless Roof Company, Limited. From 1933 to 1939, he was with the Canadian Stebbins Engineering and Manufacturing Company, Limited, in Montreal, where he was associated in the engineering design work. Lately, Mr. Bowles was engaged in sales engineering with W. S. Tyler Company of Canada, Limited.

F. L. Black, Jr.E.I.C., has accepted a position as assistant to the electrical superintendent in the Belgo mill, of the Consolidated Paper Corporation, at Shawinigan Falls, Que. He was graduated from the Nova Scotia Technical College in 1931, and went with the Maritime Accessories, Limited, at Halifax, N.S. From 1932 to 1935, he was instructor in the engineering department at Mount Allison University, doing, at the same time, consulting work on electrical problems for Enamel & Heating Products, Limited, of Sackville, N.B. In 1935, he became electrical engineer with the New Brunswick Electric Power Commission, and has been engaged, for the last five years, on construction work and design of transmission lines and sub-stations. Mr. Black was the secretary-treasurer of the Saint John Branch of the Institute. In 1936, he won the Martin Murphy Prize of the Institute.

J. F. Lynch, jr.e.i.c., lately of Moncton, N.B., has accepted a position with Canadian Industries, Limited, at Brownsburg, Que. A graduate of the University of New Brunswick, he was, at one time, with the Northern Electric Company, Limited, in Montreal. In recent years, he had been with the Department of Highways of New Brunswick.

VISITORS TO HEADQUARTERS

J. R. Morrison, m.e.i.c., from Glace Bay, N.S., on May 25th.

F. A. Masse, jr.e.i.c., from Sault Ste. Marie, Ont., on May 28th.

Lt. H. L. Cairns, m.e.i.c., from Vancouver, B.C., on May 31st.

Dr. R. W. Boyle, m.e.i.c., director, division of physics and electrical engineering, National Research Council, from Ottawa, Ont., on June 3rd.

K. R. Chestnut, m.e.i.c., field inspection engineer, Maritime Provinces, Department of Munitions and Supply, from Fredericton, N.B., on June 5th.

G. St-Jacques, m.e.i.c., engineer, Provincial Transportation and Communications Board, from Quebec, Que., on June 6th.

E. P. Muntz, m.e.i.c., president of E. P. Muntz, Limited, from Hamilton, Ont., on June 16th.

A. T. E. Wanek, from London, England, on June 18th.

L. M. Hovey, m.e.i.c., of the Winnipeg Electric Company, from Winnipeg, Man., on June 19th.

A. R. Babbitt, m.e.i.c., from Fredericton, N.B., on June 22nd.

E. L. Ball, jr.e.i.c., from Halifax, N.S., on June 22nd.

Obituaries

James Veitch McNab, m.e.i.c., died at Moose Jaw, Sask., on May 11th, 1940. He was born at Ayr, Ont., on June 11th, 1884, and was educated at the University of Toronto, where he was graduated in 1906. Upon graduation, he went with the Canadian Pacific Railway, at Moose Jaw, Sask., as an instrumentman on railroad construction and maintenance. From 1910 to 1915, he was resident engineer, and from 1915 to 1920, roadmaster, at Moose Jaw. He became division engineer in 1920. In 1932, he was appointed district engineer, a position which he held until his death.

Mr. McNab became a Member of the Institute in 1938, as a result of the agreement with the Association of Professional Engineers of Saskatchewan.

Herbert Thomas Routly, m.e.i.c, died in the hospital at Toronto, Ont., on May 24th, 1940. He was born at Lindsay, Ont., on January 20th, 1878, and was educated at the University of Toronto, where he was graduated in civil engineering, in 1906. From 1908 to 1911, he was town engineer at Haileybury, Ont., and later he was engineer for the Township of Coleman. He also carried a private practice as a general land surveyor, and municipal engineer at Haileybury, from 1907 to 1917. He owned a contracting business and did work at different periods in Ontario, Quebec and the State of New York. At one time, he was chief engineer of the Ontario Highways Department.

Mr. Routly joined the Institute as an Associate Member in 1912, and he was transferred to Member in 1922.

Alexander Potter, m.e.i.c., died in Great Barrington, Mass., on June 20th, 1940, after a long illness. He was born at Gibraltar on January 18th, 1866, and he received his education at Lehigh University, where he was graduated in 1890, with the degree of civil engineer. Except for brief periods with the Canadian Pacific Railway, and in the office of the city engineer of Halifax, he had been in private practice as a consulting sanitary and hydraulic engineer, in New York, for almost 50 years. He was associated with water supply projects in Cuba and many parts of the United States. During the Great War he supervised construction of sanitary works in military camps in the United States.

In 1936, he received the honorary degree of Doctor of Engineering from Lehigh University. Dr. Potter, who had written many technical papers, was a member of the American Society of Civil Engineers, the American Association of Engineers and many other professional organizations.

He joined the Institute as an Associate Member in 1893, and was transferred to Member in 1917.

ELECTIONS AND TRANSFERS

At the meeting of Council held on June 15th, 1940, the following elections and transfers were effected:

Members

Clark, Francis W., (Univ. of Toronto), asst. engr., Hydro-Electric Power Commission of Ontario, Toronto, Ont.

Matheson, Armen, b.sc. (Tech.), Manchester University, senior dftsman., Bepco Canada Limited, Montreal, Que.

Johnstone, Robert William, c.e. (Edinburgh Univ.), asst. mgr., Anglin-Norcross Ontario Ltd., Toronto, Ont.

Merriman, Horace Owen, b.a.sc. (Univ. of Toronto), engr. in charge, Interference Section, Dept. of Transport, Ottawa, Ont.

Pinet, Joseph F. Marcel, b.a.sc., c.e. (Ecole Polytechnique, Montreal), div. engr., Quebec Roads Dept., Parliament Bldgs., Quebec, Que.

Telmosse, Paul Godfroi, b.a.sc., c.e. (Ecole Polytechnique, Montreal), res. engr., Shawinigan Water & Power Company, Shawinigan Falls, Que.

Juniors

Baldwin, Oscar Lionel, b.sc. (Civil), (Univ. of N.B.), Albert, N.B.

King, Cameron Norcott, b.sc. (Civil), (Univ. of N.B.), Aluminum Company of Canada Ltd., Montreal, Que.

White, George Augustine, b.eng. (Civil), (N.S. Tech. Coll.), 31 Bentinck St., Sydney, N.S.

White, William Newton, b.sc. (Civil), (Univ. of Sask.), sample boss, Canadian Malartic Gold Mines, Malartic, Que.

Affiliates

Bartlett, Richard Lear, (Univ. of Sheffield), Lieut., No. 2 Army Field Workshop, r.c.o.c., c.a.s.f., Aldershot, England.

Leigh-Mallory, George Edward, (McGill Univ.), auto stamping inspector, General Motors Limited, Oshawa, Ont.

McIntyre, Walter Baker, (Univ. of Man.), field engr., C.N.R., Port Arthur, Ont.

Pollock, Allan, (Queen's Univ.), mine survey office, McIntyre Porcupine Mines, Schumacher, Ont.

Transferred from the class of Student to that of Junior

Brown, Donald Whidden, b.sc. (Mech.), (Queen's Univ.), junior engr., Horton Steel Works Ltd., Fort Erie North, Ont.

Hunt, William Sinclair, b.eng. (Chem.), (McGill Univ.), i/c standard costs and cost estimating, Dominion Rubber Company, Montreal, Que.

Nelson, William Andrew, b.sc. (Queen's Univ.), sales service engr., Bailey Meter Co. Ltd., Montreal, Que.

Students Admitted

Bishop, Percival William, (Univ. of N.B.), Three Hills, Alta.

Dinsmore, Clarence Sherman, (Univ. of Toronto), Clarksburg, Ont.

Laird, Alan Douglas Kenneth, b.a.sc. (Mech.), (Univ. of B.C.), General Delivery, Montreal, Que.

Madill, Floyd Alexander, b.sc. (Civil), (Univ. of Alta.), 10039-107th St., Edmonton, Alta.

Peck, Robert Cartwright, b.sc. (Civil), (Univ. of Alta), 11128-86th Ave., Edmonton, Alta.

Potter, Edward Bullivant, b.a.sc. (Chem.), (Univ. of Toronto), 18 Yates St., St. Catharines, Ont.

Sandberg, John Warren, (McGill Univ.), 256 Waterloo St., Winnipeg, Man.

Staniforth, Harold Fassett, b.eng. (McGill Univ.), 715 Grosvenor Ave., Westmount, Que.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

BORDER CITIES BRANCH

H. L. Johnston, m.e.i.c. - *Secretary-Treasurer*
A. H. Pask, Jr.e.i.c. - - *Branch News Editor*

On May 11, 1940, the Border Cities Branch was honoured with the presence of the councils of the Engineering Institute of Canada and the Association of Professional Engineers of the Province of Ontario. In the morning, councils of both organizations met, and in the afternoon, there was a joint inspection trip of the tower department of the Canadian Bridge Company and of the power plant of the Ford Motor Company of Canada.

At 7.00 p.m., a joint dinner meeting was held in the Prince Edward Hotel. Among those at the head table, were Dr. T. H. Hogg, president, e.i.c.; Mr. E. P. Muntz, vice-president, e.i.c.; Mr. J. W. Parker, vice-president, a.s.m.e., and president of the Engineering Society of Detroit; Mr. J. E. Porter; Mr. Alexander Grant, past president, e.i.c.; Mr. W. G. Knickerbocker, chairman of the Detroit Section a.i.e.e.; Mr. L. Austin Wright, general secretary, e.i.c.; Mr. J. F. Bridge, chairman of the Border Cities Branch of the e.i.c.; Mr. S. J. McGorman; Mr. J. W. Rawlins, president a.p.e.o.; Mr. J. Clark Keith, vice-president, e.i.c.; Mr. M. DuBose, vice-president e.i.c.; Mr. J. F. Pringle; Dr. J. B. Challies, past president, e.i.c; Mr. M. Barry Watson, registrar, a.p.e.o.; Mr. G. E. Medlar; Mr. B. W. Beyer, chairman, Detroit Chapter a.s.m.e.; and Mr. C. M. Goodrich.

Following the dinner, after the toast to the king and the president of the United States, Mr. T. H. Jenkins as toastmaster, welcomed the Professional Engineers and the E.I.C. to Windsor and introduced the guests. Then, Mr. J. Clark Keith proposed a toast to the professional engineers. He traced the development of engineering societies in Canada and dwelt on the necessity of legislation to set the profession apart. Mr. W. J. Rawlins responded and expressed his pleasure at being in Windsor. He paid tribute to the E.I.C. for its work in aiding the start of this Association and outlined the history and aims of the professional body.

Mr. E. P. Muntz saluted the founder societies of the U.S.A. and Great Britain and spoke of the necessity of the technical societies. He proposed a toast to these. The response was given by Mr. J. W. Parker who tendered the good wishes of the Detroit Society in that it represented fifteen chapters of engineering societies. He remarked on the closeness of the point of view of the Canadian and U.S. societies, expressed the belief that the intellectual and moral common interests will exist forever.

Dr. T. H. Hogg also responded and stated agreement with Mr. Rawlins in the aims of the professional association. He thanked Dr. Challies for the suggestion of the joint meeting of the two councils which should be an annual event. The first was held last year in Toronto. Dr. Hogg expressed his personal appreciation to Mr. Grant for attending this meeting and to local members for the way the meeting had been carried out.

Mr. Alexander Grant then in a few words said how glad he was to be at this meeting.

Appreciation to the president of the E.I.C. was expressed by Mr. F. H. Kester, after which Mr. J. Clark Keith presented Dr. Hogg with a bronze plaque of the E.I.C. crest engraved.

Mr. J. B. Porter, with a few words on the importance of engineering societies, expressed appreciation for the presence of the president of the Association of Professional Engineers.

Mr. J. Clark Keith then presented Mr. Rawlins with a silver mounted gavel engraved.

Mr. Jenkins expressed the thanks of the Border Cities Branch, after which the meeting adjourned.

CALGARY BRANCH

F. J. Heuperman, m.e.i.c. - *Secretary-Treasurer*
G. W. O'Neill, m.e.i.c. - *Branch News Editor*

A special meeting of the Calgary Branch was held at the Palliser Hotel on May 14 to take advantage of the opportunity of having as guest speaker Prof. W. G. Worcester of the University of Saskatchewan. Prof. Worcester, who is head of the Department of Ceramics at Saskatchewan University, spoke on **Ceramics and Ceramic Engineering.** The speaker was unusually well qualified to discuss this subject since he has been associated with ceramic engineering from the earliest days of its inclusion in university curricula.

The paper outlined the importance of ceramics in the industry of North America and explained that the work of the ceramic engineer is essentially to process non-metallics or "industrial minerals" at elevated temperatures. His field embraces a wide range of manufactured products from glass, pottery and structural materials to abrasives, enamel surfaces and insulation products.

A brief description was given of the Saskatchewan course of studies and statistics were presented to show how completely Saskatchewan students have been absorbed by the industry.

Prof. Worcester then presented a description of certain technical aspects of the subject such as the classification of clays, and the examination of clay deposits together with the technique of sampling and methods of testing clay samples. Absorption, shrinkage, loading, spalling and rattler tests were described and illustrated by means of slides.

The speaker concluded by showing a number of slides of clay deposits in Alberta and Saskatchewan. The very lively discussion which followed indicated how much the paper had been appreciated.

A joint luncheon meeting of the Calgary Kiwanis Club and the Calgary Branch of the Institute was held at the Palliser Hotel on June 10. The speaker was Prof. Robert F. Leggett of the Department of Civil Engineering of the University of Toronto.

Prof. Legget spoke on **Conservation in Canada,** referring particularly to forests and water resources. In describing the urgent necessity for conservation measures he cited several examples of areas in Canada, which in a relatively few years, because of indiscriminate cutting of native timber, have experienced the resultant difficulties of depleted forests, declining stream flow and even soil erosion. On the other hand the speaker referred to classic examples in Europe of communities which, through proper conservation measures, have used for hundreds of years the same wood lot without depleting the timber supply.

It was suggested that in spite of the fact that Canada is at war it is not too early to think of the future when two serious problems might be solved at the same time by devoting the energies of the otherwise unemployed to a conservation programme. A hopeful sign in this connection was in the recent formation of the Canadian Conservation Council.

HAMILTON BRANCH

A. R. Hannaford, m.e.i.c. - *Secretary-Treasurer*
W. E. Brown, Jr.,e.i.c. - - *Branch News Editor*

A joint meeting of the Branch and the Hamilton Chapter, Ontario Association of Architects, was held at McMaster University on the evening of May 16th.

The chairman, Geo. T. Evans, m.r.a.i.c., president of the local Chapter of Architects, welcomed the members of the

Institute and guests, including several insulation technicians from London, Kitchener and Toronto and representatives of the building trades.

Mr. Evans then introduced the speaker, Mr. W. W. Cullen, chief engineer of insulation, H. W. Johns-Manville Company Limited, New York, whose subject was **Insulation and Condensation in Building.**

The speaker said that so rapid was the expansion of the industry of insulation material that frequently it was applied before all the problems coincident with it were fully realized. Condensation was one of these problems. All building materials have the ability to carry and transfer water vapour. In old buildings the atmosphere in the room, the walls and the outside atmosphere were in balance and little condensation was present. But under certain conditions, the introduction of insulation in the building might upset the balance so that condensation would take place.

Of many important points brought out by the speaker, one which he stressed as of most interest to the average layman was that with an insulated house, great care must be exercised in the use of humidification. He stated that in the plastering of the average home, upwards of 3,000 lbs. of water was introduced and that it would be at least six months before the plaster became thoroughly dry. If, in the meantime, additional moisture were introduced in the form of any of the methods of humidification, there would occur excessive condensation behind the plastered walls or in the attic spaces, to the detriment of plaster and decorations.

The speaker also made a remark that caused considerable surprise to the effect that high medical authorities in United States are not so certain of the supposed benefits of humidification in homes and offices as some advocates would imply. Intensive research is in progress on this subject and more will be heard later.

Mr. Cullen predicted a radical change in the methods of heating. He foresaw the day, in the not distant future, when the present methods of heating by means of radiators or warm ducts would be replaced by heating coil concealed in the walls of a building.

At the conclusion of the address, a question and answer period followed.

A vote of thanks to the speaker was proposed by Alex. Love, chairman, Hamilton Branch.

MONTREAL BRANCH GOLF TOURNAMENT

Huet Massue, E. A. Ryan, H. J. Vennes, the winner

MONCTON BRANCH

V. C. Blackett, m.e.i.c. - *Secretary-Treasurer*

Annual Meeting

The annual meeting of the branch was held on May 31st. The chairman, F. O. Condon, presided. The annual report and financial statement, which was presented, showed an improvement in the branch finances over the preceding year and also the addition of several new members. The officers chosen to act for the year 1940-41 were announced.

Five meetings of the Executive were held during the year. Two meetings of the branch were held as follows. On December 15, 1939, a complimentary dinner was tendered Dean H. W. McKiel, president of The Engineering Institute of Canada. President McKiel spoke on **The Responsibilities and Future of the Engineering Profession.** On May 13, 1940, a meeting was held for the purpose of nominating branch officers for the year 1940-41.

Our membership at present numbers 47.

It is with regret that we record the passing of Branch Affiliate E. A. Cummings, whose death occurred on October 29, 1939.

MONTREAL BRANCH

L. A. Duchastel, m.e.i.c. - *Secretary-Treasurer*

On Tuesday, June 4th, 1940, members of the Montreal Branch met at the Senneville Country Club and held the first of what is hoped to be an annual golf tournament of the branch. The turn of events in Europe was responsible for the rather poor attendance; however, members who were able to join the tournament enjoyed the game under perfect weather conditions and ideal surroundings.

Following the tournament, a dinner was held in the clubhouse. Other members who were unable to play during the afternoon attended the dinner, at which time prizes were presented.

The chairman of the branch, Mr. H. J. Vennes, won low gross honours and low net went to Mr. I. S. Patterson. Other winners were: low gross first nine, M. Gérin; low gross second nine, J. R. Dupuis; low net first nine, W. L. Yack; low net second nine, E. V. Gage; largest number of pars, E. R. Smallhorn. In addition, several minor prizes were distributed for sealed holes, highest gross, etc.

I. S. Patterson, R. E. Heartz, E. V. Gage, E. R. Smallhorn

L. Trudel, L. A. Duchastel, L. Brossard, M. Laflamme

NIAGARA PENINSULA BRANCH

J. H. Ings, M.E.I.C. - - *Secretary-Treasurer*
J. L. McDougall, M.E.I.C. - *Branch News Editor*

The annual dinner meeting of the Niagara Peninsula Branch was held on May 20th, 1940, at the General Brock Hotel, Niagara Falls, Ontario. The chief guest and speaker of the evening was Dr. T. H. Hogg, president of the Institute.

Chairman of the meeting was A. W. F. McQueen. Sixty-three members and guests attended and letters of regret were read from officers of near-by branches and from Vice-President Keith, who were unable to be present. Members and guests at the head table were introduced, among whom were Vice-President E. P. Muntz, Alexander Love, and W. L. McFaul, chairman and councillor, respectively, for the Hamilton Branch.

The retiring branch secretary, George Griffiths, read the branch report for the past year. Mr. McQueen then introduced the members of the branch executive for the ensuing year.

In a short address, the new vice-president for Ontario, Mr. E. P. Muntz, dealt with the present problems of relationship between the several provincial professional engineering associations and the E.I.C. in an attempt, as he aptly remarked, "to put engineering under one roof."

Introduced by Mr. McQueen, Dr. Hogg gave a few personal reminiscences of his engineering experiences in the district, and then went on to explain at some length the functioning and problems of several of the more important E.I.C. committees. Dr. Hogg's remarks were greatly appreciated.

On behalf of the branch members, Walter Jackson moved a vote of thanks to the retiring executive committee.

To close the evening, a color film entitled "The History of Power in Canada," was shown through the courtesy of the Canadian Geographic Society. This film depicts man's quest for various sources of energy, the ingenious primitive mechanisms devised or produced by the pioneers of this country and their development to the extremely efficient prime movers in use today.

VANCOUVER BRANCH

J. V. Berry, M.E.I.C. - - *Secretary-Treasurer*
Archie Peebles, M.E.I.C. - *Branch News Editor*

On Monday, May 27, the Vancouver Branch met in the York Room of the Hotel Georgia to listen to an address on **The White River Flood Control Project and Mud Mountain Dam.** Guests at the meeting were members of the Association of Professional Engineers of B.C., and of the Engineering Bureau of the Vancouver Board of Trade. About 100 members and guests were present. A vote of thanks was tendered by Major J. R. Grant.

The speakers were Lieut.-Col. Layson E. Atkins, district engineer, U.S. Army (Seattle District), and Captain Arthur G. Trudeau, chief of Construction Division. They were introduced to the audience by C. E. Webb, branch chairman, who presided over the meeting.

In a short introductory address, Col. Atkins outlined the engineering work carried on by the Corps of Engineers of the U.S. Army. He stated that West Point Military Academy was originally founded in 1802 as an engineering college, and functioned as such for a number of years, before becoming a school of military training.

Work of a protective nature on rivers, harbours, and coastal waters has been done by army engineers in the United States for many years. More recently, the Corps had constructed flood control works in various parts of the country as part of a federal government scheme of public works. At present, about one-third of the personnel is engaged in civil work, and two-thirds in the usual military programme. The speaker also explained the administrative procedure by which a project is started under the supervision of the Corps of Engineers, including the preliminary investigations and appraisal of the economic value of the scheme by the federal government. In some cases, actual construction is done under contract by private firms, as in the White river project. Portions of the work as well as all design and supervision is performed by the staff of the Corps of Engineers.

Following Col. Atkins' introduction, Capt. Trudeau, in the principal address, described in detail the White river flood control project and the proposed dam being built to control flood waters which have in the past caused severe damage to agricultural lands and industrial property in the vicinity of Tacoma, Wash. The White river rises on the slopes of Mount Rainier to the southeast of Tacoma, and is joined by two other streams before discharging into Puget Sound near that city. Previous improvements to the river channel near its mouth, made by adjacent counties, proved inadequate in the 1933 flood which caused damage estimated at $951,000. The possibility of similar or worse conditions serves to justify the estimated cost of control of five and one-half million dollars.

The most striking feature of this project, vividly portrayed by about 80 lantern slides accompanying the address, is the ruggedness of the site. This is formed by a narrow box canyon with vertical rock cliffs about 230 ft. in height. The canyon is 90 ft. wide at the river bed and 150 ft. wide at the top of the rock walls. Above bedrock the banks consist of glacial till, some of which may be suitable for the embankment of the dam. This site appeared to lend itself perfectly to the use of a concrete arch or gravity dam, but exploration soon disclosed that the rock was badly faulted and shattered, and quite useless as a foundation for a concrete structure. The dam as designed is outstanding because it will be the highest rolled earth fill dam ever constructed. It will be 425 ft. high, from bedrock to the 50 ft. wide top.

To prevent any possibility of water overtopping the dam, a spillway with a designed discharge nearly five times the largest flow ever recorded in White river will be provided. Ordinarily the reservoir will be empty, but during a flood the water will be held in the reservoir and released slowly through the outlet works. Two tunnels, one 23 ft. in diameter and the other 9 ft., will be constructed to by-pass the river around the dam. During construction the river will be diverted through the larger tunnel, which will be 2,000 ft. long. It will be lined with concrete and fitted with plugs, penstocks and three 96 in. valves to control the flow of the river after completion of the project. These valves will be the largest of their type ever used. The smaller tunnel, which will be unregulated, will handle the normal flow. The reservoir created by the completed project will have a storage capacity of approximately 130,000 acre-feet when the water is at the spillway crest level. The area covered by this lake will be about 1,200 acres, and its length 5½ miles.

Some further data on the project are as follows·

Drainage area....................	402 sq. miles
Elevation above sea level—top of dam..........................	1,250 ft.
Lowest elevation of bedrock.......	825 ft.
Maximum flood on record (1933)...	28,000 cu. ft. per sec.
Spillway design capacity..........	139,000 " "
Outlet capacity..................	16,000 " "
Length at crest (excluding spillway)	700 ft.
Width at crest...................	50 ft.
Width at base....................	2,200 ft.
Volume of compacted fill..........	3,000,000 cu. yds.
Concrete in project...............	50,000 cu. yds.

Library Notes

Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

SOME DEVELOPMENTS IN ALLOYS DURING THE LAST TWENTY YEARS

The paper presented at the Annual Meeting of the Institute last February by Mr. O. W. Ellis of the Ontario Research Foundation, on the subject of "Some Developments in Alloys During the Last Twenty Years," is now available as a technical supplement to *The Engineering Journal*.

The discussions contributed by experts in the field of metallurgy are published along with the paper as well as the author's reply.

"Too frequently one must search laboriously not one, but several heavy books in order to arrive at the information that Mr. Ellis has so intelligently set forth" — A. E. Cartwright, Metallurgist, The Robert Mitchell Company, Limited, Montreal.

"Mr. Ellis' paper is packed with so much interesting data that it would be difficult to add even a little to the abundant store of useful information which he has assembled. We are indebted to him for his excellent treatment of so complex a subject."—A. B. Dove, Chemical Engineer, Steel Company of Canada, Limited, Montreal.

The paper is illustrated and is published in the form of a stitched booklet, 8¾ by 11¾ in. A review, prepared by the author, appears in the July issue of *The Engineering Journal*.

The supplement is available at the Engineering Institute of Canada, 2050 Mansfield Street, Montreal. The price is $0.75 per copy, with special prices in lots of ten or more. The single copy price to members of the Institute is $0.50.

BOOK REVIEW

FUEL BURNING AND STEAM GENERATION

By Otto de Lorenzi, Montreal, Combustion Engineering Corporation, Limited, c. 1939, 265 pp. 8¾ by 11¼ in., $3.25.

Reviewed by H. H. ANGUS, M.E.I.C.*

This book covers, in a practical manner, the historical background of design developments, and at the same time deals quite fully with the different types of apparatus used. It is profusely illustrated and the text contains comparatively few mathematical formulae, so it can be easily read by anyone generally familiar with the subject. It is not intended as a theoretical treatise but instead contains descriptions and illustrations of different types of fuel burning and steam generating equipment and sufficient discussion so that the engineer may be guided in selecting the proper type of equipment for any specific installation.

The writer devotes a chapter to each of the different types of stokers and pulverized fuel equipment as well as equipment for burning oil and gas. In addition, there are chapters devoted to superheaters and economizers and other similar equipment. Considerable space is devoted to methods of operating different pieces of equipment in order to secure efficiency.

The last chapter contains curves and tables to simplify the work of those in charge when calculating efficiency, fuel costs and other items of interest.

The book is intended for use by executives and engineers and as such is quite complete, and the illustrations and descriptions are not confined to the products of the publishers.

Consulting Engineer, 1221 Bay St., Toronto 5, Ontario.

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

Buildings:

By H. C. Turner, N.Y. Turner Construction Company, 1939. 82 pp., 12 by 9½ in.

REPORTS

Alberta—Department of Lands and Mines:

Annual Report for year ended March 31st, 1939, Edmonton, 1940.

American Institute of Mining and Metallurgical Engineers:

Directory Section, May, 1940.

Asphalt Institute—Information Series:

Flexible Pavements by Bernard E. Gray, No. 36, Washington, December 5, 1939.

Association of Ontario Land Surveyors:

Annual Report, 1940.

Bell Telephone System:

Application of Negative Feedback to Frequency-Modulation Systems; Dielectric Properties of Insulating Materials—111; Fractional-frequency Generators Utilizing Regenerative Studies; Remaking Speech; Decamethylene Series of Polyesters; Numerical Calculations of the Reflection of Electrons by Metals; Solar Cycle and the Region of the Ionosphere; Molecular Weight of Sol and Gel in Crude Hevea Rubber; Metallic Materials in the Telephone System; Geometric Aspects of Relativistic Dynamics; Identification of Aluminum Hydrate Films; Characteristics of Certain Types of Noise; Thermocouple and Fluxmeter; Thallous Sulphide Photo-E.M.F. Cell; Physical Basis of Ferromagnetism; New Standard Volume Indicator and Reference Level; Contact Phenomena in Telephone Switching Circuits; Low Temperature Coefficient Quartz Crystals; Effect of Quadrature Component in Single Sideband Transmission; Auditory Patterns; Statistical Measurements on Conversational Speech; Lodgepole Pine Poles; Auditory Significance of the Term Hearing Loss; Molecular Rotation in the Crystals of Certain Benzene Derivatives; Oxidation of Vulcanized Rubber.

Canada Department of Mines and Resources:

Report of Mines and Geology Branch for year ended March 31st, 1939, Ottawa, 1940.

Canada Department of Mines and Resources—Mines and Geology Branch:

Investigations in Ore Dressing and Metallurgy, July to December, 1938, Ottawa, 1940.

Canada Department of Mines and Resources—Mines and Geology Branch—Geological Survey—Memoirs:

Halfway Lake-Beresford Lake Area, Manitoba by C. H. Stockwell and C. S. Lord, Memoir 219; Mining Industry of Yukon, 1938, by H. S. Bostock, Memoir 220.

Electrochemical Society:

An Electrolytic Chromium Plate Thickness Tester; The Electro-galvanizing of Wire; Electrolyete Films in Acid Copper Plating Baths, Preprints 78-1 to 78-3.

National Harbours Board:

Annual Report for year 1939, Ottawa, 1940.

Province of Ontario:

Mineral Production of Ontario for first three months 1940. Bulletin No. 127.

Province of Quebec—Department of Mines:

Mining Industry and Statistics of the Province of Quebec for year 1938. Quebec, 1939.

U.S.Department of Commerce—National Bureau of Standards:

Building Materials and Structures BMS44, Surface Treatment of Steel Prior to Painting.

U.S. Department of the Interior—Bureau of Mines:

Metal-Mining Practice—Bulletin 419; Joseph A. Holmes Safety Association and Its Awards—Bulletin 421.

U.S. Department of the Interior—Bureau of Mines—Technical Papers:

Safety Factors in Construction and Ventilation, Wawona Vehicular Tunnel, Yosemite National Park, California, by S. H. Ash; Coke-Oven Accidents in the United States during the year 1938 by W. W. Adams and V. E. Wrenn. Technical Papers 608 and 614.

Universal Oil Products Company:

Use of U.O.P. Inhibitors; Universal Leads another "Revolution" in Refining. Nos. 224 and 240.

University of Minnesota—Engineering Experiment Station:

Methods of Moisture Control and Their Application to Building Construction by Frank B. Rowley, Axel B. Algren, and Clarence E. Lund—Bulletin No. 17.

Winnipeg Hydro-Electric System:

Annual Report, December 31, 1939.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at Headquarters, or may be sent direct to the publishers.

AEROSPHERE, 1939, including World's Aircraft Engines with Aircraft Directory

Edited by G. D. Angle, Aircraft Publications, New York, 1940. 1,420 pp., illus., diagrs., tables, 12 x 8½ in., cloth, $15.00.

This unusually comprehensive work is the first edition of a publication which is to appear annually. The first section is devoted to full descriptions of the world's aircraft engines of all time, alphabetically arranged. In the second section appear the construction, performance, etc., of all current types of aircraft. Statistics, records and other useful data are included in the third section. The fourth section consists of two parts: the first lists for each country the firms and organizations engaged in aircraft activities; the second arranges by product, under each country, the firms previously listed. Some two thousand photographs and cross-sections illustrate the descriptive material.

AIRCRAFT MAINTENANCE

By D. J. Brimm and H. E. Boggess. Pitman Publishing Corp., New York and Chicago, 1940. 492 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $2.50.

This is a thoroughly revised edition of "Airplane and Engine Maintenance," from which the maintenance of engines has been omitted and space formerly devoted to that subject has been used for additional matter on the airplane itself. The book is designed for use by airplane mechanics as a text for home study or use in secondary schools, and for reference purposes. It presents a practical course, covering wood work, metal work, fabric work, rigging, handling and maintenance. The various jobs to be done are set forth, with detailed directions for doing them.

AIRPLANE DESIGN

By K. D. Wood. 4th ed., published by the author at Purdue University, Lafayette, Indiana; distributed by Cornell Co-Op. Society, Ithaca, N.Y., 1939. Chapters paged separately, illus., diagrs., charts, tables, 11 x 8½ in., mimeographed, stiff paper, $4.00.

This book aims to show how an airplane can be designed. The following topics are covered: layout; load factors; materials and construction; costs; the design of wings, control surfaces, landing gear, the fuselage, hulls and floats, including stress analysis; drafting procedure; and detail design. A large appendix contains most of the data necessary to carry a design project through its preliminary stages. This is the fourth of frequent editions which have kept up with a rapidly changing industry

APPLIED MECHANICS

By A. P. Poorman. 4th ed. McGraw-Hill Book Co., New York, 1940. 354 pp., diags., charts, tables, 9½ x 6 in., cloth, $2.75.

In the new edition of this standard textbook certain material has been rearranged for purposes of simplicity or better continuity, and some new material has been added on moment of inertia of mass. The data of all problems have been made new, and many problems have been added, all the numerical answers being given as before. The subject matter covers both statics and dynamics.

BIBLIOGRAPHY ON INDUSTRIAL RADIOGRAPHY, including Addenda I —April, 1940. Document 1139

By H. R. Isenburger. American Documentation Institute, 2101 Constitution Ave., Washington, D.C., photographic copies, 8 x 6 in.. paper, $10.70.

This bibliography contains references to over two hundred articles on the industrial uses of radiography. The list supplements the bibliography published in St. John and Isenburger's "Industrial Radiography" and consists of articles published since its appearance in 1934, with a few omitted from the book. It covers the literature to April, 1940.

BRICK ENGINEERING, Handbook of Design

By H. C. Plummer and L. J. Reardon. Structural Clay Products Institute, Washington, D.C., 1939. 400 pp., illus., diagrs., charts, tables, 9 x 6 in., fabrikoid, $4.00.

This is the first complete book to come to our attention on the design and construction of brick masonry. The properties of brick, mortar and brick masonry are discussed thoroughly. Many types of structures are treated in both plain and reinforced brick masonry, this latter subject having received special treatment. There are numerous charts and tables for the design of reinforced brick masonry structures. The appendix contains tables for estimating quantities of masonry materials, standard specifications, bibliography, glossary of terms, etc.

CONVERSION OF PETROLEUM, Production of Motor Fuels by Thermal and Catalytic Processes

By A. N. Sachanen. Reinhold Publishing Corp., New York, 1940. 413 pp., diagrs., charts, tables, 9 x 6 in., cloth, $6.00.

The most important works relating to the fundamental principles and practices of converting petroleum products into gasoline and other fuels are surveyed and discussed critically. The theories and processes of thermal and catalytic cracking, hydrogenation, polymerization and alkylation are considered, including a large chapter on cracking equipment. The properties and treatment of cracked gasolines and other cracked products are given. The patent literature is not evaluated.

COSMIC RAYS

By R. A. Millikan. Macmillan Co., New York; University Press, Cambridge, England, 1939. 134 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $2.50.

Three lectures delivered in 1936 and 1937 by Dr. Millikan are here presented in revised form. The first is on "the discovery of cosmic rays and its general significance." The second, "superpower particles," deals with the experimental technique for investigating them, and is illustrated by cloud-chamber photographs. The third describes investigations of the "earth's magnetic field and cosmic-ray energies."

DESIGN OF ELECTRICAL APPARATUS

By J. H. Kuhlmann. 2 ed. John Wiley & Sons, New York, 1940. 506 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $5.00.

Practical methods of design are given for the direct-current machine, synchronous machine, induction motor and transformer. Complete explanations of the construction, procedure, formulae and limits of design are given. There are complete sample calculations for several pieces of electrical apparatus, and various graphs and tables of useful data are appended.

DICTIONARY OF METALS AND THEIR ALLOYS, Their Composition and Characteristics

Edited by F. J. Camm. Chemical Publishing Co., New York, 1940. 245 pp., tables, 9 x 5½ in., cloth, $3.00.

The principal facts concerning metals and commercial alloys, their composition, properties, uses, etc., are presented in an alphabetical arrangement with a selection of general metallurgical terms. There are also brief special sections on hardening, case-hardening and tempering, electroplating, polishing, chemical coloring, metal spraying, rustproofing, and useful tables.

ECONOMICS OF TRANSPORTATION IN AMERICA

By K. T. Healy. Ronald Press Co., New York, 1940. 575 pp., maps, charts, tables, 9½ x 6 in., cloth, $4.00.

From a survey of the large amount of economic data available concerning transportation, the author presents a study of economic forces and motives, and the reasons for economic phenomena in this field. Following an historical introduction come an analysis of demands for transportation and a résumé of the construction and development of transportation facilities. The functioning of these facilities and their regulation by government action are considered in detail. A brief supplementary bibliography and a list of railroad histories are appended.

ELECTRODYNAMICS

By L. Page and N. I. Adams. D. Van Nostrand Co., New York, 1940. 506 pp., diagrs., tables, 9½ x 6 in., cloth, $6.50.

The theoretical aspects of electrodynamics are treated in an advanced manner, covering the electromagnetic field, energy, stress, momentum, wave motion, radiation, three-dimensional and four-dimensional vector analysis, and the principle of relativity. Electrostatics and magnetostatics are generally omitted, and no attempt has been made to include quantum electrodynamics.

ELEMENTS OF ACOUSTICAL ENGINEERING

By H. F. Olson, D. Van Nostrand Co., New York, 1940. 344 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $6.00.

This book is an exposition of the fundamental principles used in modern acoustics as applied to communication, sound reproduction and architecture, with a description of existing acoustical instruments. Particular efforts have been directed towards the development of analogies between electrical, mechanical and acoustical systems. Measurements and testing procedures are discussed and a chapter is devoted to speech, music and hearing.

EROSIONAL TOPOGRAPHY AND EROSION, a Mathematical Treatment

By J. M. Little. A. Carlisle & Co., San Francisco, Calif., 1940. 104 pp., diagrs., charts, tables, 9½ x 6 in., cloth, $2.50.

The variables of hydraulics and hydrology, which contribute to the erosional effects of both sheet and channel runoff, are co-ordinated in this brief mathematical treatise. Data tables are included for practical application, and various specific calculations are developed in appendices.

FLIGHT WITHOUT POWER

By L. B. Barringer. Pitman Publishing Corp., New York and Chicago, 1940. 251 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $3.50.

Gliding and soaring are comprehensively covered by various authorities. Following a brief historical summary comes an exposition of the aerodynamics of motorless flight. The design, construction and maintenance of gliders, launching and soaring technique, meteorology and instruments are discussed. There are chapters on flight training and soaring sites. A brief bibliography and a glossary are included.

GENERAL AERONAUTICS

By H. F. Lusk. Rev. ed. Ronald Press Co., New York, 1940. 524 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $3.75.

All phases of the aviation industry are covered in this general textbook: the principles of aircraft flight; the construction and operation of airplanes; aircraft propellers; principles, construction and operation of aircraft engines; instruments and safety appliances; navigation methods; and aeronautical meteorology. The opening chapter describes occupations in the industry and questions and problems accompany each chapter.

HANDBOOK OF MICA

By R. R. Chowdbury. Thacker, Spink & Co., Calcutta; W. Thacker & Co., London, 1939. 344 pp., illus., diagrs., charts, maps, tables, 9 x 5½ in., cloth, 15 rupees or 22s. 6d.

This manual affords a comprehensive review of the mica industry as carried on throughout the world. The geology, characteristics and composition of micas, production methods, occurrence and distribution of mica deposits, commercial preparation of block, split and ground mica, the industrial utilization of mica and its products, and marketing technique are described. Statistical data are appended. The book is primarily for the Indian mica producer, but will be of interest generally to those in the industry.

INDEX TO THE LITERATURE OF FOOD INVESTIGATION, Vol. 11, Nos. 1-3, June, Sept., Dec., 1939-1940

Great Britain, Scientific and Industrial Research Dept., London. 304 pp., 10 x 6 in., paper, 4s. 6d. each (obtainable from British Library of Information, 50 Rockefeller Plaza, New York, $1.35 each).

The Index provides abstracts of the literature upon properties, preservation and investigation of meat, fish, eggs, dairy and grain products, fruits and vegetables, and edible fats and oils. Special attention is given to canning and cold storage, and the engineering problems involved. The index covers the major periodicals of the whole world.

IRON AND STEEL TO-DAY. (The Pageant of Progress)

By J. Dearden. Oxford University Press, New York and Toronto, 1939. 190 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, $1.75.

A simple, interesting account of the various processes used in the production of iron and steel products, with explanations of the reactions and reasons involved. The blast furnace, iron foundry, Bessemer converter, open-hearth and electric furnace are described. Casting, working, testing, heat treatment, and various grades of steel are explained. The book is one of a series on technical subjects by recognized English authorities.

MACHINE DESIGN DRAWING ROOM PROBLEMS

By C. D. Albert. 3 ed. John Wiley & Sons, New York; Chapman & Hall, London, 1940. 441 pp., diagrs., charts, tables, 9½ x 6 in., cloth, $3.50.

The basic idea of this text is that complete, comprehensive problems of machine design are preferable to those that deal with unrelated details or groups of details. The course here presented offers thirteen chapters of problems of a comprehensive nature. In addition several chapters of reference information on stresses, gears, tolerances, etc., are given.

MACHINE SHOP TRAINING COURSE, 2 Vols.

By F. D. Jones. Industrial Press, New York, 1940. Illus., diagrs., charts, tables, 9½ x 6 in., cloth, Vol. 1, 474 pp.; Vol. 2, 552 pp. $4.00 each vol. if purchased separately; $6.00 for Vols. 1 and 2 together.

This treatise on machine-shop practice is especially designed for use as a text in manufacturing plants and vocational schools. It covers the fundamental principles, methods of adjusting and using different types of machine tools, measuring instruments and gages, screw-thread cutting, thread grinding, gear cutting and precision toolmaking methods. The chapter subheadings are in the form of questions which are answered in a practical manner with typical examples. There is a large glossary with full definitions.

MAGIC MOTORWAYS

By N. Bel Geddes. Random House, Inc., 20 East 57th St., New York, 1940. 297 pp., illus., maps, 11 x 8 in., cloth, $3.50.

One of America's foremost designers explains what is wrong with highways, highway systems, and traffic management. He then presents a detailed plan for a new system of national motorways, incorporating in it a number of radical departures from present practice. The book is profusely illustrated with diagrams and photographs, including many of the Futurama designed by the author for the World's Fair exhibit of the General Motors Company.

MODERN STEELS, Manufacture, Inspection, Treatment and Uses

Edited by E. E. Thum. American Society for Metals, Cleveland, Ohio, 1939. 374 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.50.

This volume contains the substance of a series of thirteen lectures delivered before the Pittsburgh chapter of the American Society for Metals. The topics discussed include the raw materials, the production of pig iron, the steel-making process, steel pouring, hot rolling and forging, inspection and testing, metallography, heat treatment, and alloy, stainless and tool steels. The lectures are designed as practical introductions to these subjects, and are accompanied by exercises and suggestions for further reading.

NATIONAL RESEARCH COUNCIL COMMITTEE ON CATALYSIS, Twelfth Report

John Wiley & Sons, New York, 1940. 388 pp., diagrs., charts, tables, 9½ x 6 in., cloth, $5.00.

The state of progress in the various fields of catalytic research is discussed by authorities in the respective fields. The literature on the subject for 1935, 1936 and 1937 has been comprehensively covered from a critical viewpoint, with some reference to 1938 material, and bibliographies accompany each topic treated. There are also critical reviews of fifteen books on catalysis which have appeared from 1936 to 1939.

PLASTICS IN ENGINEERING (Machine Design Series)

By J. Delmonte. Penton Publishing Co., Cleveland, Ohio, 1940. 616 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $7.50.

This work is intended for the machine designer and manufacturer, rather than the chemist, and it aims to present the data needed by designers in convenient form for reference. The opening chapters review the various types of plastics, methods of compounding, and physical and chemical properties. Succeeding chapters discuss methods of molding, uses for bearings, gear and other machine parts, engineering applications of plastics, fabrication and finishing of plastic parts, common failures, etc. A chapter is devoted to synthetic rubbers.

PRACTICAL PETROLEUM ENGINEERS' HANDBOOK

By J. Zaba and W. T. Doherty. 2 ed., rev. and enl., Gulf Publishing Co., Houston, Texas, 1939. 492 pp., illus., diagrs., charts, tables, 9 x 5½ in., lea., $5.00.

This work is intended to provide a collection of information constantly wanted by those in the petroleum industry, in convenient form for quick reference. So far as possible, the data are presented in charts, tables, formulas, etc., only such textual material being included as is necessary to explain theoretical questions and practical operations. The contents include data upon general engineering matters, steam production, power transmission, drilling, oil production and pipe-line transportation.

PRINTING INKS, Their Chemistry and Technology

By C. Ellis. Reinhold Publishing Corp., New York, 1940. 560 pp., illus., diags., charts, tables, 9½ x 6 in., cloth, $7.00.

This monograph is a welcome addition to the limited library on its subject. It provides an unusually comprehensive review of our knowledge of the chemistry of these inks, their manufacture and use, accompanied by an exhaustive bibliography of books, articles and patents. The book can not be neglected by any inkmaker or printer.

PUBLIC AIDS TO TRANSPORTATION

4 Vols. Published by Federal Co-ordinator of Transportation, for sale by Government Printing Office, Washington, D.C., 1940. Charts, tables, 11½ x 9., paper, Vol. 1, 171 pp.; Vol. 2, 316 pp.; Vol. 3, 330 pp.; Vol. 4, 317 pp., available only in sets $2.40 per set, 4 Vols.

These reports present the results of an investigation begun by the Federal Co-ordinator of Transportation and completed after that office ceased to exist. The broad question under study was "the extent to which public aid has been and is being given to the various modes of transportation and is a factor in their competition with each other." Volume 1 explains the steps taken in determining the public aids received by the various forms of transportation, summarizes the underlying reports, compares the aids as to amounts and kinds, discusses the benefits they have conferred and the problems they have created and offers suggestions for appraising future proposals for additional public aid. It also includes the report on public aids to scheduled air transportation. Volume 2 deals with public aids to railroad transportation, volume 3 with aids to transportation by water, and volume 4 with aids to motor vehicle transportation.

PRELIMINARY NOTICE

of Application for Admission and for Transfer

June 29th, 1940

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

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

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

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

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

The Council will consider the applications herein described in August, 1940.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

A 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 nstruction 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 attainment 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

ATKINSON—CHARLES CLIFFORD, of Edmundston, N.B. Born at Melbourne, Que., April 29th, 1893; Educ.: B.Sc. (Forestry), Univ. of N.B., 1921; 1911-12, rodman, forest surveys; 1921-22, instr'man. and chief of party, base line surveys, N.B.; 1922-24, chief of party, forest surveys, and 1924-33, logging supt., Abitibi Railway, Abitibi Power & Paper Co. Ltd., Iroquois Falls, Ont.; 1933 to date, supt. in charge of all pulpwood operations, Fraser Companies Limited, Edmundston, N.B.

References: F. O. White, C. R. Townsend, J. E. Cade, E. W. G. Chapman, J. Stephens.

CLARKE—LORNE MacKAY, of 2150 Tupper St., Montreal, Que. Born at Malagash, N.S., Feb. 16th, 1907; Educ.: B.Sc. (Mech.), N.S. Tech. Coll., 1929; 1924, Geol. Survey; 1929-30, constrn. and mtce. of power lines, Avon River Power Co., Nova Scotia; 1930-37, transit work, mapping, map drfting., Hydrographic Survey, Ottawa; 1937-40, sales and service, mining machinery, Canadian Ingersoll Rand Ltd., Montreal.

References: M. S. Madden, R. E. Hanson, A. K. Laing, I. P. Macnab, G. M. Sutherland.

DORSEY—JOHN WORTHINGTON, of Winnipeg, Man. Born at Howard Co., Maryland, U.S.A., Jan. 21st, 1887; Educ.: E.E., Lehigh Univ., 1908. R.P.E. of Man.; 1906-07, instructor, Balto Polytechnic Institute; 1908-09, instructor, N.C.A. and M. College; 1907-09 (summers), ap'tice, Westinghouse Electric, mach. shop, Winchester Repeating Arms, engrg. testing, Gen. Elec. Co.; 1909-10, prof. of elec. engrg., Clarkson School of Technology; 1916-18, overseas with A.E.F.; 1910-16, lecturer, 1916-38, asst. professor, and 1938 to date, associate professor of elect'l. engrg., University of Manitoba, Winnipeg, Man.

References: E. P. Fetherstonhaugh, A. E. Macdonald, G. H. Herriot, E. S. Braddell, J. Hoogstraten.

FORSTER—DUNCAN HUNTER, of 408 Spruce St., Sudbury, Ont. Born at Coxhoe, Co. Durham, England, April 5th, 1908; Educ.: 1924-25, Armstrong College, Durham Univ.; I.C.S. course in steam engrg. Ontario Operating Engr's. Cert.; 1925-27, drawing office, Dornan Long & Co., Middlesborough, England; 1927-28, steel constrn., Steel Gates Co., Welland Ship Canal; 1929-30, erection foreman, Babcock-Wilcox & Goldie-McCulloch; 1931-38, supt., pulverized coal plant, Ontario Refining Co., Copper Cliff, Ont.; 1938 to date, with the International Nickel Company, Copper Refining Division, gen. supt., pulverized coal plant, power dept. mtce., steam fitters shop, fire chief, and at present, gen. foreman, mech. dept.

References: C. O. Maddock, J. F. Robertson, R. L. Peek, F. A. Orange, H. J. Kurtz.

FRANKLIN—EDWARD, Donnacona, Que. Born at Liverpool, England, June 30th, 1888; Educ.: 1903-10, apprenticeship course, and attended evening Technical School, Liverpool, England; 1910-20 and 1925-26, erecting engr., Babcock-Wilcox & Goldie-McCulloch Ltd., Galt, Ont.; 1920-25, master mechanic, Dominion Tire Company, Kitchener, Ont.; 1926 to date, mech. supt., Donnacona Paper Co. Ltd., Donnacona, Que.

References: K. O. Elderkin, R. E. MacAfee, J. A. Beauchemin, L. H. Birkett, C. A. Buchanan.

GLANCE—EARL IRVINE, of 1324 Dundas St., Toronto, Ont. Born at Winnipeg, Man., Oct. 15th, 1911; Educ.: B.Sc. (Elec.), Univ. of Man., 1933; 1935-38, elec. and mech. dfting., Rogers-Majestic Radio Corpn., Toronto; 1939-40, elec. power and lighting, T. Eaton Co. Ltd., Toronto; 1940 (Feb.-May), elec. power layout, Canadian Comstock Company; May 1940 to date, elec. power and lighting design, T. Pringle & Son, Montreal, Que.

References: E. P. Fetherstonhaugh, R. G. Barbour, A. D. Ross, W. F. Riddell, G. H. Herriot.

LANE—ROBERT CAMPBELL, of Copper Cliff, Ont. Born at Sault Ste Marie, Ont., July 5th, 1912; Educ.: B.Sc., Mich. Coll. of Mining and Technology, 1938; 1938-39, asst. tester, and 1939 to date, apprentice operator, International Nickel Concentrator, Copper Cliff, Ont.

References: J. F. Robertson, F. A. Orange, C. O. Maddock.

LINTON—WILLIAM REGINALD, of 130 Galley Ave., Toronto, Ont. Born at Orono, Ont., Dec. 30th, 1900; Educ.: B.A.Sc., Univ. of Toronto, 1934; 1921-24 (intermittent), radio operator, Canadian Marconi Co., Toronto; 1924-30, Bell Telephone Company of Canada, Toronto, in various central offices testing and maintaining tel. lines, circuits and equipment; 1936-38, with the inductive interference branch, radio divn., Dept. of Transport, Toronto. Tracing and eliminating sources of inductive interference to broadcast reception, radio station inspections, etc.; June 1938, transferred to the engrg. staff of this branch at Ottawa—assisting in the development of interference measuring techniques, the application of these in the field, special equipment design and constrn., receiver and test equipment characteristic measurements, field intensity measurements, etc. Sept. 1939, transferred to Toronto office, doing similar work to above. At present, Radio Inspector, Dept. of Transport, Toronto, Ont.

References: P. E. Doncaster, G. H. Burbidge, H. Os, H. F. C. Sefton, W. E. P. Duncan.

MATHEWSON—PHILIP LAVENS, of 4339 Westhill Ave., Montreal, Que. Born at New Westminster, B.C., Jan. 27th, 1907; Educ.: B.A.Sc. (Elec.), Univ. of B.C., 1927; 1927-28, test course, 1928-30, switching equipment engrg. office, Canadian Westinghouse Co. Ltd.; 1930-37, elect'l. inspr. in office of mech. and elec. engr., C.N.R., Central Region, Toronto; 1937 to date, asst. engr. in office of chief elec. engr., C.N.R., Montreal.

References: F. R. Barnsley, D. W. Callander, H. L. Currie, H. F. Finnemore, R. G. Gage, C. A. Laverty, R. O. Stewart.

MERRETT—JOSEPH STEPHEN, of 1089 Corydon Ave., Winnipeg, Man. Born at Montreal, Que., Dec. 7th, 1903; Educ.: B.Sc. (Civil), Univ. of Man., 1926; R.P.E. of Man.; 1921-26 (summers), surveying, inspecting and 3 years course in R.C.A.F.; 1926 to date, dftsman., estimator, chief dftsman. and engr., and at present engr. and chief dftsman., Western Steel Products Corpn. Ltd., Winnipeg, Man.

References: A. E. Macdonald, C. V. Antenbring, E. S. Kent, H. L. Briggs, A. J. aunton.

MURRAY—WILLIAM JOHN, of 505 Soudan Ave., Toronto, Ont. Born at Balloch, Loch Lomond, Scotland, Sept. 2nd, 1906; Educ.: 4 years evening classes; I.C.S. course in mechanics and dfting; 1923-25, dfting. and marine engrg., W. Beardmore Co., Dalmuir, Scotland; 1925-29, mech. dfting., machine shop practice, C.N.R.; 1929 to date, with the H.E.P.C. of Ontario—1929-33, transmission lines engr., 1934-40, running instruments on survey parties, designing structures, locating transmission lines, compiling constrn. line data, field dfting., and at present, senior draughtsman, transmission section, elec. engrg. dept.

References: A. H. Hull, H. E. Brandon, J. W. Falkner, J. R. Montague, J. A. G. White, H. V. Armstrong, R. G. Allan.

McDOUGALL—JOHN FORSYTH, of Fergus, Ont. Born at Ottawa, Ont., Jan. 25th, 1914; 1924-31, Upper Canada College—Senior Matric.; 1929, rodman, Fraser Brace Ltd.; 1931, inspr., Beauharnois Constrn.; 1935, foreman, Rayner Constrn. Ltd.; 1936, foreman, 1936-40, supt., Quinte Construction Ltd.; at present, night supt., Shand Dam, for Rayner Construction Ltd., Fergus, Ont.

References: G. W. Rayner, W. P. Wilgar, W. B. Hutcheson, S. Stephenson, T. W. W. Parker.

(*Continued on page 339*)

Employment Service Bureau

SITUATIONS VACANT

YOUNG MECHANICAL ENGINEERING graduate, single, with a couple of years draughting experience wanted for Pulp Mill in Eastern Canada. Please give full particulars in first letter. Apply to Box No. 2091-V.

ENGINEER, preferably mechanical, over thirty years old, with several years' industrial experience, for responsible position in production work. Excellent opportunity for advancement. Apply to Box No. 2110-V.

YOUNG MECHANICAL ENGINEERING GRADUATE, who can speak French, required by firm of repute for position of assistant safety engineer. Apply to Box No. 2111-V.

GRADUATE MECHANICAL ENGINEER having qualifications and keen desire to become sales engineer. Required for Toronto territory by well established organization. Prompt action essential. Apply Box No. 2126-V.

ELECTRICAL AND MECHANICAL DRAUGHTSMEN, experienced in modern generating and transformer station design practices. 25 to 40 years of age with at least two years' experience. State education, qualifications, age, length of experience and present location. Apply to Box No. 2129-V.

YOUNG MECHANICAL ENGINEER who is a recent graduate of a Canadian university. Preferably a single man who is willing to learn the business of an industrial concern from the ground up. Excellent opportunity for the right man. Apply Box No. 2133-V.

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

CANADIAN ENGINEERS NOT RESIDENT IN CANADA

If you are in a position to consider returning to Canada to aid in the country's war work, please write Headquarters for information.

SITUATIONS WANTED

MANUFACTURING EXECUTIVE, M.E.I.C. Services of steel plant executive having mechanical and shell manufacturing experience available to company contemplating installing munitions equipment. Capable of assuming complete responsibility for plant layout, tooling and production. Apply Box No. 67-W.

DEVELOPMENT AND EXPANSION of new processes and enterprises of a widely diversified nature are familiar to writer, who has had 10 years' experience in industrial research. A graduate of McGill, in Mechanical Engineering, with a successful record of a varied range of developments, and at present employed as research engineer in the paper industry. Desires connection offering greater scope and/or an opportunity to make a greater contribution to War Effort. Apply to Box No. 631-W.

CIVIL ENGINEER, B.SC., E.C. (U.N.B. '32) M.E.I.C. P.E. of N.B. Age 34. Married. Experience, general construction, mining, surveying, reinforced concrete, railroad, water and sewerage layouts. Apply to Box No. 1562-W.

ELECTRICAL ENGINEER, B.SC. (Queen's Univ., 1938). JR.E.I.C. Canadian, age 27, single. Experience includes 3 mos. testing transmitters and associated equipment with Canadian Marconi Co.; 4 mos. draughting, designing and redesigning, with the Northern Petroleum Corp.; 4 mos. assembly, testing and research on electric fence controllers with The W. C. Wood Electric Co.; on spare time radio servicing and generator rewinding. Wishes to take an apprenticeship course with radio engineering firm or power transmission company. Good references are available, will consider any location. Available on about one week's notice. Apply to Box No. 1969-W.

INDUSTRIAL ENGINEER, M.E.I.C., P.E. Quebec and Ontario, desires permanent industrial connection. Years of extensive experience in engineering and construction of pulp and paper mills, also hydro-electric power plants; experience includes all operations in the production and manufacture of pulp and paper, maintenance and purchasing, in some of the largest mills in Canada. Apply to Box No. 2162-W.

SAFETY ENGINEER, Affil. E.I.C., age 24; single; bilingual; presently employed; Canadian; 40 months with large industrial firm. Familiar with all phases of accident prevention and editing of bilingual company organ. Interested in industrial relations, safety, personnel and employment work. Location immaterial. Available with month's notice. Apply to Box No. 2187-W.

INDUSTRIAL EXECUTIVE, Canadian, M.E.I.C., presently associated in an executive capacity with an outstanding firm producing quality communications equipment, actively engaged for past twelve years in directing manufacture, development of new processes, design and provision of production facilities and cost control, will consider responsible position in the production or sales organization of other industrial enterprises. Apply to Box No. 2188-W.

ELECTRICAL ENGINEER, B.Eng. (McGill '34). Canadian, age 28, married. Three years' experience in pulp and paper mills, operation and maintenance of electrical equipment and paper machines; operation of associated hydro-electric system. Bilingual. Available on about two weeks' notice. Apply to Box No. 2192-W.

PRELIMINARY NOTICE (*Continued from page 338*)

FOR ADMISSION

McWILLIAMS—DAVID BURRELL, of 9 Vesta Drive, Forest Hill Village, Ont. Born at Chicago, Ill., Aug. 27th, 1893; Educ.: C.E., Lafayette College, Easton, Pa., 1914; 1914-15, at instructional school, New Kensington, Pa., of Aluminum Company of America; 1916-17, with Call Switch Co., New York; 1917-19, U.S. Army Air Service; 1919-20, with Grace Motors Ltd., Toronto; 1921-24, organized and was president and gen. mgr., Westco Pumps Ltd., Toronto; 1925-31, Canadian representative for Victualic Company of America, New York and Toronto; 1930 to date, managing director, Simplex Valve and Meter Co. of Canada Ltd., and the Dresser Manufacturing Co. Ltd., of Toronto, Ont.

References: A. E. Berry, A. U. Sanderson, G. G. Routledge, N. G. McDonald, W. B. Redfern, C. J. Desbaillets, W. S. Lea.

PROUDFOOT, CHARLES ALEXANDER, of 307 Montrose St., Winnipeg, Man. Born at Winnipeg, Sept. 18th, 1910; Educ.: B.Sc. (C.E.), Univ. of Man., 1934; 1935, constrn. work, Manitoba Bridge & Iron Works; 1935-36, asst. geol., Geological Survey of Canada; 1937, underground survey work, Hudson's Bay Mining & Smelting Co., and instr'man. and dftsman., Churchill River Power Company; 1937-38, instr'man., Prov. Govt. Survey Branch, Manitoba; 1938 to date, airways engr., Trans-Canada Airlines, Winnipeg, Man.

References: E. S. Braddell, J. Hoogstraten, D. M. Stephens, A. Sandilands, A. E. Macdonald, E. P. Fetherstonhaugh, C. V. Antenbring.

STETHEM—ARCHIBALD JOHN RIDLEY, of 576 Wall St., Winnipeg, Man. Born at Winnipeg, Dec. 15th, 1911; Educ.: Senior Matric., Univ. of Man., 1930; Home studying mech. engrg.; 1929, 1930, 1933 (intermittent), survey and constrn. work; 1933-34, mech. dept., M. & O. Paper Co. Ltd.; 1935-40, mech. and power equipment engr., Mumford-Medland Ltd., Winnipeg; 1936-40, transmission and conveying divn., Link-Belt Ltd., Western office, Winnipeg. Layout, design, specifications for mining power plant equipment for diesel, gas and steam plants, pumping and power equipment, mine dewatering, constrn. etc., gen. constrn., road bldg. and contracting mech. equipment; 1938-40, design, assembly and erection of mech. power plant equipment, conveyor and transmission machy. and mech. equipment, with Mumford-Medland Ltd.; 1937-40, Adjutant and Schools Commandant, 10th District Engineers, R.C.E. (N.P.), Winnipeg; Present position—mechanical and sales engr., Link-Belt Ltd., Western Ontario Divn., Toronto.

References: J. H. Edgar, G. E. Cole, S. G. Harknett, C. H. Fox.

THISTLETHWAITE—ROBERT, of Winnipeg, Man. Born at Winnipeg, May 1st, 1909; Educ.: B.Sc. (C.E.), Univ. of Man., 1933; Season 1927, engrg. dept., C.N.R.; 1928-29, divnl. engr's clerk, and dftsman. on constrn., Manitoba Northern Rlys.; Seasons 1930-31, asst. to municipal engr., St. Vital, Man.; Season 1932, student asst., Geol. Survey of Canada; 1933-34, estimator, F. C. Pain & Co., Winnipeg; 1934-36, physical tests of bldg. materials and production control, Building Products Ltd., Winnipeg; 1936-37, articled pupil, computer, asst. to observer on astronomic control, Topog'l. Survey of Canada; 1937 to date, land surveyor, engaged principally in making astronomic observations for control purposes, also on property and reconnaissance surveys, Tropical Oil Company, Colombia, South America.

References: F. H. Peters, S. H. deJong, G. H. Herriot, J. N. Finlayson.

WANEK—ALEXANDER THOMAS ERIC, of Montreal, Que. Born at Brighton, England, August 7th, 1909; Educ. 1935-36, University College, Southampton. 1938-39, Northampton Polytechnic, London; Associate, Royal Aeronautical Society; Regd. Prof. Engr., London, England; 1925-30, ap'ticeship, John Samuel White & Co. Ltd., Cowes, Isle of Wight, Shipbldrs. & Engrs.; 1935-36, foreman and later asst. works mgr., Airports Ltd., Surrey; 1936-37, works mgr., R. K. Dundas Ltd., The Airport, Portsmouth; 1937-38, production mgr., Gallays Ltd., London. At present, aeronautical engineer, British Air Ministry, Montreal.

References—P. F. Sise, A. P. Shearwood, R. J. Durley, L. Trudel, L. A. Wright.

WESTBEARE—FREDERICK HENRY, of 2174 Queen St. East, Toronto, Ont. Born at Picton, Ont., Oct. 19th, 1896; Educ.: 1922-23, commercial study at Queen's Univ.; 1924-27, compiling specification data for Reid & Brown Structural Steel Works, Toronto; 1928, same work as above on elec'l. energy for General Motors, Oshawa; 1930-35, practical tests and analysis of nickel ores, Delta Mines, Sudbury; 1935-37, sinking of shaft and installing of steam plant, Van Nickel Mines Ltd.; 1937-38, geophysical and magnetic survey, Drury Nickel Mines Ltd., and supervising diamond drilling; at present, manager of the Westpeer Prospecting Syndicate, Toronto, Ont. (Applying for admission as Affiliate).

References: J. J. Spence, W. B. Redman, H. N. Gzowski.

WRIGHT—CLAUDE PERCIVAL, of Winnipeg, Man. Born at Carnduff, Sask., Sept. 25th, 1908; Educ.: B.Sc. (E.E.), 1935, M.Sc. (E.E.), 1937, Univ. of Man.; 1936-37, electrician, western region, C.N.R., wiring of bldgs. and installn. of elec. equipment, power line constrn.; 1937-38, electrician, Transcona shops, C.N.R., installn. of air conditioning equipment as applied to rly. coaches, mtce. and repair of elec. equipment and overhaul of motors and generators; 1938 to date, inspecting engr., Western Canada Insurance Underwriters' Association, Winnipeg, Man. Inspection of power plants and waterworks systems in Man., Sask. and Alta.

References: E. P. Fetherstonhaugh, G. H. Herriot, W. F. Riddell, N. M. Hall, J. Veitch.

FOR TRANSFER FROM JUNIOR

STEWART—JOHN RUFUS, of Montreal, Que. Born at Beebe, Que., Sept. 3rd, 1905; Educ.: B.Sc. (Mech.), McGill Univ., 1927; 1927-29, constrn. work, Anglo-Canadian Pulp & Paper Co., Quebec; 1929 to date, with Canadian Liquid Air Company, Montreal, service engr. and at present, welding engr. (St. 1925, Jr. 1934).

References: C. R. Whittemore, G. Sproule, T. C. Darling, R. Ford, R. E. Jamieson, D. A. Killam.

FOR TRANSFER FROM STUDENT

LEFEBVRE—JEAN A. A., of Bogota, Colombia, S.A. Born at Montreal, Jan. 27th, 1908; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1934; with Imperial Oil Limited as follows: 1929-34 (summers), lab. work, 1934-36, production dept., 1936-39, technical service div., dept. of asphalt, technology; 1939-40, road work, Standard Oil of Venezuela; at present, asphalt technician, technical service divn., dept. of asphalt technology, Imperial Oil Limited and Tropical Oil Company, Bogota, Colombia, S.A. (St. 1934).

References: F. C. Mechin, A. Frigon, A. Circé, L. Perrault,

Industrial News

Industrial development — new products — changes in personnel — special events — trade literature

COMBUSTION CONTROL

"Automatic Combustion Control" is the title of a booklet of Republic Flow Meters Co., Chicago, Ill., and designated as Databook S-21. The contents include discussion of advantages of automatic combustion control, basic problems in efficient boiler operation, operating principles of a complete regulator, the applications of the equipment to various types of boiler installations, and to dampers, fan vanes and fan speeds.

STEEL

A low-alloy copper-nickel-molybdenum steel forms the subject matter of the bulletin "Double Strength Steel" of Republic Steel Corp., Cleveland, Ohio. This 40-page text presents analysis, physical properties, fabricating data and forms of this steel available. Illustrations of cars, trucks, cranes, bulldozers, etc., employing this material are also shown.

CONCRETE PAINTING

The booklet, "How to Paint Concrete, Stucco, Masonry," of Medusa Products Co. of Canada, Ltd., Paris, Ont., provides helpful information regarding a cement-base paint which is unaffected by water and lime alkalis and can be applied to interior or exterior concrete, stucco and masonry walls by either brush or spray methods.

AIR LINE LUBRICATION

Bulletin No. 2600 of the Canadian Ingersoll-Rand Co. Ltd., Montreal, Que., is a source of informative data regarding the company's new "Oil-Ir" rock drill air line lubricator.

CHAIN HOIST

A line of triple-gear chain hoists covering fourteen sizes, ¼ to 20 ton capacity, is described in a leaflet of Herbert Morris Crane & Hoist Co. Ltd., Niagara Falls, Ont. Typical hoisting applications are illustrated and construction details given.

STEEL SCAFFOLDING

The versatility of "Safeway Steel Scaffold" in construction and maintenance jobs is depicted in an illustrated folder of Sarnia Bridge Co. Ltd., Sarnia, Ont. Emphasis is especially given to the safety features of this equipment, both in erection, use and dismantling.

VALVES

Penberthy Injector Co. Ltd., Windsor, Ont., have completed a new 16-page booklet on their R-S (removable seat) Compodisk Valves.

MOTOR PUMP

Canadian Allis-Chalmers Company is now manufacturing type SSU centrifugal pump and motor units. Each unit is a single suction, single or two stage pump and driving motor, designed and built as a complete piece of equipment, with one shaft supported by two liberal-sized ball bearings for the entire unit.

These pumps are compact and have a wide field of application. Because they readily operate in any position they are unusually adapted to special installations where unorthodox mounting arrangements are necessary. They may easily be mounted, vertical, or the sides of tanks, or where space would ordinarily be a limiting factor. Discharge nozzles are made to be rotated to from 4 to 8 different positions to facilitate piping arrangements. Motor pumps are available in sizes handling from 10 to 1,000 gallons per minute.

CIRCUIT BREAKERS

Westinghouse Outdoor Oil Circuit Breakers of single tank construction, are described in detail from the construtcion and operating viewpoints in Bulletin H-7403-A of Canadian Westinghouse Company, Limited. The particular units dealt with are rated 600 to 3000 amps, 5000 to 73000 v, and with rupturing capacities up to one million kva at 73 kv.

BELT PLATES

Steel belt plates for conveyor, elevator and transmission belting—leather, canvas, rubber, cotton, etc.—are described in Bulletin 729 of The Bristol Company of Canada, Ltd., Toronto. The line covers a wide range of sizes and incorporates a number of interesting features in the plate design.

REFRACTORIES AND COATINGS

In looseleaf form, the general catalogue of G. F. Sterne & Sons, Ltd., Brantford, Ont., covers a wide range of industrial and structural specialties. Conveniently indexed sections deal with high temperature cement; plastic firebrick; a monolithic refractory, "Monopour"; protective coatings; window cleaners; roof paints; and a number of structural specialties.

GEAR UNITS

Bulletin No. 112 of Hamilton Gear & Machine Company, Toronto, is a 16-page booklet devoted to Helical Gear Units, manufactured by the company, of single, double and planetory types. The bulletin describes features of the various types and includes specifications of materials and construction, instructions on selection of the correct size of speed reducer, table of AGMA horsepower capacities, instructions for setting up and dimensional data.

METERS

A 60-page pocket-size meter instruction book, listed as Bulletin No. 48, has been published by Ferranti Electric, Limited, Mount Dennis, Toronto. Single-phase a.c. watthour meters are covered and the data includes testing and servicing of meters, adjustments, installation instructions of indoor and outdoor meters, price list, and reference to Ferranti Meter Test Board and parts for same.

CENTRIFUGAL PUMPS

Details of the Type HL single-stage centrifugal pump for oil refining service are given in Bulletin W-341-B7 of Worthington Pump & Machinery Corp., Harrison, N.J. This unit is of vertically split casing type, 10 to 1050 g.p.m., 10 to 280 ft. head.

THERMOMETER

A thermometer specially designed for outdoor use is described in a leaflet of The Palmer Thermometer Co. Ltd., Toronto. Features of this instrument, it is noted, include the use of shatterproof cover glass and the "Red-Reading Mercury" column construction for greater ease in reading.

AIR OPERATED CONTROLLERS

The Bristol Company of Canada, Ltd., Toronto, Ont., has completed Catalog No. 4050 pertaining to air control instruments for temperature, pressure, liquid level, PH control, and a number of other applications. Special attention is given to Bristol's Free-Vane principle of operation and various models of control units are illustrated and described with accompanying isometric drawings explaining the three basic types of control available. The catalogue also explains the British system of pneumatic and electric remote control.

LUBRICATION

Two new catalogues of lubrication systems and equipment are announced by Stewart-Warner-Alemite Corporation of Canada, Ltd., Belleville, Ont. One is a new issue of the Alemite Service Equipment Catalogue, of interest particularly to automobile service men and containing listings, descriptions and specifications of this class of equipment. The other catalogue covers Alemite Hand Guns and Fittings and for convenience in reference is provided with a thumb index.

TACHOMETERS

Recent developments on recording and indicating tachometers for paper machines, engine speeds, bake ovens, travelling ovens, blowers, and other applications are given in Bulletin No. 542 of The Bristol Company of Canada, Ltd., Toronto, Ont. Information is given concerning Bristol's Round-Chart and Strip-Chart potentiometer type tachometers and a full size reproduction of a strip chart is included.

WALLBOARD

A 24-page booklet entitled, "Sheetrock Plaster Wallboard," issued by Canadian Gypsum Co. Ltd., Toronto, is devoted to a description of what "Sheetrock" is and how it can be used in building and remodelling. Many illustrations are provided to demonstrate the wide range of application of this product and the method of handling it. A considerable section is devoted to illustrating and describing the application and handling details of "Wood Grained" Sheetrock, and the final page is devoted to detailed specifications.

TUBE FABRICATING EQUIPMENT

The Parker Appliance Co., 17325 Euclid Ave., Cleveland, Ohio, have issued a 36-page catalogue entitled "Parker Benders" (Bulletin No. 40E), which deals with their tube fabricating equipment.

The catalogue is thoroughly illustrated and in addition to the descriptive matter contains general instructions and price lists.

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 23 AUGUST 1940 NUMBER 8

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

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PUBLISHED MONTHLY BY
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OF CANADA
2050 MANSFIELD STREET - MONTREAL

Price 50 cents a copy, $3.00 a year, in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

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(*Photo Shawinigan Engineering Company, Ltd.*)

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Mechanical Engineer, Foster Wheeler Limited, London, Eng.

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Brief History of the Use of Superheated Steam

As applied to steam boilers, a superheater may be described as a device for increasing the temperature of the steam without increasing its pressure.

The use of superheated steam dates back over one hundred years, but it was not until 1856, as a result of extensive tests on H.M.S. *Dee* by the Royal Navy, that the advantages of superheated steam were fully appreciated. On this vessel, a portion of the boiler output was superheated to some 500 or 600 deg. F., in a crude form of steam dryer in the uptake, and afterwards mixed in with the main saturated supply. For the next decade superheaters were installed on practically all the new steam driven ships for the Navy, and to a considerable extent in the mercantile marine.

Shortly after this came the introduction of the compound engine, accompanied by rapid increases in steam pressure. When single stage expansion was the rule, boilers seldom operated at gauge pressures greater than 15 lb. per sq. in., and quite often less. After the thirty year interval between 1870 and 1900, however, it was not uncommon to find pressures of 250 lb. per sq. in. in use on naval vessels, and 200 lb. per sq. in. in the mercantile marine. The higher saturated steam temperatures involved, introduced difficulties with gland packings and cylinder lubrication, to such an extent that the use of superheated steam, which seemed to aggravate these troubles, practically died out during this period.

While the introduction of the compound engine retarded the development of superheating equipment for a quarter of a century, metallic packing and mineral base cylinder oils eventually overcame the mechanical disadvantages involved in its application to machinery of this type. The large turbine installations which became common shortly afterwards, depended to no small extent on a superheated steam supply for their satisfactory operation.

During the last thirty years the use of superheated steam has increased to such an extent that it is now the rule rather than the exception for a power installation with any pretence to efficiency. In the year 1908 there were 160 ocean-going vessels fitted with superheaters, while in 1931 the number had increased to 4,456. The relative increase in locomotive and stationary application has probably been even greater.

Economic Advantages of Superheated Steam

Superheated steam, due to its relatively higher specific volume, shows the largest thermodynamic gain when applied to reciprocating engines, its effect being equivalent to reducing the percentage cut off. Incidental advantages are the reduction of heat lost through the cylinder walls by conduction, and a saving in lubricating oil, which is not washed away to the same extent as with saturated steam.

As an approximate rule, each one per cent of moisture in the steam at cut off will reduce the engine efficiency by two per cent. About 8 deg. F. of superheat is required to eliminate one per cent of moisture in the steam at this stage.

Engines originally designed for use with saturated steam will in most cases operate satisfactorily at temperatures up to 500 deg. F. Beyond this temperature some difficulties may be experienced with cylinder lubrication, gland packings, and expansion stresses in the piping. On the other hand, suitably designed reciprocating engines, notably in locomotive work, have operated at steam temperatures of 850 deg. F. with perfect satisfaction.

As applied to steam turbines, superheat results in actual gains considerably greater than the theoretical. This is principally due to reduced frictional or windage losses within the machine, and the reduction of moisture at the exhaust end. In general each ten deg. F. of initial superheat will decrease blade and nozzle losses approximately one per cent.

With more than ten per cent of moisture in the turbine exhaust, pitting and erosion of the blading is probable, with a rapid falling off in efficiency of the low pressure stages. In consequence, the initial superheat is largely determined with reference to steam conditions at the exhaust.

Until recently, limitations of available materials practically fixed the initial steam temperature to a maximum of 850 deg. F., which in conjunction with a steam pressure of 650 lb. per sq. in. was sufficient to give a reasonable dryness factor at the turbine exhaust. The use of higher pressures therefore involved the use of a reheat cycle with its additional equipment and complication. Within the last few years, however, developments in design and materials have made practical the use of steam at 950 to 1,000 deg. F., thus opening up a higher pressure range for non-reheat cycles.

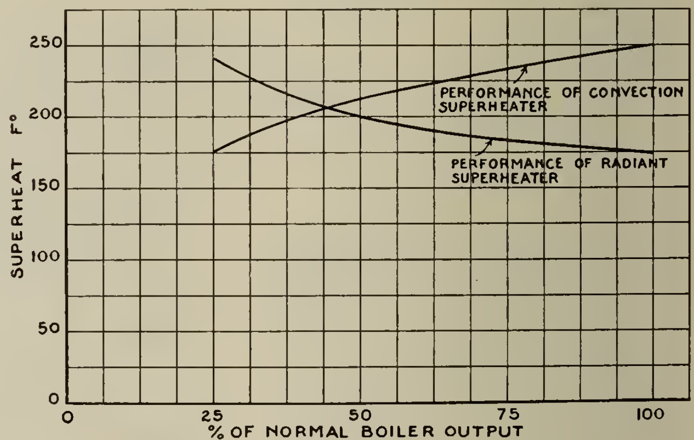

Fig. 1—Performance curves.

In the process, as opposed to the power field, the use of superheated steam is seldom justified, as it results in no thermodynamic increase in efficiency to warrant the initial investment of a superheater installation.

When a saturated steam supply is not available for heat transfer equipment such as dryers, evaporators or stills, superheated steam may of course be used instead, provided that the temperature is not sufficiently high to cause damage to the equipment. Though film coefficients for superheated steam are considerably lower than those for saturated, the superheat is lost so rapidly that in most cases the capacity of the equipment is not affected.

Types of Superheater

Superheaters for water tube boilers may be classified either by the process of heat absorption for which they are designed, or by their location within the steam generator.

According to the first classification superheaters may be either:—

(*a*) Convection type.
(*b*) Radiant type.
(*c*) Combination type.

According to the second classification they may be either:—

*The Phelps Johnson Prize is one of the Institute zone prizes made available annually to Student and Junior members.

(*a*) Overdeck.
(*b*) Interdeck.
(*c*) Pendent or hanging type.
(*d*) Inverted.
(*e*) Intertube.
(*f*) Furnace tube.
(*g*) Separately fixed.

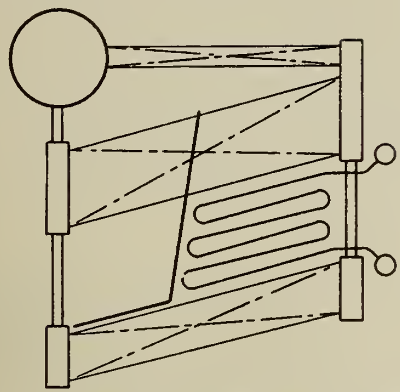

Fig. 2—Arrangement of interdeck superheater.

As regards the first classification, by far the most common type in use at the present day is the convection superheater. In this type the elements are shielded by sufficient boiler heating surface to protect them from direct furnace radiation, and the heat transfer from gas to tube is largely a process of convection, plus a small amount of non-luminous gas radiation.

The characteristic of a convection superheater is that of rising steam temperature with increasing load.

The radiant superheater is a comparatively new development. In this type the superheater is located inside the boiler furnace, either on the walls or floor, and with its elements exposed to direct furnace radiation.

The characteristic of a radiant superheater is that of falling steam temperature with increasing load. Typical performance curves for the two types are shown in Fig. 1.

As radiant heat transfer rates are considerably in excess of convection transfer rates, it is evident that for a given duty, a radiant superheater will require proportionately less surface than a convection type. However, as this surface is exposed to more severe temperature conditions, particularly at light loads and during starting up periods, a higher grade of material is usually called for in its construction.

The present day field of the radiant superheater is either as a booster for existing convection installations which are too cramped to permit of a further increase of surface, or as a complement to the convection type in combination installations. Occasionally a radiant superheater may be installed alone, though cases in which this is advisable are unusual.

The combination superheater as its name implies, is a combination of both radiant and convection types. The principal advantage of such an installation is that the radiant and convection surfaces may be so proportioned as to give a practically constant steam temperature over a wide operating range. Where practical, it is advisable to place the radiant section in series before the convection section, so that the maximum steam cooling effect is secured in the former.

Figures 2 to 6 illustrate various arrangements of superheater classified as to location within the steam generator.

Figures 2 and 3 show interdeck and overdeck types of superheater respectively. Originally all header type boilers used overdeck superheaters, but due to the low gas temperatures in the overdeck zone, particularly in high boilers, the surface required for high degrees of superheat was often excessive. Later on, the introduction of water cooled furnaces aggravated this condition still further. Higher steam temperatures and the increasing use of water walls led to the development of the interdeck type, which can be made of considerably less surface for the same duty.

It is interesting to note, however, that an interdeck superheater does not necessarily give a cheaper steam generator installation, as the reduced cost of the superheater is sometimes offset by the greater cost of a higher boiler, with its additional height of pressure parts supporting steel and brickwork. The cost of heat resisting element supports and spacers is another factor which must be taken into consideration when deciding upon the most economical type for a given set of conditions.

The recent tendency with large header type boilers to increase the economizer and air heater surface at the expense of boiler surface, has in many cases made the boiler bank so shallow that an overdeck superheater of reasonable dimensions can easily be installed. If this tendency becomes common practice, it is possible that the interdeck superheater may in turn be largely displaced by the overdeck.

In general, the more rows of boiler tubes between furnace and superheater, the greater will be the variation in temperature with load, and consequently an overdeck superheater will have a steeper characteristic than an interdeck type.

Figure 4 shows a pendent or hanging type superheater as applied to a bent tube boiler, and Fig. 5 shows an inverted type. It will be seen that the elements of the latter are completely drainable, which is an advantage for installations which spend long periods out of service. However, the inverted superheater does not as a rule permit of the installation of such large surfaces in a given space, and the headers are located in a difficult working position. For these reasons the pendent type is more popular at the present day.

An intertube superheater may be described as a pendent type superheater which has been moved forward into the first boiler bank in such a manner that its elements lie between the boiler tubes. The elements will therefore absorb heat at the same rate as the first bank, in which the greater part of the steam output is generated, and in theory the characteristic will be flat over a wide range. In effect it is a combined radiant and convection superheater with but one set of surface.

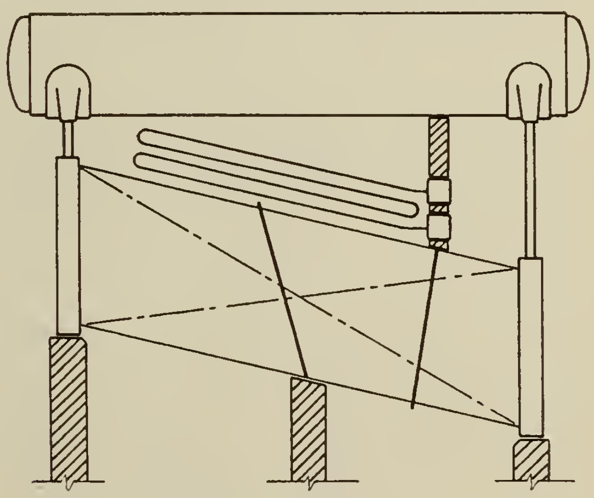

Fig. 3—Arrangement of overdeck superheater.

In practice, however, not all installations of this type have behaved in accordance with the theory underlying their design, and several have had rather steep characteristics when installed over water cooled furnaces. The arrangement is prone to slagging difficulties with low fusion ash coals, and usually a high grade of tube material is required for that length of element exposed to furnace radiation.

Figure 6 illustrates a furnace tube type of radiant superheater. This form usually consists of 2-in. diameter tubes located on $4\frac{3}{4}$-in. centers and advanced 9 in. from the furnace wall. When the vertical length of tube exceeds ten or twelve ft., it is customary to tie the tube back to the wall

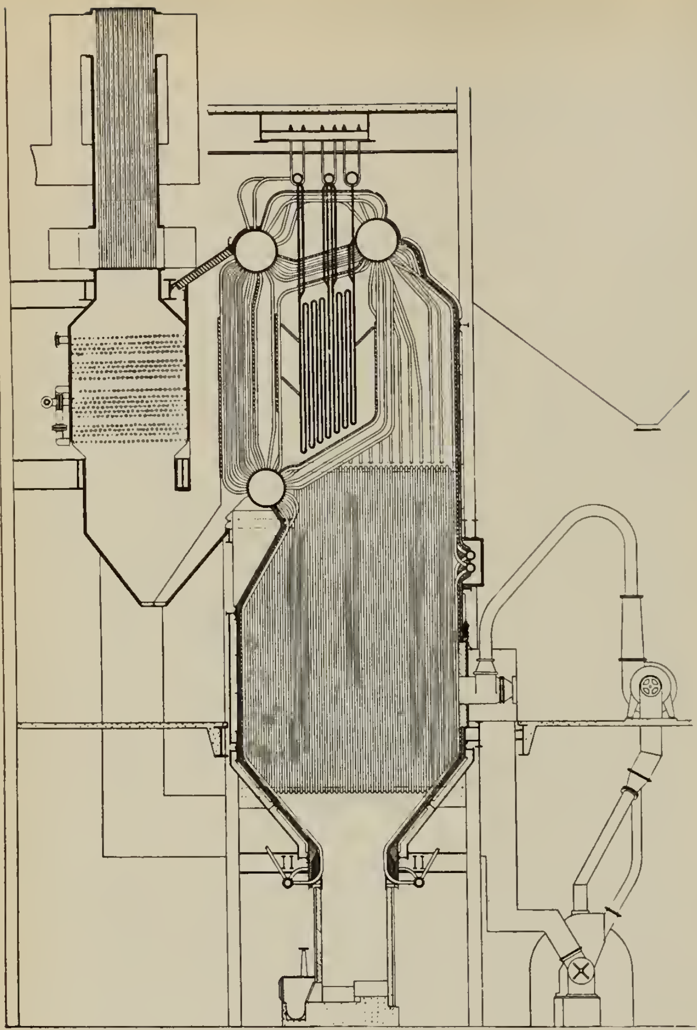

Fig. 4—Arrangement of pendent superheater.

at an intermediate point as shown. However, for exceptionally severe furnace conditions, the elements may be partially shielded by water wall tubes, given a cast iron block surface, or buried under a light layer of refractory. If it is necessary to install maximum surface in a minimum of space, or secure high wall cooling effect, the tubes may be located flat against the wall at a pitch of little more than the tube diameter.

In land installations, it is customary to install the wall tube type as illustrated, but due to the limited wall area on certain types of marine water tube boiler, installations afloat have occasionally been made on the furnace floor.

A separately fired radiant superheater may be incorporated in the casing of a boiler. An installation of this type is useful when varying amounts of saturated steam are to be drawn from the steam generator without affecting the superheat on the main supply. Installations such as this have been fitted to oil tankers, on which large quantities of saturated steam are required for pumping duty in port, and for a similar reason the separately fired type is well adapted to naval vessels. The saturated steam in this case is taken direct from the boiler drum, and the temperature of the main supply held constant by burner regulation on the separate furnace.

Superheater elements may be either of the bare tube or extended surface types, the former being by far the most common at the present day. The extended surface type consists of a steel tube over which cast iron gilled rings have been shrunk. The effect of these rings is to increase the gas-exposed surface of the element, thus raising the heat transfer per unit length, while at the same time the steel inner tube is protected from external corrosion. The gilled rings behave well at moderate temperatures, but above a certain limit they gradually become loose due to growth, and the transfer falls off badly. This, together with the fact that they cannot be applied to the intricate shapes of element so common to-day, has restricted their use to a limited field in superheater construction.

Heat Transfer in Convection Superheaters

Before commencing the design of a convection superheater, it is necessary to have complete information as regards the nature and disposition of the boiler heating surface in front of the superheater zone, and also as regards the combustion conditions in the furnace at the design load. As superheater performance will vary with changes in CO_2, feed water temperature, and moisture content of the steam leaving the boiler drum, the designer must have definite values of these conditions on which to base the performance guarantee.

The first step in the design is to determine the quantity and temperature of the gas entering the superheater zone. This involves the calculation of the gas weight from the weight of fuel burned per hour at a given CO_2, the calculation of the furnace exit gas temperature, and the calculation of the first pass exit gas temperature.

The determination of furnace exit gas temperature is beyond the scope of this paper. Several methods which give satisfactory results have been described in a paper entitled "Review of Methods of Computing Heat Absorption in Boiler Furnaces" by W. J. Wohlenberg and H. F. Mullikin. (*Trans.*, A.S.M.E., Vol. 57, p. 531.)

Having found the furnace exit gas temperature, it is possible to calculate the heat drop through that part of the boiler heating surface located between the furnace and the superheater zone. The method used is based on the expression:—

$$Q = S \times U \times T_m / W$$

in which,

Q = B.T.U. per hr. lost per lb. of gas.
S = effective boiler heating surface passed over by the gas, sq. ft.
W = lb. of gas flowing per hour.
U = overall coefficient of heat transfer between gas and heating surface, B.T.U. per hr. per sq. ft. per deg. F.
T_m = logarithmic mean temperature difference between gas and heating surface, deg. F.

Knowing the mean specific heat of the gas in the bank, the heat drop Q can readily be converted to temperature drop. As the final gas temperature must be known in order to determine T_m, the calculation will be of a trial and error type.

In a convection superheater the overall heat transfer coefficient U is made up as follows:—

$U = U_c + U_r$.

in which,

U_c = overall convection coefficient, B.T.U. per hr. per sq. ft. per deg. F.

U_r = non-luminous radiation coefficient, B.T.U. per hr. per sq. ft. per deg. F.

U_c = in turn may be expressed as follows:—

$$1/U_c = 1/K_g + 1/K_s + 1/K_t/t$$

in which,

K_g = gas film coefficient
K_s = steam film coefficient
K_t = conductance of the tube wall
t = thickness of tube wall, inches.

Under the conditions of operation in superheater practice, values of K_s and K_t/t are so high in comparison to values of K_g that their effect on the convection coefficient U_c is insignificant, and they may be neglected with safety. In other words, the value of U_c commonly used for superheater design is equal to that of the gas film coefficient K_g.

Figures 7 and 8 give values of the gas film coefficient U_c for flue gas flowing across banks of tubes, both for a staggered arrangement and for an in line arrangement.

Convection heat transfer in tube banks has been investigated by Reiher, McAdams, Reitschel and others, with the aid of theoretical formulae developed from applications of the theory of similarity.

There is at present a distressing lack of reliable data on practically all types of heat transfer, more so perhaps than in any other branch of engineering of equal importance. Though determination of transfer rates will never be an exact science, due to the large number of variables involved, it should be possible to arrive at considerably closer approximations than available data will permit of to-day.

Actually Figs. 7 and 8 are plotted from simplifications of Reiher's formulae which are given in "Industrial Heat Transfer" by Schack (John Wiley & Sons). Fig. 7 is a plot of equation 274, page 134, and Fig. 8 a plot of equation 270, page 132.

The equations, which are based on data for air, are approximately true for stack gas as well.

Incidentally Reiher's distinction between staggered and in line arrangements is not of such great importance as he believed when the formulae were developed. Recent data by Grimson and Peirson (*Proc.*, A.S.M.E., Dec. 1937) indicates that the tube pitch in line with the flow may influence the transfer rate to as great an extent as either the cross pitch or tube arrangement.

It will be noted that the coefficients apply only to cross flow of gas over tube banks, whereas in practice it is not uncommon to find instances of partial or almost complete longitudinal flow. This will be evident from an examination of the pendent superheater in Fig. 4. It would be quite feasible to prepare a heat transfer graph for longitudinal flow based on available data for gas flowing inside tubes. In this case the pipe diameter term would be represented by the equivalent diameter of the spaces between the tubes.

$$D = \frac{4 \times (P_1 \times P_2) \text{—cross section of one tube}}{\text{circumference of one tube.}}$$

In which, P_1 and P_2 are the pitches of the tubes in each direction.

For a combination of cross and longitudinal flow, a value from Fig. 7 or Fig. 8 would have to be averaged with a value from the curve thus plotted, to give the true value of U_c. Determination of the exact effect of each component would of course be a matter of judgment. A very close approximation, however, is obtained when a value from the figure is reduced by 20 per cent for a case of pure longitudinal flow. Intermediate cases would be reduced in the same proportion. For example, with a gas flow direction of 45 deg. from the line of tubes, a reduction of 10 per cent would be made.

Other factors which influence the values of U_c are the presence of gas lanes through the superheater bank, liability of the gas to short circuit certain portions of the surface, particularly at low loads, and the possible introduction of a dirt factor where slagging conditions are known to be bad.

The figures therefore are at best only an indication of results that may reasonably be expected in practice. Before using such curves for design purposes, it would be necessary to develop a number of correction factors from tests of existing installations, in order to cover the possible variations from standard conditions which might be encountered in service.

Fig. 9 gives the non-luminous radiation transfer coefficient U_r, which is to be added to the value of U_c taken from Figs. 7 or 8. This is developed from data given on page 68 of "Heat Transmission" by McAdams (McGraw Hill Book Co.) and covers the range of gas temperatures and tube spacing encountered in superheater work. The surface receiving heat is assumed to be at a temperature of 700 deg. F., but for temperatures of 200 deg. F. above or below this, the error is sufficiently small to be neglected.

As the degree of accuracy to which the overall transfer coefficient may be estimated is somewhat limited, it is customary to provide a liberal margin on the calculated surface. Most manufacturers of superheaters protect themselves on guarantees of steam temperature by installing the designed surface, while drilling the headers to take up to 20 per cent additional surface. The extra holes are blanked off with plugs or blind nipples. This precaution has often saved costly alterations to the headers and heating surface in cases where the contract superheat has not been attained on trial.

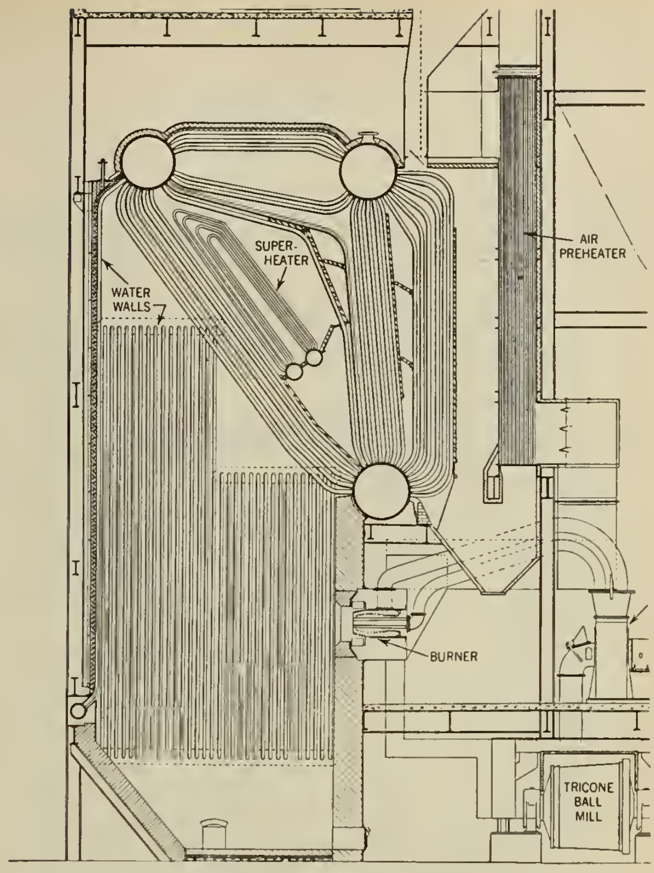

Fig. 5—Arrangement of inverted type superheater.

Heat Transfer in Radiant Superheaters

Due to the shortage of reliable data at present available for radiant heat transfer rates in boiler furnaces, the calculation of radiant superheaters depends to a considerable extent upon the judgment of the designer.

It is evident after consideration of combustion conditions inside a furnace that the radiant heat transfer rate may vary considerably over the extent of the cooled surface. The B.T.U. per hr. absorbed per sq. ft. of water cooled surface on a stoker arch for example, will be much higher than the absorption rate for that portion of the front water wall directly opposite the boiler bank. The effect of location on radiant transfer rate cannot be determined accurately by any method developed to date.

There are, however, several methods which will give very close approximations of the average absorption rate throughout a furnace for various boiler ratings, and these may serve as a valuable guide in determining the actual transfer rate to use for a radiant superheater design. For the most part these methods are rather involved, due to the large number of factors which may influence the result.

In view of this, it is remarkable that an empirical formula published by J. G. Hudson in 1896 will give approximations of absorption rates which are as accurate as can be made with several of the more complicated methods in their present state of development.

This formula has since undergone slight modifications by Orrok and others, which have served to increase its accuracy. A variation given by H. O. Croft and C. F.

Schmarje (*Trans.*, A.S.M.E. Vol. 57, 1935) in which a dirt factor has been introduced is as follows:—

$$X = 0.95\ (1 - 0.5D)\ C_r\ U \left(\frac{0.5 + 1.7D}{1 + \frac{A\sqrt{C_r}}{27}} \right)$$

in which,

X = average radiant transfer B.T.U. per sq. ft. per hr.

C_r = lb. of fuel burned per hr. per sq. ft. of cooled surface exposed to radiation.

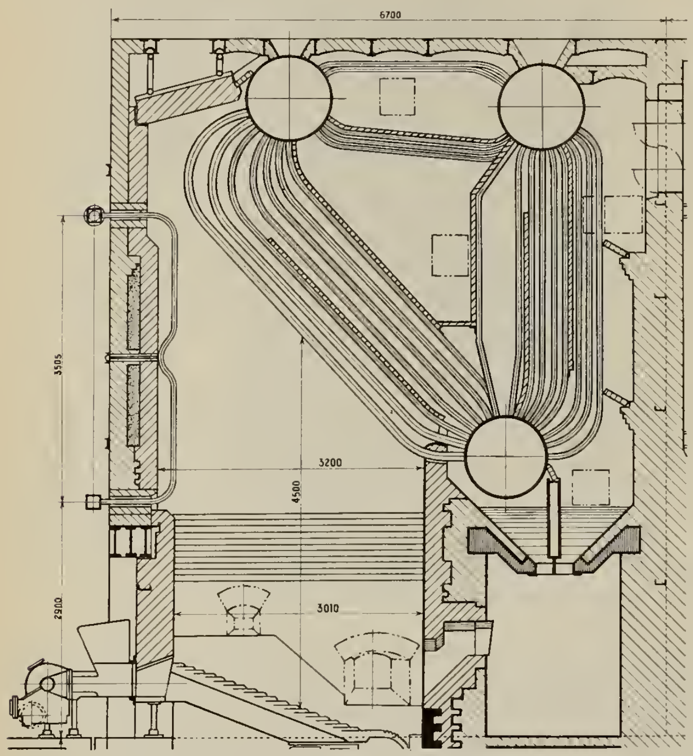

Fig. 6—Furnace tube type superheater.

A = lb. of air per lb. of fuel.

U = B.T.U. heat release per lb. of coal corrected for moisture and unburned combustible.

D = dirtiness factor = fraction of cooled surface in furnace covered with coal or ash.

The factor D may vary in practice from a value of almost zero for a clean new furnace, to 0.4 which is considered a very dirty condition.

The quantity X in the foregoing expression will give a reasonable approximation of the absorption rate which can be expected from a radiant superheater located in a boiler furnace.

A manufacturer of this equipment would, however, possess a number of performance curves of previous installations, on which he would prefer to base his design transfer rate.

Such a performance curve is shown in Fig. 10, which gives test results of a front wall radiant superheater for a small stoker-fired three drum bent tube boiler with refractory furnace. The elements were in this case of 2 in. tube located on 4¾ in. centres, and advanced 9 in. from the wall. Later installations of similar layout and combustion conditions designed from this curve have given consistent results. When a series of these curves is available covering various locations of superheater in different designs of boiler, and for different methods of firing, it becomes unnecessary to rely on formulae such as Hudson's to approximate the transfer rate.

In the case of non-standard superheater tube spacing, it is possible to adjust the radiation given for the standard arrangement by means of effectiveness factors. A typical set of curves for these factors is given in the paper "Evaluation of Effective Radiant Heating Surface and Application of the Stefan-Boltzman Law to Heat Absorption in Boiler Furnaces" by H. F. Mullikin (*Trans.*, A.S.M.E., Vol. 57, p. 518).

To illustrate the effect of water walls on the transfer rate, the dotted line in Fig. 10 gives the performance of a similar type of superheater located on the rear wall of a completely cooled stoker fired furnace.

These curves might quite well have been plotted to a base of B.T.U. heat release per cu. ft. of furnace volume per hr., instead of the B.T.U. per ft. wide per hr. base. Experience has shown, however, that for superheater locations other than on the side walls the latter plot serves as a more reliable basis of comparison.

Having determined the design transfer rate, the calculation of the surface required is made in a similar manner to that already described for convection superheaters. Provision for a reasonable margin on the designed surface is advisable in this case also.

Tube Wall Temperature

When selecting a suitable material for the superheater elements, it is essential to know the maximum tube wall temperature that will be encountered in service. A good grade of mild carbon steel is usually satisfactory for wall temperatures up to 900 deg. F. without exceeding the commonly accepted creep limit of one per cent in 100,000 hours, but for higher tube temperatures some form of alloy steel must be employed, the cost of which increases with its ability to withstand elevated temperatures.

In order to determine the wall temperature of a superheater tube, one must first of all know the overall transfer rate from gas to tube, the conductivity of the tube wall, and the steam film coefficient. The former, if not already available, may be calculated from Figs. 7, 8 and 9 in the case of a convection superheater, or from the design transfer curve in the case of a radiant superheater. The conductivity of a mild steel tube is usually taken as 300 B.T.U. per hr. per sq. ft. per deg. F. per in. However, this figure may vary considerably for certain alloys. A KA_2 steel, for example, having a conductivity of only 130 under the same conditions of temperature.

Having worked out these values for a given set of conditions, the determination of wall temperatures is best illustrated by means of an actual example.

Consider a radiant superheater consisting of 1.500 in. O.D. x 1.212 in. 1.D. tubes, close spaced on 1½ in. centres. If the overall transfer rate per sq. ft. of projected wall area is 53,700 B.T.U. per sq. ft. per hr., then the overall transfer rate based on that half of the inside cricumference receiving heat will be:—

53,700 x 2/*r* x 1.500/1.212 B.T.U. per sq. ft. per hr.

This in turn will equal the product of the steam film coefficient, which we will assume as 570 B.T.U. per hr. per sq. ft. per deg. F., and the temperature difference between the inner tube wall and the steam. Solving the equation, we find this temperature difference is 74 deg. F.

If the steam temperature at this point happens to be 720 deg. F., then the inside wall temperature of the tube will be 720 + 74 = 794 deg. F.

By similar reasoning, the temperature drop across the tube wall is given by the following equation:—

53,700 x 2/*r* x 1.500/1.365 = T x 300/0.144

in which

T = temperature drop across tube wall, deg. F.

1.365 = logarithmic mean diameter of the tube, inches.

0.144 = tube wall thickness, inches.

300 = tube wall conductivity, B.T.U. per hr. per sq. ft. per deg. F. per in.

As the outside tube wall temperature is obviously going to be below 900 deg. F., a tube wall conductivity of 300 for mild steel has been assumed.

The solution of this second equation gives a value of T = 18 deg. F. The outside tube wall temperature is therefore 794 + 18 = 812 deg. F.

Usually the highest tube wall temperature occurs at maximum load. It may, however, occur during the starting up period when there is no steam flow to cool the tube, and for this reason the tubes of radiant superheaters are almost invariably made of alloy steel.

Pressure Drop in Superheaters

The permissible pressure drop across a superheater must lie between the lower limit set by considerations of steam

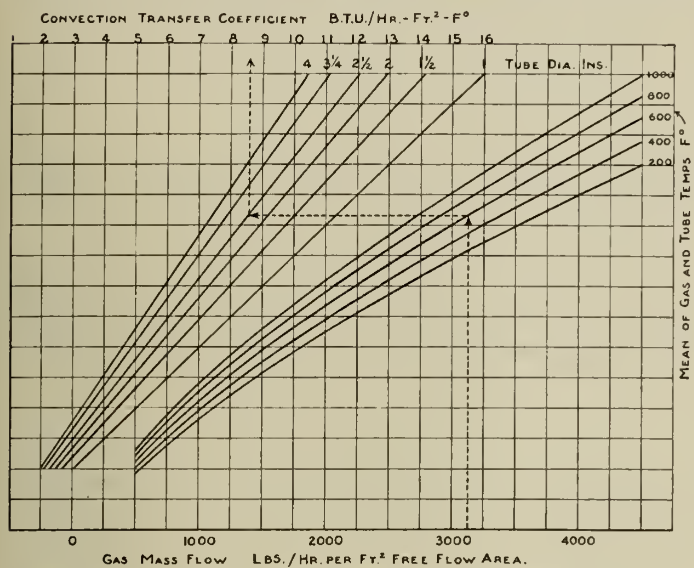

Fig. 7—Convection heat transfer for staggered tube banks.

cooling effect on the element, and the upper limit set by cost considerations of heavier boiler drum and tube construction to withstand the greater pressure difference between drum and steam line. With a low pressure drop across the superheater, the poor cooling effect is further aggravated by a tendency towards poor steam distribution within the superheater, and resultant shortening of the life of the starved elements.

A general rule, which needless to say has many exceptions, is that the pressure drop should be approximately 5 per cent of the drum pressure when operating at normal load. While this indicates the order of the drop to be expected, each case must of course be investigated with reference to its governing factors.

Arrangement of the superheater elements in such a manner as to secure a suitable pressure drop is often complicated by constructional requirements. Whenever possible it is advantageous to use a single pass layout, while considerations of rigidity and strength will in some cases require a minimum element size of very close to 2 in. diameter.

When the number of passes and the tube size are fixed, the pressure drop may be varied by altering the number to carry. Methods of doing this are by 'loop within a loop' constructions, and variations in the element pitch across the boiler. The latter method is somewhat restricted as the element pitch is often governed to a great extent by the boiler tube spacing, and by slagging considerations with solid fuels.

Calculation of the pressure drop in the straight parts of the element is best accomplished by some convenient form of the Fanning equation for turbulent flow in pipes. While the friction factor may be determined very closely for known conditions, an average value for superheater work is 0.006. Entrance and exit losses are of the order of 1.5 Vh, and each 180 deg. bend in the element is likewise 1.5 Vh, where Vh is the velocity head for flow conditions within the element.

In a well designed superheater, pressure loss within the headers is usually negligible. Investigation of a number of satisfactory installations indicates that the internal header area may vary between 0.8 to 1.2 times the area of the tubes per pass. The minimum practical header size is about 4½ by 4½ in. square, or 5 in. internal diameter with flattened sides. Either of these headers will take a handhole for 2-in. elements.

Draught Loss in Superheaters

The draught loss across a superheater should be as low as is consistent with a reasonable rate of heat transfer and satisfactory spacing of elements. In practice the full load draught loss ranges from 0.05 in. of water in natural draught boilers with small superheaters, up to 1.75 or 2.00 in. of water in large mechanical draught central station boilers, operating at high ratings and with a high degree of superheat.

On a 200,000 lb. of steam per hr. boiler operating at 87 per cent efficiency and with 14 per cent CO_2, each increase of 1.0 inch of water draught loss will involve an additional 21 kw. of fan power, which is a considerable item of expense on a yearly basis.

Due to the uncertain path of the gas flow across many forms of superheater, calculation of the draught loss is as much a matter of judgment as the transfer rate determination.

Cases of pure longitudinal flow may be solved by the Fanning equation, the pipe diameter term being replaced by the equivalent diameter of the spaces between the elements. An average value of the friction factor is 0.008.

For cross flow, the following equation gives accurate results when used with the proper friction factors:—

$D_L = f N F^2 T/43{,}000$ in. water.

in which:

f = friction factor
N = number of rows crossed
F = gas mass flow, 1,000 lb. per hr. per sq. ft.
T = average gas temperature, deg. F. absolute.

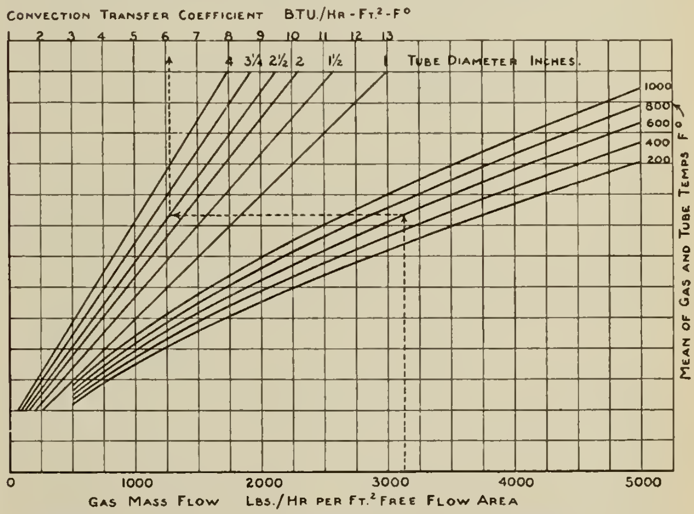

Fig. 8—Convection heat transfer for in-line tube banks.

Max Jakob (*Trans.*, A.S.M.E., May, 1938, p. 385), in a discussion of a paper by E. D. Grimson, gives formulae for determining the value of f for various tube spacings and Reynold's number values. With tube spacings common to superheater installations, f is usually of the order 0.05.

Control of Superheat

With the high steam temperatures in use at the present day, control of final steam temperature over the whole range of operating loads is often a practical necessity, both for reasons of safety and economy. The former will be evident from the fact that sudden temperature variations in large turbine sets can often cause serious stresses in the machine. As an example of the latter, it has been calculated for an American installation of 100,000 lb. of steam per hr. output, that the annual cost of a drop of one deg. F.

in superheat was approximately $400, based on constant full load conditions.

Control of final steam temperature may be secured by the following methods, each of which has its advantages for particular classes of service:—

(*a*) By-pass gas dampers.
(*b*) Desuperheating.
(*c*) Twin furnace boilers.

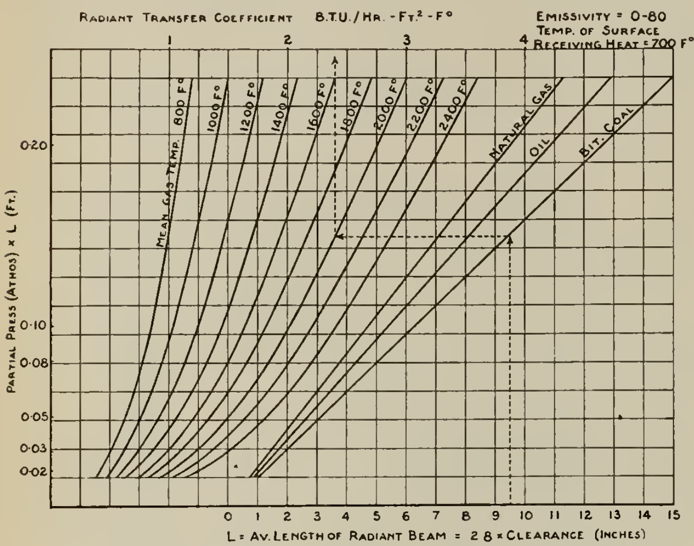

Fig. 9—Non-luminous radiation transfer coefficients.

The first method mentioned is probably the oldest, and was first applied to marine boilers of the Yarrow type, in which the superheater was located on one side of the boiler only. By means of uptake dampers, located one on each side of the boiler, a greater or a less proportion of the furnace gases could be passed up the superheater side as desired, and the degree of superheat varied accordingly. Since then, modifications of this method of control have been used on land boilers, including both header and bent tube types, and by suitable baffling and arrangement of gas passes it may be applied to practically any water tube design.

This type of control has the advantages of simplicity and comparatively low first cost. Its disadvantages are that it can seldom be worked in on existing boilers not originally designed for it, it is not easily adaptable to automatic control, and it gives the least exact regulation of the three methods mentioned above. Unless the dampers can be located in a low temperature zone the upkeep will be high.

Desuperheaters may be either of the surface or direct contact types. The latter type is seldom used in combination with a superheater installation, as accidental flooding of the steam line would have disastrous effects on the prime mover.

Surface type desuperheaters are usually installed in the steam circuit before the last one or two superheater passes. This has the effect of maintaining lower tube wall temperatures than would occur if the desuperheater were installed beyond the superheater outlet.

Continental practice favours a desuperheater consisting of a tube coil submerged in one of the upper boiler drums. When the tube coil is designed to take the whole steam output of the boiler, the drum tends to become overcrowded to an inconvenient degree. Several interesting examples of this type have been installed in water tube boilers in the American Mercantile Marine for desuperheating that portion of the steam output required for auxiliary use. In these instances, the in port demands for auxiliary steam were so large that there would have been a risk of overheating the superheater, had the whole supply been drawn direct from the steam drum.

In marine type of twin furnace boiler, the superheat can be varied from zero to a maximum over the whole operating range. This is a great advantage on high superheat marine turbine installations, as it avoids the necessity of admitting high temperature steam into cold reversing turbines during manoeuvring. In addition it permits of gradual warming up of the machinery after a start, and the normal operating temperature may be varied to give satisfactory moisture conditions in the low pressure blading.

Twin furnace construction has also been applied to land boilers in several different forms. A recent American installation consists of a bent tube boiler over a divided water cooled furnace. The boiler in this case is fitted with a convection superheater, and one section of the furnace only, with a radiant superheater in series with it. By slight alterations in the relative rate of firing of the furnaces, the superheat can be held remarkably constant over a wide load range, or varied at will when under constant load. An incidental advantage of this installation is that it is possible to raise steam on the furnace containing no radiant superheater surface, and the usual starting up precautions with this type of superheater are thereby avoided.

Twin furnace boilers of small and medium size are relatively expensive, and to date this method of superheat control has only been applied to units of large capacity. The example described above is a pulverized coal fired unit of 625,000 lb. per hr. normal output.

Operation of Superheaters

The critical period of superheater operation is invariably that during the starting up procedure, when overheating of the surface is most liable to occur. This risk is always present until a reasonable steam flow has been established in the elements.

The characteristics of the various kinds of superheaters will indicate that risk of overheating is least with the convection and separately fired types, and greatest with the intertube and radiant types. The latter in particular, often present a problem requiring careful study.

Numerous attempts have been made to neutralize the danger of overheating, usually by water sprays, steam circulation from an independent source, or some form of flooding gear. In practice, however, none of these methods has been developed to a thoroughly satisfactory stage. Water spraying through atomizing nozzles in the headers appears to be the most suitable form of artificial cooling, though this requires constant attention on the part of the operator to prevent accumulations of water in the superheater.

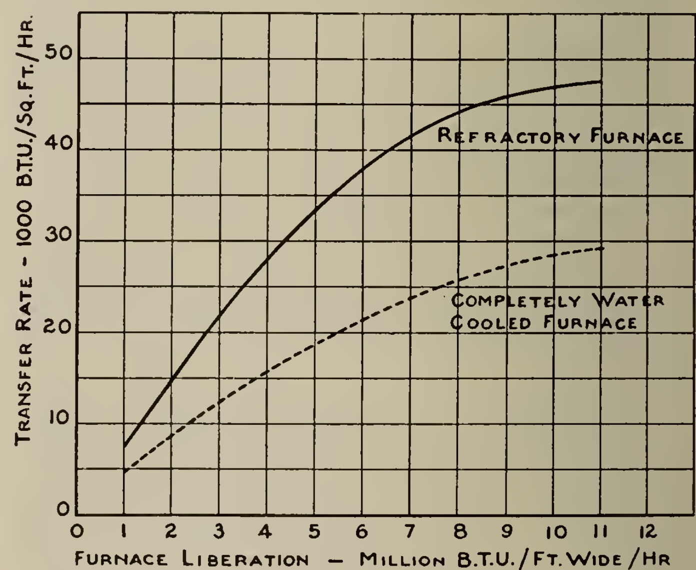

Fig. 10—Typical radiant superheater transfer rates for stoker fired boilers.

During recent years the use of artificial cooling has decreased, and there now exists a preference for very gradual starting up at low firing rates, with the superheater outlet drain kept open until the boiler is on the line. With convection superheaters the firing equipment can usually be cut down to a point where dangerous gas temperatures are not developed in the superheater zone, and in this case the starting up risk is a minimum. With radiant superheaters, particularly on pulverized coal installations, continuous operation of the firing equipment even at its lowest rating and with high excess air will sometimes result in the building up of dangerous furnace temperatures, and it becomes necessary to start up with intermittent firing. This procedure consists of firing at a low rate for a five or ten minute interval, and then cutting out for a similar period. While this involves considerable attention and manipulation on the part of the operators, the starting up period is usually not excessive, and large units can be put on the line within two or three hours from cold without risk of overheating.

Front wall radiant superheaters in stoker fired furnaces usually present little difficulty to the operator when he can carry his highest compartment pressure well down the grate. An overfire air supply is of considerable assistance in this case, as it can be used to prevent flame from running up the superheater elements.

BY-LAWS OF THE ENGINEERING INSTITUTE OF CANADA

THE BY-LAWS OF THE INSTITUTE—REWORDING AND REARRANGEMENT

Under an amendment adopted in 1937, the council was empowered to arrange at intervals of not less than three years for the rewording and rearrangement of the by-laws, the resulting proposals to become effective only after approval by the council and the executive committees of the branches, followed by publication in the Journal, and approval by an annual general meeting of the Institute.

In March, 1938, a resolution of the council assigned this work to the secretary-emeritus, and the version of the by-laws which is now presented, received the council's informal approval in January, 1940. Since that time there have been included the changes made necessary by the amendments adopted by ballot in May, 1940, which abolished the class of Associate Member, and increased the number of vice-presidents.

It will be noted that although no new matter has been introduced, the sections have been regrouped, and their number increased from seventy-five to eighty-one, as shown in the attached list of old and new sections. These changes have been made for the sake of clarity, and in the hope that a new and more logical arrangement would as far as possible avoid the necessity of looking in two or more places for information about a single subject. In a few cases phrases have been reworded to avoid apparent inconsistency or ambiguity.

The resulting new version now awaits formal approval by resolution of the council and by the executive committees of a majority of the branches. It will finally become effective if and when approved by formal motion at the next annual general meeting of the Institute.

It is printed herewith for the information of members and in accordance with the by-laws.

L. Austin Wright, *General Secretary.*

Montreal, July, 1940.

Objects

Section 1.—The objects of the Institute shall be (*a*) to develop and maintain high standards in the engineering profession, (*b*) to facilitate the acquirement and the interchange of professional knowledge among its members, (*c*) to advance the professional, the social and the economic welfare of its members, (*d*) to enhance the usefulness of the profession to the public, (*e*) to collaborate with universities and other educational institutions in the advancement of engineering education, (*f*) to promote intercourse between engineers and members of allied professions, (*g*) to co-operate with other technical societies for the advancement of mutual interests, (*h*) to encourage original research, and the study, development and conservation of the resources of the Dominion.

Membership

General Qualifications for Membership

Section 2.—An engineer who has been engaged as prescribed in sections 7, 9, or 10 in the design or construction of engineering works such as railways, canals, harbours, lighthouses, bridges, roads or river improvements, or engaged in hydraulic, transportation, municipal, sanitary, electrical, mining, metallurgical, chemical, mechanical, naval, military, aeronautical or any other branch of engineering, shall be eligible for admission to The Engineering Institute of Canada.

Classes of Members

Section 3.—The membership of the Institute shall consist of Honorary Members, Members, Juniors, Students and Affiliates. Members, and Honorary Members who have previously been corporate members, shall be styled corporate members. Juniors, Students, Affiliates, and Honorary Members who have not previously been corporate members, shall be styled non-corporate members. Non-corporate members shall not be entitled to vote on Institute affairs, or to hold office as an officer of the Institute or as chairman or vice-chairman of a provincial division or branch, or to vote on provincial division or branch affairs, except as hereinafter provided. Juniors shall be entitled to vote on branch affairs, and to hold branch offices other than those of chairman or vice-chairman.

Titles

Section 4.—Any Honorary Member, Member, Junior, Student or Affiliate, having occasion to designate himself as belonging to the Institute, shall state the class to which be belongs according to the following abbreviated forms: Hon.M.E.I.C., M.E.I.C., Jr.E.I.C., S.E.I.C., Affiliate E.I.C.

Resident and Non-Resident Members

Section 5.—Corporate and non-corporate members residing in Canada and not more than twenty-five miles from the headquarters of a branch, shall be styled branch residents. All others resident in Canada, but more than twenty-five miles from a branch headquarters, shall be styled branch non-residents. Those residing outside of Canada shall be styled non-residents.

Honorary Members

Section 6.—Honorary Members shall be chosen from those who have become eminent in engineering or kindred sciences.

Members

Section 7.—A 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 or 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.

Section 8.—Upon the adoption of these By-laws, all Associate Members of the Institute shall *ipso facto* become Members, and the present class of "Associate Member" is hereby abolished.

Juniors

Section 9.—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.

Students

Section 10.—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.

Affiliates

Section 11.—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.

Admission and Transfer of Members

Honorary Members

Section 12.—Honorary Members shall be elected by unanimous vote of the council given by letter ballot, one month's notice having been given to the members of the council of the names of the nominees, and of the meeting at which it is proposed to canvass the ballot.

The number of Honorary Members shall not exceed twenty.

The general secretary shall write the Honorary Member advising him of his election, and shall request him to notify the Institute by letter of his acceptance within three months. Failing such acceptance, his election shall be void.

Applications for Admission or for Transfer

Section 13.—Applications for admission to the Institute, or for transfer from one class to another, shall be made upon forms approved by the council and shall contain a statement, over the applicant's signature, of his age, residence, the record of his engineering experience, and an undertaking to conform to the by-laws and regulations of the Institute if elected or transferred. The applicant shall give as references the names of at least five corporate members, from whom the council shall obtain satisfactory evidence in writing that they know the applicant personally, and that he is worthy of admission or transfer. An application for admission as Student shall require the name of only one corporate member as a reference.

Consideration of Applications for Admission or for Transfer

Section 14.—Immediately upon receipt of an application the general secretary shall forward a copy thereof to the secretary of the branch, if any, to which the applicant belongs or would belong. 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.

There shall be published from time to time in the Journal of the Institute or otherwise issued to corporate members as the council may direct, a list of 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 general secretary any information in their possession which may affect the classification or eligibility of the applicant.

The general 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. These recommendation-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.

Election and Transfer of Applicants

Section 15.—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 recommendation-forms referred to in Section 14 must have been returned to the general secretary, and the recommendations contained in these forms must have been placed before council.

If in their recommendation-forms five or more members of council oppose the admission or transfer of an applicant, he shall not be elected, otherwise the affirmative vote of three-quarters or more of those present and voting 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.

Applications for membership in the class of Student shall be passed upon by council without the formality of notification to all councillors.

Notification of Election

Section 16.—On the election of a candidate, he shall be notified by the general secretary and he shall then be entitled to the privileges of membership. Membership shall date from the date of election.

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.

Certificates

Section 17.—A certificate shall be issued to all members on election which shall be the property of the Institute. This certificate shall be returned by any member who has resigned, or whose name has been removed from the list of members, on his receipt of notice of such removal or of council's acceptance of his resignation.

List of Members

Section 18.—Council may direct that a list of members with the names arranged alphabetically and geographically, indicating the zones and branches, be sent to corporate members each year.

Notices to Members

Section 19.—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 prescribed dates.

Fees

Entrance Fees

Section 20.—The entrance fees, payable at the time of application for admission to the Institute, shall be as follows:

Members	$10.00
Juniors	5.00
Affiliates	10.00

Honorary Members and Students shall be exempt from entrance fees.

Annual Fees

Section 21.—All annual fees shall be due and payable on the first of January for the calendar year then commencing, at which time a bill for the sum shall be mailed to each member, in accordance with the following schedule of fees:—

	Montreal Branch Residents	All Other Branch Residents	Branch Non-Residents and Non-Residents
Members	$12.00	$10.00	$8.00
Juniors	7.00	5.00	4.00
Students	2.00	2.00	2.00
Affiliates	11.00	11.00	11.00

Honorary Members shall be exempt from annual fees.

A deduction of *one dollar* will be made in the cases of all members who pay their fees prior to March 31st; this will apply to all payments mailed before midnight of that date.

Journal Subscription

Section 22.—In addition to the annual fees provided in Section 21, a subscription of *two dollars* per annum for The Journal of The Institute 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. Branch Affiliates may receive the Journal on payment of an annual subscription of *two dollars.* 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.

Transfer Fees

Section 23.—A member when transferred from any one class to any other shall pay the difference between the entrance fees of the two classes.

Liability of Members

Section 24.—The portion of the first annual fee for which a newly elected member shall be liable shall be a proportion of the regular annual fee based on the unexpired portion of the year, calculated from the beginning of the month in which the election takes place.

Any person once admitted to the Institute shall belong thereto, and be liable for the payment of all fees until be shall have resigned, have been expelled, or have been relieved from payment by the council.

Arrears

Section 25.—The general secretary shall notify any member whose fees become in arrears. No member shall be considered in arrears for any year until after the thirtieth day of June of that year. A member who is in arrears shall not have the right to vote, he shall not receive the publications of The Institute, nor shall he be eligible for office in the Institute or any of its branches.

Should his fees still be in arrears on the first day of October, he shall again be notified in form prescribed by the council, and if still in arrears on the first day of January of the year following, he shall forfeit his connection with the Institute and shall be so notified by the general secretary.

The council, however, may for cause deemed by it sufficient, extend the time for payment and for the application of these penalties.

Exemptions

Section 26.—The council may for sufficient cause temporarily excuse from payment of annual fees any member who from ill health, advanced age, or other good reason assigned, is unable to pay such fees, and the council may remit the whole or part of fees in arrears.

The council, at its discretion, may as a privilege exempt from further payment of annual fees any corporate member who has reached the age of sixty-five, or who has been a corporate member for thirty years, or who has rendered signal service to the Institute. The names of such members shall be placed on a Life Membership List.

Re-Admission

Section 27.—The council, at its discretion, may re-admit, with or without the payment of a second entrance fee, any person who has resigned or who has ceased to be a member for non-payment of fees, provided that all arrears have been paid.

Compounding of Fees

Section 28.—At the time of his election a corporate member may compound all future annual fees by a single payment of two hundred and fifty dollars. A corporate member in good standing after ten years of corporate membership may compound his future annual fees by a single payment of one hundred and fifty dollars, and after fifteen years of corporate membership by a single payment of one hundred dollars. The money thus received shall be invested and only the income thereof used for the current expenses of the Institute.

Management

Officers

Section 29.—The officers of the Institute shall be a president, six vice-presidents, one councillor from each branch having less than two hundred corporate members, two councillors from each branch having two hundred and less than four hundred corporate members, three councillors from each branch having four hundred corporate members, and an additional councillor from each branch for each two hundred corporate members over four hundred.

Term of Office

Section 30.—The term of office of the president shall be one year, of the vice-presidents two years, and of the councillors two years, except in the case of councillors representing branches entitled to three or more councillors, whose term of office shall be three years.

At least three vice-presidents shall be elected each year, one each from Zones (*b*) and (*c*), and one from Zones (*a*) and (*d*) alternately.

At least one councillor shall be elected each year from each branch entitled to two or more councillors, and one councillor shall be elected each alternate year from each branch entitled to one councillor. The elections for branches entitled to one councillor shall be so held that as nearly as possible one half of such branches shall elect their councillors in any one year.

The term of each officer shall begin at the close of the annual general meeting at which such officer is elected, and shall continue for the period above named or until a successor is duly elected or appointed by the council.

Vacancies

Section 31.—A vacancy in the office of president shall be filled by the senior vice-president. Seniority shall be determined by priority of election as a vice-president, and failing that, by priority of admission to corporate membership.

A vacancy in the office of vice-president shall be filled until the following annual election by the senior councillor from the zone in which the vacancy occurs. Seniority shall be determined by priority of election as a councillor and, failing that, by priority of admission to corporate membership.

A vacancy in the office of councillor shall be filled until the following annual election by a corporate member chosen by the council from a list of nominees submitted by the executive of the branch concerned.

The Council

Section 32.—The affairs of the Institute shall be managed by a council. This council shall consist of the officers and three honorary councillors who shall be the three surviving past-presidents who have most recently served as presidents and who continue to be members.

The council shall direct the investment and care of the funds of the Institute, shall make appropriations for specific purposes, shall pass upon all applications for admission or for transfer, and in general shall direct the business of the Institute either by its own action or through its officials and committees.

The council shall not incur any expenditure for extraordinary purposes unless previously authorized to do so at an annual general meeting, or at a special general meeting called for that purpose.

The council shall make a report at each annual general meeting, transmitting the reports of the treasurer and of committees.

The President

Section 33.—The President shall have general supervision of the affairs of the Institute and shall be ex-officio a member of all committees.

The General Secretary

Section 34.—The general secretary shall be a corporate member of the Institute. He shall be appointed by the council and shall hold office subject to removal by an affirmative vote of a majority of the members of the council.

He shall be the executive official of the Institute under the direction of the president and the council.

He shall attend all meetings of the Institute and of the council; he shall present the business therefor and record the proceedings thereof.

He shall see that all moneys due to the Institute are carefully collected, and deposited with the funds of the Institute.

He shall personally certify the accuracy of all bills or vouchers on which money is to be paid and present them to the finance committee for their approval. He, or in the case of his absence or inability to act, the treasurer, together with any one member of the finance committee shall have authority on behalf of the Institute, to draw, accept, sign, make and agree to pay all or any bills of exchange, promissory notes, cheques and orders for the payment of money.

He shall be responsible for the editing of the publications of the Institute.

He shall have charge of the books and accounts of the Institute.

He shall conduct the correspondence of the Institute and keep full records of the same.

He shall be in responsible charge, under the president and the council, of all the property of the Institute.

He shall, with the approval of the council, employ such help as may be necessary and shall be responsible for the work of all employees of the Institute.

He shall perform such other duties as may be assigned to him by the council.

His time shall be devoted solely to the affairs of the Institute.

He shall give a bond for the faithful performance of his duties, in a sum to be fixed by the council, at the expense of the Institute.

The Treasurer

Section 35.—The treasurer shall be a corporate member of the Institute. He shall be appointed by the council and shall hold office subject to removal by an affirmative vote of a majority of the council.

He shall attend meetings of council and shall prepare and present annually to the council in time for the annual general meeting a financial statement, as of the 31st December, of the affairs of the Institute. He shall furnish from time to time such other reports as may be prescribed.

He shall, with the general secretary, invest the funds of the Institute as may be ordered by the council.

Nomination and Election of Officers

Electoral Districts and Zones

Section 36.—For the purpose of the nomination and election of officers the membership of the Institute shall be divided into branch districts for the election of councillors, and zones for the election of vice-presidents. The branch districts shall be determined by the council. The four vice-presidential zones shall be (*a*) the Western Zone, (*b*) the Ontario Zone, (*c*) the Quebec Zone, and (*d*) the Maritime Zone. The zone boundaries shall be determined by the council.

Election of Nominating Committee

Section 37.—The nomination of officers of the Institute shall be made by a nominating committee. The honorary councillors shall be ex-officio members of this committee. The remaining members, who shall not be officers of the Institute, shall be elected annually as follows:—Each branch shall appoint one member, an additional member appointed by the council shall be chairman of the committee. The membership of the committee shall be announced at the annual general meeting.

Vacancies in the nominating committee as announced at the annual general meeting shall be filled by council from the nomination or nominations submitted by the branch in which the vacancies occur.

Meetings of Nominating Committee

Section 38.—The nominating committee shall meet not later than the first of August to nominate officers for the ensuing year.

Three members shall constitute a quorum, and members unable to be present may vote by letter.

List of Nominees for Officers

Section 39.—The nominating committee shall prepare a list of nominees for officers, which shall contain the names of one or more nominees for each office to be filled, with the exception of that of president, for which only one name may be submitted.

A vice-president shall be elected by vote of the corporate members resident within the zone for which he is a candidate. One vice-president each shall be elected from zones (*a*) and (*d*) and two vice-presidents each from zones (*b*) and (*c*). One of the vice-presidents for zone (*c*) must be resident within twenty-five miles of the headquarters of the Institute.

A councillor shall be elected by vote of the corporate members resident within the branch district for which he is a candidate.

The list of nominees for officers shall be forwarded by the nominating committee to reach headquarters not later than the fifteenth day of September, for presentation to council at a meeting to be held not later than the thirtieth day of September, and should be accompanied by a letter of acceptance of nomination from each nominee.

The council shall examine the list of nominees for officers submitted by the nominating committee. If the council find a nominee ineligible for the office for which he is nominated, or should the consent in writing of a nominee to appear on the list of nominees for officers not be furnished before the first meeting of council in October, or should any nominee after such consent withdraw his name, such name shall be deleted, and, if necessary, the council shall substitute another name therefor. The words "Proposed by Nominating Committee" and "Proposed by Council" shall be printed conspicuously on the list of nominees for officers, to indicate the manner of nomination of all nominees.

Publication of Nominations

Section 40.—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

Section 41.—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 general 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.

Officers' Ballot

Section 42.—A ballot form, prepared in accordance with the list and additional nominations (if any) shall be mailed to corporate members at least thirty days before the annual general meeting, and shall state the name and residence of each nominee, his class of membership and the zone or branch district in which he resides. The names of the nominees for each office shall be arranged alphabetically by zones and branches.

Voters may strike out names from this officers' ballot and may substitute other names therefor, but the number of votes cast for each office must not exceed the number to be elected to such office. In voting for councillors, each voter shall vote for the councillor to be elected from his own branch. Directions in accordance with the above provisions shall be printed conspicuously on the officers' ballot, and any vote which does not comply with them shall be rejected.

Canvass of Officers' Ballot

Section 43.—Officers' ballots must be delivered to the general secretary before twelve o'clock noon of the first day of the annual general meeting when the polls shall be closed and the ballot shall be canvassed publicly by scrutineers appointed either by the meeting or with its consent by the presiding officer.

Elections

Section 44.—The nominee receiving the highest number of votes for any office shall be declared elected to such office.

In case of a tie between two or more nominees for the same office, the corporate members present at the annual general meeting when the result of the ballot is announced, shall elect by ballot the officer from among the nominees so tied. In case of a further tie the presiding officer shall cast the deciding vote.

The presiding officer shall announce to the meeting the names of the officers elected in accordance with this section.

Appointment of General Secretary, Treasurer and Committees

Section 45.—The council shall meet within seven days after its election and shall then appoint the general secretary, the treasurer, and the following standing committees:—

A finance committee of five members, including the treasurer.
A library and house committee of five members.
A papers committee as prescribed in section 48.
A publication committee of five members.
A legislation committee of three members.

The chairman of each standing committee shall be a member of the council.

Standing committees shall perform their duties under the supervision of the council, and shall report to the council.

STANDING AND SPECIAL COMMITTEES

Finance Committee

Section 46.—The finance committee shall have immediate supervision of the financial affairs of the Institute; it shall employ an expert accountant to audit the books and to certify the annual statements; it shall approve all bills before payment, and shall make recommendations to the council as to the investment of moneys, and as to other financial matters.

A member of the finance committee shall countersign all cheques drawn by the general secretary.

Library and House Committee

Section 47.—The library and house committee shall have general supervision of the library and house of the Institute and the property therein; shall make recommendations to the council with reference thereto, and shall direct the expenditure for books and other articles of permanent value, of such sums as may be appropriated for these purposes.

Papers Committee

Section 48.—The papers committee shall be composed of representative members selected, as far as possible, from the several branches. The committee shall advise and assist in obtaining papers for the meetings of the Institute and its branches.

Papers which have been published previously, which advocate personal interests, which are prepared carelessly, which controvert established facts or are purely speculative or foreign to the objects of the Institute, shall not be accepted for publication.

Publication Committee

Section 49.—The publication committee shall be composed of members representative of the principal branches of the engineering profession. The committee shall decide whether papers submitted to it, either by the author directly, or through any of the branches, and the discussions thereon, shall be printed for advance circulation or published. It shall also advise the general secretary in the editing of the publications of the Institute.

An appeal from the decisions of the committee may be made to the council upon the signed application of five corporate members.

The right of prior publication of all papers accepted to be read at a branch or professional meeting is reserved by the Institute. Any such paper not accepted for publication shall be returned promptly to the author.

No paper shall be considered eligible for any of the prizes of the Institute, which has been published elsewhere prior to its publication by the Institute, unless so published with the consent and approval of the publication committee, officially transmitted by the general secretary.

Legislation Committee

Section 50.—The legislation committee shall consider all suggestions and reports concerning legislation which may be made by a branch or provincial division. It shall keep itself advised of all legislation, either actual or proposed, which is likely to affect the interests of the Institute or of its members, and shall report to the council thereon.

Special Committees

Section 51.—The council at any time may appoint special committees to report upon engineering subjects or upon other matters of interest to the Institute. The annual general meeting may recommend to the council the appointment of special committees, and such recommendations shall be considered by the council at the first meeting following the annual general meeting.

Special committees shall perform their duties under the supervision of the council, and shall report to the council.

MEETINGS

Annual General Meeting

Section 52.—The annual general meeting of the Institute shall begin on the fourth Tuesday in January, or on such other day in January as the council may direct, and notice thereof shall be mailed to the members twenty-one days before the date of the meeting.

The council shall lay before the meeting a report of the proceedings of the Institute for the year ended on the thirty-first day of December preceding. This report shall be approved by the council and be signed by the president and the general secretary. The financial statement of the treasurer and the reports of standing committees, branches, provincial divisions and such other reports as the council may determine, shall be presented. The address of the retiring president shall be delivered. The vote for the election of officers for the current year shall be announced. Any other business of interest to the Institute may be brought before and transacted at the meeting.

The council may adopt, from time to time, rules for the order of business at annual general meetings, which shall be printed in the notice calling the meeting.

Thirty corporate members shall constitute a quorum.

Special General Meetings

Section 53.—Special general meetings of the Institute may be called by the council, and shall be so called on receipt of written requests from thirty corporate members or from a majority of the branches. The notice for such a meeting shall state the specific object thereof and shall be mailed at least thirty days before the date of the meeting. No other business shall be taken up.

Thirty corporate members shall constitute a quorum.

General Professional Meetings

Section 54.—General professional meetings of the Institute may be held at such places and times as the council may direct, for the presentation of papers and the discussion thereof, visiting engineering works of interest, and generally for professional intercourse. Such meetings shall be conducted by the officers of the provincial division in the province in which the meeting is held, or if no provincial division has been established therein, by the officers of a branch in that province to be selected by the council. The general secretary of the Institute shall act as secretary of the meeting and shall furnish a report of the meeting for the transactions of the Institute.

Meetings of Council

Section 55.—The council shall meet at least once each month, from the beginning of October to the end of April, and at such other times as may be deemed necessary.

Five members shall constitute a quorum.

Presiding Officer

Section 56.—In the event of the absence of the president, one of the vice-presidents, or in the event of their absence, a member of the council, shall preside at all meetings of the Institute and of the council.

In the absence of the officers above mentioned, the meeting shall select a member to act as chairman.

Meetings of Standing Committees

Section 57.—Standing committees, except the papers committee, shall meet at the call of their chairmen at such times as may be found necessary to transact properly the business before them.

Three members shall constitute a quorum.

Branches

Formation and Title

Section 58.—A branch of the Institute may be established under the authority of the council at the request of ten or more corporate members who are desirous of forming themselves into such a branch.

Branches shall be distinguished by the name of their locality, as for example, "The Montreal Branch of The Engineering Institute of Canada."

Branch Functions

Section 59.—The branches shall promote the objects and interests of the Institute, and shall encourage the preparation of papers and addresses on engineering subjects or on subjects of scientific or engineering interest, both for presentation at meetings of the branch, and of the Institute.

Branch Membership

Section 60.—The membership of a branch shall consist of the members of the Institute of all classes residing within an area known as the branch district and so allocated that such members are members of the branch most convenient geographically. Branch districts shall be so apportioned that all members of all classes resident within the Dominion shall be members of a branch. The boundaries of the branch districts shall be determined by the council.

A non-resident member shall have the right to designate himself a member of any branch he may choose, failing which designation he shall be attached, for Institute voting purposes only, to the Montreal branch.

Branch Affiliates

Section 61.—Branches may at their option admit to branch privileges persons not members of the Institute, which persons shall be styled "Branch Affiliates." The qualifications, fees and privileges of Branch Affiliates shall be such as may be specified by branch by-laws

Branch Management

Section 62.—Each branch shall be managed by an executive committee which shall include:—

(*a*) A chairman, secretary and treasurer, and not less than three other members, all to be known as elected members and to be balloted for by all members of the branch entitled to vote at branch elections. The secretary and treasurer may, as an alternative, be appointed by the executive committee, instead of being elected by the members of the branch.

(*b*) Those members of the council resident within the jurisdiction of the branch, to be known as ex-officio members, and

(*c*) The immediate past-chairman and the immediate past-secretary of the branch, to be known as members emeriti, these latter to be members for only the year immediately following their term of office.

Sections of Branches

Section 63.—At the request of ten corporate members of a branch made in writing to the secretary of the branch, and approved by the executive committee, sections of the branch shall be established, corresponding to any of the generally recognized branches of the engineering profession, such as chemical, civil, electrical, mechanical, mining, etc.

Student or Junior sections may likewise be established at the request of ten members of a branch, made in writing to the secretary of the branch, and approved by the executive committee. The rules for such sections shall be submitted to the council for approval.

Branch By-Laws

Section 64.—Branches shall adopt by-laws governing the election of officers, the holding of meetings, and other matters of local jurisdiction. As far as possible, there shall be uniformity in the by-laws of all branches of the Institute. The draft of such by-laws, and of amendments or additions thereto, shall be submitted to the council for approval, and shall then be submitted by letter ballot to the vote of the corporate members and Juniors of the branch for final adoption.

Branch Reports

Section 65.—Each branch shall submit an annual report of its proceedings and of its finances, to the general secretary, who shall present it to the annual general meeting of the Institute.

Branch Revenue

Section 66.—The general secretary shall each year remit to each branch a rebate of the annual fees, current or arrears, received from the members of that branch during that year, payments being made quarterly, as follows:—Thirty per cent to all branches having a corporate membership of less than one hundred; twenty-five per cent to all branches having a corporate membership of one hundred and less than two hundred; and twenty per cent to all branches having a corporate membership of two hundred or more.

For the purpose of this by-law, the branch membership list shall be revised on the first day of January and the first day of July in each year, but the change shall not be retroactive except in the case of new admissions to the Institute.

Financial Responsibility

Section 67.—The establishment of a branch shall not release members from any of their obligations to the Institute, nor shall the Institute be liable for any expense incurred by a branch.

Branch Procedure

Section 68.—Where not otherwise provided for, the branches shall conform in rules of order and general procedure to the methods and rules adopted by the Institute.

Provincial Divisions

Formation and Membership

Section 69.—A provincial division of the Institute may be established under the authority of the council, at the request of a majority of the corporate members residing in any province. Members of the Institute, of all classes, residing within such province, shall be members of the provincial division so formed.

Management

Section 70.—Each provincial division shall be managed by an executive committee consisting of (*a*) those members of council resident within the division, (*b*) one representative to be appointed by the executive of each branch of the division, (*c*) the officers of the division, (*d*) the past-chairman and the past-secretary-treasurer for the year following their term of office.

All members of the committee shall be corporate members, and four members shall constitute a quorum.

Officers

Section 71.—The officers of a provincial division shall be a chairman, a vice-chairman, and a secretary-treasurer, or a secretary and a treasurer, who shall be elected by the executive committee of the division.

By-Laws

Section 72.—Provincial divisions shall adopt by-laws governing the election of officers, the holding of meetings, and other matters of local jurisdiction. As far as possible, there shall be uniformity in the by-laws of all provincial divisions of the Institute. The draft of such by-laws, and of amendments or additions thereto, shall be submitted to the council for approval, and shall then be submitted by letter ballot to the vote of the corporate members of the provincial division for final adoption.

Reports

Section 73.—The secretary of a provincial division shall transmit to the council, copies of minutes of all meetings and reports of all proceedings of the division. He shall also present an annual report to the general secretary, who shall present it to the annual general meeting of the Institute.

Rules and Procedure

Section 74.—Where not otherwise provided for, provincial divisions shall conform in rules of order and general procedure to the methods and rules adopted by the Institute.

Specifications of The Institute

Adoption of Specifications

Section 75.—Specifications of the Institute shall be adopted by letter ballot of the corporate members.

Reports of special committees on specifications shall be issued to the membership after presentation to the council, and shall be open for discussion by all members for a reasonable period. All discussion thereon shall be forwarded to the special committee before a date fixed by the council, and the committee shall then present a final report to the council, which report shall be issued to the membership, and the council shall determine whether it shall be voted upon for adoption by the Institute. If the report be submitted for adoption, the secretary shall issue a letter ballot to corporate members in a form prescribed by the council, and an affirmative vote of two-thirds of all valid ballots shall be necessary for adoption. The ballot shall be canvassed by scrutineers appointed by the council, and the result of the voting shall be announced to the membership.

Discipline

Expulsion and Discipline

Section 76.—(*a*) The council shall have the right to expel from the Institute any corporate or non-corporate member who may be convicted by a competent tribunal, of felony, embezzlement, larceny, misdemeanour, or other offence which in the opinion of the council renders him unfit to be a member. Such expulsion shall be effected by causing the name of such member to be erased from the register of members, and such member shall not be entitled to receive previous notice of such expulsion, but upon such expulsion shall be notified in writing by the secretary to that effect.

(*b*) If, in the opinion of the council, any corporate or non-corporate member be guilty of a breach of the code of ethics adopted by the Institute or have acted in a manner unbecoming to a member of the Institute or in a manner detrimental to the character, reputation or interests of the Institute, or adverse to the objects of the Institute, the council may discipline such offending member by:

1. Censuring such member in writing by letter addressed to him by the general secretary or by having such member appear in person before the council for the purpose of receiving such censure; or,

2. Suspending the membership of such member for such length of time as the council sees fit; or,

3. Causing the name of such member to be erased from the register and thereby expelling him from the Institute.

Any enquiry or investigation with a view to disciplining a member as aforesaid, may be instituted by the council at any time by its own action, or upon the complaint in writing of any member or members, addressed to the general secretary, who shall submit the same for consideration to council at its next meeting, and such enquiry and investigation shall be conducted in such manner and to such extent and at such time or times as the council may in its absolute discretion decide. No verbal or anonymous complaint against any corporate or non-corporate member shall be considered or acted upon by the council. If the council be of the opinion that any complaint is trivial and not of sufficient gravity or importance to justify an enquiry, the general secretary shall notify the complaining member to that effect, and the council shall not be obliged to take any further action in regard thereto and no further record shall appear in the minutes.

No disciplinary action as aforesaid shall be taken by the council unless the same has been approved by the affirmative vote of at least three-fourths of the members of the council present at a meeting specially called for the purpose of considering the same, and at which at least twelve members of the council are present. Should the complaining member or offending member be a member of council, he shall not act as a member of council at any such enquiry or vote on any matter relating thereto.

Any member, whose conduct or action is to be made the subject of enquiry with a view to disciplinary action as aforesaid, shall be entitled to be notified by the general secretary by registered letter addressed to his last known place of residence and specifying the nature of the charges against him, and before any such disciplinary action is taken by the council, such offending member shall be given a fair opportunity of being heard by the council, either by appearing in person before it, or, subject to the approval of the council, by submitting to the council a sworn statement in writing addressed to the general secretary.

If the council, after holding an enquiry, decides to take disciplinary action, the same shall be duly recorded and the offending member notified in writing thereof by the general secretary.

Letter Ballots

Enclosure of Letter Ballots

Section 77.—All ballots to be valid shall be enclosed within two sealed envelopes; the outer envelope shall be endorsed with the signature of the voter, but the inner envelope, containing the ballot, shall have no identifying mark upon it.

Co-operation with Professional Associations

Agreements with Associations

Section 78.—The council may co-operate with any association or corporation of professional engineers constituted by an Act of any Province of the Dominion of Canada (hereinafter referred to as "the Association") in furtherance of the mutual interests of the members of the Institute and of the Association. To this end, the council may, notwithstanding the foregoing by-laws, enter into an agreement with the Association regarding—

(*a*) The admission and classification as members of the Institute (in accordance with the foregoing by-laws insofar as the council in its discretion deems advisable) of applicants for membership in the Institute who are members of the Association;

(*b*) The amount, if any, and method of collection of entrance fees payable by applicants for membership in the Institute who are members of the Association;

(*c*) The amount and method of collection of annual fees payable by members of the Institute who are also members of the Association;

(*d*) Provision for the termination of the said agreement;

(*e*) Any other provisions necessary for the carrying out of the said agreement.

To become effective, the said agreement, after publication in the Journal of the Institute, must be sanctioned by—

(1) An affirmative vote of two-thirds of the letter ballots cast by the members of council; and

(2) An affirmative vote of a majority of all valid letter ballots cast by the corporate members of the Institute resident within the Province of the Association.

Component Associations

Section 79.—An association which enters into an agreement in accordance with the provisions of Section 78 shall, when requested by the Association and for the purpose of that by-law, be termed a "Component Association."

Changes in By-Laws

New By-Laws—Amendments—Repeal

Section 80.—Proposals to introduce new by-laws or to amend or repeal existing by-laws shall be presented in writing to the council, signed by at least twenty corporate members, and shall reach the general secretary not later than the first day of October. The council shall consider the proposals and the proposers shall be notified of the opinion of the council in regard thereto not later than the seventh day of November. The proposers may then withdraw their proposals, accept any changes suggested, or insist on the original form, sending their decision to the general secretary not later than the fifteenth day of December. The proposals, as accepted by the proposers, shall be mailed to corporate members not less than twenty-one days before the annual general meeting. Proposals to introduce new by-laws or to amend or repeal existing by-laws, may also be made by the council and shall be mailed to corporate members not less than twenty-one days before the annual general meeting.

All proposals shall be submitted for discussion at the annual general meeting; the members there present may propose an amendment or amendments thereto, and all proposals together with such amendment or amendments as are approved by the annual general meeting shall be printed on a letter ballot to be submitted to the corporate membership of the Institute. The general secretary shall issue the letter ballot not later than two months after the annual general meeting. The reasons advanced for and against the proposals edited by a committee appointed by the chairman consisting of an equal number of members favouring and members opposing the proposals shall accompany the letter ballot. The letter ballot shall be returnable to the general secretary not later than three months after the annual general meeting. Scrutineers appointed by the council shall immediately thereafter count the ballots and report the result to the council.

An affirmative vote of two-thirds of all valid ballots shall be necessary for the amendment or repeal of existing by-laws, or for the adoption of new by-laws.

The by-laws as revised shall take effect forthwith, except that changes affecting the tenure of office of an officer of the Institute shall not take effect until the next annual election.

Rewording or Rearrangement

Section 81.—Notwithstanding anything to the contrary, the council may, at intervals of three years, strictly for purposes of clarification and simplification, re-word any by-law or re-arrange the by-laws. Such re-wording and/or re-arrangement shall become effective if and when it has been (i) approved by a majority of members of the council upon letter ballot, (ii) approved by the resolutions of the executive committees of a majority of the Institute branches, (iii) published in the Journal, and (iv) finally approved, upon a formal motion to that effect, at a regular business session of an annual general meeting of the Institute.

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CANADIAN COAL PRODUCTION GAINS

Coal production in Canada during the first quarter of 1940 totalled 4,529,273 tons compared with 3,676,847 in the corresponding period a year ago. The production this year included 3,335,753 tons of bituminous, 1,068,883 tons of lignite, and 144,637 tons of sub-bituminous.

Operators in Nova Scotia mined 1,900,582 tons, an increase of 46 per cent over the tonnage produced in the corresponding months of 1939. Production in Alberta amounted to 1,698,607 tons made up of 836,221 tons of bituminous coal, 144,637 tons of sub-bituminous, and 717,749 tons of lignite. In the first quarter of 1939 Alberta produced 597,056 tons of bituminous, 147,499 tons of sub-bituminous, and 774,023 tons of lignite. Mines in British Columbia produced 466,016 tons of coal as against 348,358 tons a year ago. Saskatchewan's output was recorded at 350,469 tons, and New Brunswick accounted for 132,934 tons.

Canada imported 1,345,315 tons of coal during the period under review as compared with 1,436,563 tons in the first three months of 1939. Receipts from the United States were five per cent lower and consisted of 413,475 tons of anthracite, 881,274 tons of bituminous and 778 tons of lignite. Great Britain supplied the remainder of the importations.

Coal made available for consumption in Canada during the first quarter of 1940 totalled 5,765,944 tons or 15 per cent above the tonnage made available during the months of January, February and March of 1939.— *Canadian Resources Bulletin.*

Abstracts of Current Literature

Contributed abstracts of articles appearing in the current technical periodicals

ATOMIC POWER

URANIUM 235-POWER FUEL OF THE FUTURE?

By Philip W. Swain, Editor, *Power*, New York, July, 1940

Abstracted by L. M. Arkley, M.E.I.C.

In June 1939, Drs. O. Hahn and E. Stressman of Germany bombarded uranium with neutrons and thereafter found traces of lighter elements having about one half the atomic weight of uranium. Immediately, laboratories in Europe and the United States commenced work on this problem and in a short time American experimenters of Columbia University and the Carnegie Institution of Washington had proved by tests that the bombardment of uranium by neutrons actually does split up uranium into light substances with tremendous energy release.

Uranium, heaviest of all metals, has three forms (chemists call them isotopes). In most chemical and physical respects they are practically identical. These isotopes are called uranium 234, uranium 235 and uranium 238; the numbers being the respective atomic weights. It has been proved by actual laboratory tests that a relatively slow atomic projectile impinging on the nucleus of an atom of 235 will explode it, breaking the massive atom into two atoms of substances about half as heavy.

More important still, it has been proved that the fragments of this explosion have far greater energy than that of the original projectile so that the energy released is practically all net gain. These moving fragments of a terrific atomic explosion are easily brought to rest by barriers of matter, thereby heating the barriers and delivering their energy as ordinary sensible heat, just as burning coal does. The atomic energy so released is actually a conversion of mass into energy. About 0.1 per cent of the mass of the uranium atom is lost in being transformed.

If every atom in one pound of 235 were thus exploded the heat delivered for outside use would be 37,000,000,000 B.T.U. per lb., therefore uranium 235 as a fuel is equivalent to 1,370 tons of 13,500 B.T.U. coal. Directly or indirectly this heat could make steam. This steam with present-day equipment could easily be converted into 2,700,000 kw.h. of electrical energy, assuming the very conservative conversion efficiency of 25 per cent. This would be enough to operate a 100 hp. motor continuously at full load for three years.

Difficulties in the Way

The above rather rosy picture of limitless power from small bulk of raw materials is somewhat blurred by certain facts which cannot be overlooked. First, uranium is obtained from pitchblende, which is a rather rare mineral, and the separation of the uranium fraction is so difficult that it may be decades before commercial quantities can be obtained. After the uranium has been obtained there is as yet the unsolved problem of separating the 235 from the parasitic 234 and the 238 with which it is always mixed in a state of nature. Every pound of uranium 235 recovered from natural ores is intimately mixed with about 140 lb. of 238 and about 1/120 lb. of 234. Commercial uranium metal always runs about 0.005 per cent of 234, 0.7 per cent of 235 and over 99 per cent of 238. Getting rid of the 238 is the practical problem.

Assuming that several pounds of 235 could be obtained at reasonable cost (it would be cheap at several thousand dollars per lb.), there would still be numerous engineering problems to be solved in transferring the released heat into steam or some other medium. These problems, nevertheless, seem less difficult than that of obtaining the 235.

Future Applications

Waving aside all these practical difficulties and looking forward to an imaginary future state in which they have been solved, it is interesting to attempt prediction of the effect on commercial generation of steam and power. Let us assume that uranium cost per unit of energy output is negligible and that plant investment and labour cost is the same as now.

In that case the only possible saving would be the present cost of coal. In a central station this saving would be from 2 to 4 mills per kw.h. The effect on process steam costs in industry would be more important since the total amount of coal burned to make process steam is two or three times that used by central stations.

Because of its extreme concentration of energy, uranium 235 has an immense appeal to the imagination as the future fuel for house heating and for the powering of planes, autos, ships, etc.

In the household, ten tons of coal could be replaced by the consumption of 1/140 lb. of uranium. With no improvement in conversion efficiency a car that runs 15 mi. on a gallon of gasoline would run about four million mi. on one lb. of uranium, but as intimated before there are many obstacles to be removed before these results could be obtained and the author of the original article, the distinguished editor of *Power*, Philip W. Swain, ends his article in this way, "Obstacles such as these make early practical application of atomic power on a substantial scale unlikely. Nevertheless, uranium 235 gives us the 'makings' of atomic power plants. In the light of the history of science and engineering, eventual application seems probable—perhaps within our lifetime."

MOSCOW'S SPECIAL FLEET

Of British Trolleybuses for Goods Transport

By Robert Williamson, London, Eng.

The modern demand for speedier, smoother and quieter urban transport has resulted in trolleybuses replacing tramcars in many important cities all over the world.

Sometimes called trackless trams, trolleybuses derive their power from overhead electric wires, but are manoeuvreable almost anywhere on the road, can carry up to 70 passengers, and are fitted with pneumatic tyres.

The largest fleet of trolleybuses in the world is operated in London, where there are 1,560 vehicles over 250 miles of route formerly served by tramcars.

During the last few years British engineering firms have been producing large quantities of trolleybuses for overseas services. Special designs are evolved for tropical and subtropical countries, where cool running engines and bodies immunized against temperature and insects are very necessary.

Britain has been able to secure the lead in design and production by pioneering the trolleybus on the streets of her own cities. In spite of the war, researches and experiments are being continued. Some of the latest improvements are automatic sliding doors, electrically operated, and a braking system which safeguards both the tyres and the comfort of passengers.

Many countries in the British Commonwealth are replacing trams with trolleybuses of British manufacture, and they have also appeared in many of the principal foreign countries, including Japan and the Soviet Union. The city of Moscow is probably unique in ordering from Britain a special fleet for goods transport only.

TRENDS IN RAILROAD MOTIVE POWER

By Sidney Whithington, Fellow A.I.E.E., *Electrical Engineering*, April, 1940

Abstracted by H. J. MacLeod, m.e.i.c.

Among the important problems met in railroad operation to-day are those presented by the demand for increasingly high speed in both passenger and freight operation. These involve increased power capacity, refinements in design, braking, and obviously, added capital and operating expense. In general speed limits are imposed by track and other fixed property rather than by motive-power limitations. The light modern train, operating at increasingly higher speeds, often does not require the horsepower capacity of the long heavy train of older cars, but rapid acceleration is important, particularly when runs are short, in meeting schedules now demanded.

Three general types of locomotives have been developed for railroad operation, namely, the steam, the Diesel and the electric. The characteristics of these locomotives are quite different. In the steam locomotive, the horsepower rises with the speed to a maximum point and then falls off. The Diesel locomotive is essentially a uniform horsepower device in which the engine operates at practically uniform speed with no overload capacity. The horsepower ratings of electric locomotives are usually based upon continuance capacity. But the limitation of the power of the traction motors is a temperature limitation and allows the application of considerable overloads for short periods of time.

The relative weights based upon continuous drawbar horsepower capacity are roughly as follows per horsepower: standard steam including tender, 190-220 lb.; Diesel 150-160 lb., and electric 100-120 lb. The ratio of costs, also very approximately stated, are: standard steam 100 per cent, Diesel 330 per cent and electric 250 per cent. If, however, in the case of the electric locomotive, 90 per cent overload can be usefully employed for short periods in a given service, the relative cost could be reduced to perhaps 130 per cent and the weight per horsepower to perhaps 55-65 lb. The relative cost of Diesel locomotives might be materially reduced through quantity production.

Steam Motive Power

The conventional type of steam locomotive has been subject to many important improvements in recent years. Boiler pressure and superheat have been increased, feed-water heaters, mechanical stokers, and many other devices have been added. All these have increased the efficiency, the capacity, and the practicable length of run to a noteworthy degree. The thermal efficiency is now roughly between seven and eight per cent under normal load conditions. Twenty-five years ago few locomotives ran more than 100 miles without being sent to the engine house for inspection and cleaning, whereas now runs of 500 to 800 miles are not uncommon though occasional stops are necessary for fuel and water. This represents one of the greatest increases in economy of operation.

Several designs radically different from the standard locomotive are briefly described. These include the extra high pressure type—up to 1,700 lb., the Velox boiler utilizing combustion under pressure and giving very high efficiency, and the steam turbine locomotive with mechanical or electrical drive.

Diesel Motive Power

The Diesel engine has many advantages in fuel efficiency and in operation and has thus found considerable application in handling relatively light high speed passenger trains through non-congested territory, in yard switching and in local freight transfer operation. The capacity of single prime-mover units normally varies from about 300 to 1,000 hp. The thermal efficiency of the engine is of the order of 25 or 30 per cent. Electric drive is most common and auxiliary electric service operates air-conditioning, lighting, battery charging, refrigeration, radios, telephone and other appliances.

For flat-yard switching the Diesel locomotive characteristics are so nearly ideal that they are being increasingly employed for such service.

Electric Motive Power

Developments in electric locomotives have been made possible by improvements in traction-motor design. The concentration of power may be greater than in the other types since the power plant is not carried in the locomotive. The tendency is towards individual axle drive and away from coupling the drivers by means of side rods. In Europe the link type of drive is most commonly used with pinions and gears usually located outside the driving wheels. In America the quill type is common with the motors usually mounted in pairs and the gears between the driving wheels. As speed and horsepower increase, tracking characteristics become paramount and are obtained by using four-wheel guiding trucks at either end with the driving wheels, usually four or six in number, between on articulated trucks.

Improvements in the design of single phase motors include brush supports, increased number of poles, higher peripheral speed of the commutator, increased efficiency of ventilation and insulation which permits temperatures up to 140 deg. C. In recent years America has adopted the European practice of using oil-cooled transformers. Electric braking is more common in Europe than in America.

Interesting experiments have recently been undertaken in Europe utilizing power at commercial frequencies and single phase distribution—for example, 50 cycles and 20,000 volts. Various types of motors are experimentally operating including a phase convertor with three-phase traction motors, mercury arc rectifiers with standard series wound D.C. motors and single phase series commutator motors utilizing the 50 cycle supply direct. No data are as yet available as to the relative advantages of these different methods of operation.

Conclusion

Each of the three types of locomotives has definite advantages. It may be expected that improvements in each type will continue to be made and that, with further developments in other railroad facilities, the railroads will continue to serve as the country's most important transportation agency.

RAYS IN AIRCRAFT DEFENSE

From *Mechanical Engineering* (New York), May, 1940

Infrared rays are being utilized in the present war to detect enemy aircraft, according to an article by D. W. F. Mayer appearing in the March, 1940, *Discovery* (Great Britain), which ceases publication with this issue after twenty years of existence. These feeble heat rays, that are given out by an airplane engine, may be picked up by sensitive thermocouples and used to detect the presence of enemy aircraft. Such detectors have been in use for several years in astronomical observatories, for measuring the heat given out by stars and planets. So sensitive are these instruments that they can detect the heat of a candle at a distance of 50 miles. As infrared waves travel at 186,000 m.p.s., compared with the 1080 f.p.s. of sound, heat waves from an airplane engine can be detected long before the sound of the engine is picked up by the most sensitive sound detector.

Experiments have been made with powerful beams of these invisible infrared rays, says Mr. Mayer, which can be directed into the sky and reflected back onto detectors by enemy airplanes. Further experiments have been made, chiefly in America, using infrared rays not only for detecting bombers, but also for destroying them. The heat rays given off by a bomber would be used to steer a small, unmanned airplane loaded with explosive. Such an aerial torpedo would follow the nearest bomber discharging hot exhaust gases.

THE EMPIRE AGAINST GERMANY

Extract from an editorial in *The Engineer* (London, Eng.), June 21st, 1940

At this hour, when the Empire faces its destiny in circumstances more critical than at any time in its history, those subjects proper to our vocation elude us. Try as we may to pin our minds down to scientific, technical, or industrial problems, the war intrudes. We cannot escape from it. It interrupts consecutive thought upon any other subject. It creeps between the lines as our pen moves over the paper and insinuates itself into the shortest sentences. A hundred and one problems and anxieties crowd upon us, breaking down our concentration. Problems of the Empire, of Great Britain and her islands, of our works and factories and industries, of our cities and towns and hamlets, and even of our own homes and families. Yet in all this confusion of thought but a single purpose remains. The problem that we face is not how to elude or escape from the dangers that beset us, but how so to turn them to our advantage that in the end victory for all that we hold dear may be won through the tribulations, sorrows and sacrifices that we know await us. That is the end and object of all our thoughts. Not how to secure peace, but how, through trial, we can best direct all the powers and abilities and courage that lies in us to achieving the purpose to which we have set our hand. We are conscious that in this we do not write for ourselves alone, nor for a few handfuls of people here and there. We write not only for the great profession and industry which we have the honour to represent, but for all, save a few timid hearts, of the millions who compose the British Empire. The same resolve moves us all; to bear all and to win through whatever the bitterness that must be endured.

The first effects of a blow are always the worst. When at midday on Monday the tapes told us in a few hurried words that France was seeking for terms of peace, consternation and depression fell upon us all. We had foreseen the coming disaster, yet hoped against hope that somehow, by some unknown means, it might be averted; yet when it fell upon us we were momentarily stunned. But in a few hours new hope, and, better still, new resolution came to our aid. We said to ourselves the war is not over because our gallant ally has received a mortal blow; we can, and we shall fight on alone. And then we began to examine the position and found it far from being as desperate as for a bitter instant it had seemed. We reminded ourselves that if Germany had defeated France she had suffered enormously in the doing of it. She is not the military power that she was. She cannot command so many men and tanks and aeroplanes and ships as she did but a few weeks ago. She may have overthrown our great ally, but she is licking her own sores. And the task she has now set herself is very different from that which she has completed. She has not but to cross the Meuse, the Marne, and the Seine. She must throw a bridge across the Channel and establish a bridgehead on our shores. Until she has done that her vast array of tanks and armoured vehicles will avail her nothing. And that she cannot do until the command of the sea has been wrested from British hands. She must therefore rely upon the air, and the air is an element more fickle even than the seas. For days on end flying will be impossible even across the narrow seas. The weather, which favoured Germany throughout her land campaigns, will often be the friend of Britain, again, as it has been in the past. Furthermore, with the increasing output of the Empire and America our Air Force is ever growing and Germany cannot stop its growth. She cannot go overseas to bomb the factories of the Western hemisphere and the Antipodes. If she increases her squadrons of planes by capture or manufacture she will find it difficult to train pilots for them, whilst we shall be continually receiving recruits from safe training grounds far across the oceans. Hence the blows she may strike at us with her bombers will not be unavenged. She, too, will feel the terror that comes by night and leaves havoc behind. Her people do not yet know the full bitterness of war. They shall know.

Turning our minds in another direction, we recall that for nine months Germany has been partially blockaded, as she is now almost wholly blockaded, against all seaborne commerce. Belittle as much as he may the effects of that blockade, the greatest pessimist cannot deny that it must have had some effect and that it has, and still is, weakening her power to continue a war of long and bitter duration. The pinch will be felt by Germany and by all the unhappy States which she has made her vassals as the autumn and winter come on. Against the angry murmurings of millions of people made desperate by hunger and with an army ill-fed her resistance will be sorely tried. Finally, yet, indeed first of all, the British fleet is not only in being, but greater than it was and daily growing more powerful. It is the bulwark of our defence and not until it has been overthrown will Britain and the freedom she stands for bow to the conqueror.

Such thoughts as these give us courage and resolution to carry on the fight. With these things on our side the position is far from desperate, and there are others of which we know not yet the import and significance. America is stirring; Russia is an unknown quantity; but the alliance between her and Germany is of too brittle a nature to stand much strain; Germany must hold in a curb the nations she has dominated. Her very conquests may contribute to her downfall. Hence we may look at the pros and cons without despondency. Hard as the immediate future must be for us, it will be harder for our enemy. We are not beaten and we shall not be beaten. On that we are resolved. The well-worn words come back to us, breathing the spirit that has inspired this people for over seven hundred years and inspires it still:

> *"Come the three corners of the world in arms,*
> *And we shall shock them. Nought shall make us rue,*
> *If England to itself do rest but true."*

MODERN EUROPEAN LIGHT CARS

By Charles B. Brull, President, Research Section, Société des Ingénieurs de l'Automobile

From *The Journal of The Society of Automotive Engineers*, April, 1940

Although mass-production methods of manufacture have become the law everywhere in Europe since 1935, it takes three times as many man-hours to build a car in France as in the United States, Mr. Brull points out.

French output has remained stationary at around 200,000 cars for three or four years, he explains, partly because of the fiscal pressure of increasing taxation. As an example he shows that French gasoline taxes are 164 per cent of the cost price of gasoline compared with 66 per cent for England, and 37 per cent for the United States. Not only has motor traffic been slowed down by this pressure, he shows, but so also has the income brought in by such taxes. After portraying further some of the elements of the light-car problem in Europe, and particularly in France, Mr. Brull divides the European light-car market into three overlapping types, corresponding to distinct public requirements, and gives details of various European examples of each type:

1. The 2 to 4-seater, 5 to 6 hp., 2 to 4 cyl., weighing 800 to 1,000 lb.
2. The 4 to 5-seater, 8 to 11 hp., 4 cyl., weighing 1,500 to 1,800 lb.
3. The 4 to 6-seater, 11 to 15 hp., 4 to 6 cyl., weighing 1,800 to 2,600 lb.

Among the more striking present types of European light cars reviewed in detail by Mr. Brull are the 7, 11 and 15 hp. Citroëns, the Peugeot 202 and 402, the Renault "Juvaquatre," and the Samca 5 and 8 hp.

CANADA'S HISTORIC HIGHWAYS

From the *Daily Commercial News and Building Record*, Toronto, Ont., May 7th, 1940

Commemoration of several of Canada's earlier roads by the National Parks Bureau, Department of Mines and Resources, in co-operation with the Historic Sites and Monuments Board of Canada reveals that Canada's highways are rich in historical associations.

The first highway of importance in Canada was the Chambly Road in the province of Quebec, which was opened in 1665 under the instructions of M. de Courcelle, Governor of New France. It was built by the French to connect Montreal with the chain of forts along the Richelieu river as a defence measure against the Iroquois Indians.

In Ontario, the Niagara Portage Road between Queenston and Chippawa was opened by the United Empire Loyalists in 1788. It was the principal route of travel to the Upper Lakes region and served as an important strategic position and line of communication during the War of 1812-14 and the Rebellion of 1837-38.

Yonge Street, which leads into Toronto from the north, was planned by Lieutenant-Governor Simcoe in 1793 as a military road and commercial highway between lakes Ontario and Huron. It was laid out and constructed by the Queen's Rangers in 1794-96, and named in honour of Sir George Yonge, a member of the British Government who later became the Governor of the Cape of Good Hope. Dundas Street (The Governor's Road) was planned by Governor Simcoe in 1793 to promote the settlement of the province. It provided communication between lake Ontario and the Thames river, and was named after the Honourable Henry Dundas, Secretary of State for War and the Colonies.

In western Canada three historic roads have been marked—the Dawson Road, the Rosseau Route and the Cariboo Road. The Dawson Road, a land and water route from Fort William to Red River, was Canada's first attempt to provide an all Canadian highway linking the East with the prairie provinces. Surveyed in 1858 and completed in 1871, this road was 530 miles long and took its name from the engineer who carried out the survey.

The Rosseau Route was the war road of the Sioux Indians leading to the lake of the Woods, and it was also the earliest route to the West used by the French explorers and traders under LaVérendrye in 1733.

The Cariboo Road in British Columbia was completed in 1865 and played an important part in the gold rush to the Cariboo area. This road runs from Yale to Barkerville, and the wealth in gold which has passed over it is estimated at more than forty million dollars.

HIGH FLYING MILITARY AIRCRAFT

PROBLEMS BEFORE THE INDUSTRY

From *Trade & Engineering*, (London, Eng.) May, 1940

High flying has been used extensively in the war for purposes of evading enemy action. Thus a large number of the reconnaissance flights of both Allied and German aeroplanes have been made at great heights in order to escape the effects of anti-aircraft fire and of fighter action. It must be confessed, when the position is weighed up, so far as it is possible to weigh it up after eight months of war, that high flying does seem to be an excellent protection for military aircraft engaged on reconnaissance. The aircraft are sometimes not spotted, and when they are spotted they seem to be largely immune from accurate fire. Moreover, the time taken for single-seat fighters even of the interceptor type to climb up to them is such that they often manage to complete their mission and to get away long before contact can be made.

All this tends to place the emphasis on height as a tactical factor, and there can be no doubt that aircraft-manufacturing companies must think increasingly of means to develop the climbing qualities and also the high flying qualities of their aircraft. This is a field which extends into both civil and military aviation. It is the opinion of many commercial aircraft operators that the transport aeroplane flying in the sub-stratosphere will prove the best type of aircraft for long-distance passenger work. Indeed, it is for the production of such machines that most of the experiments have been made with pressure cabins. It may be concluded that work done on improving the high flying qualities of military aircraft will also be useful for civil aircraft.

Value of Height

For military purposes the advantages of the very high flying machine are also fairly clear. It may escape the attention of listening posts until it is nearly overhead. Having been heard, it will still be difficult if not impossible to see. Searchlights at night will fail to reach it. Anti-aircraft guns by day will find extreme difficulty in hitting it. Inasmuch as the time interval between the firing of the gun and the attainment by the shell of the target area is dependent upon height, the risks of error are increased as the aircraft flies higher and its evasive action is made easier. High layers of clouds, instead of marking out the aircraft and causing it to become an easier target, as they do when the aircraft cannot get above them, can be used as a cover.

It is not necessary to say more about the value of height to the military machine. The objection that, from very great heights, accurate observation and photography and accurate bombing are impossible is answered by the fact that height need not be used by the aircraft when it is observing, photographing, or bombing. It can be used only on the way to the target and on the way home again. The aircraft can approach from a great height, dive to a lower level to do its work, and then climb away again. In this respect high rate of climb would be as valuable to the bomber and reconnaissance aeroplane as speed on the level is to the fighter.

THE HELICOPTER

From *Society of Automotive Engineers Journal*, July, 1940

Igor I. Sikorsky recently made successful flight demonstrations at Stratford, Conn., of the Vought-Sikorsky VS-300 Helicopter. The machine rose vertically approximately 30 feet, hovered motionless over one spot and then flew about 200 feet across the field before descending vertically to the ground. Several shorter flights were also made.

Mr. Sikorsky, who is engineering manager of Vought-Sikorsky Aircraft, stressed the fact that the helicopter is still in an experimental stage, but that the flights had clearly demonstrated that the problems which have balked helicopter designers for years had been successfully solved.

Using data already obtained from the experimental model, he said, it would be readily possible to produce a two-seater helicopter powered with a 200 hp. motor. Such a craft, he continued, would be able to take off and land in small spaces; would be able to travel forward at any speed between zero and slightly more than 100 mph., which would be its normal cruising speed; would be able to move sideways or backwards at speeds up to 25 mph.; would have a ceiling of more than 12,000 ft.; and would have an initial rate of climb in excess of 1,000 fpm.

Two earlier helicopters were built by Mr. Sikorsky in Russia some thirty years ago, but this was the first to fly successfully.

ENDURANCE IS SKIN DEEP

Extract from *The Engineer* (London, Eng.), June 21st, 1940

Had the famous "one-hoss shay" lasted another nine centuries, it still would not have seen the service of an automobile's eight-year average life. Aeroplane engines have remained continuously in the air for as much as 650 hours, and in the largest of them the pistons sweep past 12 square feet of hot metal surfaces with each revolution—half an acre a minute! A 60 hp. V-8 engine must flash its pistons past a full newspaper page of cast iron with each turn of the motor; and these figures take no account of journals, gear teeth, and other working surfaces.

That modern equipment meets increasingly severe demands yet improves in reliability and endurance, is a tribute both to increased knowledge of forces and materials, and to advances in metallurgy, lubrication, and surface quality. In particular, minute changes in surfaces have significantly improved resistance to the combined abrasion, erosion, and corrosion we call wear. The difference between turning and lapping lies within a thousandth of an inch, yet a lapped gauge will outwear a ground one, and a ground surface will outwear the usual turned one, as the Germans dramatically demonstrated during the World War. By grinding all critical surfaces in their Diesel engines, they gave U boats a range and freedom from breakdowns which amazed and disheartened Allied commanders. The effectiveness of wholesale grinding in improving the performance of the higher compression internal combustion engines accelerated its spread to other fields, among them locomotives and automobile engines; and it was mainly the tremendous demands of the latter industry which forced the development of other machinery for producing highly accurate surfaces on a mass scale. The ability of a present-day owner to drive his new car away from the sales room at the same speed he approached it in his old one is an indication of improved surface quality. His increased freedom from lubrication troubles and overhauls is in part another.

Although improvements in finish are accompanied by reduced initial wear and slower wearing final surfaces, continued progress towards smoother surfaces may increase the dangers of insufficient clearances for oil films, and of seizure. Highly finished surfaces, for instance, give tighter press fits. It is easily possible to scrape a smooth glass plate clean of liquid, but not a sheet of frosted glass, where innumerable hollows act as tiny reservoirs that a squeegee cannot touch. Similarly, in a recent process, constituents of a smooth steel surface are selectively removed by chemical action to form an irregular mesh of tiny grooves and pits. Enough remains of the surface to create an even bearing area, but space is also provided for storing oil, thus reducing break-in time and increasing the load-carrying capacity of bearing areas. On the other hand, where proper lubrication can be maintained between dead smooth surfaces they appear practically immune to wear.

Less obvious is the effect of surface quality on fatigue strength, that is, the strength of materials under repeated, fluctuating stresses. Stresses concentrate at discontinuities; as Professor A. V. de Forest puts it, they "accumulate in corners like dirt." A diamond scratch one-thousandth inch deep can lower the fatigue and impact strength of a glass specimen to as little as one-hundredth part of its former value. With a more ductile material like steel, a single scratch on a polished surface can reduce fatigue strength by 20 per cent. Springs retaining the original hot-rolled surface may possess but half the fatigue strength they have when ground, and on other machine parts surface irregularities caused by machining and exposure to reactive furnace atmospheres can have a greater effect on properties than heat treatment or minor variations in compositions.

Even corrosion is inhibited by sheer mechanical perfection of surface, for although corrosion can start at inclusions in the smoothest of surfaces, it is apparently favoured by sharp notches. It may also be noted that fatigue strength is seriously and adversely affected by even mild corrosion.

The general use of highly refined surfaces is strictly a twentieth century phenomenon. Hand lapping and scraping are both older than the machine tool industry, but both are also too costly for all but special applications. Not until the grinding machine stepped into the production line in the early 1900's was there available a means for the large-scale manufacture of precision surfaces. Even a ground surface, however, ordinarily shows grooves and undulations coarse enough to prevent the use of the optical flat and interference light bands as a means of measurement, an effective obstacle to utmost accuracy in dimensions.

To-day, mass production of quality surfaces is possible by methods ranging from honing to shot blasting, the latter method being used on clutch discs, springs, and rear axle shafts to hammer out surface imperfections and lengthen life. With diamond and metal carbide tools at high speeds and fine feeds, even turned surfaces are excellent.

Attention has also centred recently on the "super-finish" from abrasives slowly and lightly rubbed over a machined area in the presence of a lubricating and cooling fluid. Compared with grinding speeds of 5,000 ft. per min. grinding pressures of 50 lb. to 100 lb. per sq. in., and surface temperatures that run to 800 deg. F., superfinishing raises the temperature scarcely a degree, runs the abrasive at less than 10 ft. per min. and keeps pressure between work and abrasive at a few pounds or less. Nevertheless, the time required to finish a piece is measured in seconds, for only enough material is removed to get below the ridges and high spots of previous machining operations. Somewhat self-controlled in operation, superfinishing erodes the high points until they are flat enough to support a film of oil, which prevents further removal of metal. The scratches which remain serve in use as reservoirs for oil. Irregularities on super-finished surfaces can be maintained at less than ten-millionths of an inch.

THE MINISTRY OF SUPPLY SALVAGE CAMPAIGN

Extract from *Engineering*, May 24, 1940

The latest figures issued by the Salvage Department of the Ministry of Supply indicate that the appeal to local authorities to organize the collection of utilizable waste materials is meeting with a very encouraging response. During the past five months, it is stated, the number of local authorities which operate salvage schemes has increased from 316 to 850, out of a total of 1,012 to which the Ministry's appeal was directly addressed; and the aggregate monthly value of the materials salvaged has risen from 28,000*l*. in November, 1939, to 115,000*l*. in April of this year. The total population now covered by organized salvage activities is about 37,000,000. Waste-paper collections by local authorities during November last amounted to 4,500 tons; in April, the amount collected was approximately 15,000 tons. Corresponding increases are recorded in respect of bones, textiles, and ferrous and non-ferrous metals. In addition, considerable quantities of scrap of all kinds are being collected by merchants and voluntary organizations, and by large industrial undertakings such as the main-line railway companies. At the same time, as is pointed out by the Salvage Controller, Mr. H. G. Judd, there is room for a considerable increase on the present totals. As the figures show, there are at least 150 local authorities which, as yet, have no salvage scheme in operation; and of those which have instituted regular collections not all are doing as much as they might to ensure that all serviceable waste materials are recovered. There is ample evidence on every side, also, that large quantities of potentially useful scrap, especially metals, still remain to be garnered from such sources as shipbuilding and repairing establishments, motorcar scrappers, derelict factories, private houses and even from roadsides; and there is reason to suppose that much of this scrap could be collected quite as speedily, and at less ultimate expense than an equivalent weight of park railings or disused tramway track, if the fullest advantage is taken of voluntary assistance to gather it into convenient dumps.

DESIGN SUGGESTIONS FOR IMPROVING VISION IN MOTOR CARS

Excerpts from the paper by Dean A. Fales, associate professor of automotive engineering, Massachusetts Institute of Technology

Extract from *S.A.E. Journal*, July 1940

Sight is the one sense necessary in moving and in driving an automobile. Clear and unobstructed vision allows the driver to pick up objects, moving or stationary, out of the "corner of his eyes." This "corner-of-the-eye" vision is necessary in driving, as it precludes any sudden appearance of an object in the path of travel. Blind corners, hilltops, and vision-obstructing objects must be approached at a reduced speed.

Anything that limits the driver's vision interferes with his timing and makes driving more dangerous. With limited vision the driver must reduce his speed in order to have his vehicle under control for possible emergencies.

The long engine hood and low seating position in the modern cars handicap the driver. He cannot see his mudguards and place his car in a precise position. This accounts for the wide swings into the third traffic lane in passing and the straddling of traffic lines. The inability to see the road close in front of the vehicle on the curb side allows children and small animals to dart into the path of the car without being seen by the operator. Wearers of bi-focal glasses find the long engine hood and low seating position trying; in order to see the road close in front of the car, they lift their heads as high as they can and that forces their line of vision through the reading lenses. The low seating position puts the driver where he suffers more from the glare of the lights of approaching vehicles.

The wide and rounded front corner posts at the sides of the windshield create blind spots. The ventilating wings in front-door windows, when covered with rain or snow, increase the size of the blind spots, especially in city driving at night where lights cause reflections. These blind spots give the driver "tunnel vision." It is impossible to see objects approaching from the side until they are too nearly in the path of travel. This accounts for many accidents where the truthful driver involved has said: "When I saw it, it was too late to avoid hitting it."

The steeply sloped windshields gather more dirt than the more nearly vertical ones and need cleaning more often. In the last few years we find many cars with steeply sloped windshields causing double vision. The lights on an approaching car show up as two bright lights and, offset from them, two dim lights. As the car comes nearer, the dim lights move closer and closer to the bright lights. The same phenomenon is noticed while a car is stopped at a traffic light. There appears to be a bright red light and a dim one. Sooner or later the driver notices this and his attention is distracted (a mild form of hypnotism). A steeply inclined windshield increases the effect of any imperfection in it. In many cars with steeply inclined windshields the instrument board, instruments, steering wheel, and gearshift lever are reflected in the windshield, and the driver has to peer through these reflections in order to see the road. In some instances, the sun shining through the steeply inclined windshield causes reflections from the instrument board that can dazzle the driver. The sun shining on the dust particles that gather on the steeply inclined windshields causes eye strain.

The V windshields that modern style dictates are a handicap to vision. In looking at a passing object, as the line of sight passes from one pane of the V through the other, the eyes re-focus. After a time the driver unconsciously moves his head to see as much as he can through the pane in front of him, and finally he sees what he can without bothering to move his head. A line in a windshield is annoying and it tends to limit vision to the pane in front of the operator.

Sloped Windshields Impede Defrosting

With steeply sloped windshields without outside protecting visors, the defrosting problem is one that has not been solved satisfactorily under severe storm conditions. With these same windshields ice and snow collect when the cars are parked, and a few drivers will stop to clean thoroughly the windshields before they start out. With engine heat and the cooling fan available, it would seem that, with properly placed louvers in the rear of the engine hood, heat could be conducted over the outside of the windshield and effective defrosting obtained.

Many cars, both old and new, have windshield glass that causes distorted vision. This is not only disconcerting to the driver but also a prolific source of eye fatigue. Safety glass is one of the greatest and most valuable improvements to be incorporated in automobiles, but, when safety glass becomes discolored due to age or extreme heat, it should be replaced and the expense involved considered as insurance. Candles should never be used as defrosting with laminated safety glass, as the heat can cause the binding material to explode.

Any one who wears glasses appreciates the protection that the visor gives on a sunny day. On automobiles no outside visors have been provided for several years, and the drivers have had to put up with tremendous eyestrain and corresponding fatigue that glare causes. A laboratory method of inducing fatigue is to place a fairly bright light in front of and a little above the eyes of the subject.

Rear vision is so limited in many of the recent cars that backing up becomes a blind manoeuver. The large rear-quarter blind spots prevent drivers from seeing overtaking cars and are the cause of many side-swipe accidents.

The steeply sloped rear windows become covered with snow and are opaque in even the mildest of snowstorms. Outside rear-view mirrors are a necessity.

A complaint that has become common is that the steeply sloped windshields and rear windows of the newer cars cause dazzling reflections to the drivers of other cars on sunny days. Such a blinding reflection gives no warning of its coming and is to be dreaded as the blinded driver may not recover his normal sight for several seconds.

In recent years the night-time accidents have been far greater in number than the daylight accidents. The use of sealed beam lights in the new cars provides better illumination, but placing the driver closer to the road subjects him to the increased glare. The lower cars give the drivers a false sense of security and no passenger car can be built low enough that some drivers can not leave the road and turn over.

Vision Better in Older Seats

Seating positions in the older cars and buses and trucks give the drivers better vision and enable better manoeuvering in congested traffic as well as placing drivers out of the headlight glare zone. The driver's seat should place him in an alert and erect position; the controls should be in naturally comfortable positions; and he should be able to see without having to crane his neck or re-focus his eyes. The bucket-type seat provides far greater comfort and causes less fatigue than the flat backed divan type of seat. Modern frothed latex upholstery makes for more comfort and less fatigue. Seats and controls should be adjustable to care better for other than average size drivers.

The simplest way to express the wishes and desires of a group of intelligent and thoughtful motorists would be to say: "Give us the vision, the higher seating positions, the roomier bodies, the greater road clearance, the faster steering, and the weight distribution we had in the cars of twelve years ago. Modernize these features and give us the present smooth and efficient powerplants, transmissions, brakes, and riding comfort."

From Month to Month

News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

EVACUEES

At the time of writing, the situation with regard to the Canadian engineers' proposal to take into their homes the children of engineers in the United Kingdom, is very unsettled. Cables are being exchanged with English institutions, and negotiations are under way with the Ottawa officials which may lead to a modified basis of operation.

The response to the Institute questionnaire was favourable almost beyond expectations. The comments which were made in practically every instance were very encouraging, and indicate beyond the slightest doubt that the membership enthusiastically supports Council's recommendations. Homes have already been offered by Institute members alone for approximately four hundred children. Offers of financial assistance already total 190. When the returns are available for the other engineering bodies, it is evident that very substantial figures will be attained.

Unfortunately, the sudden suspension of the Government sponsored scheme has brought everything to a standstill. Whether or not it will be resumed later is something upon which no reliable information can be obtained at the moment. Therefore, there appears to be nothing that can be done except to wait for word from authoritative sources.

It has been suggested that the engineers might offer to proceed with the evacuation without the support of the Government proposals. This would mean that transportation would have to be paid by the parents, and that the Canadian engineers as a group would have to assume more responsibilities. It has been argued that in view of the great good which may be accomplished these additional difficulties should not tie up the scheme. During the General Secretary's visit to the western branches in July, opinions were strongly and unanimously expressed at every meeting that the proposal should go forward irrespective of Government activities.

In view of these strong representations, it has been decided to discuss the proposal from this angle with the English institutions. Conversations are also under way with the Department of Immigration at Ottawa, to obtain for this proposal, if possible, some of the benefits that were offered under the Government plan. A decision may be reached within a few days—even before this number of the Journal reaches the members, but everyone who has offered to take children, or to make a financial contribution, will be informed by mail just as soon as there is anything definite to report.

NATIONAL REGISTRATION

The Government's proposal to register for national service all adults in Canada is the interesting topic of the day. No one can take exception to it in theory, although many protest the delay that has occurred in getting it underway. It is probable that it will be completed before these notes reach their destination.

Ever since the records were transferred to the Government at Ottawa, all the societies that co-operated, last year, to gather and classify the information about technically trained men in Canada have been receiving inquiries from their members as to what has been done with it. Since the National Registration has been announced, these organizations have been besieged with a new flood of inquiries. It is still not possible to give any encouraging information, although the joint committee of institute secretaries, has visited Ottawa on several occasions to discuss with officials the possibility of utilizing the information in Government and industrial effort.

The latest visit of the committee to Ottawa was to place before the new department of National War Services a proposal to co-ordinate the technical registration with the new national registration in an effort to increase usefulness of both. The proposal contained recommendations both as to organization and as to policy. It recommends Government control but with co-operation from the societies themselves, so that official support is given to the scheme, and the societies' knowledge of their own members is made available to the Government body.

The committee and the proposals were well received. It is hoped that something will be decided upon shortly that will permit all technically trained men in Canada to feel that the details of their qualifications are before the Government and industry, and that they will be used in whatever capacity their services may be most useful in the war effort.

LIEUTENANT-GENERAL McNAUGHTON, M.E.I.C.

All Canadians, and particularly engineers, will be pleased at the announcement of the appointment of A. G. L. McNaughton, M.E.I.C., to the command of an Army Corps, and his promotion to the rank of Lieutenant-General. General McNaughton is himself proof of his own statement that modern warfare stresses the increasing importance of the engineer.

The newspapers throughout Canada have acclaimed the appointment to the extent that there is little original observation left to be made. However, the following information may be of particular interest to members of the Institute.

General McNaughton was a graduate of McGill University in electrical engineering in 1910. In 1912 he was given the degree of Master of Science. He joined the Institute in 1914. All through his career as an engineer, a soldier and a scientist he has been interested in the affairs of the Institute, and has been particularly helpful on many important occasions. It was in interviews with him before his departure overseas that much of the valuable information with regard to the engineers' work in the war and the engineering student's attitude towards his course, was secured.

All members of the Institute will be grateful for General McNaughton's leadership at this time when such ability is greatly needed, and all will wish him success in his new responsibilities. We are confident that his unusual talents will bring great credit to himself and to the profession which he so splendidly represents.

CO-OPERATION IN ALBERTA

At the annual meeting of the Association of Professional Engineers of Alberta last March, general approval was given to a proposal to submit to its members a co-operative agreement with The Engineering Institute of Canada similar in general principle to the agreement between the Institute and the Association of Professional Engineers of the Province of Saskatchewan, which has worked out to the general advantage of the engineering profession in Saskatchewan.

For several months a joint committee, representing the Association and the Institute, has been working actively on the details of the agreement. After a great deal of discussion with the officers of both bodies, and following a conference with two headquarters representatives of the Institute's Committee on Professional Interests who went to Calgary for the purpose, this joint committee has completed a final draft of an agreement which, having been since accepted by the Council of the Association, is now ready for formal approval by both bodies. This approval will involve the submission of the agreement by ballot to the members of the Association and to the members of the Institute, pursuant to By-law No. 76. Preparations for this are now underway, and it is expected that the members of both bodies resident in Alberta will, early this fall, have an opportunity to vote upon the agreement.

Karsh, Ottawa

Lieutenant-General A. G. L. McNaughton, M.E.I.C.

THE GENERAL SECRETARY VISITS WESTERN BRANCHES

In nine and a half days absence from Montreal, the General Secretary visited seven branches from Winnipeg to Victoria, and participated in twelve meetings. To cover ground so quickly, it was necessary to go by air. Meetings were held at Winnipeg, Regina, Lethbridge, Calgary, Edmonton, Vancouver and Victoria. In most instances, they were joint meetings with the executives of the branch, the provincial professional associations, and, in Vancouver, with the Mining Institute.

The principal topic for discussion was the proposal to take care of the evacuated children of the engineers in the United Kingdom. All meetings were unanimous in their approval and advocated that the engineering societies continue with their offer even though the Government had suspended its scheme.

The Secretary also interviewed the various provincial authorities in order to establish with them acceptable procedures for the care of the visiting children. In every instance, these authorities were sympathetic and helpful, and gave assurance that children sent to any province under the Government proposal would be very welcome and would be sent to the homes of engineers who had indicated their desire to receive them.

ENGINEERING INSTITUTE ABOLISHES THE "ASSOCIATE MEMBER"

From Editorial "*Canadian Chemistry and Process Industries,*" July 1940.

Over two thousand "Associate Members" of The Engineering Institute of Canada have now become Members. Evidently the idea of simplification and consolidation in professional organizations is growing, and the trend is toward leaving the individual and not the Society to set himself apart as a person of particular consequence in his own profession.

Soon all science-workers and engineers will have found common ground for most of their organization work. The old water-tight compartments are going, mainly because of the broad knowledge which it is necessary for each member of a separate division to have about matters formerly none of his affair.

The medical and legal professions may laugh a little as they see engineers deciding, at long last, that artificial divisions in membership are futile. They knew that the public would never recognize a half-dozen classes of one profession. Legal machinery chokes at such a concept, but any layman may still have his opinion about the way a member of the medical profession does his work and may prefer one to the other. So those employing engineers know perfectly well the differences among them and do not need to ask an institution for their grading. These ideas about simplification and rationalization are everywhere in growing force. Chemical societies and professions may well make up their minds to be influenced; and there is already quite a body of opinion prepared to go a long way in the matter of building-up the whole class, not any particular division of science or engineering.

CORRESPONDENCE

The following letters deal with special work for engineers in Canada's war effort. Everyone is anxious to do something to help, but not everyone has ideas as to what can be done. It would be interesting to know what other members think of these proposals, and to receive their comments and perhaps their further suggestions.—*Editor.*

Island Falls, Sask., July 9th.

L. Austin Wright, Esq.,
General Secretary,
The Engineering Institute of Canada, Montreal.

Dear Sir:

There must be a large number of younger engineers holding positions of responsibility who will not likely be taken by the Home Defence conscription acts. In fact if men of this type are permanently placed in a defence body they would be a distinct and immediate loss to the industrial efforts of the nation when the pace is its hardest.

However, if these men and similar types could be put through a training course of from three to six months in an O.T.C. and then returned to industry to allow others to take the same course of training, there would be created a large pool of officer material and opportunities for industrial training for many more young men.

The period of training could be covered by leave of absence from employers and remuneration could be arranged at some adequate amount.

Men in this pool would be subject to call at any time but any detriment to the industrial setup caused by their being called to the colours would largely be offset by the greater number of industrially trained men available to take their places.

Some such scheme may already have been considered; comment on, or information concerning, the above would perhaps be of interest to all engineers.

I remain,
Yours faithfully,

Eric C. King, M.E.I.C.

5694 Hutchison St. Montreal.
July 10, 1940.

The Engineering Institute of Canada,
2050 Mansfield Street,
Montreal.

Attention Mr. Austin Wright, General Secretary

Dear Sir:

As a member of the Institute, I would like to make the following suggestion in connection with our War effort.

It seems to me that we, engineers, as a body can far better serve the Country at this time by doing something useful in a material way than by joining some Militia Unit or the Police or Fire Department as is now proposed under the present scheme.

If we were to give our services two or three evenings a week for a few hours, making small parts for planes, shells, bombs, tanks, etc., in various machine shops or even in the various plants where we are employed, we could be doing something very much more useful than uselessly waiting around for something that might never turn up. All this work would of course be voluntary and therefore at no cost to the Government outside of the actual cost of material.

I am sure that there are thousands of small parts of all kinds of war material that could be made in hundreds of plants all over the Dominion, and no doubt, the proprietors of these plants would be only too glad to place their equipment at the disposal of the Institute, once it was used on War Work free of charge.

There should be no cause for dispute by Labour Organizations in this case for the work would be all voluntary, and consequently no fees would be charged. On the contrary, by this means, output should be speeded up thereby increasing employment in the assembly plants.

This effort on our part would also have the advantage of cheapening the actual cost of munitions, for the work done by the Engineers would have no labour power, or overhead costs attached to them at all, thus adding a further contribution on our part.

As for trucking facilities, no doubt members with cars would be quite willing to bring raw materials to the various machine shops and return finished parts to the assembly plants, as their contribution to the scheme, if they are unable to actually do the necessary machine work.

Trusting you will give this favourable consideration, I beg to remain,

Yours truly,

H. S. Petford, M.E.I.C.

MEETING OF COUNCIL

A special meeting of the Council was held at Headquarters on Saturday, July 6th, 1940, at ten-thirty a.m., with Vice-President Fred Newell in the chair, and seven other members of Council present. Past-Presidents F. P. Shearwood and O. O. Lefebvre, and Past Vice-President P. L. Pratley, were also present by invitation to discuss the proposal regarding the evacuated children of engineers in the United Kingdom.

It was noted that a letter of welcome had been addressed to the Earl of Athlone, the new Governor General, and that a letter of acknowledgment had been received from his secretary.

An inquiry had been received from Mr. Pitts, chairman of the Radio Broadcasting Committee, inquiring whether or not Council, in view of changed conditions, still desired the committee to proceed with the radio programmes which it had been decided to put on during the coming fall and winter. Mr. Vance, chairman of the Papers Committee, stated that the western branches were looking forward to this feature, and he felt that no change should be made in the present plans without first consulting those branches. After discussion it was decided that the committee should proceed with its programme.

Mr. Wright explained that on recent visits to Ottawa he had made further inquiries regarding the register of technically trained men which had been prepared by the Canadian Institute of Mining and Metallurgy, the Canadian Institute of Chemistry and the Engineering Institute, and which is now in the hands of the Voluntary Service Registration Bureau. He had inquired particularly as to whether or not this register could be tied in with the national registration which the government is about to undertake. Very valuable information regarding engineers and technically trained men is on file at Ottawa, and if properly utilized would be of great assistance to the government and to industry. Officials were as yet unable to make a definite statement, but it was indicated that the engineering bodies might be asked to co-operate in the forthcoming national register. Following discussion, it was unanimously agreed that the Institute should continue to make its assistance available to the government, and that the Headquarters premises could be used as a centre for the registration of engineers if the government so desired. The secretary was instructed to make some comment in the Engineering Journal that would let members know that the Institute was doing all it could to assist the government, outlining if possible the nature of this assistance.

The Secretary reported that the Canadian Chamber of Commerce was considering the preparation of a submission to the Prime Minister regarding a policy for the defence of Canada. The Chamber had asked the Engineering Institute to be one of the signing bodies. The Secretary was instructed to attend a meeting which was being held to discuss this matter in further detail, and to report back to Council.

The secretary gave a brief history of a proposal for bringing into the homes of Canadian engineers the children of engineers in sister societies in the United Kingdom. The outcome of negotiations with Ottawa was that an arrangement had been made whereby these children could come to Canada as part of the official government evacuation scheme, and at the same time be consigned to homes which had been offered by the Canadian engineers. He explained that the original proposal had been discussed with several officers of the Institute, and had received their approval, and that a preliminary questionnaire had been sent out to all members in order that Council at this meeting could have before it an expression of opinion from the membership. The answers so far received had been very encouraging.

Mr. Wright explained that in his opinion it was desirable that the undertaking should be participated in by other engineering organizations, and that it had been arranged that representatives of several such organizations would be at Headquarters to meet a committee of Council to discuss this topic. An exchange of cablegrams with the secretary of the Institution of Civil Engineers in London had brought forth the information that the Institution of Mechanical Engineers and the Institution of Electrical Engineers, as well as the Institution of Civil Engineers would be glad to accept such a proposal from the Canadian organizations.

Council discussed the proposal at length, and finally it was unanimously agreed that the proposal be approved, and that the Institute should take a lead in getting the co-operation of the other engineering and allied bodies. Discussion followed as to the methods of operation. It was suggested that it might be advisable to have a Council meeting in Toronto so that the Ontario representatives would know all the details, but it was agreed that this could be decided upon later if a need for such a meeting arose.

The secretary outlined the organization set-up which he thought might meet the needs. This would have to be discussed with the other organizations, but it was desirable that the Institute appoint some one immediately who could represent the Institute on a joint committee.

In conclusion, it was unanimously resolved that the general secretary be empowered to act for the Institute; that the president be asked to appoint a committee to assist him, subject to confirmation at the next meeting of Council; and that the following be appointed a provisional committee to represent the Council in the discussion with representatives of other organizations: Dr. O. O. Lefebvre, chairman; J. B. Challies, P. L. Pratley, J. A. Vance and L. Austin Wright.

One reinstatement was effected; one Member was elected, and four Students were admitted.

The Council rose at twelve fifteen p.m.

ELECTIONS

At the meeting of Council held on July 6th, 1940, the following election was effected:

Member

Gray, Walter Duncan, B.Eng. (Civil), (Univ. of Sask.), junior engr., Prairie Farm Rehabilitation, Calgary, Alta.

Students Admitted

Blake, William Eddy (Queen's Univ.), 196 King St. East, Saint John, N.B.

Lefebvre, Gérard (Ecole Polytechnique, Montreal), 5025 St. Urbain St., Montreal.

Moore, John Beverly, (Univ. of Toronto), 826 Argyle Road, Walkerville, Ont.

Merritt, Robert James, (Univ. of Toronto), 3637 6th St. West, Calgary, Alta.

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

Major-General T. V. Anderson, M.E.I.C., former Chief of the General Staff, has been named Inspector-General for Central Canada. Major-General Anderson was graduated from the Royal Military College in 1900, and from McGill in 1901 with the degree of B.Sc. He joined the Institute as a Student in 1900. He has been associated with the army ever since his student days, and has been successively a teacher, district engineer, adjutant, in which capacity he served overseas with the Royal Canadian Engineers from 1914 to 1919, Director of Military Training, District Commanding Officer, and Quarter Master General and Chief of General Staff.

O. O. Lefebvre, M.E.I.C., a past-president of the Institute, is the new vice-chairman of the Quebec Streams Commission. For the past five years, Dr. Lefebvre had been vice-chairman of the Quebec Electricity Commission and later, a member of the Provincial Electricity Board. He now returns to the Commission of which he was the first chief engineer, having been appointed in 1913 and having served until his move to the Quebec Electricity Commission in 1935. Dr. Lefebvre has been responsible for many outstanding works, notably the large storage works on various rivers in the province of Quebec, for the regulation of the flow for power purposes. Among other important posts held by Dr. Lefebvre was that on the Joint Board of Engineers appointed by the government of Canada and the United States to investigate and report on the engineering features of the proposed St. Lawrence river navigation and power project.

Dr. Lefebvre, who has served for a number of years on the Administrative Board of the Ecole Polytechnique, has been appointed, last month, on the new Administrative Board of the University of Montreal.

W. D. Black, M.E.I.C., president of the Otis-Fensom Elevator Company, Limited, Hamilton, and a past-president of the Canadian Manufacturers Association, has been appointed a director of the Allied Supplies Limited, the government-owned company recently formed to administer the munitions and explosives programme undertaken in Canada on behalf of the British government. Mr. Black is also a member of the executive committee of the Bank of Canada.

Beaudry Leman, M.E.I.C., president of the Banque Canadienne Nationale, has also been appointed as a director of the Allied Supplies Limited.

T. C. Macnabb, M.E.I.C., general superintendent of the New Brunswick district of the Canadian Pacific Railway Company, was elected governor of the 192nd district of Rotary International at the 1940 Rotary convention held in Havana recently. As district governor and as an officer of Rotary International, he will visit the Rotary clubs in more than thirty cities of New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Maine, which comprise this Rotary district, and will counsel with and advise Rotary club officers on matters relating to the administration of club affairs.

T. M. Moran, M.E.I.C., has now joined the firm of Stevenson & Kellogg, Limited, management engineers, of Montreal. For the past eleven years, he had been with the Dominion Rubber Company, his last position being that of factory manager of the Papineau plant in Montreal. Three years ago, he was one of the accredited delegates of the Institute at the Seventh International Management Congress at Washington. He is, at present, the active chairman of the Management Section of the Montreal branch.

Major A. G. Riddell, M.C., M.E.I.C., of Hamilton, Ont., has received from the authorities his retirement with full rank. He served in France in the 1914-1918 war with the Second Brigade as officer in charge of water supply for the First Division of the Canadian Expeditionary Force. Since 1922, Major Riddell has been engaged in private practice in Hamilton, Ont.

Wills Maclachlan, M.E.I.C., of Toronto has recently been elected to the presidency of the Royal Canadian Institute.

Paul Vincent, M.E.I.C., has been appointed chief of the technical section in the Department of Colonization of the province of Quebec. He was graduated from the Ecole Polytechnique in 1934 and spent a year as a demonstrator in the electrical laboratory of the Ecole. From 1935 to 1937, he was with the marine department of the Dominion, on water level investigation. In 1937, he was appointed district engineer for the Roads and Bridges Division of the Department of Colonization of Quebec. Mr. Vincent is the secretary-treasurer of the Quebec Branch of the Institute.

Rodney Bruce, M.E.I.C., has recently joined the staff of Canadian Industries Limited, at Brownsburg, Que. For some months after his graduation from Queen's University, in 1936, he was with the Brunner, Mond Canada, Limited, at Amherstburg, Ont. In 1937, he joined Findlays, Limited, at Carleton Place, Ont., as assistant plant and heating engineer, a position which he resigned to accept his new appointment.

W. C. Tatham, M.E.I.C., has resigned his position as assistant chief engineer of Courtaulds (Canada) Limited, at Cornwall, Ont., to join the engineering staff of Defence Industries Limited as project engineer in the Montreal office. Upon graduation from McGill University in 1935, he went to South Africa, and for some time was with the East Geduld Mines, Limited, Springs, Transvaal, and later as ventilation officer, Grootvlei Proprietary Mines, Limited, in the same place. Upon his return to Canada in 1938, he went with Courtauld's, at Cornwall, Ont.

L. A. Thorssen, Jr.E.I.C., is now resident engineer in the Civil Aviation Division, Department of Transport at the Currie Barracks Airport, Calgary. He had entered the Department upon his graduation from the University of New Brunswick last year.

R. B. Logie, S.E.I.C., who was graduated this spring from the University of New Brunswick with the degree of B.Sc., is engaged with the Canadian Pacific Railway Company at Ottawa, Ont.

Alfred Peterson, Jr.E.I.C., has accepted a position as chemical engineer with the Asbestonos Corporation, Limited, at St. Lambert, Que. He was graduated from McGill University in 1934, and until 1938, was connected with the Abitibi Power & Paper Company, at Iroquois Falls, Ont., and later, with the Ste. Anne Paper Company, at Beaupre, Que. Lately, he had been employed with the Department of Public Works of Canada, at Rimouski, Que.

Reginald Bowering, S.E.I.C., is now employed by the Board of Health of the Province of British Columbia, as chief sanitary inspector. He was graduated in civil engineering from the University of Manitoba, in 1938, and he took his master's degree, at the University of Toronto in 1939, specializing in sewage and water treatment.

The G. A. Gaherty Trophy

G. A. Gaherty, M.E.I.C., president of the Montreal Engineering Company and the Calgary Power Company, has donated a series of bronze statues to establish an annual prize for the North American Bucking Horse Riding Contest at the world-famous Calgary Stampede. The statue was designed and executed by Charles A. Beil, who is well known for his western work, and shows a bucking horse with his rider just reaching the ground after an unsuccessful attempt to "ride it out." This particular contest is the main feature of the stampede, and is perhaps the most important event of its kind in America.

VISITORS TO HEADQUARTERS

F. L. Black, Jr.E.I.C., formerly junior engineer with the New Brunswick Electric Power Commission, from Saint John, N.B., on June 19th.

Price R. Reid, from New York, N.Y., on June 28th.

Guy M. Minard, Jr.E.I.C., from Kapuskasing, Ont., on July 4th.

A. Babin, M.E.I.C., resident engineer on construction, with the Quebec North Shore Paper Company, from Baie Comeau, Que., on July 8th.

F. A. Brownie, M.E.I.C., of the Calgary Gas Company, from Calgary, Alta., on July 9th.

John E. Beach, S.E.I.C., from Toronto, Ont., on July 15th.

Dan W. Patterson, S.E.I.C., from Westville, N.S., on July 18th.

Paul Vincent, M.E.I.C., chief of the technical section of the Dept. of Colonization, Quebec, on July 22nd.

Norman A. MacKay, S.E.I.C., with the Dominion Coal and Steel Co., Sydney, N.S., on July 24th.

Sam G. Porter, M.E.I.C., manager, Dept. of Natural Resources, C.P.R., Calgary, Alta., on July 25th.

John B. D'Aeth, M.E.I.C., engineer with the Dufresne Engineering Co. Ltd., Cadillac, on July 25.

Lieut.-Col. LeRoy F. Grant, M.E.I.C., Assoc. Prof. of Engineering, Royal Military College, Kingston, Ont., on July 29th.

Dean Edward P. Fetherstonhaugh, M.E.I.C., of the University of Manitoba, Winnipeg, Man., on July 29th.

Obituaries

Samuel Phillips Mitchell, M.E.I.C., died in Philadelphia, Pa., on February 11th, 1940, after a long illness. He was born at Richmond, Va., on June 10th, 1864 and was educated at the University of Virginia. He was employed with the Baltimore & Ohio Railway as resident engineer and inspector of bridges until 1887, when he went with the Edge Moor Bridge Works as assistant engineer. From 1891 until 1897, he was assistant manager and from 1897 to 1900, manager of the same firm. In 1900, he became erection engineer with the American Bridge Company of New York, and a year later he was made chief engineer and remained in that position until 1906. At that time he engaged in a private practice as a consulting engineer and was president of the Seaboard Construction Company at Philadelphia, a position which he occupied until his illness.

Mr. Mitchell joined the Institute as a member in 1912.

Flying Officer Jean A. Lalonde, S.E.I.C., was killed on July 15th, 1940, when a bomber in which he was engaged in routine manoeuvres crashed into the Halifax harbour. He was born at Outremont, Que., on June 6th, 1918, and was the son of J. Antonio Lalonde, M.E.I.C., a well-known member of the Montreal Branch. He received his general education at the Mount St. Louis College, in Montreal, where he obtained his diploma in 1935. He then entered the Ecole Polytechnique, where he was graduated in 1939 with the degree of B.A.Sc.

Flying Officer Jean A. Lalonde, S.E.I.C.

Upon graduation, he entered the Royal Canadian Air Force, and received his first training at Cartierville, Que. Subsequently, he was stationed at Camp Borden and Trenton, Ont. Last spring, he had been transferred to Dartmouth, N.S., where he was located at the time of his tragic death.

He was a skiing enthusiast, and a member of the University of Montreal ski club. He was also a lover of music, and played the piano.

Flying Officer Lalonde joined the Institute as a Student in 1937.

Joseph N. Têtu Bertrand, M.E.I.C., died at Isle Verte, Que., on July 21st, 1940. He was born at Isle Verte on October 13th, 1864, and received his education at McGill University. He first engaged in railway construction at Parry Sound, Ont., and in the County of Temiscouata, Que. In 1898, he became district engineer of Gaspé with the Department of Public Works of Canada and remained in that position until 1922, when he became consulting district engineer at Rimouski, Que.

Mr. Bertrand joined the Institute as a Student in 1897 and was transferred to Associate Member in 1906.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

BORDER CITIES BRANCH

H. L. Johnston, m.e.i.c. - *Secretary-Treasurer*
A. H. Pask, Jr.e.i.c. - - *Branch News Editor*

The monthly meeting of the Border Cities Branch was held at the Sarnia Riding Club at Sarnia, Ont., on June 1, 1940. Following a dinner, the branch chairman, Mr. J. F. Bridge, put the meeting in charge of Mr. C. E. Carson, who introduced the speaker of the evening, Mr. C. M. Baskin, Asphalt Technologist for the Imperial Oil Co. Ltd. The subject was **Field Technology, a New Approach to Industrial Development.**

The speaker defined field technology as an extension of technical service. In outlining its growth he told how field tests had grown into systematic investigation and experimentation to see if improvements could be effected. The first crude methods changed to scientific analysis and synthesis. The laboratory is built around field observations, and deductions are made from these observations on a new product.

As examples of the inter-dependence of industries for developments, the speaker pointed out the growth of a better kerosene and kerosene lamp. The integration of the manufacturers of the different lamp parts to create the better lamp is also field technology. In other fields, this has also been carried out as the simultaneous development of gasolines and the gasoline engine.

The speaker pointed out that modern industry is interdependent so that one improvement is often of no great use without a step in an allied industry. Therefore an object of field technology is to correlate the objects and findings of different industries.

In general, laboratory tests attempt to duplicate actual conditions. This cannot always be done so then work must be done in the field. Asphalt tests originally were done to standardize conditions on different jobs. This started scientific research to find reasons for the different qualities of asphalt. From the study of properties came changes in manufacture.

Field technology is a study of the behaviour of a product in use so that the observations made can be used to advance the laboratory tests. Systematic observation is the basis of field technology and makes field technology a basis of all industry.

Following an interesting question period, the vote of thanks to the speaker was moved by Mr. J. E. Phelps. Coloured still and motion pictures of South America were then shown. These had been taken by the speaker and were much appreciated by all present. Mr. C. F. Davison thanked the Sarnia Committee for their work in the arrangement made. The meeting then adjourned.

LETHBRIDGE BRANCH

E. A. Lawrence, s.e.i.c. - *Secretary-Treasurer*

The Lethbridge Branch held its Annual Meeting at the Marquis Hotel on April 10th. The corporate members were the dinner guests of Chairman A. J. Branch earlier in the evening. The Annual Report of the branch was read and adopted, and the incoming chairman, Wm. Meldrum, was introduced. During the evening C. S. Donaldson, on behalf of the branch, presented an electric chime clock to Vice-President P. M. Sauder, whose appointment as Director of Water Resources, in the Alberta Government, has made necessary his removal to Edmonton. Mr. Donaldson paid tribute to the good work and sound advice Mr. Sauder had given the branch during the past years. Mr. Sauder in replying hoped he would have an opportunity of visiting at frequent intervals. The balance of the evening was taken up with a discussion of the policy the branch should pursue in the future, and a number of valuable suggestions for the incoming executive were set forth.

The Lethbridge Branch held a joint luncheon meeting at the Marquis Hotel on May 15th, when Professor G. Worcester, m.e.i.c., Professor of Ceramics, University of Saskatchewan, was the speaker. Branch Chairman Wm. Meldrum presided. J. M. Campbell, councillor, introduced Professor Worcester, who addressed the meeting on "Ceramics."

Professor Worcester first outlined the development of Ceramic Engineering on this continent and then acquainted his listeners with the varied branches of the ceramic industry, and the wide range of products that are produced.

The duties of a ceramic engineer were set forth, and the methods of clay testing were described.

Professor Worcester mentioned how large sums of money had been wasted in attempts to utilize unsuitable clays and how proper testing would have resulted in more economical development.

At the conclusion of the meeting President Chas. McMillan of the Board of Trade expressed a hearty vote of thanks to Professor Worcester.

During the day members of the branch took Professor Worcester to Picture Butte to inspect the modern beet sugar factory of the Canadian Sugar Factories Ltd.

SAGUENAY BRANCH

K. A. Booth, Jr.e.i.c. - *Secretary-Treasurer*

The 1940 annual meeting of the Saguenay Branch of the Institute was held at Arvida, July 4th, 1940. During the afternoon the members engaged in a round of golf over the course of the Arvida Golf Club. At 6.00 p.m., forty-eight members and visitors gathered at the Saguenay Inn for dinner and the annual meeting. The chairman in a few appropriate words proposed a toast to the King and defeat to his enemies after which the members sat down to dinner. At the conclusion of the dinner the chairman, Mr. Adam Cunningham, introduced the guests of honour for the evening, Dr. T. H. Hogg, president of the Institute, Mr. McNeely DuBose, vice-president for Quebec, Mr. Muntz, vice-president for Hamilton, and Mr. L. Austin Wright, general secretary.

Visit of President Hogg to Saguenay Branch

Dr. Hogg gave a summary of the work of the Institute in the past year, mentioning the work of the Bennett Committee on the Training of the Young Engineer, of Dr.

Challies Committee on obtaining closer relations between The Engineering Institute and the provincial associations, of the Fairbairn Committee in connection with international relationships. He described the decision of council to do away with the associate membership and the installation of two vice-presidents each for Ontario and Quebec.

Mr. Wright then informed the meeting that membership was being maintained, that collections were coming in as expected, and that although the Institute scheme for registration of all engineers had not, so far, been used in preparations for the war, still the method of dealing with it was to be reorganized. He then described the projected scheme by which the children of engineers in the Old Country would be able to find temporary homes with willing members of the Institute in Canada. Vice-President DuBose next gave a necessarily short, but very entertaining talk on the place of the engineer in fitting into the political and economical sphere of present day activities.

Vice-President Muntz supplemented the remarks of Mr. Wright with regard to evacuees from the British Isles.

Mr. M. G. Saunders expressed on behalf of the members, the pleasure the Saguenay Branch had due to the presence of so many visiting speakers of The Engineering Institute.

Our visitors then left to catch the 8.55 p.m. train and the business of the meeting began.

The chairman then called on the secretary-treasurer to read the minutes of the last annual meeting. This was followed by the reading of the annual report of the branch activities.

Mr. Adam Cunningham, the retiring chairman, then thanked the members of the executive in a few well-chosen words for their support in the past year and turned over his chair to the incoming chairman, Mr. J. W. Ward, who gave a short address, announced the appointment of Mr. T. Taylor as secretary-treasurer and then declared the meeting adjourned.

THE GENERAL SECRETARY VISITS THE WEST

LETHBRIDGE, ALTA.
Wm. Meldrum, chairman of the branch

VICTORIA, B.C.
R. C. Farrow of the executive; E. W. Izard, chairman; K. Reid, secretary-treasurer

REGINA, SASK.
P. C. Perry, chairman; C. J. McGavin; H. S. Carpenter; J. J. White, secretary-treasurer; D. A. R. McCannel, president of Dominion Council of Professional Engineers; G. L. Mackenzie

Library Notes

Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

LIST OF THE NEW AND REVISED BRITISH STANDARDS

Issued during April, 1940

B.S. No.

538-1940—Metal Arc Welding in Mild Steel as applied to General Building Construction (Revision).

In this revised issue the details of the forms of welded joints to be used have been amplified and the stresses permitted are now specified in definite values instead of being expressed as percentages of the stresses in the parent metal. The specification has been recast in general.

752-1940—Test Code for Acceptance Tests for Steam Turbines (Revision).

This revision includes extensive additional notes on instruments and methods of measurement.

883-1940—Cables and Flexible Cords for Electrical Equipment of Ships (including Electrical Propulsion).

Includes details of rubber, paper and varnished cambric insulated cables, and rubber-insulated flexible cords.

890-1940—Building Limes.

Provides for quicklimes new hydrated limes (non-hydraulic and semi-hydraulic) of qualities suitable for finishing and plastering and for coarse stuff and building mortar. The chemical composition and physical properties are defined together with the methods of testing.

891-1940—Method for Direct Reading Hardness Testing (Rockwell Principle).

The standardization of the Rockwell test relates to scales A, B and C. The essential requirements of the machines and the methods by which the test is to be made are specified. There are two appendices—one describes the range of material with which the different scales may be used and the other describes a simple means of checking the accuracy of the machine by means of a calibrated block.

892-1940—Glossary of Highway Engineering Terms.

Gives definitions of most terms used in highway engineering. It is hoped that the publication of this Glossary will clarify the present position with regard to terminology, as, in cases where numbers of synonyms exist, guidance is given as to which term should be used.

893-1940—Method of Testing Dust Extraction Plant and the Emission of Solids from Chimneys of Electric Power Stations.

Describes the method for sampling the dust content of flue gases, the method of air elutriation for grading the dust also, describes the various forms of sampling tubes which may be used.

894-1940—The Determination of the Flow and Drop Points of Fats and Allied Substances (Apparatus and Method of Use).

This specification which forms part of a series of specifications for scientific glassware defines the apparatus to be used and the method of using this apparatus.

895-1940—Methods for the Microbiological Examination of Butter.

Gives the method of sampling, the treatment of the sample, the apparatus to be used, the diluent, the plating and counting and the media for the differential enumeration of various micro-organisms in butter.

896-1940—Dimensions of Stretchers, Stretcher Carriers in Ambulances and Hospital Trolleys.

This specification is limited to dimensional requirements and gives those dimensions which are essential for stretchers of various types of construction so that they may readily fit interchangeably into ambulances and on hospital trolleys.

Copies of the new specifications may be obtained from Canadian Engineering Standards Association, 79, Sussex Street, Ottawa.

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

Coal

By Elwood S. Moore, New York, John Wiley & Sons, Inc., 1940. 9¼ by 6 in., $6.00.

Early Days of the Power-Station Industry

By R. H. Parsons, London, Cambridge University Press, 1940. 9½ by 6 in., 15s.

Erosional Topography and Erosion

By James M. Little, San Francisco, A. Carlisle & Co., 1940. 9 by 6 in.

James Douglas—A Memoir

By H. H. Langton, Toronto, University of Toronto Press, 1940. 9½ by 6¼ in. (Presented by the Sons and Daughters of James Douglas).

Molesworth's Pocket Book of Engineering Formulae

Edited by Albert Peter Thurston, London, E. & F. Spon, Ltd., 1940. 5 by 3 in., 7/6.

PROCEEDINGS, TRANSACTIONS, ETC.

Association of Professional Engineers of British Columbia

Year Book of the Engineering Profession in British Columbia, 1940.

British Engineers' Association

Classified Handbook of Members and their Manufactures, 1940.

Highway Research Board

Proceedings of the Nineteenth Annual Meeting held at Washington, D.C., December, 5-8, 1939.

Naval Architects and Marine Engineers

Year Book, 1940.

REPORTS

Canada Department of Mines and Resources—Mines and Geology Branch

Investigations in Ore Dressing and Metallurgy, July to December, 1938. Ottawa, 1940.

Canada Department of Mines and Resources—Surveys and Engineering Branch

Surface Water Supply of Canada St. Lawrence and Southern Hudson Bay Drainage Ontario and Quebec, Climatic years 1933-34 and 1934-35—Water Resources Paper No. 76. Atlantic Drainage (South of St. Lawrence River) New Brunswick, Nova Scotia and Prince Edward Island, Climatic years 1934-35 and 1935-36.—Water Resources Paper No. 81.

Canadian Government Purchasing Standards Committee

Specifications for Aluminum pigment for paint (Type 2, paste); Cellulose finishes for aircraft fabric; Exterior paint, quick drying, flat; Fire-retardant paint, for interior use; General purpose chip soap and powdered soap containing builder; Dishwashing compound, soap-free, for use in mechanical equipment.

Electrochemical Society

The Hydrogen and oxygen overvoltages of chromium nickel alloys in 1 Molal Patassium Hydroxide; Phase segregation and its relation to the properties of the system Palladium-Hydrogen; Effect of Glycerine on the throwing power of Plating Baths. Preprints Nos. 78-4 to 78-6.

Hydro-Electric Power Commission of Ontario

Thirty-second Annual report, 1939. Toronto, 1940.

International Union of Chemistry

Rules for naming inorganic compounds—report of the Committee for the reform of inorganic chemical nomenclature.

Kenya and Uganda Railways and Harbours

Report of the General Manager on the Administration of the Railways and Harbours for the year ended 31st December, 1939. Nairobi, Kenya Colony, 1940.

Manitoba, Department of Mines and Natural Resources—Mines Branch

Eleventh Annual Report on Mines and Minerals for the year ending April 30th, 1939.

National Research Council of Canada

Note on the Velocity distribution of gaseous molecules; and a table for obtaining values of the error function complement by A. H. Heatley.

Ontario Department of Mines

Forty-eighth annual report, V. XLVIII, Parts 1, 2, 5, 8, Toronto, 1940.

Quebec Department of Mines—Bureau of Mines

Mining Industry and Statistics for the year 1938. Quebec, 1939.

Quebec Department of Mines—Geological Division

Geological report No. 2, Lower LaFlamme River Area Abitibi District 1—Western section, by P. E. Auger, 2—Eastern section, by W. W. Longley. Quebec, 1939.

U.S. Department of Commerce—Building Material and Structures

BMS45, Air infiltration through windows; BMS46, Structural properties of "Scot-Bilt" prefabricated sheet-steel constructions for walls, floors, and roofs sponsored by Globe-Wernicke Co.; BMS48, Structural properties of "Precision-Built" frame walls and partition construction sponsored by the Homasote Co.; BMS49, Metallic roofing for low-cost house construction.

U.S. Department of Commerce—National Bureau of Standards—Miscellaneous Publication

Report of the twenty-ninth National Conference on weights and measures, publication M164.

U.S. Department of the Interior—Bureau of Mines

Quarry accidents in the United States during the year 1937, Bulletin No. 426; Metal-mine accidents in the United States, 1937, Bulletin No. 428.

U.S. Department of the Interior—Bureau of Mines—Technical Papers

Phenomena in the ignition of firedamp by explosives—pt. 1, particles from the detonation, paper 603; Carbonizing properties and petrographic composition of Pocahontas No. 3—Bed coal from buckeye No. 3 mine, Wyoming County, W.Va. and of Pocahontas No. 4—bed coal from No. 4 mine, Raleigh, County W. Va., paper 604; Developments in coal research and technology in 1937 and 1938, paper 613; Bentonite; its properties, mining, preparation and utilization, paper 609.

U.S. Department of the Interior—Geological Survey Water-Supply Papers

Surface water supply of the United States 1938, pt. 2, South Atlantic slope and eastern Gulf of Mexico basins, paper 852; Surface water supply of the United States 1938, pt. 8, Western Gulf of Mexico basins, paper 858; Surface water supply of the United States 1938, pt. 12, Pacific slope basins in Washington and Upper Columbia River basin, paper 862.

U.S. Department of the Interior—Geological Survey—Professional Paper

Some structural features of the Northern Anthracite coal basin, Pennsylvania, paper 193-D.

U.S. Department of the Interior—Geological Survey Bulletin

Spirit levelling in South Carolina, pt. 2, Southern South Carolina, 1896-1938. Bulletin 890-B; Geophysical abstracts 96, January-March 1939, Bulletin 915-A; Geology of the Alaska railroad, Bulletin 907; Microscopic determination of the ore minerals, Bulletin 914; Clay investigations in the Southern States, 1934-35, Bulletin 901.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

THE COAL-MINING INDUSTRY, an International Study in Planning

By J. H. Jones, G. Cartwright and P. H. Guénault. Pitman Publishing Corp., New York, 1939. 394 pp., charts, tables, 9 x 5½ in., cloth, $5.00.

This volume consists of a survey of the efforts made by different coal-producing countries to deal with the problem of depression in their respective mining industries. It is concerned with the organization of capital, not labor. About half the book is devoted to an investigation of the situation in Great Britain and contains considerable statistical material. Other countries dealt with are France, Belgium, Poland, Germany, Canada and the United States.

ELEMENTS OF STRENGTH OF MATERIALS

By S. Timoshenko and G. H. MacCullough. 2nd ed. D. Van Nostrand Co., New York, 1940. 365 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.25.

The principal features of Timoshenko's two volumes, the "Strength of Materials," are presented in abridged form as a textbook for undergraduates. In addition to a certain amount of revision, both in the text and the large number of problems, material has been added on welded joints, photo-elasticity and moments of inertia of plane areas.

ENGINEERING SURVEYS

By H. Rubey, G. E. Lommel and M. W. Todd. Rev. ed. Macmillan Co., New York, 1940. 321 pp., text; 141 pp., logarithmic and trigonometric tables. Illus., diagrs., charts, tables, maps, 8 x 5 in., lea., $3.50.

Written from the viewpoint of the modern engineer and executive, this book is a clear, concise presentation of the subject of plane surveying. It covers thoroughly the fundamentals of engineering surveys and explains the procurement and use of maps and data, the organization and costs of surveys, etc. The necessary tables are included, and a sample set of student field-notes has been appended to this revised edition.

FUNDAMENTALS OF ELECTRICITY AND ELECTROMAGNETISM

By V. A. Suydam. D. Van Nostrand Co., New York, 1940. 690 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, $4.75.

The fundamental laws, theories and principles of electricity and magnetism are presented in such a way as to provide a foundation both for the physicist and for the electric power and communication engineer. The field from electrostatics to thermionic electron tubes is covered with as full mathematical development as is consistent with the student's previous instruction. Problems and literature references are included.

Great Britain. Dept. of Scientific and Industrial Research

METHODS FOR THE DETECTION OF TOXIC GASES IN INDUSTRY, Leaflet No. 7, CARBON MONOXIDE

His Majesty's Stationery Office, London, 1939. 9 pp., illus., diagrs., tables, 10 x 6 in., paper, 1s. 6d. (obtainable from British Library of Information, 50 Rockefeller Plaza, New York, $0.45).

Tested and standardized methods for the detection of dangerous gases in low concentration are presented in this series of leaflets. In the present one, the poisonous effects of carbon monoxide are given, in addition to a detailed description of its detection by means of the reduction of palladium chloride to metallic palladium.

INDEX TO THE PROCEEDINGS, JOURNAL AND OTHER PUBLICATIONS OF THE AMERICAN WATER WORKS ASSOCIATION, 1881-1939 inclusive

American Water Works Association, New York, 1940. 285 pp., 9 x 6 in., cloth, $1.75 to members; $1.50 to members if cash is included with order; $2.00 to non-members.

The publications of the American Water Works Association, from its beginning in 1881 through 1939, are indexed. All published papers are listed chronologically under seventy major subjects of the water works field. There are also an author index, a guide to the topics in the subject index and description of other publications issued by the Association alone or in co-operation.

INDUSTRIAL DESIGN

By H. Van Doran. McGraw-Hill Book Co., New York, 1940. 388 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $4.50.

This book is presented as a practical textbook on industrial design, but is expected to be useful to the engineer, commercial artist, and business man as well. Part I outlines the scope of the work, the difficulties and something of its possibilities. Part II is an elementary treatise on designing in three dimensions. Technique is dealt with in Part III covering the gathering and presentation of data and ideas, information on material and processes, etc. Part IV offers problems, including possible solutions, and gives case histories of the development of three actual products.

INDUSTRIAL ELECTROCHEMISTRY (Chemical Engineering Series)

By C. L. Mantell. 2nd ed. McGraw-Hill Book Co., New York, 1940. 656 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $5.50.

A considerable range of subject matter is covered in this comprehensive textbook: the theoretical and technical sides of electrochemistry; the aqueous and fused electrolyte industries; electrothermics; the electro-chemistry of gases; and such engineering aspects as power generation and the materials used in the construction of electrochemical equipment. New material has been added in this edition and some rearrangement of topics has been made.

INTRODUCTION TO ELECTRICITY AND OPTICS

By N. H. Frank. McGraw-Hill Book Co., 1940. 398 pp., diagrs., charts, tables, 9 x 6 in., cloth, $3.50.

Intended for second-year students majoring in electrical engineering or physics, this textbook presents a compact logical exposition of the fundamental laws of the electric and magnetic fields. The elementary applications of these laws to circuits, to a study of the electrical and magnetic properties of matter and to the field of optics are also discussed. Problems are included with each chapter.

MAC'S DIRECTORY AND HANDBOOK OF ANTHRACITE, 1940

Ed. by W. C. MacQuown. National Coal Publications, Law Bulletin Bldg., Pittsburgh, Pa., 1940. 76 pp., illus., diagrs., tables, maps, 12 x 9 in., paper, $5.00.

The directory section contains anthracite selling companies arranged both alphabetically and geographically, anthracite producing companies arranged alphabetically and by fields, anthracite collieries and mines, trade names and a map of the anthracite fields. In addition there are a brief equipment directory and numerous technical articles on various phases of anthracite production.

MATHEMATICAL RECREATIONS AND ESSAYS

By W. W. Rouse Ball, rev. by H. S. M. Coxeter. 11th ed. Macmillan and Co., Ltd., *London; Macmillan Co., New York, 1939. 418 pp., illus., diagrs., charts, tables, 8 x 5 in., cloth, $2.75.*

This amusing little book for the mathematically inclined covers arithmetical and geometrical problems, magic squares, chess and playing card recreations. Cryptographs and ciphers are discussed and brief descriptions are given of the feats of various calculating prodigies. Several chapters have been enlarged in this edition, a chapter on polyhedra replaces one on mechanical problems, and string figures have been omitted.

NATIONAL PHYSICAL LABORATORY REPORT FOR THE YEAR 1939. Dept. of Scientific and Industrial Research

His Majesty's Stationery Office, London, 1940. 100 pp., tables, 10 x 6 in., paper, 2s. 6d. (obtainable from British Library of Information, 50 Rockefeller Plaza, New York, $0.75).

In addition to general information concerning the laboratory and its work, this publication presents the reports of the William Froude Naval Laboratory and the departments of physics, electricity, radio, metrology, engineering, metallurgy and aerodynamics, indicating the state of the current researches.

NATIONAL RESEARCH COUNCIL. HIGHWAY RESEARCH BOARD, Proceedings of the Nineteenth Annual Meeting held at Washington, D.C., December 5-8, 1939

Edited by R. W. Crum. National Research Council, Washington, D.C., 1940. 578 pp., 10 x 6½ in., cloth, $2.25.

In addition to official information about the Highway Research Board, this volume contains over 500 pages of papers, discussions and reports presented at the 1939 meeting. This material is arranged by departments under the headings: finance; economics; design, materials and construction; maintenance; traffic and safety; and soils. Some papers have bibliographies and there is an author index.

OUTLINE OF INDUSTRIAL RELATIONS POLICIES IN DEFENSE INDUSTRIES

Princeton University, Industrial Relations Section, Princeton, N.J., June, 1940. 47 pp., 10 x 7 in., paper, $0.75.

Brief discussion and reported experiences are presented on the following topics: expansion of management organization; recruitment of production workers; training of skilled and semi-skilled workers; wages and hours of work; employee-management cooperation in accelerated production. There is a selected bibliography.

AN OUTLINE OF METALLURGICAL PRACTICE

By C. R. Hayward. 2nd ed. D. Van Nostrand Co., New York, 1940. 690 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $7.50.

Fundamental information concerning metallurgical processes is given for each metal in turn. Concentration, roasting, smelting and refining are described, together with special processes for certain metals, and brief information is included upon occurrence, mining method and physical properties. Non-ferrous alloys are discussed briefly. Supplementary reading lists accompany most of the chapters. The book has been revised to keep in line with present-day practice.

PRESENTING FLEX-ANAL CHARTS, a New and Modern Treatise for Design of Piping for Flexibility

By E. A. Wert and S. Smith. Blaw-Knox Company, Power Piping Division, Pittsburgh, Pa., 1940. 80 pp., illus., diagrs., charts, tables, 11½ x 8½ in., fabrikoid, free to those interested in piping design problems, $3.00 to general public.

To facilitate the rapid designing of piping systems, methods and procedures are given for flexibility analyses and for determining the magnitudes of forces, moments, stresses and movements. These procedures are based on a large group of charts which relate only to the use of wrought iron and certain steels, although the formulas are applicable to other materials.

PRINCIPLES AND PRACTICE OF ELECTRICAL ENGINEERING

By A. Gray, revised by G. A. Wallace. 5th ed. McGraw-Hill Book Co., New York, 1940. 586 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

This standard practical textbook has again been revised in accordance with modern practice. A considerable range of electrical theory and machinery is covered, including control and applications, with a minimum of mathematical derivation. The problems have been shifted from the back of the book to the ends of the chapters and some new ones have been added.

PRINCIPLES OF ALTERNATING-CURRENT MACHINERY. (Electrical Engineering Texts)

By R. R. Lawrence. 3rd ed. McGraw-Hill Book Co., New York, 1940. 678 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $5.50.

The principles underlying the construction and operation of the more important types of alternating-current machinery are fully treated. The subject matter is grouped under eight headings: synchronous alternators; static transformers; synchronous motors; parallel operation of alternators; synchronous convertors; polyphase induction motors; single-phase induction motors; and series and repulsion motors. The present edition is considerably revised and much new material has been added.

PRINCIPLES OF DIRECT-CURRENT MACHINES. (Electrical Engineering Texts)

By A. S. Langsdorf. 5th ed. McGraw-Hill Book Co., New York, 1940. 746 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $5.50.

This well-known text aims to supply a reasonably complete treatment of the fundamental principles that underlie the design and operation of all types of direct-current machinery. In addition to the customary revision to bring the material up to date, the present edition includes a more extensive treatment of the general principles of electricity and magnetism. Entirely new sets of problems are collected at the end of the book.

PROBLEMS AND POLICIES IN INDUSTRIAL RELATIONS IN A WAR ECONOMY. A Selected, Annotated Bibliography.

Rev. ed., prepared by H. Baker. Industrial Relations Section, Princeton University, Princeton, New Jersey, May, 1940. 30 pp., 9 x 6 in., paper, $0.25.

The books, reports and articles listed in this bibliography of industrial organization in wartime cover conditions in the United States and Great Britain during the World War and the reconstruction period, legislative developments in the United States affecting current adjustment to a war economy, and discussions of current problems. There is an author index.

RAILROADIANS OF AMERICA

New York, Book No. 2, 1940. 76 pp., published by Railroadians of America, N.Y., 56 Tuxedo Ave., Hawthorne, New Jersey. Illus., charts, tables, maps, 11 x 8 in., paper, $2.00.

Number 2 of this series contains a history of the Sixth Avenue elevated line with contemporary illustrations, and article on the development and types of compound locomotives, and a history of the work and a description of the shops of Norris Brothers, locomotive builders, also with contemporary illustrations.

S.A.E. HANDBOOK, 1940 ed.

Society of Automotive Engineers, 29 West 39th St., New York. 834 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $5.00.

All the current standards and recommended practices of the Society of Automotive Engineers concerning automobile and aircraft materials and parts, tests and codes, production equipment, nomenclature and definitions are contained in this annually revised handbook. Fifty-five changes (new and revised standards, corrections and cancellations) from the 1939 edition are noted.

SOUND TRANSMISSION IN BUILDINGS, Practical Notes for Architects and Builders

By R. Fitzmaurice and W. Allen. Dept. of Scientific and Industrial Research, London, His Majesty's Stationery Office, 1940. 48 pp., illus., diagrs., charts, tables, 12½ x 9½ in., cloth, $1.20.

This volume is a practical report of investigations on sound transmission in buildings undertaken jointly by the National Physical Laboratory and the Building Research Station. The nature and transmission of sound are discussed, and proper construction for sound insulation purposes is described, with many detailed architectural drawings. There is a short bibliography.

STEAM POWER STATIONS

By C. A. Gaffert. 2nd ed. McGraw-Hill Book Co., New York, 1940. 592 pp., illus., diagrs., charts, maps, tables, 9 x 6 in., cloth, $4.50.

This comprehensive and interesting volume on steam power-station work falls roughly into two sections. Chapters I-XVII deal with the construction and performance characteristics of the mechanical equipment, including fuels and feed water. The succeeding chapters, XVIII-XXIV, cover plant economics and the integration of the machinery, with considerable discussion of steam and binary-vapor cycles. Problems and short bibliographies are included with the separate chapters.

THEORETICAL PHYSICS. Vol. 3, Relativity and Quantum Dynamics, Einstein-Planck

By W. Wilson. E. P. Dutton & Co., New York, 1939. 276 pp., diagrs., charts, tables, 9 x 5½ in., cloth, $5.75.

The final volume of this text covers relativity and quantum dynamics in such a way, as in the preceding volumes, as to present physical theory as a coherent logical unity. The discussion of relativity passes from Einstein's special theory to the general theory, The development of the quantum theory, starting with Planck, takes in wave mechanics, matrix mechanics and electron theory. The latter part of the volume contains a discussion of the analogy between geometrical optics and Hamiltonian dynamics, and its application to quantum dynamics.

UNTERSUCHUNGEN AN EINER KREISELPUMPE MIT LABILER KENNLINIE

By R. Dziallas. VDI-Verlag, Berlin, 1940. 58 pp., illus., diagrs., charts, tables, 8 x 6 in., paper, 6.50 rm.

A report of investigations of a centrifugal pump with unstable characteristics. The test setup and measuring equipment are described, the theoretical treatment is discussed, and the test results are presented and summarized.

PRELIMINARY NOTICE

of Application for Admission and for Transfer

July 26th, 1940

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

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

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

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

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

The Council will consider the applications herein described in September, 1940.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

A 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 attainment 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

BOOTH—FRANK MARTIN, of Winnipeg, Man. Born at Farnham, Que., Jan. 21st, 1913; Educ.: B.Eng. (Mech.), McGill Univ., 1938; 1934-1935-1937 (summers), with the International Nickel Co., Fairchild Aircraft Co., Shawinigan Engineering; with latter company, 6 mos. on structl. steel dfting. and design of minor steel structures, also checking of calculations of structure design; 1938 to date, aircraft equipment engr., Trans-Canada Air Lines, Winnipeg, Man.

References: J. T. Dyment, R. E. Heartz, E. Brown, C. M. McKergow, H. M. White, T. H. Kirby.

CARTER—TULLIS NINION, of Toronto, Ont. Born at Winnipeg, Man., Jan. 6th, 1906; Educ.: Engr. of Mines, Univ. of Minn., 1931; 1924-28, timekpr., rodman, concrete foreman, on gen. constrn., and testing engr., asphalt plant, Winnipeg, Man.; 1931 to date, with the Carter-Halls-Aldinger Co. Ltd. as follows: 1931-32, office engr., Regina, 1932, constrn. engr., Winnipeg, 1932-33, constrn. engr., Windsor, 1933, constrn. supt., Leamington, Ont., 1934, constrn. supt., London, Ont., and 1934 to date, asst. manager and office engr. at Toronto.

References: E. A. H. Menges, A. R. Robertson, R. Manning, P. N. Gross, W. S. Hall.

HALLAMORE—JOHN BARNES, of Toronto, Ont. Born at Toronto, Dec. 15th, 1911; Educ.: 1923-27, Harbod Collegiate Institute. Corres. course in elec. engrg.; 1927 to date, sales engr. with the following firms: 1927-30, Corman Engineering Co. Ltd., 1930-33, Line & Cable Accessories Ltd., 1933-37, James R. Kearney Corpn., 1938-40, Powerlite Devices Ltd. (1927-30, design, manufacture and sales work, pole line equipment. 1930-40, utility equipment, Weston instruments, S. and C. fuse protective equipment, street lighting G. and W. specialties).

References: A. W. Smith, R. E. Jones, R. Harrison, W. P. Dobson, L. G. McNeice.

KEMP—OLIVER, of 5170 Queen Mary Road, Montreal, Que. Born at London, England, Oct. 19th, 1904; Educ.: B.Sc., Univ. of New Zealand, 1928; 1922-26, served pupilage (concurrently with University training), with F. E. Powell, consltg. engr., field and office work, incl. roads, sewerage, reinforced concrete and structl. steel; 1926-27 (3 mos.), with W. J. Lopdell, civil engr., Auckland, N.Z., i/c surveying for and preparation of contour plan of town district of Manurewa; 1927-28, designing dftsman., Gummer & Ford, architects and structl. engrs., Auckland; 1928 (Mar.-Sept.), designing dftsman., for H. W. White, architect and structl. engr., Sydney, Australia; 1928-29, designing dftsman., Main Roads Board of New South Wales; 1929-30, steel detailer and checker, Disher Steel Construction Co., Toronto; 1930-31, dftsman., office of engr. of standards, C.N.R., Montreal; 1936 (Apr.-Oct.), steel detailer, Canadian Bridge Co. Ltd., Walkerville; March 1939 to date, designer, structl. steel and reinforced concrete, Dominion Reinforcing Steel Co. Ltd.

References: L. B. McCurdy, W. H. G. Flay, D. T. Alexander, R. C. Leslie.

MILLIGAN—GORDON HERALD, of Edmonton, Alta. Born at Zurich, Switzerland, April 3rd, 1908; Educ.: one term, mechanics, Provincial Institute Technology and Art, Calgary, 1924; with the Calgary Power Company as follows: 1925-30, floorman and mtce. at Kananaskis and Horse Shoe plants, operator and mtce. at above and Ghost plant; 1930-31, asst. system operator, East Calgary; 1931-39, supt., Ghost plant; at present, commercial supervision, rate analysis and investigation, gen. commercial field work.

References: H. J. McLean, H. B. LeBourveau, G. H. Thompson, J. McMillan, D. A. Hansen.

MOORES—ROBERT VERNON, of 105 Jubilee Road, Halifax, N.S. Born at Blackhead, Bay de Verde, Nfld., Feb. 18th, 1907; Educ.: B.Eng., N.S. Tech., 1935; 1936, chief of survey party on highway constrn., Dept. of Public Works, Nfld. Electrician at Newfoundland Airport, installn. and operation of four Diesel electric units; 1939, electrician at Bell Island, Nfld., for Arthur G. McKee Co., Cleveland, Ohio, installn. of electric hoist; at present, engrg. inspector, Dept. of Public Works of N.S., Halifax, N.S.

References: O. S. Cox, S. Ball, A. G. Tapley, F. H. Sexton.

STANFIELD—GORDON DAWSON, of 68 Argyle St., Sydney, N.S. Born at Truro, N.S., Nov. 23rd, 1915; Educ.: B.Eng. (Mech.), McGill Univ., 1939; 1938 (summer), practical work, 1939-40, on gen. engrg. staff, inspecting gravel and sand shipments, and at present, on mech. engrg. staff, Dominion Steel & Coal Corpn. Ltd., Sydney, N.S.

References: W. S. Wilson, A. P. Theuerkauf, M. W. Booth, J. A. MacLeod, J. R. Kaye.

TREGGETT—GRAHAM ROSS, of 3560 Hutchison St., Montreal, Que. Born at Sillery, Que., May 25th, 1914; Educ.: B.Eng., McGill Univ., 1938; 1937 (summer), constrn., office work and surveys, Abitibi Power & Paper Co., Beaupre, Que.; 1938-39, city engr's. Office, City of Verdun; at present, traffic study dept., Montreal Tramways Company, Montreal, Que.

References: C. M. McKergow, R. DeL. French, R. E. Jamieson.

TROTT—WILLIAM ALFRED, of 183 Lanark St., Winnipeg, Man. Born at Vancouver, B.C., Dec. 10th, 1911; Educ.: B.Sc. (E.E.), Univ. of Man., 1933; Illuminating Engrg. Courses, General Electric Co.; 1926-27 (summers), gen. machine shop work, ap'tice., Langley Electric, Winnipeg; 1929-30 (summers), field work, trans. line constrn., etc., Manitoba Power Commission; 1930-31 (summers), factory experience, Moloney Electric Co. of Canada Ltd., Toronto; 1933 (summer), surveying, Dept. of National Defence, Dundurn, Sask.; 1936-37, illuminating engr., lighting service dept., head office, Toronto, and 1937-40, illuminating engr., i-c application engrg. commercial, industrial, interior and outdoor lighting, Winnipeg District Office (Manitoba, Saskatchewan and East to Fort William), Canadian General Electric Co. Ltd., Winnipeg, Man.

References: C. P. Haltalin, D. M. Stpehens, E. P. Fetherstonhaugh, J. Hoogstraten, H. L. Briggs, E. S. Braddell.

WARD—HAROLD JOHN, of Montreal, Que. Born at Toronto, Ont., Jan. 2nd, 1891; Educ.: Matric., McMaster Univ., Toronto, 1909; 1911-13, lighting specialist, Canadian J-M Co., Toronto; 1913, electrician, Dome Mine; 1913-16, electrical contractor, Cochrane, Ont.; 1917-19, Lieut., 11th Bn., Can. Rly. Troops; 1919-20, electrical contractor, Toronto; 1920-23, electrician and engr., Hollinger Mine; 1925-28, lighting specialist, Lighthouse Elec. Co., London, Ont.; 1928 to date, representative, The Holophane Co. Ltd., Montreal, Que.

References: F. T. Gnaedinger, A. R. Ketterston, G. K. McDougall, E. A. Ryan, G. L. Wiggs, H. W. Vaughan, G. McL. Pitts, H. F. Finnemore, J. A. Kearns, E. P. Muntz, J. A. Shaw, L. A. Wright.

FOR TRANSFER FROM STUDENT

AHEARN—WILLIAM JEFFERSON, of 538 MacLaren St., Ottawa, Ont. Born at Ottawa, March 13th, 1911; Educ.: B.Sc. (Elec.), Queen's Univ., 1937; 1937-39, Bell Telephone Company of Canada, outside plant engr.; 1939-40, radio transmitter eng. dftsman., R.C.A. Victor Company, Montreal. (St. 1935).

References: L. E. Ennis, C. L. Dewar, D. J. McDonald, J. A. McCrory, C. R. Reid, D. Rhodes.

BENOIT—ANDRE PERSILLIER, of 410 Sherbrooke St. W., Montreal, Que. Born at Montreal, Feb. 27th, 1911; Educ.: B.Eng. (Civil), McGill Univ., 1934; 1930-31 (summers), Beauharnois Constrn. Co.; 1933-34 (summers), Quebec Streams Commission; 1934-36, Noranda Power Company; 1936 to date, sales engr., Dominion Rubber Co. Ltd., Montreal, Que. (St. 1933).

References: O. O. Lefebvre, M. V. Sauer, G. O. Vogan, L. H. Burpee, E. S. Holloway.

BOONE—HAROLD PERCIVAL, of 76 Sanford Ave. So., Hamilton, Ont. Born at St. Andrews, N.B., Sept. 27th, 1912; Educ.: B.Sc., Univ. of N.B., 1937. R.P.E. of N.B., 1939; 1937-39, electrical ap'tice, 1939-40, detail correspondent, and at present, apparatus correspondent, Canadian Westinghouse Company, Hamilton, Ont. (St. 1937).

References: G. W. Arnold, D. W. Callander, J. R. Dunbar, J. Stphens, E. O. Turner.

(Continued on page 375)

Employment Service Bureau

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

SITUATIONS VACANT

ENGINEER, preferably mechanical, over thirty years old, with several years' industrial experience, for responsible position in production work. Excellent opportunity for advancement. Apply to Box No. 2110-V.

YOUNG MECHANICAL ENGINEERING GRADUATE, who can speak French, required by firm of repute for position of assistant safety engineer. Apply to Box No. 2111-V.

GRADUATE MECHANICAL ENGINEER having qualifications and keen desire to become sales engineer. Required for Toronto territory by well established organization. Prompt action essential Apply to Box No. 2126-V.

ELECTRICAL AND MECHANICAL DRAUGHTSMEN, experienced in modern generating and transformer station design practices. 25 to 40 years of age with at least two years' experience. State education, qualifications, age, length of experience and present location. Apply to Box No. 2129-V.

YOUNG MECHANICAL ENGINEER who is a recent graduate of a Canadian university. Preferably a single man who is willing to learn the business of an industrial concern from the ground up. Excellent opportunity for the right man. Apply to Box No. 2133-V.

ELECTRICAL ENGINEER—Young man with college education and some practical experience to fill position of assistant in large manufacturing plant. Apply to Box No. 2143-V.

GRADUATE CIVIL ENGINEER, interested in design and office studies with at least six years' experience, including hydraulic studies and design on hydro-electric structures. Able to forego family accommodation at job for about six months. Apply to Box No. 2145-V.

SITUATIONS WANTED

MANUFACTURING EXECUTIVE, M.E.I.C. Services of steel plant executive having mechanical and shell manufacturing experience available to company contemplating installing munitions equipment. Capable of assuming complete responsibility for plant layout, tooling and production. Apply to Box No. 67-W.

GRADUATE ELECTRICAL ENGINEER, Canadian, single. Experience includes calculation of power plants, research on and designing of high voltage equipment; radio, transmitting and testing equipment; furthermore, drawing, estimating and designing in the field of electric railways. At present occupied in own business. Would be best suited for research work and the mathematical analysis in the electrical field. Best references to capability and character. Apply to Box No. 2101-W.

INDUSTRIAL ENGINEER, M.E.I.C., P.E. Quebec and Ontario, desires permanent industrial connection. Years of extensive experience in engineering and construction of pulp and paper mills, also hydro-electric power plants; experience includes all operations in the production and manufacture of pulp and paper, maintenance and purchasing, in some of the largest mills in Canada. Apply to Box No. 2162-W.

SAFETY ENGINEER, Affil. E.I.C., age 24; single; bilingual; presently employed; Canadian; 40 months with large industrial firm. Familiar with all phases of accident prevention and editing of bilingual company organ. Interested in industrial relations, safety, personnel and employment work. Location immaterial. Available with month's notice. Apply to Box No. 2187-W.

INDUSTRIAL EXECUTIVE, Canadian, M.E.I.C., presently associated in an executive capacity with an outstanding firm producing quality communications equipment, actively engaged for past twelve years in directing manufacture, development of new processes, design and provision of production facilities and cost control, will consider responsible position in the production or sales organization of other industrial enterprises. Apply to Box No. 2188-W.

ELECTRICAL ENGINEER, B.Eng. (McGill '34). Canadian, age 28, married. Three years' experience in pulp and paper mills, operation and maintenance of electrical equipment and paper machines; operation of associated hydro-electric system. Bilingual. Available on about two weeks' notice. Apply to Box No. 2192-W.

ELECTRICAL ENGINEER, B.Sc. E.E. (U. of Man. '38), S.E.I.C., Canadian, age 24, single. Returning from England upon completion of student apprenticeship with large firm of turbo-alternator and transformer manufacturers. Experience includes preliminary and final running tests on turbo-alternators (up to 50,000 kw.), exciters and transformers; installation and maintenance of generating plant in power stations; electrical drawing office practice. References available. Apply to Box No. 2210-W.

CANADIAN ENGINEERS NOT RESIDENT IN CANADA

If you are in a position to consider returning to Canada to aid in the country's war work, please write Headquarters for information.

PRELIMINARY NOTICE (*Continued from page 374*)

BRANCHAUD—HENRI, of Outremont, Que. Born at Montreal, Nov. 29th, 1912; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1936; 1936-37, welding engr., Ecole Superieure de Soudure Autogene, Paris, France; summers 1931-33-34-35, on surveys parties for Shawinigan Engineering Co., and Quebec Streams Commission; Nov. 1937 to date, in engrg. dept. and asst. to gen. mgr., Canadian Liquid Air Co., Montreal. (St. 1935).

References: deG. Beaubien, L. A. Duchastel, A. Cousineau, O. O. Lefebvre, J. R. Stewart, L. Trudel.

BREWS—ROBERT WILLIAM, of 1130-15th Ave. W., Calgary, Alta. Born at Winnipeg, Man., June 18th, 1913; Educ.: B.Sc. (Elec.), Univ. of Alta., 1936; 1932-36 (summers), with R. L. Brews & Co., Calgary; 1936-37, assembly, adjustment of automatic telephone equipment, classes on theory and design, Automatic Electric Company, Chicago; 1937 to date, partner, R. L. Brews & Co., design and installn. of special signal equipment, sales engr. on power equipment. (St. 1936).

References: H. J. MacLeod, W. E. Cornish, B. J. Hawkey, V. A. Newhall, H. B. LeBourveau, F. N. Rhodes.

BROSSEAU—ROLAND BARRY, of Chicoutimi, Que. Born at Montreal, Jan. 13th, 1911; Educ.: B.Eng., McGill Univ., 1936; 1935 (summer), cost study, Can. Gen. Elec. Co. Ltd.; 1936-38, power apparatus dept., Northern Electric Co. Ltd.; 1938 to date, interim supt., Saguenay Electric Company, Chicoutimi, Que. (St. 1936).

References: McN. DuBose, F. L. Lawton, J. W. Ward, C. V. Christie.

GRAY—JAMES LORNE, of Vancouver, B.C. Born at Brandon, Man., March 2nd, 1913; Educ.: B.Eng., 1935, M.Eng., 1938, Univ. of Sask.; 1935, survey instructor, Univ. of Sask.; 1936 (6 mos.), i/c reinforced concrete constrn. (football stadium), 1937 (6 mos.), supervising engr., bldg. constr., Univ. of Sask.; 1938-39, test. engr., Can. Gen. Elec. Co. Ltd., Peterborough and Toronto; 1935-36, part time instructor, mech. engrg., 1937-38, full time instructor, and 1939 (4 mos.), lecturer in charge air navigation courses, Univ. of Sask.; Nov. 1939 to date, Flying Officer, R.C.A.F. Station, Vancouver, i/c navigation instruction for Seaplane Training School. (St. 1938).

References: C. J. Mackenzie, E. K. Phillips, I. M. Fraser, W. E. Lovell, G. R. Langley.

KERR—ROBERT ALLEN, of Arvida, Que. Born at Montreal, Jan. 13th, 1912; Educ.: B.Eng. (Elec.), McGill Univ., 1934; summers 1930 and 1931, telephone switchboard assembly, Northern Electric Company, silver slime treatment, Canadian Cooper Refiners; 1935-37, elec. repairs, mtce., operation, Riverbend, and 1937-38, chief operator, P. B. Hydro System at Kenogami, Price Bros. & Co. Ltd.; 1938 to date, operation of electric furnaces and allied equipment, and at present asst. to supt., Abrasive Co., Arvida Ltd., Arvida, Que. (St. 1932).

References: S. J. Fisher, G. H. Kirby, N. D. Paine, A. Sinclair, W. P. C. LeBoutillier, W. J. Thomson, G. F. Layne.

LAURENCE—JACQUES, of 3068 Maplewood Ave., Montreal, Que. Born at Montreal, Oct. 30th, 1911; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1938. M.Sc. (Elec.), Mass. Inst. Tech., 1940; 1936-37-38 (summers), Associated Engineers Ltd., Prov. of Quebec Roads Dept. (transit, level, drafting), Provincial Electricity Board, technical secretary; 1938 to date, instructor at the Ecole Polytechnique, elec. engrg. laboratories, Montreal. (St. 1936).

References: A. Frigon, A. Duperron, T. J. Lafreniere, O. O. Lefebvre, A. Lariviere.

L'HOMME—LOUIS PHILIPPE, of Farnham, Que. Born at Farnham, March 10th, 1912; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1940; 1937-38-39 (summers), Quebec Roads Dept. and Geol. Surveys; at present, training course, meters dept., Southern Canada Power Co., St. Hyacinthe, Que. (St. 1937).

References: A. Circe, S. A. Baulne, J. A. Lalonde, T. J. Lafreniere.

LOCKWOOD—CLARENCE KINGSLEY, of 1122 Laird Blvd., Town of Mount Royal, Que. Born at Brighton, Ont., June 8th, 1911; Educ.: B.Eng. (Chem.), 1934, B.Eng. (Metal), 1935, McGill Univ.; 1936-38, with J. T. Donald & Co. Ltd.; 1938 to date, metallurgical engr., stainless steel and alloys divn., Shawinigan Chemicals Ltd., Montreal, Que. (St. 1935).

References: J. B. Challies, C. R. Lindsey, J. A. McCrory, F. S. Keith, J. Morse, M. Eaton.

MILLER—JOHN JACKSON, of 105 Northview Ave., Montreal West, Que. Born at Winnipeg, Man., April 9th, 1908; Educ.: B.Sc. (Elec.), Univ. of Man., 1937; 1926-27, millwright helper, Man. Paper Co.; 1927-36, machinist ap'tice., C.N.R.; 1937 to date, inspector, covering design, layout and supervising installn. and operation of air-conditioned equipment, C.N.R., Montreal. (St. 1937).

References: H. F. Finnemore, R. G. Gage, H. L. Currie, W. H. Cook, N. M. Hall.

McMILLAN—THOMAS STEWART, of Brownsburg, Que. Born at Dalhousie, N.B., July 17th, 1912; Educ.: B.Sc. (C.E.), Univ. of N.B., 1937. Deputy Land Surveyor, 1939; 1931 (summer), rodman and chainman, highway surveys; 1936 (summer), and 1937-39, instru'man. on highway surveys; at present, mtce. engr., plastics divn., Canadian Industries Limited, Brownsburg, Que. (St. 1937).

References: E. O. Turner, J. Stphens, A. F. Baird, D. Ross, A. B. Allan.

NASON—EDWARD McKINNEY, of 90 West St., Moncton, N.B. Born at Welsford, N.B., May 31st, 1912; Educ.: B.Sc. (Civil), Univ. of N.B., 1936; 1931 (2 mos.), rodman, Dept. Public Works, N.B.; 1935 (3 mos.), note recorder, plane table party, Geol. Survey; 1936-39, instr'man. and asst. in charge of highway constrn., Dept. Public Works, N.B.; 1940 (10 weeks), asst. engr. i/c constrn. of Equipment Depot, for R.C.A.F. Eastern Air Command (St. 1936).

References: W. C. MacDonald, J. H. McKinney, S. Hogg, J. Stephens, E. O. Turner, A. F. Baird, A. S. Gunn.

PARSONS—RONALD ALBERT, of Three Rivers, Que. Born at Calgary, Alta., May 30th, 1913; Educ.: B.Sc. (Civil), Univ. of Alta., 1938; 1935-37 (summers), Dominion Topographical Surveys; 1937-38, power line constrn., field engr., Power Corporation of Canada; 1939-40, field engr. on dam constrn., and at present, instr'man., power line location and constrn., Shawinigan Engineering Company, Three Rivers, Que. (St. 1937).

References: H. L. Mahaffy, G. R. Rinfret, H. J. Racey, R. S. L. Wilson, H. R. Webb, R. M. Hardy.

PLATT—PETER LEVERICH WADDINGTON, of Temiskaming, Que. Born at Tongham, Surrey, England, June 12th, 1913; Educ.: B.Eng. (Chem.), McGill Univ., 1939; 1934-35 (summers), with Canadian Refractories Ltd.; 1936 (summers), student in plant, British Dyestuffs Corpn., Huddersfield, England; 1938 to date, asst. research engr. in laboratory, Canadian International Paper Company, at Hawkesbury, Ont., and Temiskaming, Que. (St. 1936).

References: J. G. MacLaurin, E. Brown, R. DeL. French, R. E. Jamieson, H. Anvik.

SMITH—EDGAR BERNARD, of Montreal, Que. Born at Caledonia, N.S., Feb. 9th, 1913; Educ.: B.Eng. (Elec.), N.S. Tech. Coll., 1939; 1935-36 (summers), inst'man. on highways; 1937-38, electrn's helper, and 1938 (Jan.-Apr.), electrn., for Canadian Comstock Co., at Comeau Bay and Arvida; 1938, electrn., N.S. Power Commn., Liverpool, N.S.; 1939, electrn. at Arvida, 1939-40, electrn. i/c of control work for 1939 extension at Arvida, for Aluminum Co. of Canada; Feb. 1940 to date, dftsman. and junior office engr., Canadian Comstock Co., Montreal, Que. (St. 1939).

References: A. D. Ross, A. C. Johnston, A. G. Mahon, G. H. Burchill, H. R. Theakston.

SYLVESTER—JACK DOUGLAS, of Montreal, Que. Born at Lamont, Alta., Oct. 9th, 1913; Educ.: B.Sc. (E.E.), Univ. of Alta., 1938; 1937-38 (summers), Algoma Steel Corpn., engrg. asst., Howard Smith Paper Mills, inspr., Charles Warnock & Co.; 1938-39, demonstrator, Univ. of Alta.; 1939 (May-July), engrg. asst., Howard Smith Paper Mills; Aug. 1939 to date, elec. engrg. dftsman., C.N.R., Montreal. (St. 1938).

References: R. G. Gage, R. E. Heartz, W. E. Cornish, C. A. Robb, L. A. Wright

RUBBER PLATE PRINTING

Those in printing and allied trades will find the booklet, "Bakelite Materials for Rubber Plate Printing," of considerable interest. Made available by Bakelite Corp. of Canada, Ltd., Toronto, Ont., this book tells of the procedure in making a rubber printing plate, starting from the original pattern or type, making a Bakelite matrix and producing the rubber plates from it in any desired number of duplicates.

STARTER

The Westinghouse Combination Linestarter with Nofuz Circuit Breakers recently announced by Canadian Westinghouse Co. Ltd. offers protection of a dual nature to motors: protection from running overloads of values up to stalled rotor and protection from higher currents up to short circuits.

The first protection is provided by the bimetallic thermal overload relays forming part of the linestarter which follow the motor heating curve very closely and thus provide the maximum use of the power developed by the motor while at all times ensuring that the motor will not become overheated to a dangerous point.

The second protection for currents above stalled rotor and up to short circuit is provided by the Nofuz breaker. It will readily be understood that currents of this magnitude are likely to be fault currents and it is desirable that the circuit be opened as quickly as possible when they occur. For this reason the breaker is equipped with instantaneous overload trip as well as thermal protection for similar sustained currents.

The breaker provides many advantages over fused switch protection. The mechanism of the breaker has a rupturing capacity and length of life that could never be obtained with a safety switch. The instantaneous trip supplies a more complete and quicker acting protection than any fuse rated sufficiently high to allow proper starting of the motor. The fact that the action of one pole of the trip unit opens all circuit conductors removes all chance of trouble due to single-phase conditions and the elimination of necessity of replacing any parts after an overcurrent operation besides saving valuable time, ensures against loss of protection due to plugged or oversize fuses.

DIRECTORY OF CANADIAN PUBLICATIONS

Canada has one new daily newspaper, three new weekly publications, ten new semimonthly and four fewer monthly publications, according to the 1940 (the thirty-third annual) edition of McKim's Directory of Canadian Publications, recently off the press.

The publication, in the tradition of its predecessors, summarizes exhaustive information on markets, media and population throughout Canada, constituting an industrial analysis reference of all towns having publications.

In the preface to the current edition, under the title of "Advertising in War Time," it is pointed out that "in the coming months of war and in the reconstruction period which must follow, advertising will again be called upon to assume new burdens . . . analysis and wise forehandedness, rather than unreasoning fear and excessive caution should be the keynote." Reference is made, in this connection, to the Canadian advertising book of the year, "The Story of Advertising in Canada! A Chronicle of Fifty Years" by H. E. Stephenson and Carlton McNaught, and particularly to the chapter in it entitled "The War (1914-1918) and After: Expanding Fields."

The Directory is published by A. McKim Limited, Advertising Agency, head office, Montreal.

COLD DIFFUSER

A forced air cooling unit for control of refrigerating temperature, humidity and air circulation is described in a new leaflet, CR-153, just issued by Carrier Corporation, Syracuse, N.Y. The Carrier Cold Diffusing Weathermaker, although primarily designed for product refrigeration, is adaptable to comfort cooling.

Offered in six sizes with a capacity range of ¾ to five tons of refrigeration, this unit includes a fan and motor, cooling coils, drip pan, two-way adjustable louvre type air grille, expansion valve and suction-liquid refrigerant heat interchanger. All of these are available in the suspended type for compactness and neat appearance. The entire casing is finished with a baked gray "tapestry enamel" which provides a durable surface easily cleaned and modern in style.

CHANGE IN METHOD OF MEASURING ROUND HEAD SCREWS

The Canadian Engineering Standards Association has now issued in booklet form a new C.E.S.A. standard covering wood screws. The number of the booklet is B-65-1940.

The only change from the old standard which will affect the purchasing of the wood screws is the fact that in the future round head screws will be measured under the head instead of overall. This change is in line with the practice adopted by screw manufacturers throughout the world.

PUMP GOVERNORS

Governors for the control operation of various types of steam-driven pumps form the subject matter of Catalogue 70, Bulletin 13, of Foster Engineering Co., Newark, N.J. Section views, data regarding operation features, assembly instructions and a parts list are included.

LIQUID METERS

The operation and capacities of Niagara Meters for oil, gasoline, water, chemicals, etc., is presented in the 16-page catalogue of Buffalo Meter Co., Buffalo, N.Y. Installation and maintenance suggestions are given, also details of special units, dials and strainers.

BELT FASTENER

Complete details of Flexco HD belt fasteners and rip plates are contained in bulletin No. F-100 of Flexible Steel Lacing Company, Chicago, Ill. The size range of the fasteners covered is ¼″ to 1½″ conveyor and elevator belts. The rip plates are for making patches, repairing belt rips and strengthening weak spots.

"THE WELD-IT"—A NEW HOUSE ORGAN

A new House Organ, entitled "The Weld-It," has been issued by the Taylor Winfield Corporation, Warren, Ohio, with a view to keeping industry informed regarding developments in resistance welding machines and resistance welding practice. The products of this company are manufactured for the Canadian market at the Welland factory of Commonwealth Electric Corporation, Limited, under licence, and copies of the new House Organ may be obtained on application to the latter company.

FURNACE EQUIPMENT

Heat-treating furnace equipment which apply the Vapcarb-Hump method to hardening, the Hump method to drawing, and the Homo method to tempering, nitriding and carburizing, are dealt with in a readable manner in a broadside issued by Leeds & Northrup Company, Philadelphia, Pa.

SEPARATORS

A separator unit for the removal of oil and water from steam and air lines is referred to in Bulletin No. 2950 of Cochrane Corp., Philadelphia, Pa. The unit is of ½″ to 30″ pipe size, pressures up to 600 lb., and in vertical or horizontal mounting types.

CORE OILS

The 4-page folder, "Hy-Ten Core Oil" of E. F. Houghton & Co. of Canada, Ltd., Toronto, Ont., provides moulders with interesting data concerning core-binding oils, with their physical characteristics and performance notes from users.

COATED WELDING ROD

The welding of steel has always presented a variety of problems to the oxy-acetylene welder. The high melting point and the ease with which most steels oxidize at high temperature make flame adjustment and heat control very critical. Another problem nowadays is the selection of a suitable welding rod for the welding of various alloy steels to produce welds of high strength and ductility in the as-welded condition. With ordinary steel welding rods, it is usually difficult to obtain a combination of both properties. Some alloy steel welding rods produce welds that are hot short, resulting in cracks when the hot weld is subjected to stress.

To solve the problem of a general purpose steel welding rod, the Canadian Liquid Air Co. Limited have developed Altem Trimasic. The rod has an alloying coating which, under the heat of the flame, melts with the steel core, producing a low alloy steel of exceptionally good physical properties. Weld metal in the as-welded condition has an ultimate tensile strength of over 65,000 lbs. per square inch and an elongation better than 20% in two inches. In free bend tests, the ductility is over 40%.

Unlike some alloy steel welding rods, no special welding procedure is required as the molten metal withstands overheating exceptionally well. There is very little sparking and the molten metal is easily controlled, even in vertical and overhead welds. Welds are smooth and free from porosity. The weld metal is not hot short and therefore does not crack from cooling stress. Equally good welds are produced either with forehand or backhand welding.

This new welding rod is recommended for all classes of steel welding where a combination of high strength and ductility is required. It is produced in sizes ⅛, 5-32″ and ¼″ diameter and 36″ lengths.

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 23 | SEPTEMBER 1940 | NUMBER 9

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

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PUBLISHED MONTHLY BY
THE ENGINEERING INSTITUTE OF CANADA
2050 MANSFIELD STREET - MONTREAL

Price 50 cents a copy, $3.00 a year, in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

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MODERN SANITATION AND WATER SUPPLY PRACTICE

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Abridgement of paper prepared for presentation at the British-American Engineering Congress, New York, September 4th-8th, 1939.

Introduction

Public health engineering has been defined as the art of directing the forces and activities of nature for the protection and improvement of the public health. In modern civilization the individual is unable, through his own efforts, to protect himself against the menace of transferable diseases, and control over his environment thus becomes a matter of public concern. In this programme the engineer plays a leading part.

Sanitation, with particular application to water, food supplies, and disposal of wastes, is a major public responsibility. Co-operative efforts tend to a high degree of efficiency and safety. United approach to this problem has made it possible to create a safety barrier for the urban dweller. Public health engineering strives to strengthen and complete this defence. In recent years the research has added so greatly to our knowledge that it has not been easy for practice in the field to keep pace with the rapid progress of the art.

Modern sanitation in Canada follows more closely the practice in the United States than that of Great Britain. Proximity to the United States, as well as somewhat similar conditions, has had its influence on Canadian practice.

In this paper it is proposed to refer not so much to the general problems of sanitary engineering, as to aspects which are to a certain extent peculiar to Canadian conditions. For instance, most of the sewage treatment plants in Canada are of the activated sludge type, due in part to the necessity for complete treatment, since the source of many domestic water supplies also must receive most of the sewage. Again, the facts that power is cheaper and chemicals more costly than in the United States have led to the wider use of this method of sewage treatment. In the water works field climatic conditions have been in many cases a deciding factor in the selection of methods applied for constructing intakes, and the type of water purification system adopted.

The topics of the paper include water works, sewerage systems, stream pollution, refuse collection and disposal, swimming pools, milk control, and general sanitation.

Water Works

A 'pure and wholesome' water is not easily defined in positive scientific terms. In general the term applies to a water used for drinking purposes. The water must be free from poisonous substances, from infection and from contamination. It must be clear, free from colour and odour, aerated, and reasonably free from objectionable salts in solution and miscroscopic organisms in suspension. For other than drinking purposes, hardness, iron and other constituents have to be considered.

For domestic purposes a satisfactory water should meet the sanitary requirements as to disease germs or constituents deleterious to health; be of attractive appearance; of a satisfactory hardness and at a temperature acceptable for drinking purposes.

Attention may be directed to the remarkable sources available in Canada for water supply purposes. The area of Canada is practically the same as that of the United States and its dependent territories, and almost as large as the whole of Europe. More than six per cent of this great area is covered by fresh water. It is estimated that more than half of the total fresh water on the surface of the earth is contained in the Great Lakes system.

Development of Water Works Systems in Canada

The first public water works system in Canada was constructed at St. John, N.B., in 1837. Toronto was second in 1841.

The dates at which the first municipal water works systems were built in the different provinces are as follows:—

Province	First Municipal Water Works at	Date
British Columbia	Victoria	1875
Alberta	Calgary	1891
Saskatchewan	Craven	1900
Manitoba	Brandon	1893
Ontario	Toronto	1841
Quebec	Montreal and Quebec	1857
New Brunswick	St. John	1837
Nova Scotia	Halifax	1848
Prince Edward Island	Charlottetown	1888

It was really not until after 1900 that rapid expansion began to take place. In that year the number of systems had reached only 235. The 1937 list shows a total of 1,258 systems in use, serving 54 per cent of the population of the Dominion.

Water Works Legislation in Canada

In Canada, three law-making bodies may exercise their rights in the water works field. They are the Dominion government, the nine provincial governments and the municipalities in which the systems are operated.

The Dominion is only concerned with matters of an interprovincial or international nature, or where some federal project or service is involved. For example, that government, through the Department of Pensions and National Health, supervises the water supplies on trains and boats, both being carriers which operate between provinces and other countries. Another federal activity deals with the pollution of boundary waters between the United States and Canada.

There is a close connection between the provincial and municipal legislation. In general, the authority of local councils is derived from provincial statutes. There is no standardization of this legislation in the different provinces, although there is a good deal of similarity.

Each province has a Department of Health, whose function is the general direction of health activities. These departments exercise a measure of control over water supplies, including the sources and the methods of treatment and distribution.

All provinces do not follow the same procedure, but the usual requirement is that plans and specifications for new works and for extensions must be submitted to the provincial Department of Health for approval before the project is undertaken. Another provision of fairly general application is a mandatory power to compel municipalities, and owners of water works, to adopt such treatment or other steps as may be deemed necessary by the provincial Department of Health to provide a safe and satisfactory water.

The provinces are also authorized to control pollution of the sources of supply, and in this connection areas may be defined in which no contamination may be discharged into the waters or on to the watershed. The provincial acts deal with water control in general, and leave to the municipalities the details of operation and administration.

The local governing bodies may place the direction of the water works system under the municipal council or a committee of council, or under a commission elected independently of council. Frequently the department is administered under the municipal engineer.

The legislation provided for the administration of water works in Canada not only is comprehensive, but it has proved reasonably effective over a period of years, during which few major changes have been found necessary in the various acts.

AVAILABILITY OF SUPPLIES

The reliability of surface waters in preference to those of other sources is so well established that their choice is usual where feasible. Canada has many fresh water lakes and large rivers. In the early development of the country, towns and cities sprang up on navigable waters, and to-day these same waters are being used to supply the largest communities. Such supplies are generally of good quality, apart from any local pollution which may come from urban developments. The Great Lakes system, on which the larger cities of the province of Ontario are located, is an unique source of surface water, and full use is made of it for domestic and other purposes. Such large rivers as the Ottawa and St. Lawrence are of major significance for municipalities in the provinces of Ontario and Quebec. In British Columbia snow fed streams from the mountains constitute a significant source of water for public systems.

In Canada the problem of adequate water supplies is comparatively simple for those municipalities on the many large lakes and streams. The situation is less favourable for inland communities. Here, populations in general are smaller, and they have undertaken the installation of these public works at a later date. Increasing difficulties are being experienced in some places due to the periodic low summer flows in the streams, and to the uncertainties of underground waters. Western Canada has had to face a difficult situation caused by droughts which at times have seriously interfered with both surface and underground waters.

Since rainfall is the original source of all water it is of interest to note the averages or normal precipitation figures for different gauging stations in the Dominion. These are as follows:—

Province	Gauging Station at	Normal Annual Precipitation in Inches
British Columbia	Victoria	29.70
	Vancouver	58.65
	Kamloops	10.85
	Vernon	14.71
Alberta	Edmonton	17.67
	Medicine Hat	12.75
	Calgary	16.39
Saskatchewan	Fort Qu'Appelle	15.57
	Prince Albert	15.97
Manitoba	Winnipeg	20.37
	Churchill	16.84
Ontario	Port Arthur	22.53
	Toronto	33.46
	Parry Sound	38.92
	Ottawa	33.33
Quebec	Montreal	40.65
	Quebec	42.06
	Anticosti	31.90
New Brunswick	Fredericton	42.78
Nova Scotia	Yarmouth	47.38
Prince Edward Island	Charlottetown	39.90

THE QUALITY OF RAW WATER SUPPLIES IN CANADA

The physical and chemical characteristics of Canadian raw waters vary within wide limits, depending on local conditions. Waters of the Great Lakes system are relatively free from colour, only moderately hard (100 to 150 parts per million), and generally acceptable. In contrast to these the waters from the heavily wooded northern areas are highly coloured, low in turbidity and comparatively soft. British Columbia waters from the mountains may carry a good deal of silt.

Underground supplies show a wide variation in chemical constituents. Hardness is pronounced in some of the limestone formations in Ontario, reaching as high as about 1,300 p.p.m. Iron is common in well waters and its removal has required the use of special equipment. Alkali waters are common in the western provinces. Salt (chlorides) in excessive quantities occurs in the underground waters of some sections of Ontario. Corrosive properties are found in some well supplies.

The following figures are characteristic of typical waters in Canada:—

SURFACE WATERS

Municipality	Source of Water	Hardness p.p.m.	Iron
Vancouver, B.C	River	35	Trace
Calgary, Alta	River	210	0.07
Winnipeg, Man	Lake	94	—
Toronto, Ont	Lake	110	0.08
Brantford, Ont	River	265	0.14
Chatham, Ont	River	255	0.14
Kapuskasing, Ont	River	80	0.14
Kingston, Ont	Lake	112	0.06
Port Arthur, Ont	Lake	52	0.03
Ottawa, Ont	River	40	0.08
Windsor, Ont	River	97	0.08
Montreal, P.Q	River	110	—
Quebec, P.Q	Lake and River	31	0.3

UNDERGROUND WATERS

Municipality	Hardness p.p.m.	Iron
Cochrane, Ont	322	—
Essex, Ont	525	0.15
Galt, Ont	415	—
Guelph, Ont	300 to 780	0.05
Kitchener, Ont	330	0.15
London, Ont	325	0.07
Charlottetown, P.E.I	132	0.2
Regina, Sask	514	—

POLLUTION OF WATER BY WASTES

With a few exceptions, the concentration of population and industrial development in Canada has not yet caused any serious menace to the raw water supplies. While pollution may be extensive in certain places, its effects are generally local. Offensive manufacturing wastes are not so common as in the United States or England. Accordingly, the conservation of the waters is less difficult.

CLIMATIC EFFECTS ON WATER SUPPLIES

Very great differences of climate are found over the broad territory included within the boundaries of the Dominion. In general, high summer temperatures are followed by periods of intense cold weather. The southern part of Ontario is relatively mild while in the northern parts of the Dominion temperatures well below zero may exist for extended periods. Under these conditions, the run-off from watersheds is likely to be spasmodic. In the spring of the year the rain and melting snow are carried over the frozen ground to an outlet, and do not replenish the underground water, thus affecting rivers which otherwise might carry soil water at a more uniform rate throughout the entire year. In many parts of the western provinces the growing

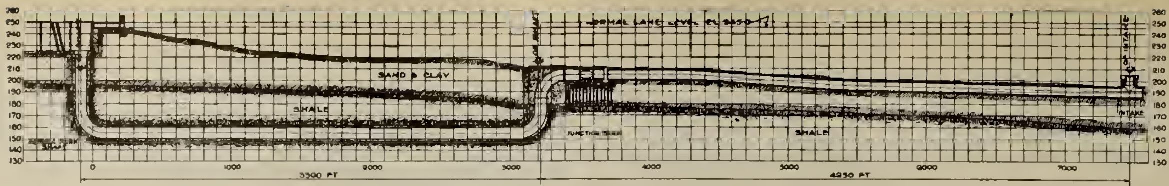

Fig. 1—Intake Tunnel, Victoria Park, Toronto

grain in the summer tends to prevent any ground water increase, and with frozen ground in the winter and spring carrying off the heavy precipitation, the time for ground water stocking is greatly shortened.

An illustration of irregularity of flow in streams is to be found in the Grand and Thames rivers of southern Ontario. In both instances the average yearly flow is a substantial one, but the variation between the flood flow and the low water of July or August is very great. To make such rivers serviceable as water supplies, means must be adopted to regulate and to reduce their wide variations in flow.

The quality of the raw water also is affected by the Canadian climate. Low summer flows intensify pollution and tend towards a prolific growth of algae and taste-producing substances. The covering of streams by ice affects natural oxidation. Cool water, even in summer, is general among Canadian public supplies.

DEVELOPMENTS IN WATER FILTRATION

In Canada, water filtration has passed through many stages, from the early infiltration basin to the modern unit now recognized as standard practice.

The early attempts in Canada to clarify water involved the use of natural sand formations. In a limited number of municipalities which could take advantage of this method, infiltration basins were built along the shores of lakes and streams. Some of these functioned well for a time, but because of clogging and reduced flows they were gradually abandoned in favour of more modern methods. The clarity of the water, except in formations which were unduly coarse, was good. It is believed that at Hamilton, Ontario, the first basin of this kind on the continent was employed. This took water from Lake Ontario. It was built before 1875 and was abandoned about 1930 to be replaced by a modern gravity mechanical filter.

SLOW SAND FILTRATION

The first slow sand filter in Canada was built at Toronto in 1912, with a capacity of approximately 50 m.g.d., and has been in service ever since, although two mechanical filtration plants have been built subsequently. It has continued to give good results on a water which varies widely in turbidity and pollution. About a dozen plants of similar type were installed in Ontario and Quebec between 1917 and 1933. Only in two of the nine provinces are slow sand filters in use now. Owing largely to climatic conditions, their installation is not likely to be continued.

MECHANICAL PRESSURE FILTERS

Mechanical filtration plants have been installed to a considerable extent in Canadian municipalities. The early mechanical filters were largely of the pressure type.

At the time when many of these plants were installed, knowledge of treatment of water by chemicals and coagulation was not well advanced. The first plant of this type was constructed at St. Thomas, Ontario, in 1890, but has now been replaced by a gravity type. At present, 47 such plants are in municipal service. Few of them give preliminary treatment.

A few of these filter plants were equipped with coagulation basins; they became strainers rather than filters and were effective clarifying agents only so long as the water was easy to treat, and the plant was worked at a moderate rate. Many of the plants have proved unable to handle periods of bad water. One provincial Health Department now refuses to approve plants of this type for municipalities; some other provinces oppose their installation except under very limited conditions.

GRAVITY MECHANICAL FILTERS

Rapid sand filters of the gravity type have been improved consistently since the earlier units were built. Probably the greatest changes have centred about the preparation of the water for filtration. These plants were first used in Canada in 1906; they are now the choice in nearly all cases where efficient treatment is desired. At present 68 are in service in the Dominion.

The application of coagulants to the water has been improved as knowledge of the process of coagulation extended and more elaborate processes found use. The period of mix has been gradually extended to about 30 to 40 minutes, along with more effective methods of mixing.

Developments in gravity filters have also been directed at the filter itself. These have brought changes in the sizes of the sand, the underdrains, wash water troughs, controllers and other mechanical equipment.

DRIFTING SAND FILTERS

A somewhat unusual type of mechanical plant has found some application in Canada. Known as a "drifting sand filter" this unit, developed by the late William Gore, was designed to utilize a moving upper layer of sand, thus providing longer filter runs without complete backwashing of the filter. The moving sand was washed continuously and then returned to the top of the sand bed.

A drifting sand plant was constructed at Toronto in 1918, and at two other places about the same time. None of these had any mixing tanks or coagulation basins ahead of the filters. The Toronto plant is still operating, producing a satisfactory effluent, and the periods between backwashing are quite long, averaging seven days. Filter runs as long as 35 days have been obtained. No recent plants of this type have been built in Canada.

DEVELOPMENTS IN WATER CHLORINATION

No single method of water treatment has meant so much in safety and health protection as chlorination. In Canada, Toronto was the first city to treat its supply in this way. This was in 1910, when chloride of lime was used following an outbreak of typhoid fever. The success which followed resulted in the application of this safety measure to other supplies. The principal objection at the start was based on taste, but as liquid chlorination equipment developed, and better methods of control were utilized this difficulty diminished.

The crude methods of dosing the water in early years could scarcely fail to result in taste complaints. The problem at that time was not only to treat the water effectively, but also to convince municipal bodies and the general public as to the necessity for doing so. At that time little consideration was given to any taste unless it became particularly offensive.

In Canada, as elsewhere, the early chlorination plants employed chloride of lime. Calcium hypochlorite was used rather than the sodium compound. The marketing of liquid chlorine and equipment for this process marked a great advance.

Canadian practice in chlorination has been confined almost entirely to the introduction of the chlorine as a solution on the suction side of the pumps. Dry feed equipment has not been found so satisfactory for conditions in this country and its use has been limited. Similarly, the employment of mechanical pumps for applying the chlorine solution has been avoided as far as possible. Breakdown in mechanical equipment results in the interruption of a treatment which must be continuous if it is to be effective.

Equipment has been developed in recent years to make possible the use of stable high test hypochlorites. The increased cost of the chlorine in this form has limited its field somewhat to the smaller water supplies, but in this it has contributed to a very important advance.

Laboratory facilities for water examination have been supplied by the provincial health agencies.

WATER WORKS INTAKES IN CANADA

The design and construction of intakes are of great importance, particularly where hazards exist from frazil or anchor ice.

The difficulties with intakes are mostly of three types. First, the inlet screen may get clogged with ice. For that reason an open bar screen is preferable to a finer mesh screen. The bar screen will keep out large material and yet the openings are such as to enable ice to enter the intake pipe and come through to the screen well where it can be handled by revolving screens or a slight increase in the temperature of the water by the use of a steam coil pipe. Where revolving screens are not used stationary screens are often made of pipes through which a steam jet can be passed. A very slight increase in the temperature will disperse the ice. The revolving screens in a suction well have the additional advantage of taking out fish and large debris that may come through the intake pipe.

A second form of trouble arises from the plugging of the intake pipe with ice; the most effective remedy is to reverse the flow in the intake pipe. This should be done on the slightest indication of an obstruction either due to the gathering of ice on the inlet screen or due to the ice becoming visible in the suction well. If an attempt to reverse the flow is made too late after the ice becomes solidified then any effort to clear the pipe is likely to meet with failure.

A third kind of damage to intakes on the Great Lakes system may be due to the accumulation of ice fields on the shore. These sometimes build up to a height of 30 feet and damage to an intake pipe may occur when such a field moves across it.

In order to avoid risks arising from the formation of ice on the shore of the lake, and where the geological formation is suitable, a tunnel is generally driven out to a point where the water is about 30 feet deep, and from then onwards the intake pipe is laid on or underneath the bottom.

The greatest hazard in the operation of intakes in Canada is that due to frazil ice. On bodies of water subject to wave action in which the sheet ice is broken up during its formation, frazil ice is formed and may be drawn into the intake by eddies or other currents. With low temperatures and high winds this ice may be formed in such quantities as to completely shut off the supply of water. Anchor ice, which forms on the bottom or on the intake itself if the water temperature at that point becomes sufficiently low, may also cause trouble. If the intake is located near the mouth of a stream, floating ice may be brought down by flood water in such quantities as to interfere with the operation of the intake. As ice is only slightly lighter than water, only a slow current is required to cause it to flow with water particularly if broken in small pieces.

The selection of the location of an intake is the first and frequently the most important step preceding its design. In many instances a municipality has to take its water supply from the same body of water as that in which the sewage is being deposited. In such a case precautions have to be taken. A study of the drainage of the adjacent lands and the sewerage system of the surrounding areas must be made. Currents in the lake or stream must also be known in order that the pollution may not be excessive.

The question naturally arises as to the extent to which raw water can be polluted without overloading the treatment process. The accepted bacteriological standard of drinking water after treatment on this continent is that of the U.S. Treasury Department which requires that the water shall not contain more than 1 B.coli organism per 100 cc. or more than 6 B.coli organisms per 100 cc. for 5 per cent of the time. It is evident that there is a definite limit of raw water pollution beyond which a safe drinking water cannot be produced. Moreover, there is always a hazard in the treatment of highly polluted raw water due to possible lapses in the treatment process, particularly in the application of chemicals.

The depth of water at the intake is important, as it reduces hazards due to ice. In navigable waters intakes should be, if possible, off the shipping routes in order to reduce the pollution resulting therefrom and avoid possible interference with the intake pipe through the dragging of anchors.

The common type of inlet for small systems is simply an elbow turned upwards, often with a screen on top. A submerged crib with single or multiple inlets is generally used. The crib is made of sufficient size to be supported on the bottom of the lake or stream without undue settlement. In lakes the crib usually contains an inlet consisting of an elbow and bellmouth facing upwards over which is placed a steel or concrete cover plate forming a square or cylindrical inlet of large area and consequently low inlet velocity. This type of inlet has the effect of drawing water on a horizontal plane as near the bottom as is practical and prevents the formation of vertical currents and vortices, thus reducing the trouble due to ice and the seasonal temperature of the water.

Fig. 2—Placing Intake Pipe—Victoria Park Intake.

Fig. 3—Inlet to Intake (20 ft. diameter), Victoria Park.

In rivers the horizontal cover plate on the inlet loses the greater part if not all of its value, as the current of the river would be parallel with the plate. A single large inlet projecting toward the middle of the stream is generally found to be satisfactory for small or moderate sized intakes.

For large supplies taken from rivers, and in a few cases from lakes, inlet structures projecting above the surface of the water with numerous inlet ports are often used. These ports are placed at various depths and positions so that the water may be taken in where found to be most satisfactory.

Inlets should be designed to give large entrance areas and consequently low entrance velocities. The nine intakes constructed on the Great Lakes system in recent years have entrance velocities varying from a minimum of 4.7 to a maximum of 32 inches per second.

Intake conduits are usually of steel pipe although some of the small ones are of cast iron and the large ones of concrete or even concrete lined tunnels where the conditions are suitable. Steel pipe has a distinct advantage in strength and weight which enables it to be laid in sections up to 100 feet in length.

The Victoria Park intake for Toronto consists of a tunnel 10 feet in diameter extending from a vertical shaft at the pumping station 3,300 feet out into the lake to a junction shaft where the water is about 33 feet in depth. From this point a pipe 8 feet in diameter is laid in the lake bottom extending out 4,150 feet to the inlet which is placed in 53 feet of water. The tunnel is about 90 feet below normal water level and has minimum covering of shale of about 20 feet. At the upper end of the junction shaft a distributor is connected with three branches, each eight feet in diameter. The westerly branch has a butterfly valve connected to the intake pipe and this valve is fitted with a power cylinder which can be operated by either air or water pressure applied through a hose connection from the surface. The pipe has a 2 inch gunite lining and a reinforced concrete casing in the shape of a horseshoe with a minimum thickness of eight inches. These pipes were constructed on the land and towed out to the site.

The inlet crib is 30 feet in diameter, built of steel plate and filled with concrete. The inlet is of steel plate in the shape of a bellmouth with dished cover plate making a cylindrical opening 20 feet in diameter and four feet high. The underside of the opening was placed about five feet above the lake bottom. The intake pipe itself was laid throughout its entire length in a dredged out trench so that the top of the pipe is about level with the lake bottom.

CANADIAN FILTRATION PLANTS

Filtration plants of slow sand and pressure mechanical type are not built any more in this country, unless some unusual condition obtains. Some 330 units of gravity mechanical filtration plant now operate in Canada, serving a population of 3¼ million persons.

The construction details of these filters vary a good deal. Modern mechanical devices are used in these plants; the more recent ones have either mechanical flocculators or the natural spiral flow. Rate controllers on the effluent pipes are standard equipment. Wash water rates have been moderate, about 20 to 30 inches rise per minute.

PREPARATION OF THE WATER

The importance of proper preparation of water for filtration has been fully recognised in recent years. A mixing period of 30 to 40 minutes followed by 2 hours sedimentation has been general practice.

The spiral flow method of mixing the coagulant with the water has been favoured for most of the more recent plants in Ontario. The results of operation have been quite satisfactory.

The City of Toronto is now completing the construction of a duplicate water filtration plant to treat water from the lake. This will have a capacity of 100 m.g.d. Some of the features incorporated in this project will serve to illustrate methods and trends in Canadian practice.

Fig. 4—Settling Basin looking towards mixing Chambers, Victoria Park.

A special feature in this plant is the provision for chlorinating and dechlorinating the filtered water. The effluent pipes from each filter discharge into a concrete filtered water conduit in the reservoir in which a meter of rectangular section is constructed. After passing through this meter the filtered water is dispersed within a walled area at the centre of the reservoir into which the chlorine solution is diffused. To reach the reservoir outlet the chlorinated water must travel a definite path by reason of the concrete baffle walls, the purpose of which is to ensure a minimum contact period of chlorine and water when superchlorination is practised. Also the path of the water is arranged to permit of dechlorination prior to the water leaving the reservoir.

The whole operation of the filter plant will conform closely to the standard practice used in mechanical filtration. The water will be treated with filter alum or other coagulants which will be supplied from dry feed machines placed in a separate building. Provision has also been made for treating the water with activated carbon should this be found necessary.

One of the main features connected with the plant is the mixing and coagulating tanks. This type of mixing tank was developed by the late William Gore. The method as now worked out has proved very efficient and for several years has been in operation at Ottawa, Calgary, Belleville and St. Thomas. Each mixing chamber is 90 feet in width and 73 feet in length, divided into twelve separate compartments. This part of the plant was designed to produce a very gentle stirring action and distribute the flocculated water into the settling tanks without breaking up the floc which is extremely fragile. Short circuiting was reduced to a minimum by dividing the process into several stages and by the special design of the passages.

On top of the concrete floor of the reservoir a waterproof membrane was placed consisting of a layer of asphalt-saturated asbestos mopped with a coating of asphalt waterproofing cement using 30 pounds of such cement for each 100 square feet, and while still hot a layer of asphalt-saturated fabric was embedded in it. The surface of this saturated fabric was again mopped with a coating of water-proofing cement and while still hot a layer of asbestos felt laid at right angles to the fabric with joints lapped 3 inches was embedded in it. Over the surface of this felt a coating of water-proofing cement was placed. Once this had been completed and allowed to set thoroughly, a two-inch layer of concrete was placed throughout the entire reservoir floor.

Under the contract a leakage test was made during which the permissible invisible leakage was not to exceed 60 imperial gallons per minute. The total floor and wall area of the reservoir subject to leakage is about 174,000 square feet and the test showed that the total leakage during one hundred and twenty hours was 6,160 gallons or somewhat less than one imperial gallon per minute.

WATER SOFTENING

While water softening has been adopted in many industrial plants in Canada, only three municipal supplies are so treated, all are in Ontario. They are of the base exchange type. Their results will be watched with interest by other municipalities in which the water is hard enough to justify this treatment.

KINDS OF TREATMENT AND EQUIPMENT IN USE

In Canada, to-day, liquid chlorination, with solution feed, is used almost entirely for the larger supplies, and hypochlorite feeders for the small systems. In the majority of installations the sterilizing solution is fed under suction or low pressure as against delivery under high pressure to the supply main. Where the latter has been unavoidable some more constant motive power than electricity has been sought, especially where power for water pumping has not been confined to this one source. Hydraulically operated pumps have been utilized in some instances. Continuity of supply has been recognized as essential.

In general, manual control has been selected, for two reasons. The first is cost of the equipment, and the second is that rates of pumping are fairly uniform. Most pumping systems deliver to reservoirs of some kind, with the result that the variation in pressures is neither rapid nor wide enough to cause serious fluctuations in pump discharge. The general practice has been to install automatic equipment where pumping is direct to mains. No installations have yet been made in Canada where the chlorine dosage is adjusted automatically in relation to the demand of the water, although in a few instances conditions would seem to warrant such a procedure.

Operators of water treatment plants are not yet licensed or required to have any specific training, but they are provided with all facilities for proper operation. In the province of Quebec, regular samples of water must be sent to the laboratory for examination. In Ontario, all operators of chlorine equipment are supplied with ortho-tolidin and instructions for making tests. Periodic inspection of the plants is also made by engineers of the Provincial Department of Health. Local Boards of Health in all Canadian municipalities perform an important function in safeguarding these supplies. Samples are sent forward regularly for examination. This chain of supervision provides safety for the consumer.

TASTE CONTROL

There has been marked progress in recent years in taste control in public water supplies. No longer is the consumer satisfied with a coloured, turbid, unpalatable or unattractive water, even though he is assured of its bacteriological safety.

There has been need for this work in many water supplies in Canada, but active steps could only follow the development of satisfactory measures for this purpose.

The various processes which have been used for taste correction in Canadian waters are as follows:—

Superchlorination followed by dechlorination, ammoniation, aeration, use of activated carbon, and combinations of these. Recognition must be given also to certain other treatments such as prechlorination, iron removal, and filtration, which have played no small part in taste correction of some waters.

SUPERCHLORINATION

Superchlorination in Canada has not had wide application, but it has gained recognition from its successful adoption for the water supply at Toronto, following the experimental work conducted by Howard on the Toronto supply. The offensive tastes and odours in this water were shown to result from industrial wastes, particularly those containing phenolic compounds, usually associated with gas manufacturing plants.

The conditions at Toronto are unique. The outfall sewer, carrying inadequately settled sewage, discharges into the lake at a point less than four miles from the water intake. When the wind blows from this direction the water reaching the filtration plant is adversely affected. The routine operation at the plant has made it possible to determine in advance when these conditions are likely to arise. The increase in the ammonia content of the water has been found most useful for this purpose. Superchlorination is then applied at the filtration plant located on the island. A lengthy contact period is had as the water passes through a tunnel under the bay to the mainland pumping station. Here the excess chlorine is removed by sulphur dioxide, and the water is pumped to the distribution system.

AMMONIATION

The water supplies to which ammoniation has been applied have demonstrated that when introduced prior to the chlorine it has a very useful function in the prevention of certain tastes, and in a reduction in the chlorine consumption. The required contact period for effective sterilization has not been possible in all plants. The chloramine process has proved effective in a number of supplies where coal tar products were present in the water. Its use in supplies containing algae and vegetation has also been valuable.

Fig. 5—Sewage Screening Plant, Hamilton, Ont.

AERATION

The value of aeration for taste removal from water supplies has lost much of its significance in Canada. It was regarded as a hopeful method before chloramine and activated carbon found a wider field of application. Aeration is still beneficial in some supplies, particularly where the entrained gases may be swept from the water. Swampy and coloured supplies have been improved in this way, but its scope is not so wide as other measures.

ACTIVATED CARBON

The most recent taste control measure, using activated carbon, has been applied to a number of waters in Canada. In some the treatment has been seasonal, and in others the year round application has been followed. The carbon has been added, where feasible, at the entrance to the mixing or coagulation basin. The long contact period prior to filtration has increased the efficiency and kept the deposited sludge in better condition. This treatment offers a wide promise for taste correction where it can be applied.

RESULTS OF WATER TREATMENT

Water treatment in Canada has brought about some noteworthy achievements. Highly coloured, polluted waters

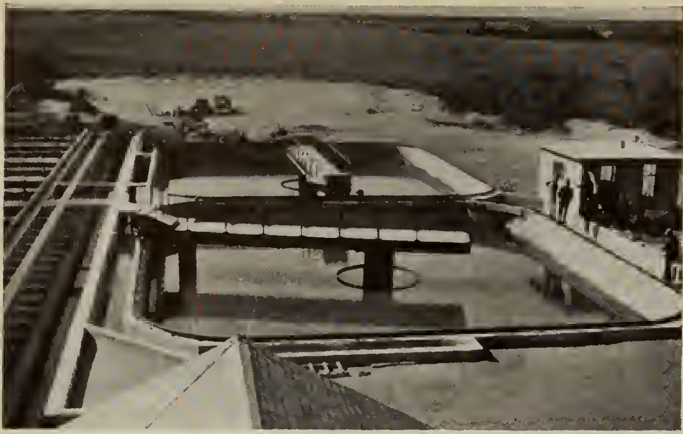

Fig. 6—Activated Sludge Plant, Guelph, Ont.

have been filtered to a clarity which appeals to the most fastidious, and the supplies have been made continuously safe. These results are not merely sporadic or temporary, but the measures employed have reached a point where this end-product is obtained regularly and without any abnormal effort on the part of the operator.

CONTROL OF TYPHOID FEVER

The work of the water works engineer has shown to particular advantage in the check he has been able to apply to the dissemination of typhoid fever through water supplies.

The benefits of water treatment are well indicated by the typhoid fever statistics of the Dominion. In former years, water was the chief agency in the spread of this disease. Epidemics were frequent, and water was involved in a high proportion of these. Hence these typhoid mortality rates may be accepted as a reliable index of progress over a period of years.

It will be obvious that effective measures can be applied most readily in large urban centres, where finances and facilities can be made available through centralized systems. At earlier times, these were the foci of infection, and these centres were responsible for the high death rates from typhoid. The introduction of water treatment and the pasteurization of milk in urban centres brought about rapid declines in mortality during the years 1910 to 1925. As these measures were extended to the smaller urban communities the downward trend was continued.

There is evidence in this country, that as the typhoid mortality curve goes down it tends to flatten out. It becomes increasingly difficult to control those deaths which may be the result of infections traced to small public water supplies, or to rural areas where the outbreaks are not so extensive in numbers affected, and where the causes are not so readily controlled. Large parts of Canada are but sparsely populated. The facilities found in urban centres are not available, yet sufficient population exists to create danger. This is one reason at least why typhoid decline in Canada in recent years has been more gradual.

The death rate from typhoid fever in the Dominion as a whole has been reduced from 10.1 per 100,000 in 1921 to 2.3 in 1936.

The results obtained in the different provinces show considerable variations caused by local conditions. In recent years public water supplies have been less and less important than milk supplies, food and general sanitation of the environment.

LABORATORY FACILITIES

In Canada, all nine provinces operate laboratories under the direction of the various Health Departments. These accept samples of water for analysis from all public systems. Examinations are made for bacteriological findings as well as chemical constituents. These laboratories are well equipped and are manned by thoroughly trained personnel. Some provinces are able to give service through one central laboratory; others have found it necessary to establish branches at convenient centres.

As an example of laboratory facilities, available for public use, the organization of the province of Ontario might be cited. In addition to the central laboratory located in the Parliament Buildings in Toronto there are six branches so situated as to give service to the entire area without too great distances being necessary. These are placed at Fort William, Sault Ste. Marie, North Bay, London, Peterborough and Ottawa. These stations receive water samples regularly for routine examinations. The department also operates an experimental station where special investigations are conducted.

Local or municipal laboratories are also in use in several centres, especially in the larger places or where the water is difficult to treat. Such facilities are in use at Toronto, Ottawa, Peterborough, Hamilton, Chatham, Windsor, St. Catharines and elsewhere.

A special system of laboratory aid has been in operation for some time in the province of Quebec. The provincial laboratory has developed a special container for use in submitting samples to the central laboratory for bacteriological examination. A group of small incubation tubes, each containing culture medium, is mailed daily to the laboratory. The operator of the plant adds the requisite amount of treated water to each tube, and mails it forward to the laboratory, where it is incubated, and the results reported. Through this arrangement the provincial department is assured of daily tests from those treatment plants where it is felt necessary to apply this supervision.

PUMPING

With the increasing use of electric power for pumping purposes the old steam operated plunger and piston pumps have gradually given way to the use of centrifugal pumps. Occasionally the steam turbine is the prime mover for centrifugal pumps. The motor driven centrifugal pump is simple in design, low in first cost compared with other types, inexpensive to maintain and repair, is easy to operate and takes up little room. These considerations together with the low cost of power now available in most parts of Canada have caused the adoption of the motor driven centrifugal pumping unit.

POWER SUPPLIES AND DEVELOPMENTS

With the ever increasing use of hydro-electric power throughout most of the provinces the use of steam as the source of power even for standby purposes is gradually being abandoned.

Many of the water works systems are under the control of utilities commissions. Where standpipe or overhead tanks are available a low power rate is obtained due to the fact that the electric pumps can be shut off during peak loads.

In many places in Ontario and Quebec, electric power is available from two and in some cases three sources, thus reducing to a minimum the possibility of interruptions to the service. Nevertheless, most water works systems make provision for standby power which is usually provided by gasoline driven engines particularly in the smaller municipalities. Some of the larger municipalities have Diesel engines or still adhere to the old steam driven pumps in case of interruption and in other systems the storage in standpipes, overhead tanks or reservoirs at the required elevation is sufficient to carry the system through any interruption in the power supply.

All gasoline driven pumps are required to be located in a portion of the pumping station in a fireproof compartment separate from the main pumping station so as to reduce to a minimum the hazard arising from fire.

A gravity source of supply is a very rare thing in Canada and pumping has generally had to be resorted to. Wherever possible storage reservoirs at the required elevation have been constructed as a link in the distribution system. This permits of a uniform rate of filtering and pumping being established throughout the day, drawing from the reservoir in the day time and filling up the reservoir during the night.

MODERN PRACTICE IN DESIGN

There are four particular materials available for distribution system purposes, namely: cast iron, steel, reinforced concrete and wood.

For the most part cast iron pipes are used and in recent years the centrifugal cast type predominates. House services are of lead or copper bronze tubing.

The use of a steel cylinder reinforced concrete pipe for large mains has been introduced in recent years. These pipes, made in lengths of 12 to 16 feet, consist of welded steel cylinders for a 36 inch diameter pipe of No. 14 B. & S. gauge blue annealed sheets with galvanized steel bell and spigot joint rings welded to the ends. The interior is lined with 1½ inches of concrete and surrounded on the outside by concrete to a thickness of 2½ inches reinforced by welded steel hoops.

The laying of this pipe is carried on much the same way as for cast iron pipe except that the joints are caulked from the inside. The gaskets are made from lead rings wedge shaped in cross section and fibre filled. After laying has been completed, the backfilling in position for some length of time, and when the pipe has had an opportunity of settling into its final position, the joints are finally caulked tight and the joint space on the inside of the pipe filled up with mortar.

FROST CONTROL

In recent years, added difficulties have occurred in protecting the distribution system from frost action due largely to the tendency in many municipalities to maintain the streets reasonably free from snow. A layer of snow lessens the depth to which the frost penetrates and thus affords protection to the mains and services. As a consequence some of the existing mains have had to be lowered and generally the new mains are being laid at a greater depth.

Hydrant inspection has to be carried out systematically and in many cases each hydrant is examined every 14 days in the winter months.

In recent years the old fashioned but effective steam boiler used for thawing out frozen mains has been supplanted by the use of the electric thawing machine.

The covering of storage reservoirs on the distribution system is a necessity not only to prevent the growth of vegetable matter which would result upon exposure to sunlight, but to prevent freezing in the winter months. In standpipes and elevated tanks frost protection is required, particularly on the riser pipe to elevated tanks which has to be enclosed in a frost casing. In some instances steam coils have been placed in the riser pipes.

WATER CONSUMPTION

The average water consumption for Canadian municipalities is high.

In 27 cities of the province of Ontario the average per capita daily water consumption has been found to be 100 gallons. The lowest of these was 40 and the highest 187 gallons. Some of these have large manufacturing plants, while others are chiefly residential centres. Some are metered, while others are flat rate consumers.

Metering has done much to curb unnecessary waste of water, but there are many municipalities where metering is either not in use at all, or only to a very limited extent.

WATER WORKS INVESTMENTS

Water works systems in Canada are almost entirely publicly owned. The capital costs may form a heavy debt for a small municipality when any unusual difficulty arises in the source of supply, cost of treatment or supply lines. Usually the capital is returned in a period of 30 years or less. The sinking fund procedure has lost favour, and the debenture is repaid in equal annual installments including interest. The revenue necessary for this purpose is secured largely from water rates. Other procedures include frontage charges for the watermains, and direct taxation on the assessed value of the property. Charges are levied for fire protection, and paid by the taxpayer on the value of property protected.

COSTS TO WATER CONSUMER

The cost of water is collected periodically by the water department, the frequency of billing ranging from one month to six months, with preference being given to two or three months. In this way there is little likelihood of the consumer getting too far in arrears. Water rates not only lack uniformity in the different centres, but different unit rates bear little relation to one another.

ADMINISTRATION OF WATER WORKS SYSTEMS

The administration of municipal water works systems in Canada is carried on under different organizations. In some cases the municipal council assumes full responsibility for the system, and the work is placed under the immediate direction of a committee. In others it may be under a public utility commission, the members of which are elected to that body rather than to the council. These commissions may be entrusted with the operation of other utilities also. This is a popular practice, and one which has proved generally satisfactory. Full authority of operation is given to the commission with the exception that all surplus funds must be turned over to the council, and debentures for capital expenditures can be issued only by the council, with the entire municipality being responsible for the debt created.

In a survey made by the Canadian Section of the American Water Works Association, it was found that in 95 Canadian water works systems the water works were operated under the following elected bodies:

Municipal Council	Public Utilities Commission	Other Board or Commission
33	45	17

In all small centres where no utility commission or board has been created, the administration comes under the municipal council.

Sewerage Systems

LEGISLATION ON SEWERAGE SYSTEMS IN CANADA

While a substantial proportion of the urban municipalities in Canada have relatively small populations there is no longer the sharp line between rural and urban standards which once held. Water works are now constructed at an early period in the life of a village, and there soon develops a demand for public sewers.

The legislation pertaining to the construction and operation of sewerage systems in Canada is somewhat similar to that for water works, although the method of administration is quite different.

The provincial statutes are prepared to serve two purposes; the one is to authorize local municipalities to carry out certain works and to maintain supervision over sewerage systems, and the other is to define certain conditions which will apply throughout the province.

Provincial public health acts in Canada provide for control of sewerage systems by the provincial departments of health. The usual procedure is that no work, either new or extensions, may be initiated until a written approval is obtained from the department. This certificate is based mainly on the possible relationship to sanitation and public health. A further provision is fairly general under which the department of health may issue orders requiring certain sewerage works to be proceeded with in the interests of public health. The departments also exercise supervision over these works by periodic inspections, and by certain returns from the municipalities.

Legislation on financing such systems varies a good deal. In general, expenditures can be incurred for trunk sewers, treatment plants and other works which are paid from the public treasury, only after sanction by the voters. Sewer lines are paid for generally by a frontage tax collected over a period of years. Such procedures as sewer rental plans for raising funds for maintenance of these works have been used to only a limited degree in Canada. The method has been adopted in Quebec province, and has been used elsewhere as well, but in Ontario it is not recognized in the statutes.

DEVELOPMENTS IN SEWERAGE SYSTEMS

The number of municipal sewerage systems now in use in Canada is but 531 as against 1,258 water works. These works have been built up over a period of years. The dates at which they were begun were influenced by the degree of treatment required or the ease of disposal. Where the sewage could be discharged into large bodies of water without causing ill effects the sewers were laid at an early date and the system extended as required. Inland municipalities have been less fortunate and the cost of treatment has retarded progress.

DEVELOPMENTS IN SEWAGE TREATMENT

The number of municipalities in Canada, with sewage treatment is relatively small, and probably very much less than in older countries where the density of population is greater, and where industrial developments have surpassed those of this country. Few countries have so many large bodies of water which can be utilized for reception of sewage. The Great Lakes system, large rivers and lengthy flows all contribute substantially to the solution of this problem. Some degree of sewage treatment has been adopted in only 24 per cent of the municipal sewerage systems.

TYPES OF SEWAGE TREATMENT PLANTS

Methods of sewage treatment in Canada have included land treatment, sedimentation, chemical precipitation, contact filters, trickling filters, activated sludge and others. Many of the older plants have been abandoned in favour of sedimentation or activated sludge.

STRENGTH AND CHARACTERISTICS OF SEWAGE

The large amount of water used for domestic purposes in Canada gives a much weaker sewage than in many European cities. Purely domestic sewage is fairly uniform, but variation occurs where industrial wastes are received into the sewers.

It is the exception rather than the rule for an industry to be obliged to give any but the simplest treatment before discharging its wastes to the sewers. This has resulted, in some instances, in strong and difficult sewage reaching the treatment works. The cost to the municipality for disposal has been greater, but the communities have in general been willing to accept this added burden with the feeling that the industry as a taxpayer would ultimately pay a proportion of this cost.

REQUIREMENTS AND OBJECTIVES IN SEWAGE TREATMENT

Sewage treatment has been found to be both expensive and unpopular with the taxpayer, but public health must be protected and reasonable standards of sanitation must be maintained. To accomplish these at the minimum of expense is the aim of municipal governing bodies.

The stream flow or the volume of the diluting water into which the sewage effluent is discharged is a prime factor with every plant. Many Canadian municipalities are fortunate in having abundance of surface water, and this has permitted a minimum of treatment. Where rivers are involved it has been a problem of preventing depletion of oxygen, and providing sufficient treatment to offset undue pollution for municipalities downstream which might wish to use the water for domestic purposes.

Fresh water lakes are used to a considerable degree in Canada for the discharge of sewage. Since most of our lakes are used both for water supplies and sewage disposal the treatment and the location of outfall and intake must be carefully chosen. Wind action has been found to be one of the most important problems to deal with in this field, and the usual dilution factors associated with a flowing stream do not hold where a lake is the receiving body.

The Canadian climate contains both hot weather and low winter temperature. To meet this situation in certain cases a high degree of treatment has been found necessary for a few months in the summer, and a relatively simple measure for the balance of the year.

Sewage treatment requirements frequently depend on the presence of industrial wastes.

No method of sewage disposal can disregard the use of waters for recreational purposes. Much of the country is visited by tourists, and the sanitary condition of the water is doubly important.

HISTORY OF ACTIVATED SLUDGE IN CANADA

The activated sludge system of sewage treatment has been used extensively in Canada. Plants have been installed in the provinces of Alberta, Saskatchewan, Manitoba, Ontario and Quebec, although the great majority of these works are located in Ontario, where low cost electric power has had much to do with its choice for both large and small plants. The number of municipal plants of this kind now operating in the different provinces is 47.

MODERN PRACTICE IN SEWAGE TREATMENT

Present day practice in sewage treatment in Canada makes use of two methods in general, sedimentation for partial treatment, and activated sludge for secondary treatment.

SEDIMENTATION AND PRIMARY TREATMENT

Where only primary treatment of sewage is necessary, sedimentation is used chiefly in Canada. A few fine screens have been built, but they have not had any wide choice as a single treatment. The larger sedimentation plants of to-day are all flat bottoms with mechanical devices for sludge removal. Both rectangular and circular tanks are in use, the majority being square or round units.

The side feed, flow—through clarifiers used so much some years ago have been superseded by the central inlet, peripheral outlet tanks. These have given good satisfaction. The Canadian climate has not necessitated a covering for these tanks except in the most northern parts. Mechanical equipment has operated under the most adverse weather conditions.

TRICKLING FILTERS

The trickling filter system has not been used to any extent in Canada in recent years where new plants were built. Those in use are doing effective work when satisfactory attention is given to them. Institutions have found this to be easily operated and less sensitive to sudden changes than the activated sludge system.

ACTIVATED SLUDGE

The activated sludge process is now well established in Canada, and in the province of Ontario a large number of plants have given good service for several years. Preliminary sedimentation of the sewage is general for the larger plants.

Modern trends in Canada may be illustrated by the North Toronto sewage treatment plant which has been constructed to take care of a population of 100,000 persons with an average sewage flow to be treated of 7.5 million gallons per day. During 1938 the suspended solids in the raw sewage averaged 262 p.p.m. and the 5 day B.O.D. 255 p.p.m. The sewage passes through a coarse rack, mechanically cleaned, and thence to the grit chambers and preliminary sedimentation tanks. The grit chambers are four in number with a width of channel of 3 feet, a length of 45 feet and an average velocity of flow of 1 foot per second.

The four preliminary sedimentation tanks have clarifiers of the Dorr type. The total water capacity is 107,200 cubic feet, giving a retention period of 2 hours at the average rate of flow.

The aeration tanks are eight in number with a total capacity of 333,400 cubic feet giving a retention period of 5½ hours when the volume of sludge returned is 20 per cent of the average flow to the plant. The volume of air used in 1938 averaged 1.22 cubic feet per gallon of sewage. The area of the diffuser plates is about 10 per cent of the total area of the tanks. Spiral flow with baffle plates has been adopted and each tank is of the flow and return type.

There are five final sedimentation tanks with a total water capacity of 236,000 cubic feet giving a retention period of 3 hours. The tanks have a maximum depth of 16 feet and are equipped with the Fidler type of clarifier. The effluent from each tank is drawn from the surface by passing over the weirs of two troughs which has proved a very effective method of withdrawing the liquid.

The sludge digestion tanks are ten in number, eight being fitted with hot water coils placed around the sides of the tank which maintain the sludge at an average temperature of 90 degrees Fahrenheit. From a population of 82,177 the average quantity of gas during last year amounted to 127,000 cubic feet per day. This gas is used for heating the plant and drying the sludge.

The ten sludge drying beds are glass covered with a total effective area of 60,000 square feet. The dried sludge is removed manually from the beds and hauled in dump cars to the sludge dump.

The bacteriological examination of the raw sewage and effluent show that there was an average total reduction of bacteria of 99.2 per cent and an average total reduction of B. Coli of 99.1 per cent. When the effluent was chlorinated these reductions amounted to 99.95 and 99.99 per cent respectively.

OPERATION OF ACTIVATED SLUDGE PLANTS

All activated sludge plants are sensitive to certain conditions in the sewage, and in some circumstances there is a tendency for the sludge to turn septic, with the escape of offensive odours. To correct this, chloride of lime has been found useful, especially in the warm weather.

Sludge handling and final disposal has been one of the most difficult problems in sewage treatment in Canada. It was intensified when activated sludge came into more general use, and when two-storey tanks were abandoned. The Canadian climate has made sludge handling more difficult than in other countries. The methods receiving most attention in recent years are sludge digestion, covered sand drying beds, and mechanical dewatering of raw or digested sludge.

Sludge digestion has been used in most of the recent disposal works in Canada. These plants are relatively small, and sludge digestion has worked to advantage. The tanks require a good amount of insulation to prevent excessive heat losses in winter.

Dewatering of sludge has been done mostly on sand beds. The early experience with open beds proved that they were unsuitable for Canadian conditions. Later, glass-covered, heated beds have been used to advantage.

Dewatering of sludge by vacuum filters is in use at three municipal plants in Ontario. The results to date have been satisfactory. In these three plants the sludge is not digested, and is from activated sludge works.

Final disposal of sludge has been largely by dumping and for use as a fertilizer. No incineration plants are in use in Canada at present, although their adoption in the future is expected. In some municipalities a success has been made of removing the wet sludge in closed trucks for distribution on the land.

The use of chlorine for sewage treatment has been on a limited scale, but is likely to increase, especially on the effluent from treatment plants. In general, the location of outfalls has been kept as far away as possible from water intakes and bathing beaches, rather than relying on disinfection of the sewage.

Fig. 7—Sewage Treatment Plant, North Toronto.

Chlorine has proved most effective in the operation of sewage treatment works. Odour control has been possible where long trunk sewers are inclined to deliver a septic sewage. A liberal use has been made also of this product to check foaming in sludge tanks. Probably its most effective use has been in connection with the correction of operating difficulties rather than for treatment of the effluent.

Stream Pollution

LEGISLATION IN CANADA

While the control of streams in Canada has been less of a problem than in many other countries there is legislation in the various provinces which is effective when applied. Some of the following requirements are in force in Ontario:—

1. The degree of treatment for all municipal sewage is determined by the Provincial Department of Health, and approval must be obtained from that body.
2. No polluting material may be discharged into any of the streams or water courses of the province. Where public water supplies are involved the Department may fix areas, both in the water and on the land, wherein no pollution of any kind may be placed. This may even exclude bathing.
3. The control of industrial wastes reaching surface waters from private outfalls is provided for in the Health Act of the province. This enables the Department to determine the degree of pollution and to define the correction necessary. The riparian owners may then enforce this through the courts.
4. Boats and other vessels plying on the lakes and streams of the province must so dispose of their sewage and refuse as to avoid pollution of the waters.

INTERNATIONAL JOINT COMMISSION STUDIES AND ACCOMPLISHMENTS

In 1910 a treaty was completed between the governments of the United States and Great Britain whereby an International Joint Commission was established, to which certain questions relating to the causes, extent and location of pollution of the boundary waters between the United States and Canada were referred. The work of the Commission also covered the remedies to be applied for the prevention of such pollution and for rendering such waters sanitary and safe for domestic, bathing, fish life and other uses. There are six commissioners, three being appointed by each country. Each commission operates independently on matters affecting one country only.

The agreement on sanitary grounds does not go into details or set standards of pollution, but it is stated that "the boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other side."

The treaty provided for investigations of boundary waters by the commission. This was done, and its final report was issued in 1918. A new treaty was drafted by the commission, at the request of the two governments, to give effect to its recommendations, but no action has been taken so far on it; and the only agreement between the two countries on this subject is that contained in the original treaty.

The Commission carried out extensive bacteriological investigations which included float and temperature observations, and were confined to the Great Lakes system and the connecting waterways as well as the St. Lawrence and St. John rivers.

Generally speaking the bacteriological examinations showed the waters to be practically free from B. coli in 100 c.c. and bacterial counts of less than 10 per c.c. on agar at 37° C. But in the neighbourhood of towns and along the lanes of navigation, there was evidence of pollution, and in the case of the Niagara and Detroit rivers evidence of pollution crossing the boundary from the American to the Canadian side was found. At the mouths of the Niagara and Detroit rivers serious contamination was found extending ten miles into Lake Ontario and Lake Erie respectively and occasionally contamination was found to travel 16 miles in Lake Ontario and 18 miles in Lake Erie.

The Commission concluded that many sections of the Great Lakes system and the connecting rivers were no longer fit for domestic use unless subjected to extensive treatment in water purification plants. In the Detroit and Niagara rivers below the cities of Detroit and Buffalo the waters were so badly polluted that it was questionable whether any ordinary water purification plant could render them at all suitable for drinking purposes. The abnormal prevalence of typhoid fever in certain sections of the territory adjoining these boundary waters was attributed by the Commission to the grossly polluted condition of these waters.

The Commission in its conclusions recommended that all sewage before being discharged into boundary waters should receive "purification treatment," the degree of such treatment to be determined in a large measure by the limits of safe loading for water purification plants. The Commission did not, however, lay down a fixed standard either as regards sewage treatment or water purification.

It is interesting to note that under Article 8 of the treaty between the two governments, the order of precedence applicable to the various uses enumerated for these boundary waters is given, and it is provided that "no use shall be permitted which tends materially to conflict with or restrain any other use which is given preference over it in this order of precedence." Such order of precedence is as follows:—

1. Uses for domestic and sanitary purposes.
2. Use for navigation, including the service of canals for the purpose of navigation.
3. Uses for power and for irrigation purposes.

This order of precedence recognizes the supreme importance of public health. All other uses are to be put aside so far as they conflict with the paramount requirement of "uses for domestic and sanitary purposes."

STREAM CONTROL

No special bodies have been created for the control of stream sanitation in Canada. What work has been done has been under the direction of the provincial departments of health. The main purpose in this has been to protect the water supplies for domestic consumption, and to avoid offensive conditions in these streams. Extensive studies have been necessary in some localities in order to secure the necessary corrective measures.

Southern Ontario offers some good illustrations of the control of inland streams, receiving much organic waste, and at the same time varying extensively in flow. Here the Grand and Thames rivers have required a good deal of attention.

The programme on the Grand river is just now being developed. This stream passes through a number of municipalities from which sewage and industrial wastes are discharged. Water supplies also are taken from it. Two difficulties have arisen due to the wide variations in the flows. These are flood damage, and inadequate dilution to care for the organic wastes in summer. The monthly flows have varied from a maximum of 30,090 c.f.s. to a minimum of 47 c.f.s. The mean flow is 1,250 c.f.s. per month.

To correct this situation storage basins are now under construction on the upper limits of this stream. This project is designed to store sufficient water to greatly increase the minimum summer flows, and to eliminate the high flows tending to flood damage.

GENERAL ATTITUDE ON STREAM POLLUTION

The present day attitude in Canada on stream pollution may be regarded as one in which the general public, and especially those riparian dwellers and others who are in contact with these surface waters, feel that no municipality, industry or private owner has any right to pollute the water to such an extent that it cannot be used and enjoyed by others. Departments concerned are expected to ensure that this condition will prevail.

STREAM CONTROL AND FISHING

Stream control in most countries is closely related to fish preservation. It is separate and distinct from health activities, but a close co-operation is needed between the departments concerned. No group is more insistent upon clean streams and lakes than the anglers, whose interest has done much to improve conditions. The discharge of improperly treated sewage or industrial wastes into these streams may have a very injurious effect. Since Canada is famed for fishing and recreational facilities there is a strong appeal for protection of our water supplies.

Refuse Collection and Disposal

Refuse collection and disposal in Canada has been developing over a period of years. The changes have had to do with the methods of collection, and in the manner in which disposal can be made under Canadian conditions. Greater care is now exercised to ensure that material is not scattered about the streets and that the vehicle used is well enclosed and is not unduly objectionable in appearance.

As regards disposal, there has been a change from dumping to incineration although both are used extensively by Canadian municipalities.

Domestic refuse in Canada has a high moisture content due to the extensive use of fruits and fresh vegetables. Another characteristic of Canadian refuse is the amount of ashes present during the winter. The amount of refuse per 1,000 population is approximately 1 ton per day, within considerable variations both above and below this figure in certain municipalities.

Very satisfactory collection equipment has been made available in recent years, utilising the wide range of trucks now possible with motor propelled units.

Canadian municipalities have for the most part become accustomed to two collections per week in the larger places, and once per week in others. For hotels and food establishments, daily collections are necessary. The ashes are placed in separate containers and collected in another vehicle.

The administration of refuse collection is generally under a department of the municipal organization. It may be under the municipal engineer or a special branch created for this purpose. In smaller places a superintendent acting directly under the council is common practice.

The cost of regular collection of refuse is not high when spread over the entire municipality. In general this is paid from the general tax rate. In Ontario, the cost per residence has averaged approximately $2.50 per year, a figure which must be considered very low for the service rendered.

REFUSE DUMPING

Dumping of refuse is general in the smaller places where suitable sites can be had without too great a travel distance. The selection of the site often involves many difficulties and much objection on the part of the public.

The important feature about refuse dumping is the need for constant care and supervision. Covering is essential unless the location is very remote from dwellings. A serious source of odours results from burning on the dump. Once started it is difficult to put out the fire. Rat control, especially on an uncovered dump, is always a problem. The only factor in favour of dumping is the low cost.

INCINERATION

Incineration of municipal refuse has proved to be a sanitary measure and one within the financial means of the average community in Canada. The end product is easily disposed of as a fill and only a small area is required.

The incinerators which are now in operation are of two general types, low temperature furnaces and high temperature destructors. A number of each are used. The low temperature plant has been employed for small centres where the amount of refuse is limited, and where a site can be chosen some distance from residences. The modern plant for larger cities utilizes forced draft and a high enough temperature to avoid offensive conditions.

Low temperature incinerators have been able to destroy large quantities of refuse without creating any serious complaints. Black smoke occurs when the plant is being started, but this is for a limited period. Similarly, odours do occur at times but the most common complaint is due to the congregation of waggons and trucks daily at the site. The low cost involved in these plants has been a factor in their selection. A careful choice of site has been sufficient to avoid most complaints.

In the modern high temperature furnaces forced draft is employed to advantage. They can be operated with little cause for complaint. The experience of the City of Toronto in this is illuminating in that these plants have been built in residential sections of the city. Drying hearths and preheated air are features incorporated in all these designs.

The recovery of heat from refuse incinerators has received little support in Canada. The operation of the furnaces is so variable that it has not been felt worthwhile to alter the design to take care of this.

The cost of incineration approximates $1.00 to $1.50 per ton of refuse burned, and this includes capital costs as well as operation.

Swimming Pools

Indoor swimming pools have gained general acceptance in recent years in Canada. Many of these have been constructed as municipal enterprises, paid for from public funds. Others have been built by service organizations, interested in the welfare of youth.

The sanitary importance attached in recent years to swimming pools has been the result of studies made by public health agencies. This is a field in which the sanitarian can perform a valuable service in health protection and general hygiene.

Treatment of the water is the most important feature in the operation of swimming pools. Canadian practice has been developed from provincial requirements. Recirculation of the water with filtration in between is employed in nearly all pools. The accepted standard is two turnovers per day. Pressure mechanical filters are used for this purpose. Hair catchers are necessary, but little attempt has been made to aerate the water before it is returned to the pool.

Chlorination of pool waters is a provincial requirement. Such other methods as ozone and ultra violet rays have not been accepted for this purpose. A good deal of importance is attached to the maintenance of a chlorine residual in the pool at all times during the bathing load. A chlorine content between 0.2 and 0.6 p.p.m. is in general use. The chlorine is applied to the incoming water, and is soon mixed by the action of the bathers. Chloramine has been used to some extent. The safety of pools with properly treated water is a strong inducement for their use in preference to outdoor areas of questionable safety.

Milk Control

From the early days in which milk control was regarded as the responsibility of the agriculturist there has been a swing to the public health field. In this the sanitary engineer is now allotted the task of supervision. The treatment process involves many engineering features.

In Canada, milk legislation is chiefly the concern of the provinces and the various municipalities. Both have authority to pass acts which will affect production, processing and distribution. The common procedure followed today provides for a licensing or certification of all milk processing plants, under some provincial body. In this way the requirements are uniform over the entire province. Much of this legislation has to do with the process of pasteurization, and the many engineering details which it involves.

Legislation in Canada recognizes the rights of all local municipalities to exercise control over the milk sold within its boundaries. By-laws may be passed, with the consent of the province, to provide for fixed standards of quality and practice. These standards must not be lower than any minimum figures set by the province.

The value of milk pasteurization in the protection of public health has been continually demonstrated to the milk consumer. Toronto was one of the first cities on the continent to make this compulsory for all milk sold in the city limits. This was in 1914. The fact that not a single case of milk-borne infection has been traced in all this time to milk sold in the city is strong evidence of the value of the process.

The province of Ontario has adopted very advanced legislation in making pasteurization of all fluid milk compulsory. This came into effect on October 1st, 1938. It applies to all cities, towns and such other areas as may be determined by the Department of Health of the Province. Some 800 pasteurization plants are operating in Ontario.

The government regulations have to do with the buildings in which the process is carried on. Detailed requirements are laid down for the rooms, the general arrangement and the equipment used for pasteurization and handling in general. Engineering supervision is designed to ensure that all parts of the milk will be heated to the requisite temperature of 143° F. for 30 minutes.

General Sanitation

In addition to the more generally recognized fields of sanitary engineering such as water supply, sewage disposal and milk control, certain other activities merit attention. These include air conditioning, ventilation, heating, industrial hygiene, etc. They are growing in importance as better living standards are being sought.

Conclusion

Since the commencement of the present century, rapid development has been made in most phases of public health engineering. In cleaning up our water supplies most effective work has been accomplished. Sewage treatment has made definite progress but we still have a long way to go. The continued pollution of our streams and lakes is a blot on humanity. Where the water supply is drawn from a sewage polluted source the problem of a pure water supply is only partially solved by the purification of the water. The treatment of the sewage is an essential preliminary if we are to maintain our streams and lakes so that they can be used safely for all purposes.

The engineer deals primarily with what lies ahead. He is continuously being called upon to devise means that will better living conditions in almost every aspect of daily life. The public as a whole comes in contact with the work which he is accomplishing. As an individual he is subjected to both criticism and praise, but as a servant of the public he is bound to derive considerable satisfaction from work well done and accomplished.

BUILDING AERODROMES FOR EMPIRE AIR PLAN

Director of Public Information, Ottawa, Ont.

The construction of eighty or more aerodromes for the British Commonwealth Air Training Plan on sites which have been prairies, cultivated farms and pasture land, within the short interval between the spring thaw and winter freeze-up is a great task which Canadian engineers and contractors are successfully accomplishing. The work is being done under the direction of the Hon. C. D. Howe, who, as Minister of Transport, has been responsible for the provision of sites and all the ground work, and, as Minister of Munitions and Supply, for the construction of the hangars and other buildings.

When the Canadian Government received its first intimation last September that the British Government was considering an extensive scheme for the training of Empire air pilots, air observers and air gunners in this Dominion, it did not wait for the details to be worked out. Officers of the Department of Transport, who had been responsible for the construction of a chain of airports and intermediary aerodromes throughout the Dominion for the Trans-Canada Air Lines, were given the task of selecting, surveying, and preparing for the construction of the required air fields.

In consultation with officers of the Royal Canadian Air Force, it was decided to distribute the proposed aerodromes throughout the Dominion so that every province would be able to take an active part in furthering the plan. For the sake of the thousands of young aviators who would be passing through the various schools, it was thought advisable that these aerodromes should be constructed as near as possible to towns and cities so that during their free moments the flying personnel might enjoy their amenities. Further, by placing the aerodromes close to existing centres, the provision of fresh water, electric power, telephones, and railway and highway facilities is possible without much additional construction.

The work is now well ahead of expectations, despite delays occasioned by unusually wet weather, and a number of completed aerodromes have already been turned over to the Royal Canadian Air Force.

The construction problems to be faced differ with each air field but the amount and kinds of work involved can best be realized by taking as an example one field selected at random. This aerodrome, now at a stage of completion weeks ahead of the time tabled, is located in central Ontario in a thriving agricultural district. Except for the surveyors' stakes it was, at the beginning of May, a stretch of cultivated farm land. To convert it into an aerodrome more than 2,500 trees, roots and all, had to be removed, and approximately 175,000 cubic yards of earth had to be handled in the stripping and grading operations. For the construction of the runways alone, which are equivalent in area to about five miles of modern highway, more than 60,000 tons of crushed stone had to be hauled from a nearby quarry and 77,000 gallons of primer and bituminous surfacing provided. Approximately eight miles of tiled drains were laid and more than 16,000 cubic yards of open ditching excavated outside the boundaries of the field. In addition 140 acres of land have to be seeded.

Before the Department of Transport can turn the field over to the Royal Canadian Air Force for use in the training of pilots, air observers and air gunners, many miles of underground cables will have to be laid to illuminate the runways, hangars, and the buildings to be erected in connection with the air training school. Water mains, capable of supplying the needs of several hundred men, and telephone and power lines have to be brought in, and many incidental undertakings, including the fencing in of the air field and erecting the necessary markers, must be completed. Incidentally, all flying hazards in the immediate vicinity of the air field must be eliminated to reduce the possibility of accidents in landing and taking off. This work includes the laying of underground cables to replace existing overhead telephone and power lines, the cutting down of high trees and, in some cases, the removal of farm buildings from the immediate vicinity.

The above figures indicate the volume of work required in the construction of a single aerodrome. When these figures are multiplied by 80, the magnitude of the task undertaken by the Department of Transport, which must be completed before winter sets in, can be realized. Modern mechanized equipment has made this rapid progress possible. In the particular air field referred to above, the number of men employed has varied from 150 to 600, working in shifts. The mechanical equipment has, however, been operating approximately 23 hours a day for weeks on end, with only short stops for refuelling, oiling and overhauling. A staff of mechanics is constantly on the job to prevent any breakdown in the equipment. Wet weather, which makes the heavy soil of that particular district unworkable, has caused some delays but any time lost has been more than made up in the dry spells. On this particular project, three caterpillar bulldozers, five "Letourneau" levellers, and a few grading and rolling machines have been used. A fleet of 25 trucks, each capable of hauling five and a half tons of material, has been steadily in operation. In addition, the contractors have had to develop their own quarries near by and to set up their own power shovels and stone-crushing plants to supply material for the runways.

Expert operators handle this array of mechanized equipment. The bulldozers have been invaluable in uprooting trees, removing boulders, cutting down slopes and preparing the ground for the grading machines and the levellers. These latter are capable of cutting a swath ten to twelve feet wide and at the same time are able to fill any depression ranging from a half inch to eight inches in depth. The heavy rollers complete the levelling operation, while special spraying machines are used to lay the priming and surfacing material. Each truck averages as many as fifteen trips per shift.

Where possible, local labour is utilized in the construction of the air fields. While the supervising engineers are mainly from the staff of the Department of Transport and the operators of the mechanical equipment, foremen, and other key men are on the permanent staffs of the contracting firms, practically all the maintenance men, labourers and office staffs are secured locally. Similarly most of the motor trucks used and their drivers are obtained from sources adjacent to the job.

When it is considered that a modern commercial air field utilizes in the neighbourhood of 40,000 gallons of water per day and that the amount of electricity consumed in one year costs about $4,000, it is understandable that the main aerodromes, on which the training school buildings are to be erected, must be within easy access to existing water mains and power lines. While it is not likely that all the aviation fields to be used under the British Commonwealth Air Training Plan will need as much lighting for night flying as a commercial airport, all advanced training fields have to be equipped with most elaborate lighting systems. The volume of water required for the barracks of a thousand or more men attached to the field will be much greater than that required for the limited staff of a commercial field and the passengers who remain there for only a short period of time.

When instructions were received to proceed with the work of constructing and improving air fields for the

British Commonwealth Air Training Plan, the Department of Transport immediately placed at the disposal of the Royal Canadian Air Force all existing airports and intermediary aerodromes under its control. Many of these have been adapted and enlarged to meet the requirements under the general scheme, but with regard to the intermediate fields remoteness from centres of population or available transportation systems, and unsuitability of adjoining territory for flying training, have, in certain cases, made them impracticable for use under the Training Plan.

Selecting, surveying, and preparing for the construction of aerodromes has been a large undertaking in itself. Department of Transport engineers and Civil Aviation inspectors who had been associated with the construction of airports and intermediary aerodromes for the Trans-Canada Air Lines were well experienced in the requirements of modern air fields. More than 1,800 possible aerodrome sites were inspected from the air by these officials. These sites were inspected from high-flying and low-flying planes. In some cases the terrain was unsuitable, in others the flying hazards of the surrounding countryside were too numerous. Sites that appeared to meet all the requirements from the air were selected for further investigation by ground parties. In such surveys, the amount of work involved in levelling the ground and removal of flying hazards, proper drainage, suitability of soil and the nearness of material for the construction of runways, were reported upon. All these factors had to be given careful consideration before a party to conduct a detailed survey was placed on the ground.

For the Service Flying Training Schools the scheme called for units of three air fields within a distance of five miles of each other. The main field was to accommodate all the school and living quarters, as well as the hangars for the planes. Such an aerodrome, to be known as the main flying field, had to have hard-surfaced runways capable of bearing the weight of the heaviest bombing planes in all types of weather. The first reserve field was likewise to be equipped with hard-surfaced runways, while the second reserve field required only grass runways. Similarly the bombing and gunnery school aerodromes had to be located within five miles of a suitable bombing and gunnery range of approximately eighteen miles in length and four miles in width. While a range over open water was considered advisable, great care had to be taken to prevent the dispossessing of fishermen's rights in waters known to be valuable fisheries.

All sites considered suitable by aerodrome engineers and conforming to the requirements of the Royal Canadian Air Force were given a final survey. This involved the preparation of a contour plan of the aerodrome and the surrounding country to ascertain all details regarding the nature of soil, buildings in the locality and any factors which might affect its suitability as an air station. In this work, the engineers of the Department of Transport received valuable assistance from the surveying staffs of the highways departments of the various provincial governments. Thus by the time details of the complete British Commonwealth Air Training Plan were announced on December 4th by Premier W. L. Mackenzie King and before the winter snows could hamper the work of field surveys, engineers of the Department of Transport had secured all necessary data about the sites required under the plan.

During the winter months, these engineers were able to prepare development plans from the reports and to estimate the cost of each separate unit. These plans, with estimated costs, were then carefully considered by the Aerodrome Development Committee, which consisted of the senior and responsible officers and officials of the Department of Air and the Department of Transport. Once approved, steps were taken to acquire the land for the proposed sites and in this work the Lands Branch of the Canadian National Railways gave the benefit of its extensive experience. Tenders were then called for, so that by spring, when the frost was out of the ground, contracts had already been awarded and work was able to commence immediately on the selected fields. With the announcement by the Hon. Mr. Howe that all the fields were to be finished this year plans and specifications for the aerodromes slated to be constructed in 1941 were rushed to completion.

By the end of midsummer many of the aerodromes will have been completed by the Department of Transport, work on the balance well advanced, and a start will have been made on the last remaining air fields provided under the two-year plan as originally scheduled. Thus the 80 or more aerodromes provided under the British Commonwealth Air Training Plan will have been completed before winter sets in and Canada will have greatly advanced the facilities for the training of aviators for service in the defence of the Empire.

PERSONNEL REQUIRED TO BUILD, MAINTAIN, AND FLY A WARTIME AIR FORCE WITH A PERMANENT BASIC STRENGTH OF 26,000 AIRPLANES

(This chart, reproduced here from an article appearing in the April 5, 1940, issue of *The Aeroplane* (London), illustrates graphically the personnel requirements of an air force of 13,000 combat planes and 13,000 non-combat craft of all-metal construction and an average gross weight of 10,000 lb. The total replacements per annum in wartime would require at least 117,000 airplanes and 221,000 engine units to maintain the basic strength. As shown, part of the man-power is used in the aircraft and accessories industry for research and the production of fuselages, engines, propellers, and instruments, and the other part in auxilliary industries for the production of fuel, lubricants, uniforms, and their distribution and transport.)

THE POWER PLANT OF THE ONTARIO MENTAL HOSPITAL, ST. THOMAS, ONT.

H. H. ANGUS, M.E.I.C.
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This institution at present consists of 15 buildings suitable for 1,800 mental patients and is arranged for extension to an ultimate capacity of 3,800 patients.

The buildings include male and female pavilions dining halls, kitchens, infirmaries, medical buildings, administration building, power house, and laundry.

The power plant is located in a separate building which contains not only the central heating plant but also pumps and storage tanks for water supply and sewage.

The boiler plant consists of three water tube boilers each having a nominal rating of 325 boiler horse power. The underfeed stokers are capable of operating each boiler at 200 per cent rating, giving a total of 1,950 horse power. Space has been left for the installation of additional boilers. The grate area of each boiler is 80 square feet, and clinker chills 4 tubes high have been installed on each side of the furnace. The separate brick settings are all firebrick, the inside walls being first quality and the outside walls second quality. This cost very little more than common brick and has practically eliminated cracks in the setting. The boilers are connected by a steel breeching to a radial brick chimney eight feet diameter and 150 feet high.

Power Plant of the Ontario Mental Hospital, St. Thomas, Ont.

Coal may be delivered to the plant by truck or railroad car and is dumped into a hopper. From there it is carried to an overhead bunker by means of a conveyor which is also used as an ash conveyor. From the overhead bunker the coal is conveyed by a weigh larry to the different boilers. This larry is arranged to record the weight of coal delivered to each stoker hopper. An integrating and recording steam meter on each boiler shows the quantity of steam used, so it is a simple matter to obtain the efficiency of each boiler. The overhead coal hopper has a capacity of 225 tons coal and 25 tons ashes.

There are two forced draft fans for the plant connected so that either one or both fans may deliver air to any boiler. Each fan has a capacity of 18,000 c.f.m. per minute and has a motor on one end and a steam turbine on the other end so either drive may be used.

An instrument panel is placed beside each boiler on which is mounted the steam meter, also four point draft gauge and hand wheel to control the damper in the uptake to the breeching.

Condensation from the buildings is delivered to a main receiver in the boiler room by means of return pumps located in the various buildings, some of which are about one half mile away from the power house. From this tank the boiler feed is pumped to the de-aerating feed water heater by centrifugal pumps and thence to the boilers by means of two vertical simplex steam pumps, 9½ x 7 x 18.

The power house has a basement part of which is used for the removal of ashes which are removed below the boiler room floor, and the rest of the space is used for piping, ducts and auxiliaries.

Steam is generated in the boilers at 125 pounds pressure and distributed to the various buildings at 60 pounds; reducing valves in the buildings reduce it to the pressures required for heating, sterilizing, cooking and other purposes.

Sewage from the institution is treated at the St. Thomas municipal plant, and owing to difference in level it is necessary to pump all sewage through about two miles of line to the city mains. The sewers from the various buildings all connect to two large tanks located beside the power house, and there are three vertical sewage pumps installed at present. The storage is ample so that in case of breakdown in the pumps or the pressure main, the institution could operate for about 24 hours during which repairs could be made.

The water supply for this large institution is taken from the St. Thomas municipal system, but the pressure in this system was not considered high enough to guarantee adequate service to all the buildings at all times. It was therefore decided to install an elevated tank to provide gravity presssure.

The water flows at comparatively low pressure from a 12-inch municipal main into two concrete storage reservoirs buried underground. These have a capacity of 250,000 gallons each, and are kept full at all times by means of a float valve which opens and shuts valves on the main as needed. From these underground reservoirs the water is pumped to the elevated storage tank, which has a capacity of 104,000 gallons and is 122 feet above ground level. This structure is a standard ellipsoidal-bottom, cone-roof tank furnished and erected by the Horton Steel Works, Limited. However, the architect who designed the buildings also added two horizontal bands to the shell of the tank between the balcony and the roof. These bands have no structural purpose, but help to bring about a harmony between the vertical aspect of the tank and the horizontal lines expressed in the building facades.

The pumping equipment used to elevate the water to the tank consists of one electrically driven unit with a capacity of 300 g.p.m. at 1,450 r.p.m., and one single stage unit capable of delivering 300 g.p.m. against a 208-ft. head when driven at 2,500 r.p.m. by a 27.5 B.h.p. steam turbine.

Abstracts of Current Literature

Contributed abstracts of articles appearing in the current technical periodicals

ELECTRICALLY HEATED ASPHALT PLANT

From *Engineering News-Record*, (New York), August, 1940

Electric heating marks an important advance in the new hotmix asphalt paving plant constructed for the Del Balso Construction Corp., The Bronx, New York City. This plant has a capacity of 100 tons of paving mix per hour. All heating of materials except the limestone and sand, which are heated in an oil-fired kiln, is by electricity, using 510 kw. in heating elements. This is the largest electric-heating installation yet made in an asphalt paving plant.

The Bronx plant consists of four storage tanks each 10 ft. in diameter and 40 ft. long having a capacity of 25,000 gal. each; two superheaters of 4,500 gal. each; two weighing buckets, and two mixers of one and two-ton capacity. The asphalt is shipped in barges; heated to a liquid state when pumped into the barge, it retains sufficient heat at the delivery point to be pumped from the barge into the storage tanks.

In the storage tanks, the temperature is raised and maintained at 225 deg. F. by eighteen heating units. Each unit consists of a steel tube 10 ft. long, sealed at one end, and a 3-kw. open-coil heating element. Each unit can be individually inspected or replaced in case of a burn-out; also each unit is individually controlled by a switch permitting flexible operation, as only the actual number of units required to maintain the desired temperature need be connected to the service. The temperature of the asphalt is controlled by a gas-filled thermostatic bulb actuating an indicating thermometer controller. The bulb is enclosed in a well socket built into the wall of the tank. In addition to the immersion units, 3 kw. in Calrod units are attached to the lower half of the end of each tank opposite the main heating units to compensate for radiation losses on the unheated end. The tanks are covered with 3 in. of 85 per cent magnesia and water-proof covering.

Twenty-four 3-kw. heating units are installed in each of two superheaters which are located directly beneath and piped to the storage tanks. These units which raise and maintain the temperature of the asphalt at 300 deg. F., are of the same type as the units installed in the storage tanks, and are controlled electrically and thermostatically by the same type of equipment.

Overhead pipelines connect the superheaters with the weighing buckets located on the mixing platform; 60 kw. in Calrod units, thermostatically controlled, are uniformly spaced around the pipelines. The bulbs of the thermostats are installed flush against the pipes to compensate for radiation losses and to maintain the temperature of the asphalt flowing through the pipes at 300 deg. F. Aluminum sheets are installed over the pipes and heating units to reflect the heat to the pipes. Insulation and weatherproof covering are installed over the aluminum sheets.

Each weighing bucket is equipped with 5 kw. in Calrod units that are insulated and attached to the lower outer sides of the bucket. The heaters are controlled by a thermostat to maintain the temperature of the asphalt at 300 deg. F.

The limestone and sand to be mixed with the asphalt are heated to 500 deg. F. in an oil-fired kiln, and are then loaded into a bucket elevator and deposited on separators for grading to size. From here the mixture passes through the hopper and into the mixer where it is combined with the hot asphalt from the weighing bucket. The mixers are each equipped with 12 kw. in Calrod units which are installed similar to those on the bucket.

The dryer is equipped with low pressure electric actuated oil burning equipment. No. 6 fuel oil is preheated to 175 deg. F. by a 39-kw. fuel oil preheater prior to entering the combustion chamber.

A schedule of operation is being prepared whereby all of the asphalt in storage tanks and superheaters will be heated during the night to a predetermined temperature, thereby preventing the heating demands from coinciding with the normal plant operation demands. This method of operation will produce a better load factor and effect considerable economies in plant operation and electric heating costs.

TROOP-CARRYING AIRCRAFT

Their Use in Modern Warfare

Extract from *Trade and Engineering*, (London, Eng.), May, 1940

Aeronautically one of the most notable features of the invasion by Germany of Norway was the use that was made of troop transport aeroplanes. It is as yet impossible to say with any certainty how large were the numbers of men carried, nor to what extent such aircraft were used for the transport of war materials and guns. But that men were carried and that light guns were also carried seems to have been positively established. Indeed a "regular ferry service" was spoken of as being run by the Germans to some base in Norway during most of the week after their invasion.

Here is an aspect of war to which the attention of all those who are engaged on the construction and development of aircraft should be directed. Troop transports have been used many times before in small operations. They were used for the famous Kabul evacuation and they have been used for revictualling purposes. Until the Norway operation by the Germans, however, they cannot be said to have had a full-scale, full-dress test of their capabilities.

On this occasion it is clear that they must have been of the utmost value to the Germans. They provided a means of evading the vigilance of the Royal Navy and they also provided a means of depositing bodies of troops at strategic points with a minimum loss of time. It might almost be said that the invasion of Norway would have been impossible in the time taken without the extensive use of air transport of troops. The Germans in this were employing a method which has indeed been noted by all staff officers in all countries, but has been accepted with varying degrees of reserve so that few air forces contain large numbers of troop transport aeroplanes. They are in fact among the subsidiary types.

Commercial Machines Used

Now the reason is not only that the possibilities of this type of machine were not appreciated. It was also that it was recognized that commercial aeroplanes could be converted for troop-carrying purposes in a very brief space of time. The Germans, it seems from the reports which have reached England so far, have been using the aircraft of their commercial fleets. Chief among the types employed is the Junkers Ju. 52. This is by no means a new type. In fact it is an old type and has no specially important qualities so far as performance is concerned. It is, however, a trustworthy type which has seen much service on the German air lines, and it has been shown to be a good aircraft for regular operation in all weathers.

The Ju. 52 has three B.M.W. radial engines or any other suitable type of radial engines. It is a low-wing, all metal monoplane with a corrugated metal skin, a feature which made it well known at Croydon, and it has a special form of Junkers wing flap along the whole of the trailing edge of the wing and slightly below, the outer sections of the flap being operated differentially to act as ailerons. Its weight loaded is 23,200 lb. and its disposable load is 10,600 lb. As a passenger machine it carried 14 to 17 passengers, or it can be arranged to take 12 stretchers. Cruising speed is about 162 miles an hour and the range at this speed is 546 miles at 3,000 ft. The wheels can be replaced by floats, in which case the cruising speed falls to 152 miles an hour. Maximum speed is 174 miles an hour for the landplane.

The aircraft could obviously be converted to take more than 14 soldiers, provided no more range were needed. No doubt one may look upon its capacity for the Norwegian operations as of the order of 20 fully equipped men, though this is purely a rough estimate and is not based on any exact information that has come from Norway. Perhaps the chief advantage of this machine from the German point of view is in fact its age. That sounds paradoxical. But it is to some extent true to say that older types of commercial aeroplane are generally built to lighter wing loadings than later types, and that in consequence they are somewhat better for operation from small aerodromes and from fields. This must have been important, for it was essential to run the air ferry service with the German troops in a manner whereby the risks of the aircraft being attacked by Royal Air Force long-range fighters were minimized. The Junkers Ju. 52 is able to land slowly and take off quickly. It is not a specialized troop carrier or a new type of commercial machine, but serves its purpose well.

British Troop-Carriers

It is, of course, known that the British also used their commercial transport aeroplanes for some of the work of transporting troops and their supplies to France in the early stages of the war. The aircraft which had previously ensured the London-Paris commercial landplane service were brought in as military transports and used to excellent purpose, enabling men and supplies to be taken over very much more quickly than could otherwise have been possible. This speed advantage was of benefit especially to sections of the Royal Air Force which expected at that time to be plunged into full-scale operations immediately war was declared.

Great Britain, however, does not rely solely upon her commercial aircraft for troop transport work. She has some specialized types. The Bristol Bombay is one. This is officially described as a bomber-transport. It is a high-wing monoplane with fixed undercarriage. Its power is provided by two Bristol Pegasus XXII engines each of 1,010 hp. The wing span of the Bombay is 95 ft. 9 in., and the length 69 ft. 3 in. Its weight empty is 13,800 lb., and when loaded 20,000 lb. The construction is metal-stressed skin. As a bomber the crew of this machine is four and as a troop carrier it has a crew of three and carries 24 fully armed infantrymen. The maximum speed is 192 m.p.h. at 6,500 ft., and the cruising speed 160 m.p.h. at 10,000 ft. The range is 2,230 miles.

The Bombay is in all respects a superior aircraft to the Ju. 52 and it has the advantage of being specially designed for the work of troop-carrying. The de Havilland Flamingo is also being built in a special troop carrying version. The Flamingo was originally a civil transport aeroplane, but the troop carrying version is modified in all necessary particulars so that it may be looked on as an aircraft designed for the work.

The Flamingo is a high-wing monoplane and has two Bristol Perseus XIIc engines each of 890 hp. Its span is 68 ft. and its length 51 ft. 10 in. Accommodation is available in this machine for 22 fully armed infantrymen. This aircraft is much smaller than the Bombay as the figures show, but it again compares well for the task of carrying troops quickly and efficiently with the converted German machines. In its civil version it has a top speed of 239 m.p.h. at 6,500 ft.

Value of Specialized Machines

Fundamentally it may be true that the troop transport aeroplane is similar to the commercial transport aeroplane. But for the highest efficiency the specially designed troop transport is likely to be a good deal better than the improvised machine. The point that must now be considered by those in the industry as well as by those in the Air Ministry is what can be done to ensure that, should operations make a call for troop transport aeroplanes, they shall be available in sufficient numbers either as converted commercial types or as individual types specially designed for the purpose.

DESIGN FOR LIVING

From *Mechanical Engineering*, June, 1940

In a thoughtful address delivered at the 1940 Spring Meeting of The American Society of Mechanical Engineers, and somewhat humorously called a "Progress Report of an Amateur Economist," Ralph E. Flanders, past-president A.S.M.E., presented a "design for living in America." Strange as it may sound on the first hearing of it, the design is intended to strengthen, rather than undermine, those virile traits of character essential to the continuance of free enterprise under the capitalistic system, in spite of the extensive, but entirely constructive, rôle that government is expected to play in it.

Like any other design for living seriously proposed for development and adoption, success in its application depends on many factors, not the least of which is the survival in this country of that capitalistic system of free enterprise we have formerly enjoyed. That this sytem is threatened from without and within is no secret; and the question arises as to whether the forces of destruction and disintegration already at work will have performed their deadly mission before Mr. Flanders' excellent suggestions can be put into effect.

Whatever design, whether it be Mr. Flanders' or some modification of it the people of this country wish to adopt, it will involve a longtime programme of adaptation to its essential elements. It will require the earnest efforts of a sufficient number of honest and resolute men to act as leaders. It will demand a reaffirmation of faith in democracy and a will to maintain the blessings of democracy too frequently assumed to-day as being some inseparable and natural right that cannot be destroyed. In short, if America is to think seriously about adopting a better design for living it must first guard against the loss of freedom of choice, a loss which may come about either from the forces of totalitarianism pressing from without or decadence of democratic vigour originating from within.

Some decisions undoubtedly will have been made before this issue is off the press. For it seems inevitable that, late as the country has awakened to the dangers that threaten it from without and within, sentiment has grown rapidly in favour of vigorous efforts to strengthen the national defense. The programme will probably seem extravagant, and wasteful, but it must be remembered that the earlier the cost is met the less it will be and no waste can compare with that of the destruction of American democracy itself.

For years the nation has been building economic cyclone cellars with the paper on which security laws are written. In Europe, to-day, similar defenses have been consumed in the fires of invasion. For years we have prattled unctuously of the uses of leisure and have frittered away time, money and human values in unavailing attempts to put men to work. War has put men to work in Europe. Advertisements in our newspapers feature costumes for "lazing" on the sands. In Europe men and women lie unburied on the sands. The thing that couldn't happen is happening. How silly to talk of three-day weeks, with a navy to be built and airplanes and defensive weapons needed in unbelievable quantities! If we are to have a design for living, it must include a design to defend the right to live, and if it is to be a design based on American ideals of democracy, it must first guarantee the survival of that democracy.

PHOTOELECTRIC PHONOGRAPH

From *Electrical Engineering*, (New York), July, 1940

Reproduction of sound from records through the use of the photoelectric cell has been accomplished in a new phonograph developed by the Philco Corporation and recently demonstrated at Chicago, Ill. Constituting the first basic change in the principles of phonographic reproduction since Edison's original invention, the new process is declared by the company to provide notable improvement in tone quality and range of reproduction and a tremendous extension of the life of records.

In this new phonograph, the needle, whose forced vibrations reproduce the variations recorded in the grooves of the revolving record, has been replaced by a sapphire jewel that floats through the grooves, transmitting the tone vibrations to a tiny mirror swinging freely on an axis. A beam of light produced by a small bulb and directed at the mirror picks up the vibrations and reflects them on a photoelectric cell, which converts them into electric currents to be amplified and reproduced as sound. The floating jewel thus acts merely as a control valve to operate the photoelectric cell. A steady flow of light for the bulb is provided by an oscillator by which 60-cycle alternating current is transformed into high-frequency current of 1,800,000 cycles. The bulb, specially designed, is filled with argon.

Replacing the needle with a floating jewel virtually eliminates wear on records, greatly increasing their life. The jewel is stated to have a life of eight to ten years.

FACTORY VENTILATION IN THE BLACK-OUT

Extract from *Engineering*, May 24, 1940

The experience gained during the past winter has shown that in their zeal to comply with the Defence Regulations, a number of factory owners blacked out their premises without realizing that the means adopted for this purpose might interfere with the ventilation. This interference became more evident as winter gave place to spring and, in fact, a number of cases have come to the notice of the Home Office where the ventilation has been so restricted as to have a serious effect on the health of the workers. Even where the conditions were not so bad as immediately to affect health, adequate ventilation and reasonable temperature are always necessary if productive capacity is not to be adversely affected.

The precautions, which must be taken to ensure adequate ventilation combined with comfort, and a due regard to the black-out regulations, are discussed in a pamphlet entitled, "Factory Ventilation in the Black-Out," which has been recently published by H.M. Stationery Office at the price of 3d. In this it is pointed out that it has been found in practice that the normal conditions of ventilation can be restored by simple means, and illustrations are given of devices to ensure the air flow essential for ventilation without permitting the escape of interior light.

Experience has shown that on the average the air should be changed about six times an hour. More frequent changes will be necessary, however, in hot weather than in cold, and where combustion or manufacturing processes vitiate the atmosphere. Where windows or ventilators are not sufficient to maintain the correct number of changes, fans or "wafters" must be employed. Natural ventilation will not be sufficient, however, unless suitably arranged openings of adequate size are provided. In designing traps for intercepting light at these openings, therefore, care must be taken to avoid restricting the air flow more than is necessary. Some restriction of flow, possibly as much as 50 per cent, is unavoidable, while louvres and baffle plates, which are often a necessary part of the design, will inevitably give rise to eddy currents and friction losses, and so reduce the effective area of the openings particularly if they are not kept clean. Where it is impracticable to provide sufficient ventilation by natural means, mechanical methods, such as the Plenum system, must be installed, care being taken that the necessary inlets and outlets for the air have not been made ineffective by black-out measures.

THE PARACHUTE

ITS VALUE IN PEACE AND WAR

From *Trade and Engineering*, (London, Eng), June, 1940

The Germans have given convincing proof of the tactical value of the parachute when used in an audacious and efficient manner. The Germans were not the first to think of this method. Indeed, they were among the last to develop it. Probably the idea was first introduced by the French in the War of 1914-18, though it was never developed by them. During the subsequent peace the Russians took up the tactical use of the parachute, and frequent reports came from Russia of army manoeuvres in which large bodies of men were dropped from large transport aeroplanes by parachute. Other Powers, however, still refused to take the device seriously, and it was some time before Germany, Italy, and France began to pay attention to this form of warfare. The Germans were reticent and also secretive. They gave out that they were not impressed by the parachute experiments, but, as now appears, they feverishly developed a large parachute corps in secret.

Italy also did a certain amount of work with parachute troops, and France to a very much smaller extent tried them on a few occasions. Great Britain alone among the big Powers did not take up the use of the parachute even experimentally. Now, however, it is quite clear that the parachute has become a device which will always be used in armies as an aid for certain kinds of operation and especially for harassing the enemy behind his lines, for attacks on communications generally, and for sabotage and the destruction of telephone lines, bridges, and railways.

Two War Forms

It has been recently stated that a large number of the parachutes used by the Germans for landing troops are of the static line type. It had previously been thought that they were all of the free type, for the free type is used almost exclusively now for emergency purposes. It is worth noting the differences between these two forms of parachute. The free parachute consists of the usual canopy and rigging and harness packed in a container which is strapped to the person of the airman, either in front or behind. The parachute is complete in itself, and when the airman jumps he does so with his parachute and all its equipment. There is no connection between him and the aircraft when he leaves it. He then makes a free fall, whose distance he can to a large extent regulate according to the requirements of the moment, and in this free fall his parachute remains in its case. Free falls of very great distances have been made experimentally and for exhibition purposes, but in the ordinary emergency the airman merely falls free long enough to make quite sure that he is clear of all parts of the aeroplane, if the aeroplane has been damaged and is itself falling.

The falling man does not get up so high a speed as had originally been supposed. In fact his terminal velocity is now known to be about 119 miles an hour. When he reaches this speed it remains more or less constant. When he has fallen the distance which he regards as appropriate he pulls on a wire by means of a large ring which is fitted in a pocket of his flying suit, usually somewhere on the breast. The wire is threaded through lace holes on the parachute pack. The consequence is that when the wire is pulled it is withdrawn from these lace holes and the pack immediately falls open. Different kinds of parachutes operate after this in slightly different ways, but one kind uses a pilot parachute which incorporates in its small canopy a spring. The pilot parachute jumps out, is immediately caught by the air, and in turn drags out the main canopy. This is the kind of parachute which is almost universally used for emergency purposes to-day.

Static Line Type

But it appears that the Germans for their parachute troops used the static line type, and it can be seen that there may be sound reasons for this choice. In the static line parachute the essential difference is that when the airman jumps he does not sever all connection between himself and the aeroplane. He wears the parachute in a similar way to the free parachutist, in a pack on his back, but folded within the parachute inside the pack is a line, and one end of this line is firmly attached to the aeroplane. The whole operation of opening the parachute is therefore automatic. The airman jumps out. When the static line pulls taut it jerks the canopy of the parachute out of the pack. The parachutist, therefore, has nothing whatever to do except to jump overboard.

It will be seen at once that for emergency purposes there would be grave disadvantages in the use of the static line parachute. At one time it was argued that these disadvantages were not as great as appeared at first sight, and in fact a great many experiments were done with static line parachutes in order to prove that the airman fitted with one could still get clear of a damaged aeroplane. It was further held that a wounded airman, who might not be able to work a free parachute through being too weak to pull the rip cord when he was falling through the air, would be saved by a static line parachute. All these objections, however, were swept away in practical service and the free parachute adopted.

Improvement in Design

In the design of parachutes themselves there have been a great many improvements in the past 20 years, and the latest type is the result of a great deal of painstaking work. The harness, too, is in itself a problem. It must hold the man firmly and in a good position so that he is not likely to be hurt on touching ground. Moreover it must be equipped with an efficient quick release to guard against the danger of the parachutist being dragged along the ground for a great distance and possibly seriously injured if he has to jump in a very high wind. One form of quick release is worn at the front of the harness where the various parts are brought together, and the operating device is a large metal disk with a milled edge. This is turned before the parachutist alights and then a smart blow will free the harness.

The static line parachute enables jumps to be made from a much lower altitude than the free parachute, because the moment of its opening is determined by the length of the line and is therefore not subject to any of the delays which the falling man might introduce. Parachutes are also used for dropping supplies, and here again automatic opening is essential. Containers with food in them, water, ammunition, and other necessaries for troops can be dropped in these containers. Small guns, mortars, rifles, and machine guns can also be dropped by parachute.

ECONOMICAL SHIPBUILDING

STANDARDIZED DESIGNS

Extract from *Trade and Engineering*, (London, Eng.), May, 1940

The methods that are being employed to increase the output of shipping tonnage in order rapidly to make good war wastage and meet the increased demand for carrying capacity at sea can have a useful influence for the immediate post-war years, when the shipping industry expects certain difficulties from intensified competition by neutral countries that are now benefiting from war profits.

The policy in the last war of building ships to a common design in the various shipyards resulted in an acceleration of construction and facilitated the supply of materials, but the results were not all that had been hoped for, and difficulties in a number of unforeseen directions were encountered. Moreover, the standard ships of that time served very limited purposes in the post-war years and many were scrapped at an early date. Yet the subject of standard ships continues to exercise an appeal in various quarters because of the apparent economies they offer. Considerable interest was being shown in Germany, before the outbreak of war, in the standardization of shipbuilding as an aid to economy, while accelerating the much-needed modernization of the merchant marine. Proposals had been framed for restricting construction of cargo ships to three designs having capacities of 6,000, 9,000 and 12,000 tons deadweight, respectively, at appropriate speeds.

American Programme

The construction of exactly sister ships offers much economy in the design and drawing offices, pattern shop and mould loft, and also in building equipment, but its value must be under review constantly to ensure that no unreasonable handicap is imposed on improvements which would be adopted if the designs were considered for individual units. This objection has been met in the American standard ships by a bold policy in the choice of highly advanced designs for the propelling machinery, so that obsolescence is anticipated for a considerable time ahead. Indeed, British owners generally have so far hesitated to adopt such machinery arrangements for similar types of tonnage that have been built in this country.

British Practice

A number of British owners adopt a measure of internal standardization by building a series of ships to the same design, and the problem more particularly concerns the owner who operates a relatively small number of units. The equipment of established shipyards is not always readily adaptable to the construction of a standardized design, so that better results are expected from the arrangements that have been made for the emergency shipbuilding programme in this country, according to which each yard will build only the types of ship it can most rapidly construct to its own design. The advantages of this in present circumstances suggest that all parties should benefit in the immediate post-war years by the yards concentrating on the types of tonnage for which they are best suited. Experimental work has established the most suitable form of hull for any particular characteristics, so that the variations in this respect, which were common when such matters were settled arbitrarily from personal predilections, can be eliminated.

TACOMA BRIDGE OSCILLATIONS BEING STUDIED BY MODEL

From *Engineering News-Record*, (New York), August, 1940

The University of Washington engineering department at Seattle has undertaken a study of the vertical oscillations of the deck of the Tacoma Narrows suspension bridge, seeking to discover means of reducing the movements, which were observed even before completion of the structure and have given the engineers much concern. They are believed to result from wind action.

Measurements show that the bridge floor rises and falls over a maximum range of 2⅔ ft.; very little side sway has occurred. According to L. V. Murrow, Washington state highway engineer, under whose direction the bridge was built, the safety of the structure is not affected. However, some persons are reported to have become seasick because of the oscillation.

Motion pictures show an up-and-down movement similar to gentle waves on water, readily seen from either shore. Experiments are to be conducted on a scale model of the bridge, which has been equipped with devices to cause the model to simulate this rippling action and damping devices of various kinds will be tried out.

The Tacoma bridge is the narrowest long-span suspension bridge ever built; the cables are only 39 ft. apart and the roadway is 24 ft. wide, though the main span of the bridge is 2,800 ft. long, third largest in the world.

Traffic over the bridge during the first two weeks of operation was double what had been expected by the engineers; $36,214.00 was taken in at the toll gates.

RUBBER PRESS TECHNIQUE

From *Canadian Metals and Metallurgical Industries* Toronto, Ont., July, 1940

What has been termed rubber press technique has achieved its most advanced development in the aircraft industry and is comparatively little known in many lines of production. According to an article in *Aircraft Production* the cost of dies may be a very important item in the production of aeroplane parts, especially where these are not required in very large numbers. Again the modifications almost inseparable from aircraft work may necessitate extensive alterations or complete re-design of tools which are little worn. This situation has led to the adoption in some instances of the rubber press technique which employs a thick rubber pad on the press ram in place of what is usually, in the normal type of press, the bottom forming die. A wooden or zinc template or male die, shaped to the internal form of the part, takes the place of a punch and is placed on the lower platen or table of the press. The sheet-metal blank is laid on the template and is forced over it by the action of the rubber descending pad. Blanking can also be performed by this process. The economies which may be effected in tooling are obvious.

Recently in Great Britain the largest press to utilize the rubber press technique was installed in the form of a 4,000-ton hydraulic unit at the works of the Bristol Aeroplane Co., Ltd.

The rubber top die measures 8 ft. by 4 ft. by 10 in. in thickness. Steam heating is provided for the die box. As a result of the provision of steam heat a damaged portion of the pad can be cut away and replaced with uncured rubber in semi-plastic form; the ram is then lowered until the die-pad rests on the press table and vulcanization is carried out without removing the pad. The large range of pressure adjustment necessary for the process is provided through a special by-pass valve mounted beneath the floor.

Using the press for forming operations, large economies have been effected, utilizing multiple die set-ups. Ribs with flanged lightening holes are formed completely in one operation on the press. Most of the parts formed have been of light alloy sheet but a considerable amount of work has also been done in steel. Tubular aerial masts made in halves from 20 s.w.g. mild steel sheets are a regular job.

SOUND TRANSMISSION IN BUILDINGS

From *Civil Engineering and Public Works Review*, (London, Eng.), June, 1940

With a view to developing methods of construction which will reduce noise in buildings the Department of Scientific and Industrial Research has carried out investigations for the past few years at the Building Research Station and the National Physical Laboratory. The practical results of these investigations are embodied in a report published by H. M. Stationery Office, entitled Sound Transmission in Buildings, by R. Fitzmaurice, B.Sc., M.Inst.C.E., and William Allen, B.Arch., A.R.I.B.A.

The report is divided into three parts, of which the first deals with the ways in which sound from various types of noises is transmitted through a building. The second discusses the insulation necessary to reduce the noise adequately, having regard to the conditions prevailing inside and outside the building. This is treated very neatly by a number of diagrams, which make no reference to units of noise, but from which the minimum insulation suitable can be read off. But as long as houses are built (as they usually are) with their parts solidly linked and continuous, there is a level beyond which the noise cannot be reduced so the third section is devoted to discontinuous construction, a new structural technique developed during the course of the researches.

A unique feature of this section is the working out of suitable examples. For instance, complete architectural drawings are furnished for a set of flats which have been designed keeping in mind both the planning and structural aspects. Hospitals, offices, and dwelling-houses also receive attention, and drawings are given for particular points of construction.

The Building Research Station has been employing the technique for some time in dealing with special problems of sound insulation which have been placed before it. A number of semi-detached houses have been built which incorporate the new ideas, and buildings of several other types have been dealt with. In all cases it appears that the methods suggested are having the desired result.

It is not yet possible to anticipate accurately the actual degree of insulation which can be attained in any instance, but it is known, from the experiments carried out, that without adding materially to the weight of the structure insulation of the order of that given by some 6 ft. or 8 ft. of solid brickwork can be attained between neighbouring rooms in buildings.

SAWHORSES AND NOSE THUMBING

Editorial, *Engineering News-Record* (New York), August, 1940

It is hard to believe but it's true. A job on two new office buildings in Washington, being rushed to completion for occupancy by the War Department and the National Defense Commission was shut down recently because of a jurisdictional dispute between carpenters and plasterers' helpers over who would build some sawhorses. Not the carpentry work, just some sawhorses. Not a new building for a haberdashery shop, but emergency quarters for the U.S. War Department. The gift of labour leaders to force their men to do the wrong thing at the wrong time was never better illustrated. Besides stopping emergency construction, the strike was also significant because it involved nose thumbing at the dispute settling machinery of the AFL's Building Trades Department by the carpenters, who refused to accept the decision of the dispute board that the plasterers' helpers should build their own sawhorses. The situation is full of danger signals. Is labour ready to scuttle its dispute-settling machinery that has worked so well for over a year ? The construction industry, including labour will be the loser if it is. Is labour going to regard the defense emergency so lightly that it will stop important jobs just to emphasize unimportant principles of work jurisdiction ? If it is, the whole nation stands to lose. The sawhorses and nose-thumbing episode in Washington should be repudiated by the top leaders of the AFL. Otherwise, Congress is apt to underline "labour" on its program listing things that something should be done about.

From Month to Month

News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

HELPING TO WIN

One of the outstanding features of the Canadian public's attitude towards the war has been the general desire to get in and help. Individuals and organizations of every kind from one end of the country to the other have offered their services to the government and have urged that some share of the work be given to them. Officers, committees and delegations in great numbers have waited on government officials to explain how they are equipped to give assistance in some particular line, or to make open offers of co-operation without restrictions as to the field in which it may be used.

This attitude is very noticeable at the Headquarters of the Institute. Members are constantly writing or calling to ask if a place can be found for them in war work. These are not unemployed but are senior and junior engineers, well satisfied with their present positions but anxious to help with the war, and therefore willing to change from permanent to temporary work for the duration and at a sacrifice to themselves. Nearly all of these have first offered their services direct to the Government.

To-day it is no novelty to hear expressions of disappointment and some criticism because of the Government's failure to take advantage of such offers. Many organizations have repeated their proposals almost to the point of demanding that they be permitted to share in the war effort. Doubtless this persistance comes from the continued demand of the membership itself, which has little or no opportunity to see the situation close at hand. Beyond a doubt some of the criticism is deserved, but the more one is permitted to know the actual conditions, the more readily can the government policy be understood.

From a perusal of English periodicals and some correspondence it is apparent that the same conditions exist in the old country. The publications of engineering societies in the United States already indicate the same trend. In each country the advice to engineers is the same as that which has been already given by the Institute and *The Engineering Journal* namely—be patient! If you have any special qualifications that can be used, and if you have made your services available, nothing more can be expected of you than that you should wait for instructions and "carry on" in the meantime.

THE INSTITUTE'S PART

Members of the Engineering Institute of Canada are anxious not only to offer their own services to help win the war, but to see the Institute give assistance also. In cases where the personal offer has not been accepted, perhaps it will bring some measure of satisfaction to know that the Institute which their membership makes possible has been able to lend a hand. Every activity cannot be detailed, but perhaps it is only fair to give some account of the part the Institute has been able to play so far.

In the first place a very substantial piece of work was done in 1938 and 1939, in co-operation with several other engineering bodies, in gathering together the academic and professional records of approximately ten thousand Canadian engineers and technically trained men. This work was done at the request of the Department of National Defense, and after almost a full year's effort, a complete card filing system was established and turned over to the government. It was expected, and in spite of disappointing experiences is still expected that this record will be of considerable assistance in locating technical help of the types that are so badly needed for war work.

The employment department has been working almost exclusively on inquiries from departments of government and from firms carrying out special contracts for war work. Problems involving the entire technical staff of new industries have been brought to Headquarters, and individuals with highly specialized experience have been found to fill positions of unusual responsibility. From students to "dollar-a-year" men represents the range, and it is believed the Institute has assisted business and government materially by its knowledge of the market for technically trained men.

In response to a request from the Minister of National War Services, every branch of the Institute was given an opportunity to aid in the recently completed national registration. A great many members throughout Canada were able to participate in this war activity because of the Institute's interest in it.

One of the most important activities is represented by a series of confidential investigations that was carried out at the request of certain officials, and which placed helpful information in their hands quickly and safely. The national character of the Institute's organization gave it special qualifications for this work.

The latest activity is the child evacuee proposal. This assistance may be more closely related to the Imperial government than to the Canadian, but the work itself is being carried out in very close co-operation with federal authorities and provincial committees. No one knows just how important this may become or how widespread in its final development,but assurances have been received from abroad that the offer was a welcome one and that advantage will be taken of it. Word has been received recently that the first children will be here about the time this issue of the *Journal* goes to press. The Institute's share in this endeavour certainly places it high on the list of war-time activities.

These are some of the things that are being done by the Institute to help win the war. The first general offer of assistance was sent to the Prime Minister from the Professional Meeting held at Pictou, N.S., in September, 1939. This unconditional offer still stands, and every member will support Council in its determination to use the resources of the Institute for the greatest national good.

WESTERN WATER PROBLEMS

During the visit of G. A. Gaherty, the chairman of the Institute's Committee on Western Water Problems, to Calgary in July, the local sub-committee held a meeting in the board room of the Calgary Power Company, Limited, at which progress reports were submitted by each member dealing with the particular phase of the work assigned to him. The chairman expects to have a detailed report for presentation to Council, which will be published in the *Journal*, but so far pressure of special work has caused delay.

In spite of the fact that members of the committee are in different parts of the west, a perfect attendance was recorded. Following are the names of those present: G. A. Gaherty, chairman, Institute's Committee on Western Water Problems; president, Calgary Power Company Limited, Calgary; H. J. McLean, chairman, local sub-commmittee; production superintendent, Calgary Power Company Limited, Calgary; P. M. Sauder, director of Water Resources, Edmonton, Alta.; S. G. Porter, manager, Dept. of Natural Resources; C.P.R., Calgary, Alta.; D. W. Houston, superintendent, Street Railway Dept., City of Regina, Sask.; D. W. Hays, general manager, Canada Land & Irrigation Co., Medicine Hat, Alta.; F. G. Cross, superintendent, Irrigation Project, Dept. of Natural Resources, C.P.R., Lethbridge, Alta.; L. Austin Wright, General Secretary, The Engineering Institute of Canada.

COMMENTS ON EVACUEES SCHEME

Many members have asked how the engineers' evacuee proposals were received throughout the country. Perhaps a quick way to answer this question is to quote a few sentences from some of the questionnaires that were returned to Headquarters.

From Halifax, N.S.

—"I read with interest the work you are proposing to do in connection with evacuated children. If we can be of any assistance please let us know."

From Dartmouth, N.S.

—"Consider the above a splendid effort for our society to sponsor."

From Arvida, Que.

—"Very glad to see the Institute taking a hand in the evacuation scheme. Perhaps there will be less governmental sluggishness if one or two societies go ahead on their own."

—"I think this is an admirable idea and it has all my whole-hearted support."

From Harvey Junction, Que.

—"With great admiration for your very excellent plan and wishing you every success in its fulfilment."

From Montreal, Que.

—"Je sympathise grandement avec mes confrères anglais et j'approuve l'initiative prise par l'Engineering Institute of Canada."

—"Will gladly do what we can to help the victims of brutality."

—"Let me congratulate once more you and your Society for this humanitarian initiative and accept from all the family the expression of our best wishes for your enterprise."

—"This movement has my whole-hearted support, but unfortunately cannot accommodate any extra children at present."

—"A very commendable idea, and I wish it success."

—"This is a good move and may take in many not covered by other organizations.'

From Ottawa, Ont.

—"I am now prouder than ever to be a member of the Engineering Institute."

—"Heartily in accord with the idea."

—"I think this is an excellent idea."

From Toronto, Ont.

—"Think the Institute project excellent."

—"A most worthy undertaking. I am glad to contribute to it financially although it is at present not practicable to take a child into our home."

—"Most commendable movement."

From Fort William, Ont.

—"I think this is a splendid scheme."

From Lethbridge, Alta.

—"I received a real thrill when I opened the envelope and saw that the engineers were ready to help in this important work."

From New Westminster, B.C.

—"Please allow me to compliment the Institute on their action in regard to British children."

From Vancouver, B.C.

—"I think the proposal is excellent and it would be a very fine thing for the Institute to carry out."

—"It is a splendid proposal and I hope it will meet with a large measure of acceptance from those in a position to take part."

THE EVACUEE PROPOSAL

Arrangements have now been completed by which children coming to Canada under the Canadian engineers' proposal will be accepted by the Canadian government on the same basis as is available to those children who come here under the fully sponsored government scheme. The only difference in treatment is that the children may be sent here with the fare to the destination prepaid by the parents, instead of by the British government. If the parents so desire, their children also may come by this latter scheme, but for quicker transportation the privately paid fare proposal is available.

To Canadian engineers the present procedure is identical with that originally described. The homes offered will be submitted to the local child welfare organization for approval. The children will be placed by these organizations in the approved homes with some measure of co-operation with the engineers' provincial committees. The services of the organizations will be afforded the hosts, so that serious illness or hospitalizations, or other problems can be taken over in whole or in part by them.

Announcement of the first children to be sent here came in a cable late in August. It is impossible to receive accurate information in advance, but it is expected they will arrive in Montreal about the end of the first week in September.

Further advice has been received, indicating that most children are due to sail under the auspices of the Children's Overseas Reception Board ("Corb") which is the fully sponsored government scheme. Doubtless this is due to the fact that boats transporting such children are fully convoyed, whereas passage privately paid may be in boats not so well protected. This will lead to a slowing up of the undertaking, but it is not difficult to understand why many parents prefer such procedure.

The lack of shipping facilities has held down the number of children from all sources arriving in Canada, and it is understood that in all parts of the country more homes are available than will be required for several months at the present rate of arrival. This will apply equally well to the engineers' scheme and to all "group schemes," as to the open offers made by individuals to the provincial refugee committees. However, the future is just as hard to read as ever, and there appears to be little that can be done except to wait patiently and be ready.

WINNERS OF PRIZES

Each year the Institute awards eleven prizes of twenty-five dollars each to outstanding students in the third year of the engineering courses of eleven Canadian universities. The selection is made by an appropriate authority in the college and the award goes to the student, "in any department, who has proved himself most deserving, not only in connection with his college work but also as judged by his activities in the student engineering societies or in the local branch of a recognized engineering society."

The awards for 1940 were announced in the July Journal. Recently acknowledgments have been received from several of the students which it is thought will be interesting to the membership at large. Other letters will appear in the October Journal.

136 Girton Blvd., Tuxedo, Manitoba.

Dear Sir: June 27, 1940.

Please accept my sincere thanks for the third year engineering award which the Institute granted to me. I received your cheque for $25.00 last week and I assure you that part of this amount will be set aside as my Student membership fee for this year.

Every engineering student realizes the fine work that the Institute is doing in the furthering of professional engineering in Canada, and it is very encouraging to know that it is also taking an active interest in our University activities. We appreciate this interest and hope that we may be worthy of acceptance in the Engineering Institute after graduation.

Thanking you again for the honour you have given me,

I am, sincerely yours,

John A. Hopps, University of Manitoba.

Pendleton Aerodrome, Curran, Ont.

Dear Mr. Wright: July 4, 1940.

May I thank you for your kind congratulatory letter. I assure you it was a pleasure to learn that I had been awarded the Engineering Institute of Canada Prize.

I was present when you gave your very interesting and timely address to the Engineering Society at Queen's this past spring and therefore I feel that I know you.

At present I am employed with the contractor as engineer on the construction of an airport here. It is a wonderful opportunity to gather some practical experience which I trust will stand me in good stead when I become a mature member of the Engineering Institute.

With all good wishes for an interesting and pleasant summer, I remain,

Sincerely yours,

Jim Courtright, Queen's University.

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124 John St. North, Hamilton, Ont.

Dear Sir: July 8, 1940.

I wish to thank you for your kind letter of June 24 in which you refer to the award of "The Engineering Institute of Canada Prize" made to me at the Nova Scotia Technical College for the year 1940.

As a student of the Nova Scotia Technical College, may I take this opportunity of thanking The Engineering Institute of Canada for the interest it has shown in the education and development of the engineering students in our College.

I shall consider it a great privilege to become a member of The Engineering Institute of Canada as soon as my qualifications permit.

Yours very truly,

W. A. MacCallum.

Nova Scotia Technical College.

R.M.S. Cornwallis, Port of Montreal, P.Q.

Dear Mr. Wright: July 8, 1940.

I was very pleased to receive your kind letter regarding The Engineering Institute's prize in third year at the University of Toronto. I feel greatly honoured for being fortunate enough to receive this prize. I must apologize for the delay in acknowledging this but at present I am in the Merchant Marine and I have been away from Canada for the past two months.

May I say that this prize is a great source of encouragement to me in my work and I look forward to many pleasant contacts both with you and The Engineering Institute during my engineering career.

Yours sincerely,

B. K. Smith, University of Toronto.

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9 Waterford Bridge Road, St. John's, Newfoundland.

Dear Sir: August 1, 1940.

I wish to offer my sincerest thanks to the Council of The Engineering Institute of Canada for having awarded me the "Engineering Institute of Canada Prize." I am indeed very grateful for the practical assistance and kind encouragement which the Institute has thus given me.

Within the next few months I hope to enjoy the privilege of student membership in your Institute. Please accept my thanks for your letter and the good wishes expressed in it.

Yours respectfully,

William C. Brown, McGill University.

(*Continued in next column*)

(*Continued from previous column*)

Sherbrooke, Que., 10 août, 1940.

Cher Monsieur le Secrétaire.

Je vous serais obligé de bien vouloir transmettre au Conseil de l'Engineering Institute of Canada mes sincères remerciements pour m'avoir accordé le prix de l'Institut cette année, à l'Ecole.

Je suis sûr d'exprimer le sentiment de tous les étudiants en vous disant que nous apprécions grandement l'encouragement apporté par l'Institut à la cause de l'éducation scientifique. L'amabilité que vous avez eue de venir personnellement, en compagnie d'autres officiers, présenter le prix nous a touchés et nous vous en sommes reconnaissants.

Je compte avoir le plaisir de vous revoir prochainement.

Sincèrement vôtre,

Gérard Aubry, Ecole Polytechnique.

BALLOT IN ALBERTA

The proposed agreement between the Engineering Institute of Canada and the Association of Professional Engineers of Alberta which was referred to in the August *Journal* and is reproduced on the opposite page is being submitted to ballot this month. These ballots will be in the hands of all members of the Association and all corporate members of the Institute in Alberta about the fourteenth of September.

It is expected that Members of the Engineering Institute of Canada who already belong to the Association will approve the proposal without hesitation. To them it means a substantial reduction in fees and the support of co-operative efforts within the province. Their solid vote and leadership should ensure a favourable result.

To other Members who at present do not enjoy the privilege of membership in the Association, the Institute's Committee on Professional Interests specially recommends the proposal. Their support of the Association will do much to strengthen the professional status in the province and at the same time will add to their own prestige. For the general good of the profession there is much to be gained by unification and co-operation. The value of a solid front to the public cannot be overestimated.

All Members are urged to vote. Please remember that a favourable reaction towards the proposal is apparent only if the ballots are returned. In Saskatchewan and Nova Scotia an unusually high return was received from similar ballots. Council hopes that Alberta will do at least as well.

CORRESPONDENCE

The Editor, Moncton, N.B., August 22, 1940.
The Engineering Journal,
Montreal.

Dear Sir:

One of our branch members has called attention to the following:

The cover picture of the August issue of the Journal, illustrates and throws light on a point that is sometimes very disturbing to construction and maintenance engineers.

Quite frequently we are called upon to blast underneath obstructions that are perilously near the footings of abutments or piers. Experience has shown that considerable charges of dynamite may be exploded reasonably close to such structures without injurious effect, and the illustration of the blasting of this cofferdam confirms this. For while timbers and water fly straight up, you will note that at the critical time of the explosion, there is not a ripple on the mirror-like surface of the water adjacent to the blast.

V. C. Blackett, *Secretary-Treasurer,*
Moncton Branch, E.I.C.

PROPOSED AGREEMENT BETWEEN THE ENGINEERING INSTITUTE OF CANADA AND THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF ALBERTA

MEMORANDUM OF AGREEMENT made in duplicate at the City of.................., in the Province of.................., this .... day of ...., 19.....

By and Between

THE ENGINEERING INSTITUTE OF CANADA having its Head Office at the City of Montreal, in the Province of Quebec, hereinacting by its President and General Secretary, duly authorized for the purpose hereof by a resolution of its Council passed at a meeting duly called and held on the........day of.............. 19 . . ., hereinafter called "the Institute,"

Party of the First Part

and

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF ALBERTA, of the Province of Alberta, hereinacting by its President and Registrar duly authorized for the purpose hereof by a resolution of its Council passed at a meeting duly called and held on the .... day of ....19. . . , hereinafter called "the Association,"

Party of the Second Part,

Whe eas it is desirable in the interest of the Engineering Profession that there be close co-operation between the Institute and the Association, and

Whe eas such close co-operation will be promoted if, so far as is practicable, there is effected:

(a) A common Membership in the Province of Alberta of the Institute and the Association.

(b) A simplification of existing arrangements for the collection of fees.

Now, therefore, the parties hereto agree with each other as follows:

1. Any person resident in the Province of Alberta who, on the date of this Agreement, is registered as a Professional Engineer in the Association and is not a Corporate Member of the Institute, shall have the right, under the provisions of this Agreement, to become a Corporate Member of the Institute. Also, any person resident in the Province of Alberta registering as a Professional Engineer in the Association subsequent to the date of this Agreement who is not a Corporate Member of the Institute shall, upon such registration, have the right to become a Corporate Member of the Institute. If such registered Professional Engineer desires to become a Corporate Member of the Institute under the conditions of this Agreement, he shall notify the Registrar of the Association, in writing, within ninety days of the date of this Agreement or date of future Registration.

2. Also, under the same terms provided in Clauses 1 and 4 hereof for members of the Association, Pupils of the Association shall have the right to become Students of the Institute, and Engineers-in-Training of the Association shall have the right to become Juniors of the Institute. The fees payable by Pupils and Engineers-in-Training shall be determined by the Committee provided for in Clause 6 of this Agreement.

3. Any Corporate Member of the Institute who is, at the date of this Agreement, or who thereafter becomes, a resident of the Province of Alberta and any resident of the Province of Alberta who becomes a Corporate Member of the Institute subsequent to the date of this Agreement, shall be eligible for membership in the Association if qualified for such membership, and all entrance fees otherwise payable to the Association shall be remitted provided that application for membership in the Association is made within ninety days of

(a) The date of this Agreement in the case of any Corporate Member of the Institute who is at such date a resident of the Province of Alberta; or

(b) The date on which he becomes a bona fide resident of the Province of Alberta in the case of any Corporate Member who is not at the date of this Agreement such a resident; or

(c) The date on which he becomes a Corporate Member of the Institute in the case of any resident of the Province of Alberta who becomes such a Corporate Member subsequent to the date of this Agreement

4. Registered members of the Association shall not be required to pay the transfer or entrance fees of the Institute.

5. In lieu of the ordinary membership fees of the Institute the Association shall pay to the Headquarters of the Institute the sum of $6.00 per annum for each member of the Association who is or becomes a Corporate Member of the Institute under provisions of Clause 1 hereof. These fees shall entitle the members of the Association who are Corporate Members of the Institute or who become Corporate Members of the Institute under the provisions of Clause 1 hereof to all the privileges of the Institute membership and shall include the annual subscription to the Institute Journal.

These fees shall be due annually in advance on the first day of January in each year and shall be payable to the Institute by the Association as collected.

The provisions of this Section of this Agreement shall not be effective until the first day of . . . . . 19 . . .

6. It is agreed that the Branches of the Institute in Alberta shall continue actively to function as such during the term of this Agreement and to enable such functioning there shall be set up and continued from year to year during the term thereof a Committee of five members all of whom shall be members of both the Association and the Institute to be known as the Joint Finance Committee. Two of said members shall be appointed annually by the Council of the Institute; two members shall be appointed annually by the Council of the Association and the fifth member shall be appointed annually by the four members aforesaid and shall be Chairman of the Committee.

In the case of the four members aforesaid failing to appoint the fifth member within thirty days from the date of their appointment the said fifth member shall be appointed by the President of The Engineering Institute of Canada within a further period of thirty days. The said Committee shall recommend to Council of the Association annually the sums of money required from fees collected from joint members of the Association and the Institute to be paid by the Association to the Branches of the Institute for their operation, and such sums to be paid by said Council shall be not less per joint member than the rebates now required by the Institute by-laws, provided, however, that such payments shall be made from annual revenue and in no case from capital reserve.

7. The term of this Agreement shall be for a period of three years commencing on the...... day of ...., 19..., and ending on the....... day of . ..., 19...., on which date this Agreement shall terminate provided either party has given to the other a notice of termination at least six months prior to the .... day of .... , 19. . . , and if no such notice is given this Agreement shall continue after the...... day of .... , 19 , from year to year but may be terminated at the end of any calendar year by either party giving notice in writing to the other of such termination at least six months prior to the end of any calendar year. Notice of termination of this Agreement shall be given by the delivery by one party to the other of a certified copy of a resolution of the Council of the one party to that effect.

This Agreement shall not come into operation unless a percentage of the membership of the Association acceptable both to the Council of the Institute and to the Council of the Association take advantage of its provisions.

8. The terms and conditions of this Agreement may be amended by mutual agreement, in writing, between the Councils of the parties hereto duly executed by their accredited officers.

9. This Agreement and the terms and provisions thereof shall not be applicable to the Institute members who are not, and do not become, registered with the Association.

10. Nothing in this Agreement shall prevent either party thereto from exercising its rights and privileges with respect to the disciplining, the suspension, or the expelling of any of its members.

Before final action is taken by either party hereto with respect to the discipline, the suspension, or the expulsion of one of its members affected by this Agreement, it shall furnish the other party with sufficient information to enable it to determine whether the circumstances warrant action by the other party, but neither party shall be affected by lack of action by the other party. Any person expelled from the Association or the Institute during the term of this Agreement shall forfeit all rights under this Agreement until re-instated.

11. This Agreement is intended to apply with respect to residents of the Province of Alberta only, and no person who is not a resident of the Province of Alberta may become or continue to be a Corporate Member of the Institute under the provisions of this Agreement, but may continue to be a Corporate Member of the Institute and/or a member of the Association on the same conditions as if he had been admitted as a Corporate Member of the Institute and/or a member of the Association without reference to this Agreement.

In witness whereof these presents have been duly executed on behalf of the parties hereto on the date and at the place first above written.

THE ENGINEERING INSTITUTE OF CANADA

In the presence of

....

.... *President.*

.... *General Secretary.*

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF ALBERTA

....

.... *President.*

.... *Registrar.*

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

Col. H. F. G. Letson, M.C., M.E.I.C., of Vancouver has been appointed Canadian Military Attaché in Washington. He is the first military attaché to be appointed by Canada to the United States. Born at Vancouver, B.C., in 1896, he served in France with the 54th Battalion, C.E.F., in the Great War. He was severely wounded, and was awarded the Military Cross. Col. Letson maintained his military interest after demobilisation and has been associated with the Non-Permanent Active Militia ever since.

He received his education at the University of British Columbia, where he was graduated with the degree of B.Sc. in mechanical engineering in 1919. In 1923 he was granted the degree of Ph.D. in engineering by the University of London, England, and was appointed assistant professor of mechanical engineering at the University of British Columbia. In 1931 he became associate professor of mechanical engineering, a position which he retained until 1934. At that time he became chief engineer and managing director of Letson & Burpee, Vancouver. In 1936 Col. Letson was president of the Association of Professional Engineers of British Columbia.

Blank & Stoller.

Colonel Norman C. Sherman, M.E.I.C., F.R.S.A.

Colonel Norman C. Sherman, M.E.I.C., F.R.S.A., chief ordnance mechanical engineer, Department of National Defence, Ottawa, completed thirty years of continuous service with His Majesty's Canadian Forces on 31st July, 1940. The occasion was marked by a complimentary dinner held in the Chateau Laurier on that evening, some twenty engineers, military and civilian, being present.

Colonel Sherman graduated in mechanical engineering from the University of Toronto in 1910 and on the first of August of that year he was commissioned at Halifax, N.S., as a lieutenant in the Canadian Ordnance Corps and appointed inspector of ordnance machinery. He spent nearly two years in training in arsenals and armament manufacturing plants in Great Britain. Upon his return he was stationed at various districts throughout Canada, from Halifax, N.S., to Esquimalt, B.C., as inspector of ordnance machinery. He was in the latter station serving with the rank of captain, when war was declared in 1914. He was promoted to the rank of major in 1915 and proceeded to National Defence H.Q., Ottawa, to become acting inspector of carriages and inspector of artillery stores and reorganized the inspection division. In April, 1917, he became assistant superintendent of the Dominion arsenal at Quebec, and later, at Lindsay until September, 1918.

He was then appointed inspector of ordnance machinery for Canada on the Siberian Expeditionary Force and spent several months in Siberia mostly at Vladivostock. Upon his return to Canada in 1919, he remained at Esquimalt until 1926 when he became ordnance mechanical engineer for central Canada stationed at Kingston. In 1930 he was promoted to Lieutenant-Colonel.

With the outbreak of war in September, 1939, his duties and responsibilities increased very rapidly and extensively. He was moved to N.D. H.Q., Ottawa, where he assumed the duties of chief ordnance mechanical engineer and in March, 1940, was promoted to the rank of Colonel.

He acts as a consulting engineer for the master general of ordnance and is responsible for the maintenance of ordnance machinery and mechanical transport in Canada, as well as for the organization of various technical establishments of Canadian troops overseas.

C.A.S.F. PROMOTIONS OVERSEAS

As a result of the establishment of an army corps under the command of Lt. Gen. A. G. L. McNaughton, M.E.I.C., staff promotions and appointments among Canadian officers overseas have been made and affect members of the Institute.

Brigadier G. R. Turner, M.E.I.C., of Fredericton has been promoted from Colonel to the rank of Brigadier and the post of Brigadier General at Corps Headquarters. He was formerly general staff officer (1st Grade) at 1st Division Headquarters.

Brigadier C. S. L. Hertzberg, M.E.I.C., of Toronto, who went overseas as Officer Commanding 1st Divisional Engineers, has been promoted to the rank of Brigadier and made Chief Engineering Officer at Corps Headquarters.

Major A. B. Connelly, M.E.I.C., of Ottawa, has been appointed Staff Officer, Royal Engineers.

Colonel J. E. Genet, M.E.I.C., of Kingston has been promoted from Lt. Colonel to the rank of Colonel, and made Chief Signals Officer at Corps Headquarters. He went overseas as Commander, 1st Divisional Signals.

Captain T. M. Fyshe, M.E.I.C., of Montreal is now Air Intelligence Liason Officer at Corps Headquarters.

Lt. Colonel F. R. Henshaw, M.E.I.C., of Halifax, former commander of the Field Company, Royal Canadian Engineers, has been promoted from Major to the rank of Lt. Col. and to command the 1st Canadian Pioneer Battalion, R.C.E.

Dr. John S. Bates, M.E.I.C., for the past few years located in England as technical adviser for Price & Pierce Ltd., pulp and paper agents, London has now returned to Montreal where his firm has recently opened an office. The emergency in Europe has shut off very large tonnages of all pulp grades from export markets and has thrown on Canada the responsibility of supplying as many grades and as much tonnage as possible for the urgent needs of the United Kingdom. It is for the purpose of facilitating direct contacts with suppliers that Price & Pierce Ltd. have opened a Canadian office. It is thought that the shipment of pulp from Canada in larger quantities represents a permanent trend not only for the duration of the war but for the future. Previous to his stay in England, Dr. Bates had been connected with different Canadian firms in the pulp and paper industry. For some time he had been superintendent of the Forests Products Laboratories of Canada in Montreal.

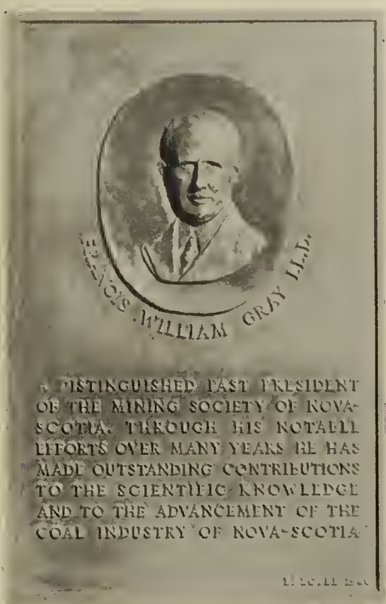
Eric P. Muntz, M.E.I.C.

Joseph J. White, M.E.I.C.

Eric P. Muntz, M.E.I.C., vice-president of the Engineering Institute of Canada for Ontario, has recently joined the Foundation Company, Limited, and is engaged on special contracts for war work. He is located in the head office at Montreal.

W. P. Dobson, M.E.I.C., immediate past president of the Association of Professional Engineers of Ontario, has recently been appointed to represent that body on the Senate of the University of Toronto.

Otto Holden, M.E.I.C., received his C.E. degree last June at the University of Toronto Convocation. He is chief hydraulic engineer of the Hydro Electric Power Commission of Ontario with whom he has been associated since graduation from the University of Toronto in 1913.



Courtesy of Canadian Mining and Metallurgical Bulletin.

Plaque of Dr. F. W. Gray
Unveiled at Annual Meeting, M.S.N.S.

Dr. F. W. Gray, M.E.I.C., a past president of the Mining Society of Nova Scotia, has been constrained by his friends to execute in bronze a portrait of himself. This bronze was unveiled at the annual meeting of the Society, at Sydney, last June, to commemorate Dr. Gray's outstanding contributions to scientific knowledge and to the advancement of the coal industry of Nova Scotia. It was none too easy for a man of Dr. Gray's nature to express his feelings at the unveiling of a portrait of himself, done by himself. He did so with modesty and wit.

Dr. Gray is assistant general manager of the Dominion Coal & Steel Corporation. He joined the Engineering Institute in 1921.

Joseph J. White, M.E.I.C., city building inspector for Regina, Sask., joined the Royal Canadian Air Force last month and has been attached to the engineering staff in Winnipeg. A veteran of the first Great War, Mr. White served in France with the Canadian Expeditionary Forces, later transferring to the Royal Air Force.

Returning to Regina from overseas in 1919, he worked in the city for a while and, in the fall of that year, entered the University of Saskatchewan where he was graduated as a bachelor of engineering in 1925. During his undergraduate days, he became associated with C. M. Miner's Construction Company with whom he stayed until 1939, when he was appointed building inspector for the city of Regina. During his period of office at the Regina city hall, he prepared for the architectural profession and passed his final examinations in 1937.

Mr. White has always been active in engineering circles and for the past four years has served as secretary-treasurer of the Saskatchewan Branch of the Institute and registrar of the Association of Professional Engineers of Saskatchewan. He is responsible in no small part, for the successful conduct of the negotiations which brought about the signing of the agreement between the Institute and the Association in 1938, and almost entirely for the subsequent arrangement of operating details.

W. J. LeClair, M.E.I.C., has been named as chairman of the prices committee appointed by H. R. McMillan, timber controller for the Dominion.

Mr. LeClair studied civil engineering at the University of Toronto with the class of 1917. He went overseas in 1917 as a technical officer with the Canadian Forestry Corps, and was attached to a French army until 1919. Upon demobilization in England, he formed the firm of Lawson & LeClair, timber merchants and woodenware manufacturers. In 1928 Mr. LeClair returned to Canada as woods and sawmill engineer of the International Paper Company, and in 1930 became chief of the lumber-seasoning and wood-utilization division of the Forest Products Laboratory, Ottawa. He resigned in 1937 to accept appointment as manager and secretary of the White Pine Bureau, the Canadian Hardwood Bureau and the Canadian Lumber and Timber Association, and is now also acting manager of the Canadian Lumberman's Association.

Mr. LeClair is a member of the advisory committee of the Forestry National Research Council of Canada of the National Building Code Committee, and of the National Construction Council. He is well known as a writer and lecturer on lumbering topics.

F. R. Barnsley, M.E.I.C., of Canadian General Electric Company Limited, Montreal, has recently been elected chairman of the Montreal Chapter of the American Society for Metals. He was graduated from the University of British

Columbia in 1927, and ever since he has been with the same firm. He is, at present, manager of the Air Conditioning Division in Montreal.

Lyle G. Trorey, M.E.I.C., of Vancouver, has been appointed Reinforcement Officer, 1st Corps Field Survey Coy., Royal Canadian Engineers, to be attached to the Engineering Training Centre at Halifax. Mr. Trorey, who is a graduate of the University of British Columbia and the University of London, had been with the Department of Public Works in British Columbia for the past few years.

F. A. Masse, Jr.E.I.C., is now located at Cornerbrook, Newfoundland, with the Bowaters Newfoundland Pulp and Paper Company. Since graduation from the University of Toronto in 1931, Mr. Masse had been with the Abitibi Power and Paper Company at Sault Ste. Marie, his latest position being that of assistant chemist.

Marcel Scheen, Jr.E.I.C., is now with the Elpeco of Canada Ltd., in Montreal. Upon graduation from the Ecole Polytechnique in 1937, he went with Lalonde & Valois, consulting engineers, Montreal. For the past year he had been on the staff of Robert A. Rankin & Co., Montreal, as a draughtsman.

E. M. Nason, S.E.I.C., is now with the No. 3 Training Command R.C.A.F., on the construction of hangars at Moncton, N.B.

W. M. Diggle, S.E.I.C., is at present employed as a draughtsman by the Canadian Bridge Company at Walkerville, Ontario. He was graduated this spring from the University of Saskatchewan.

A. K. Mortin, S.E.I.C., has joined the staff of Frost & Wood Company, at Smith's Falls, Ontario. He is a graduate of this year at the University of Saskatchewan.

VISITORS TO HEADQUARTERS

Morris Fast, S.E.I.C., **Claude E. Green,** S.E.I.C., and **W. R. Topham,** S.E.I.C., from Ottawa, Ont., on July 27th.

C. H. White, S.E.I.C., from Winnipeg, Man., on July 30th.

W. C. Baggs, S.E.I.C., from Bathurst, N.B., on August 2nd.

Professor I. F. Morrison, of the University of Alberta, from Edmonton, Alta., on August 7th.

S. Plamondon, S.E.I.C., district sanitary engineer, Department of Health of Quebec, from Amos, Que., on August 8th.

Leonard Badgley, M.E.I.C., structural engineer with the City of Toronto Department of Buildings, from Toronto, Ont., on August 8th.

Jean Doucet, Jr.E.I.C., superintendent of the Plessisville Foundry, from Plessisville, Que., on August 9th.

W. H. Ackhurst, S.E.I.C., from Peterborough, Ont., on August 13th.

Harry F. Bennett, M.E.I.C., district engineer with the Department of Public Works, Canada, and chairman of the London Branch, from London, Ont., on August 13th.

R. Phillips, S.E.I.C., from Peterborough, Ont., on August 13th.

L. S. Dixon, M.E.I.C., from Bangor, Maine, on August 15th.

G. H. Kirby, M.E.I.C., electrical superintendent of Price Brothers and Company, Limited, from Riverbend, Que., on August 17th.

L. Brodie Stirling, Jr.E.I.C., assistant engineer of Shawinigan Water and Power Company, from Shawinigan Falls, Que., on August 20th.

L. C. Young, M.E.I.C., secretary-treasurer of Halifax Branch, from Halifax on August 26th.

Obituaries

Alexander Loudon Hay, M.E.I.C., died on November 27th, 1939, at Glace Bay, Nova Scotia, following a long period of illness. He was born at Hamilton, Scotland, on March 23rd, 1882, and received his education at Glasgow. He came to this country in 1903 as a compass man with Dominion Coal Company, Glace Bay. From 1911 to 1920 he was in charge of mine surveys for the same firm and in 1921 he became assistant mining engineer, a position which he held until his death.

Mr. Hay joined the Institute as an Associate Member in 1921, and he became a Member in 1925.

William Percy Wilgar, M.E.I.C., died in the hospital at Ottawa on August 3rd, 1940. He was born at Cobourg, Ontario, on March 9th, 1878, and received his education at Queen's University where he obtained the degree of B.Sc. with honours in 1903. Upon graduation he engaged in railway construction, and from 1904 to 1908 he was engineer in charge of exploration and location with the National Transcontinental Railway. In 1908 he was appointed division engineer at Nipigon, Ontario. He became professor of civil engineering at Queen's University, Kingston, in 1914 and served in the Great War with the Royal Canadian Engineers. He was appointed a captain in 1915 and became lieutenant-colonel in 1917. He was awarded the Distinguished Service Order.

Col. Wilgar served as honorary aide-de-camp to His Excellency the Earl of Bessborough during the latter's tenure as Governor General from 1931 to 1935.

He was Officer Commanding the Officers' Training Corps at Queen's University from 1932 to 1934. For the past eighteen months he had been head of the Engineering Department at Queen's.

Mr. Wilgar joined the Institute as a Student in 1902. He was transferred to Associate Member in 1905 and he became a Member in 1909. He was a councillor of the Institute in 1925.

COMING MEETINGS

The Canadian Good Roads Association—Annual Meeting, definite dates not set, Quebec City, Que., in September.

American Mining Congress—Seventh Annual Metal Mining Convention and Exposition, Colorado Springs, September 16 to 19.

Association of Iron & Steel Engineers — Annual Convention and Iron and Steel Exposition, Stevens Hotel, Chicago, Ill., September 24 to 27.

New England Water Works Association—59th Annual Convention, Commodore Hotel, New York, September 24 to 27.

Electrochemical Society, Inc.—Fall Meeting, Ottawa, Ont., October 2 to 5.

American Public Health Association—The 69th Annual Meeting, Detroit, Mich., October 8 to 11.

American Chemical Society—100th Meeting, Detroit, Mich., October 9 to 13.

American Welding Society — Twenty-first Annual Meeting, Cleveland, Ohio, October 20 to 25.

Canadian Institute on Sewage and Sanitation—Annual Meeting, Royal York Hotel, Toronto, October 24 to 25.

BRANCH NEWS

HALIFAX BRANCH

L. C. Young, M.E.I.C. - *Secretary-Treasurer*
A. G. Mahon, M.E.I.C. - *Branch News Editor*

A meeting was held at the Nova Scotia Technical College on Monday evening, August 26th, under the chairmanship of Charles Scrymgeour.

Those present were the executive of the Halifax Branch, together with a certain number of other members who had been invited to attend the meeting for the purpose of hearing an address given by Harry F. Bennett, chairman of the Young Engineer's Committee sponsored by the Institute. In addition to the regular members of the executive there were present:—Dr. F. Sexton, principal of the Nova Scotia Technical College, Prof. Flinn, Mr. Ira P. Macnab, Mr. J. Lorne Allen, Mr. Chas. Bennett, Mr. S. W. Gray, Mr. John Kaye and Mr. Jerry Clarke.

Mr. Bennett outlined in his address the aims and ambitions of the Young Engineers' Committee, giving details of the work which already had been done and also the proposed programme for this committee. He advised that the local branches were to be invited to form committees of their own to assist in carrying out the programme of the main committee, with a serious effort to assist young and student engineers.

After Mr. Bennett's interesting and instructive address on this subject, the chairman invited all members present to express their reactions and allotted five minutes for each speaker. It was particularly pleasing to note that all present availed themselves of the opportunity to offer suggestions and criticisms, and expressions of approval of the scheme in principle were unanimous.

In introducing the speaker, Mr. Bennett, the chairman welcomed him back to the Maritimes and particularly to Halifax where he had some years ago been chairman of the local branch and the general feeling of the meeting was that the Institute was fortunate in having Mr. Bennett to head up a committee to look after the interests of the young engineer.

The secretary, Mr. L. C. Young was, unfortunately, absent owing to military duties.

CANADIAN COAL MINES

OPERATING COSTS AND REVENUES, 1939

The following statement has been prepared by the Dominion Fuel Board, Ottawa, and gives the salient features of operations in the Canadian coal mining industry for 1939.

For the first time since 1934 the industry, as a whole, showed a profit on the year's operations. All the operating districts except one showed a profit, the exception being the Alberta sub-bituminous field. For the industry as a whole the profit for 1939 was 4.4 cents per net ton as compared with a loss of 2.4 cents in 1938.

The individual items in the cost sheet show very little change from last year. On the credit side the value of coal sold shows a gain of 12 cents per ton, but the value of company credits (coal sold to employees, used for colliery power, etc.) has fallen 6 cents per ton. There is thus a net gain of 6 cents per ton in the total credits.

An analysis of the returns shows that:

Sixteen operations representing 57% of the total tonnage reported average net profits of 18 cents per ton.

Twenty-five operations representing 25% of the total tonnage reported average net losses of 23 cents per ton.

Eighty-two operations covering the balance of tonnage (18%) showed a fractional profit on average.

The average realization per net ton of coal sold in 1939 was $3,513.00, an increase of 12 cents per net ton over 1938.

The tonnage represented in the table for 1939 totals 14,507,127 net tons, and is equivalent to approximately 94% of the total coal production of Canada for the period.

The presentation of these statistics has been made possible through the generous co-operation of the coal operators throughout Canada.

Canadian Coal Mines Operating Costs and Revenues per Net Ton of Marketable Coal Produced 1939

OPERATING COSTS	Nova Scotia	New Brunswick	Saskatchewan	Alberta Lignite	Alberta Sub-Bituminous	Alberta Bituminous	British Columbia	Canada
	$	$	$	$	$	$	$	$
Distribution	.536	.111	.185	.127	.136	.050	.392	.339
Workmen's Compensation	.107	.128	.047	.081	.082	.093	.113	.098
Rent and Royalties	.128	.120	.055	.130	.092	.061	.075	.107
Insurance and Taxes	.083	.044	.027	.054	.105	.096	.099	.077
Administration and Miscellaneous	.178	.252	.118	.205	.243	.140	.194	.179
Bond and General Interest	.058	.015	.014	.019	.029	.003	.006	.034
Power	.234	.081	.099	.079	.241	.202	.247	.194
Depreciation and Depletion	.216	.235	.154	.175	.219	.326	.309	.232
Stores	.420	.415	.143	.210	.297	.275	.385	.341
Labour	2.246	2.025	.520	1.468	1.457	1.615	2.070	1.877
Total	4.206	3.426	1.361	2.548	2.901	2.861	3.890	3.478
REVENUES								
Coal sold, used by company and stock adjustments	4.193	3.390	1.333	2.532	2.702	2.782	3.736	3.434
Miscellaneous profits	.063	.059	.030	.065	.145	.129	.214	.088
Total	4.256	3.449	1.363	2.597	2.847	2.911	3.950	3.522
Profit	.050	.023	.002	.049	Loss .054	.050	0.60	0.44
Value received per net ton of coal sold	4.294	3.405	1.346	2.704	2.803	2.805	3.822	3.513

Library Notes

Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

CANADIAN ENGINEERING STANDARDS ASSOCIATION

APPROVALS DIVISION

SPECIAL NOTICE—C.E.S.A. APPROVAL OF ELECTRICAL EQUIPMENT

To satisfy the repeated requests of a wide representation of Canadian interests, in the electrical field, the C.E.S.A. Executive Committee, in March, 1939, authorized the organization of a special division to provide for approval of electrical equipment to be sold or installed in Canada. The C.E.S.A. Main Committee confirmed this action in December, 1939. This proposal met with the unanimous approval of electrical inspection authorities in each of the provinces, and of power supply, manufacturing and electrical interests in general, throughout Canada.

Date of Inauguration—May 1st, 1940

An appropriate organization has been in the course of development during the past year and preparations were completed whereby the C.E.S.A. Approvals Division would be in a position, by May 1st, 1940, to enter into agreements with manufacturers for the purpose of issuing approval of electrical equipment, and provide suitable labels for such equipment where it meets the requirements of the appropriate Specifications of the Canadian Electrical Code, Part II, and of prescribed tests performed by laboratories authorized for the purpose by the C.E.S.A.

Basis of Approvals

Approvals work will be carried out in accordance with the provisions of the Canadian Electrical Code, Part I (current edition) and the supplementary Standard Specifications of the C.E. Code, Part II. All current editions of Specifications of the Canadian Electrical Code, Part II, published prior to February 1st, 1940, will be effective for C.E.S.A. approvals purposes as of May 1st, 1940, and all Specifications under that section of the Code published after February 1st, 1940, will be effective as of date of publication or will be otherwise specifically marked as to effective date.

Procedure for Application for Approval

Applications for approval of electrical equipment should be made to the C.E.S.A. Secretary, or to the Approvals Engineer at the addresses indicated below. An Approvals Manual giving general information and detailed instructions as to procedure in seeking C.E.S.A. approval of electrical equipment is being prepared and will be available on request. *Manufacturers are requested to ask for instructions as to the submitting of samples for testing, by applying to:*

THE APPROVALS ENGINEER,
CANADIAN ENGINEERING STANDARDS ASSOCIATION
APPROVALS DIVISION,
ROOM 101, 8 STRACHAN AVENUE,
TORONTO (TELEPHONE—WA. 6127 OR 6128)

or to

THE SECRETARY, CANADIAN ENGINEERING STANDARDS ASSOCIATION
APPROVALS DIVISION,
3010 NATIONAL RESEARCH BUILDING,
OTTAWA (TELEPHONE—2-8211, LOCAL 2056)

Follow-Up Inspection Service Agreements

By agreement with the Hydro-Electric Power Commission of Ontario, all *Follow-up Inspection Service* Agreements between the H.E.P.C. and manufacturers or submittors, that, at the time of the transference of Approvals work from the Commission to the C.E.S.A., are valid, will be assigned to the C.E.S.A., which body will thereafter be the responsible party to such agreements, in place of the Commission. As these agreements expire they may be formally renewed between the C.E.S.A. and the other party or parties thereto.

In connection with the *Re-examination Service*, the C.E.S.A. will permit its name, together with the number of the Approval Report, to be imprinted upon all *"C.E.S.A. Approved"* electrical equipment, as was done under H.E.P.C. *Re-examination Service.*

Approvals Labels

All existing *Approvals Labels* bearing the name of the C.E.S.A. and the H.E.P.C. that have not yet been used will be accepted by the Provincial Electrical Inspection Authorities until the stocks have been exhausted; thereafter, standard C.E.S.A. labels, only, will be accepted.

Approvals Card Index and Printed List of Approved Equipment of the H.E.P.C., Ontario

The card index record and the printed *List of Approved Electrical Equipment* embracing the details of approvals issued by the Hydro Electric Power Commission of Ontario and in effect on April 30th, 1940, will be adopted by the C.E.S.A. as of May 1st, 1940, subject to the general provisions of the C.E.S.A. *Approvals Manual* relative to continued effectiveness of approvals.

On and After May 1st, 1940,

the C.E.S.A. is prepared to follow the procedure laid down in the C.E.S.A. *Approvals Manual* for the issuing of approvals on electrical equipment for Canadian use. An effort will be made to send a copy of the *Approvals Manual* to all parties known to be interested, but to anyone who does not receive one, a copy will gladly be sent on request.

The C.E.S.A. Approvals Division has agreed to take over and complete those applications for approval which have not on May 1st, 1940, been completed,—as would have been done by the H.E.P.C. under the former arrangement.

Caution

Please do NOT submit samples for testing to the Ottawa office. Ask for instructions as to the location of the laboratory to which they are to be sent. This will obviate unnecessary delay and expense.

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

Ducks Unlimited:
Census 1938 and 1939 and Kee-man Record Book, Winnipeg, Ducks Unlimited. A report of the wild duck population of North America's vast duck factories in the Canadian West; assembled with the persistent and active co-operation of hundreds of Ducks Unlimited Kee-men—across Alberta, Saskatchewan and Manitoba.

Handbook of English in Engineering Usage:
By A. C. Howell, N.Y. John Wiley & Sons, 1940. 433 pp., 5 by 7½ in. $2.50.

Sewage Treatment:
By Karl Imhoff and Gordon Maskew Fair, N.Y. John Wiley & Sons, 1940. 370 pp., 5½ by 8¼ in. $3.00.

TRANSACTIONS

Institution of Mining and Metallurgy:
Transactions, forty-eighth session, 1938-1939. Vol. XLVIII London, Institution of Mining and Metallurgy, 1939.

REPORTS, ETC.

Canada Department of Mines and Resources—Lands, Parks and Forests Branch—Dominion Forest Service Bulletin:
Density and Rate of Growth in the Spruces and Balsam Fir of Eastern Canada, Bulletin 94. Ottawa, 1940.

Canada Department of Mines and Resources—Mines and Geology Branch—Geological Survey Papers:
Wildcat Hills Map-Area, East Half, Alberta, Paper 40-2; Michwacho Lake, Abitibi Territory, Quebec, Paper 40-3; Mechamego Lake, Abitibi Territory, Quebec, Paper 40-4; Fish Creek, Alberta, Paper 40-5; Gordon Lake, Northwest Territories, Paper 40-9; Gordon Lake South, Northwest Territories, Paper 40-7. Ottawa, 1940.

Canada Department of Transport:
List of Shipping issues by the Department of Transport—list of Vessels on the Registry Books of the Dominion of Canada on the 31st December, 1939. Ottawa, 1940.

Electrochemical Society:
Electrodeposition of Alloys, 1930 to 1940; The Porosity of Lead Storage Battery Plates; Electrochemical Methods in Microchemistry. Preprints 78-7 to 78-9.

Ohio State University Studies Engineering Series—Engineering Experiment Station Bulletin:
The Development of Superduty Refractories from Ohio, Pennsylvania and Kentucky Fire Clays, by Ralston Russell, Jr., Bulletin No. 105.

Province of Quebec:
Statistical Year Book, Quebec, 1939.

U.S. Department of Commerce—National Bureau of Standards:
Building Materials and Structures Report BMS47, Structural Properties of Prefabricated Wood-Frame Constructions for Walls, Partitions, and Floors.

U.S. Department of the Interior—Bureau of Mines—Bulletins:
Mechanical Shoveling in Underground Metal Mines, Bulletin 423; Coal-Mine Accidents in the United States: 1937, Bulletin 430.

U.S. Department of the Interior—Bureau of Mines—Technical Paper:
Correlation Index to Aid in Interpreting Crude-oil Analyses, Technical Paper 610.

U.S. Department of the Interior—Bureau of Mines—Economic Papers:
Trends and Seasonal Variations in Factors Influencing Domestic Motor-Fuel Demand, Economic Paper 21; Petroleum Statistics 1935-1938, Economic Paper 20.

OLD BOOKS

In the library at Headquarters there are several very old books on engineering subjects. These have come into the Institute's possession as donations from members, some being received in 1887 and others as late as this year. One book, "Sherwin's Mathematical Tables" by William Gardiner, is now within two years of celebrating its two hundredth anniversary.

For some time it has been hoped that a series of reviews could be developed that would tell the members something about these interesting publications, but it has been difficult to find reviewers who could spare the time. The idea has not been abandoned, but may have to be further postponed. If any members have an interest in such work, one or more books can be sent to them about which they may care to prepare a review for the entertainment of other members.

It is a pleasure to call attention to one such review that has already been received, and which is printed in this issue under Book Reviews. Perhaps it will prove an inspiration to other members. A partial list of the books follows:

Sherwin's Mathematical Tables:
Containing Dr. Wallis's account of logarithms, Dr. Halley's and Mr. Sharp's ways of constructing them, with Dr. Newton's contraction of Brigg's logarithms. London, Mount and Page, 1742.

Miscellanea Curiosa Mathematica:
Or, "the Literary Correspondence of some eminent mathematicians in Great Britain and Ireland. London, printed for Edward Cave, at St. John's Gate, and sold by F. Holliday, Master of the Grammar Free School at Houghton Park near Retford, Nottinghamshire, 1749."

The Principles of Mechanics:
"Explaining and Demonstrating the General Laws of Motion. London, printed for G. G. and J. Robinson, in Paternoster-Row, 1794."

A Practical Treatise on Rail-Roads and Interior Communication in General:
With "Original Experiments and Tables of the Comparative value of Canals and Roads. By Nicholas Wood. London, printed for Knight and Lacey, 1825."

Ensamples of Railway Making:
"Which, although not of English Practice, are submitted, with practical illustrations, to the Civil Engineer, and the British and Irish Public. London, Architectural Library, 1843."

The St. Lawrence and Atlantic Rail-Road:
Montreal, Canada Gazette office, 1849.

The Manufacture of Iron:
By Frederick Overman. Philadelphia, Henry C. Baird, 1850.

An Encyclopaedia of Architecture:
By Joseph Gwilt, London, Longman, Brown, Green, and Longmans, 1851.

Our Iron Roads:
Their history construction and social influences. By Frederick S. Williams. London, Ingram, Cooke and Co., 1852.

Canada at the Universal Exhibition of 1855:
Printed by order of the Legislative Assembly. Toronto, John Lovell, 1856.

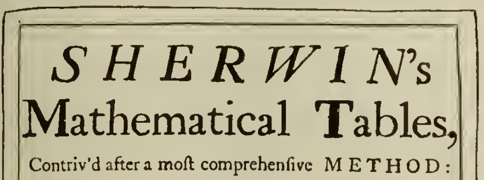
BOOK REVIEW

SHERWIN'S MATHEMATICAL TABLES

By William Gardiner, London, 1742. 3rd edition, 440 pages of tables and text, 5¼ x 8¾ in., 12 shillings.

Reviewed by A. H. HEATLEY, M.E.I.C.*

At about the time that La Vérendrye was exploring the far West, one William Gardiner, a surveyor of London (George II being the king), undertook the preparation of the third edition of Sherwin's Tables. Nearly two hundred years later a well preserved copy of his book enriches the library of the Engineering Institute in the city which then was the trading post whence La Vérendrye set forth on his expeditions.


SHERWIN's
Mathematical Tables,
Contriv'd after a most comprehensive METHOD:
CONTAINING,
Dr. *Wallis*'s Account of Logarithms, Dr. *Halley*'s and Mr. *Sharp*'s Ways of constructing them; with Dr. *Newton*'s contraction of *Briggs*'s Logarithms,
VIZ.
A TABLE of Logarithms of the Numbers from 1 to 101000, with the means to find readily the Logarithm of any Number, and the Number of any Logarithm, to seven places of Figures:
AND
TABLES of natural and logarithmic Sines, Tangents, Secants, and Versed-sines, to every minute of the Quadrant:
WITH THE
EXPLICATION and USE prefix'd.
The third EDITION.
Carefully revised and corrected,
By WILLIAM GARDINER.
LONDON:
Printed for WILLIAM MOUNT and THOMAS PAGE, at the *Postern* on *Tower-Hill*, M,DCC,XLII.

Title page of "Sherwin's Mathematical Tables" by William Gardiner

The title page shown herewith is an incomplete "Table of Contents." The seven-figure logarithmic table is quite similar in appearance to that in the current edition of "Chambers." On the other hand the arrangement of the trigonometric tables is slightly different; one table gives the natural and logarithmic versed sines; the natural and logarithmic sines, tangents, secants, cosecants, cotangents and cosines are all included in another table. The type is crowded too much for convenience in reading and the horizontal guide lines (instead of spaces) are somewhat wobbly.

But the more interesting parts of the book are those that have no counterpart in Chambers. The book includes a reprint of the dedication of the first edition, July 12, 1705, to Mr. Edm. Halley, Savilian Professor of Geometry in the University of Oxford, better known by his comet than by his geometry. Sherwin's original preface explains among other things how his tables were compared with earlier publications to ensure their correctness: "And in all these examinations there were never less than two to harken, whilst one read over the printed sheet to be corrected." Under the heading, "Advertisement" (what we should now call the "Preface to the Third Edition") Gardiner tells of the improvements in his edition.

There are ten chapters of explanatory matter ranging in difficulty from decimal fractions to the solution of spherical triangles. The chapter "of Logarithms, their Invention and Use" seems quaint to us who take logs as much for granted as the multiplication table. An early paragraph reads . . . .

"Mr. Briggs, upon the first publication of it by John Neper, was so pleas'd with it, that he presently repair'd into Scotland, to consult the Author, advise with him, and be assistant to him, in the perfecting of it; and in calculating Tables for it; which was a Work of great labour and subtilty."

Two different writers give articles on methods of making logarithms. A four-page table gives the sixty-one place logarithms of all numbers to 100 and of all primes under 1,100; there is a supplementary table with instructions for finding the logarithms of any number to sixty-one places. An article on "An Easy Quadrature of the Circle" gives several methods for computing the value of π, and reprints from earlier literature its value to 100 places. This reviewer admits that he knows of no use in any conceivable case for significant figures beyond ten or fifteen places.

It appears that with the exception of a table of squares and cubes this single volume included all the tables available in that day. Now we live in the lap of luxury, for industrious workers throughout the years have computed for our convenience innumerable tables: reciprocals, exponentials, hyperbolics, gammas, probabilities, Bessels, etc. Two organizations which are continuing this good work are worthy of special notice, The Mathematical Tables Committee of the British Association and the Project for the Computation of Mathematical Tables of the W.P.A. of New York City. And let no one think the task is done; to give an example, there are some commonplace problems in chemical kinetics whose solution involves Bessel functions which are not yet tabulated.

* *Research chemist, Shawinigan Chemicals, Ltd., Shawinigan Falls, Quebec.*

PRELIMINARY NOTICE

of Applications for Admission and for Transfer

August 24th, 1940

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

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

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

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

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

The Council will consider the applications herein described in October, 1940.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

A 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 attainment 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

ANTENBRING—STANLEY VICTOR, of 114 Cameron St., Sarnia, Ont. Born at Winnipeg, Man., Oct. 7th, 1916; Educ.: B.Sc. (Civil), Univ. of Man., 1937; 1936-37 (summers), geol. surveys, and Sherritt Gordon Mines Ltd.; Nov. 1937 to date, designing engr., gen. engrg. dept., Imperial Oil Limited, Sarnia, Ont.

References: T. Montgomery, G. H. Herriot, A. E. Macdonald, C. V. Antenbring, W. F. Riddell.

BUTTERFIELD—HARRY VERNON, of 94 Brule Gardens, Toronto, Ont. Born at Leeds, Yorks., England, Dec. 19th, 1892; Educ.: B.Sc., Leeds Univ., 1914; Assoc. Member, Inst. Mech. Engrs. (England); 1905-09, Naval College, and apprenticed to marine engrg., Portsmouth; 1909-12, at sea in H.M. Fleet; 1914-17, asst. engr. to gen. mgr., Aircraft Mfg. Co., Hendon, England; 1917-19, asst. gen. mgr., National Aircraft Factory, Aintree, Liverpool, England; 1919-25, inspr. in the mech. service, Ministry of Public Works, Cairo, Egypt; 1926-33, mech. supt., and later plant mgr., Massey-Harris Co. Ltd., Toronto; 1934-39, gen. mgr., and later president and managing director, Leland Electric Canada Ltd.; 1939-40, plant mgr., bomber divn., National Steel Car Co. Ltd., Malton, Ont.

References: W. D. Black, J. L. Miller, D. M. Fraser, J. Breakey, D. Massey, D. Boyd, C. B. Hamilton.

CHARD—ALBERT ELGIN, of Kapuskasing, Ont. Born at Weyburn, Sask., June 15th, 1913; Educ.: B.Sc. (Mech.), Univ. of Sask., 1935. B.A.Sc. (Forestry), Univ. of B.C., 1940; 1937-38, engr.-draftsman., B.C. Pulp & Paper Co., Port Alice, B.C.; 1939 (summer), compassman, B.C. Forest Service; 1940 (Mar.-May), dftsman., Sumner Iron Works, Vancouver. At present, engr.-dftsman., Spruce Falls Power & Paper Co., Kapuskasing, Ont.

References: C. C. Ryan, J. N. Finlayson, W. E. Lovell, I. M. Fraser, R. A. Spencer, P. C. Perry, C. W. Boast.

FAIRHURST—THURSTAN WILLIAM, of 15 Kingsway, London, W.C.2, England. Born at Chorlton, Manchester, England, April 27th, 1889; Educ.: Cert., College of Technology, Manchester, 1910; M. Inst. Mech. Engrs. (England); 1905-11, pupil, Crossley Bros., Manchester; 1911-12, engr., Winnipeg H.P. Fire Service Pumping Station; 1912, i/c Swift Current and Medicine Hat municipal power plants; 1912-14, res. engr. for Crossley Bros. in India and Burma; 1914-19, Sapper to Major, R.E., responsible for Palestine water supply. 1917-19 in command of 360 Coy., R.E.; 1919-23, sales engr., Vancouver Machinery Depot, Vancouver; 1923-28, export sales mgr., Marion Steam Shovel Co., Marion, Ohio; 1928-33, export sales mgr., Nordberg Mfg. Co., Milwaukee; 1933-36, gen. mgr., Crompton Parkinson Ltd., England; 1936 to date, director, Ruston & Hornsby Ltd., Lincoln, England, Ruston & Hornsby (India) Ltd., Bombay, and Davey Paxman & Co. (Colchester) Ltd., Colchester, Eng.

References: F. S. Keith, G. A. Walkem, W. T. Fraser, W. H. Powell, J. P. Mackenzie, W. G. Swan, W. G. Tyrrell, A. L. Mieville.

FERGUSON—DAVID McLEAN, of East Angus, Que. Born at Glasgow, Scotland Mar. 25th, 1900; Educ.: Diploma in E.E., Royal Technical College, Glasgow (in affiliation with Glasgow Univ.), 1923; 1918-23, ap'ticeship in elec. engrg., Bane & McNicol, Glasgow; 1923-24, Diesel electric & steam electric ship drive, Hartland & Wolff, Glasgow; 1924-26, underwriters' insurance inspr., Canada, Co-operative Insurance of Glasgow; 1926-28, sub-station installn., power house control installn., etc., Aluminum Company of Canada, Arvida, Que.; 1928-31, installn. of small hydro-electric plants, and charge of repair shops, Price Bros. & Co. Ltd., Kenogami; 1931-35, i/c control installn. and later chief shift operator, Beauharnois Light, Heat & Power Co.; 1935-40, i/c elec. dept., Canadian Celanese Ltd., Drummondville; At present, elec. supt., Brompton Pulp & Paper Co. Ltd., East Angus, Que.

References: N. D. Paine, B. K. Boulton, G. O. Vogan, K. O. Whyte, G. D. Bailey, J. L. Balleny.

FULTON—EDWARD ARTHUR, of 7918 Kingsbury Ave., St. Louis, Miss. Born at Parrsboro, N.S., Dec. 31st, 1898; Educ.: B.Sc., C.E., 1924, M.S., 1930, Mass. Inst. Tech.; 1932 to date, private practice as consltg. engr., gen. municipal practice in water supply, purification, sewerage & sewage disposal, power development and paving projects. (A.M.E.I.C. 1928-33).

References: J. N. Finlayson, G. M. Gilbert, W. F. Riddell, N. M. Hall, W. M. Scott, D. L. McLean.

GABOURY—JOHN LOUIS FREDERIC, of 3712 Park Ave., Montreal, Que. Born at Chatham, Ont., Dec. 28th, 1882; Educ.: B.A.Sc., Univ. of Toronto, 1923; R.P.E. Que.; 1917-21, estimator & dftsman., Montreal Tramways Co.; with the Dominion Bridge Co. Ltd. as follows: 1912-15 (summers), estimating, dfting, etc., 1915 (3 mos), inspr. on munitions, 1924-32, estimating, dfting., designing, layouts, etc., some field supervision & surveys on bldgs. and small bridges; 1934 to date, consltg. engr. to various municipalities in the province of Quebec, work incl. constrn. design and supervision of various projects, incl. highways, bridges and bldgs.

References: D. C. Tennant, F. P. Shearwood, C. S. Kane, J. W. Roland, W. McG. Gardner.

REEVE—DAVID DOUGLAS, of Arvida, Que. Born at Vancouver, B.C., Nov. 29th, 1912; Educ.: B.A.Sc. (Mech.), Univ. of B.C., 1933: 1930 (4 mos), rodman, City of Vancouver; 1934-36, pulpmill operator, Port Alice, B.C.; 1936 (June-Dec.), dftsman. on equipment layout, B.C. Pulp and Paper Co., Port Alice; 1937-39, chief dftsman., Abitibi Power & Paper Co., Smooth Rock Falls, Ont.; 1939-40, designer, Quebec North Shore Paper Co., Baie Comeau; 1940 (June-July), designer, Bloedel, Stewart & Welch, on pulp mill project at Port Alberni, B.C. (project abandoned); at present, dftsman., mech. dept., Aluminum Company of Canada, Arvida, Que.

References: H. V. Haight, R. E. Smythe, P. G. Gauthier, W. G. Reekie, D. Anderson, A. Babin, C. C. Ryan.

ROBERTSON—WILLIAM, of 5640 McLynn Ave., Montreal, Que. Born at Paisley, Scotland, Aug. 13th, 1901; Educ.: Evening classes, Montreal Technical School. 3 yrs. maths., 4 yrs. arch'l. dwg., 2 yrs. struct'l. design, Wilson Engrg. Corpn. course in reinforced concrete design; 1916-18, junior in engrg. dept., Shawinigan Water & Power Co.; 1920-24, instr'man. & constrn. engr., Thompson Starrett Co., 1924 to date, constrn. engr., gas distribution dept., Montreal Light, Heat and Power Cons., Montreal.

References: W. J. Yorgan, J. B. Challies, H. Massue, R. E. Heartz, L. A. Kenyon, F. V. Dowd, P. E. Jarman, J. H. Wheatley, L. L. O'Sullivan, D. O. Wing.

SPALL—EDWARD ARTHUR GEORGE, of 3 Thornhill Ave., Toronto, Ont. Born at Ipswich, Suffolk, England, May 20th, 1910; Educ.: Junior Matric., 1926; Evening classes in engrg. subjects at the Central and Western Technical Schools, Toronto, and University of Toronto extension courses; 1926-28, mech. work, chief dftsman. & engrg., Canadian Kodak Co.; 1928-31, dftsman., power plant design, stoker installns., materials handling equipment, Riley Engrg. & Supply Co.; 1934-38, with Jas. Robertson & Co. Ltd., Toronto, i/c heating engrg. & stoker depts., also layouts of plumbing fixtures & equipment; 1938 to date, manager, Penn Electric Switch Division, Powerlite Devices Ltd., Toronto, Ont. (Applying for admission as Member or Affiliate).

References: A. C. Blue, E. C. Williams, G. R. Conrod, W. P. Dobson.

WHARTON—WILLIAM HENRY, of Montreal, Que. Born at Chesterfield, England, Sept. 27th, 1882; Educ.: 1902-08, metallurgy, Univ. of Sheffield, England; 1899-1909, engrg. ap'tice to works mgr., Spital Works, Chesterfield; 1909-11, dftsman & asst. to mech. supt.; 1911-12, chief dftsman., engr. in charge of extension, Nova Scotia Steel & Coal Co., New Glasgow; 1912-20, chief designer, asst. supt. constr., and tech, asst. to president, Algoma Steel Corporation, Sault Ste. Marie, Ont.; 1920-24, sales and consltg. engr. on steel and paper mill equipment; 1924-40, private practice, Toronto. Still acting as consltg. engr. for the Allis Chalmers Co. of Milwaukee, and the Canadian Allis Chalmers Co., on steel and paper mill project; 1935, took charge of extensions to Temiskaming mill of International Paper Co.; 1936-37, in charge of designing and engrg. of the Baie Comeau paper mill; At present, chief engr., Allied War Supplies Corporation, Montreal, Que.

References: J. Stadler, J. S. H. Wurtele, A. I. Cunningham, J. R. Donald, C. H. Gordon, C. Stenbol.

FOR TRANSFER FROM JUNIOR

DUBESKY—WILLIAM J., of 162 Yale Ave. W., Transcona, Man. Born at Winnipeg, Dec. 15th, 1911; Educ.: B.Sc., Univ. of Man., 1932; Summers, 1928, dfting., Langley Electric, 1930, constrn., Winnipeg Hydro, 1931, constrn. on elevator, at Churchill, Man.; 1933-37, refinery operation, power operation, Radio Oil Refineries; 1937-38, refinery design, dfting., etc., Brown Steel Tank Co.; 1938 to date, supt.. Anglo-Canadian Oils Ltd., Brandon, Man., refinery and power plant, dfting., refinery design, constrn. (Jr. 1937).

References: W. H. Shillinglaw, A. E. Macdonald, E. S. Braddell, J. T. Rose, E. C. Cowan.

(*Continued on page* 411)

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SAFETY ENGINEER, Affil. E.I.C., age 24; single; bilingual; presently employed; Canadian; 40 months with large industrial firm. Familiar with all phases of accident prevention and editing of bilingual company organ. Interested in industrial relations, safety, personnel and employment work. Location immaterial. Available with month's notice. Apply to Box No. 2187-W.

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PRELIMINARY NOTICE (*Continued from page* 410)

PITFIELD—BARCLAY WALLACE, of Edmonton, Alta. Born at Edmonton, June 13th, 1910; Educ.: B.Sc. (Civil), Univ. of Alta., 1934; Summers, 1930 & 1932, Nor. Alta. Rlys., 1931, rodman, West Kootenay Power & Light Co., 1934, dftsman., Canadian Industries Ltd.; 1935 to date, asst. engr., Northwestern Utilities Ltd., design of gas transmission and distribution systems, etc., and engrg. supervision of constrn. of company's projects in Edmonton (St. 1933, Jr. 1938).
References: J. Garrett, E. Nelson, C. E. Garnett, H. R. Webb, W. R. Mount.

FOR TRANSFER FROM STUDENT

AMAN—THOMAS FREEMAN STEWART, of 133 Moira St. West, Belleville, Ont. Born at Toronto, Ont., July 8th, 1912; Educ.: B.Sc. (Elec.), Queen's Univ., 1935; 1935 (May-Nov.), asst., Belleville meter dept., H.E.P.C. of Ontario; 1936-38, Canada Cement Co., Plant No. 5, Belleville. Shift electrician during operating season; when plant not operating in charge of any new electr'l installns.; 1938-39, instructor, elec. engrg. dept., Queen's Univ.; 1939 to date, inspr. of electricity and gas, Dept. of Trade and Commerce, Belleville, Ont. (St. 1934).
References: D. M. Jemmett, L. T. Rutledge, T. R. Durley, P. L. O'Shaughnessy, R. L. Dobbin.

BARRY—DONALD JOHN OSWALD, of Toronto, Ont. Born at Montreal, Sept. 1st, 1899; Educ.: B. Eng., McGill Univ., 1936; With the C.P.R., Eastern Lines as follows: 1927-30, layout and tracing of electrical circuits for rly. signal systems and related work, at Montreal, and 1930-36 (summers) and 1936 to date, design, layout and estimating in connection with rly. signal systems, now located at Toronto (St. 1936).
References: J. E. Armstrong, R. B. Jones, R. Mudge, B. Ripley, W. O. Cudworth, H. W. Lea, C. C. Langstroth.

BELANGER—MAURICE, of 53 Cote St. Catherine Road, Outremont, Que. Born at Montreal, Dec. 12th, 1912; Educ.: B.A.Sc., C.E., Ecole Polytechnique, 1939; Summers, 1937, road work, 1938, investigator, Ministry of Health; May 1939 to date, concrete inspr., Messrs. Baulne & Leonard, Montreal, Que. (St. 1938).
References: S. A. Baulne, J. A. Lalonde, J. P. Lalonde, A. Duperron, A. Circe, A. Frigon.

CHRISTIE—R. LOUIS, of 12 Marmaduke St., Toronto, Ont. Born at Truro, N.S., March 23rd, 1912; Educ.: B. Eng. (Mech.), McGill Univ., 1935; 1931-32 (summer), bridge inspr., & instr'man. on highway surveys & gen. office work, Dept. of Highways, Truro, N.S.; 1935-36, design work on plant layout and equipment, 1936-39, asst. master mechanic, and at present, general design and layout work and supervision of equipment installn. (partial only) at Canadian Kodak Company, Toronto, Ont. (St. 1932).
References: W. P. Copp, J. R. Kaye, G. H. Tate, C. M. McKergow.

COLE—ALFRED HERMAN PURKIS, of 301 Broadway, Lachine, Que. Born at Montreal, Apr. 13th, 1912; Educ.: B. Eng. (Elec.), McGill Univ., 1936; 1936, elec. testing, Montreal Tramways Co.; 1937 to date, asst. mtce. engr., D. W. Ogilvie & Co. Inc., (St. 1931).
References: E. Brown, C. V. Christie, G. P. Cole, E. R. Jacobsen, F. S. Keith.

DAIGNAULT—LAWRENCE GEORGE, of Montreal, Que. Born at Montreal, May 17th, 1911; Educ.: B. Eng., McGill Univ., 1934; 1935-36, engr., sales & design, Truscon Steel Co. of Canada Ltd.; 1936 to date, industrial engr., i/c cost control & wage methods for different plants in Quebec & Ontario, Dufresne, McLagan & Associates, Montreal, Que. (St. 1933).
References: J. A. Beauchemin, O. O. Lefebvre, T. R. McLagan, R. E. Jamieson, R. DeL. French.

KIMPTON—GEOFFREY HOLIDAY, of 4505 Mariette St., Montreal, Que. Born at St. Lambert, Que., Sept. 6th, 1911; Educ.: B. Eng. (Chem.), McGill Univ., 1935; 1935 (May-Dec.), Dominion Rubber Co., Montreal; 1936 to date, plant manager (engr. & chemist), Oxygen Company of Canada, Montreal, Que. (St. 1934).
References: R. DeL. French, T. M. Moran, E. Brown, G. Sproule, C. M. McKergow, J. B. Phillips.

LAIRD—DAVID WILLIAM, of 265 Balmoral St., Winnipeg, Man. Born at Victoria, B.C., Sept. 20th, 1909; Educ.: Passed third year civil engrg., Univ. of Man., 1940; 1928, rodman, Good Roads Board, Manitoba; 1929-31, rodman, 1935-36, gravel inspr., and 1936-39, res. engr., reclamation branch, Province of Manitoba; May 1940, instructor in surveying field work, dept. of civil engrg., Univ. of Man.; At present, dftsman., works & bldg. divn., No. 2 Training Command, R.C.A.F., Winnipeg, Man. (St. 1939).
References: A. E. Macdonald, G. H. Herriot, A. J. Taunton, J. Hoogstraten, N. M. Hall, W. F. Riddell.

LAMB—HUGH, Jr., of Montreal, Que. Born at Forfar, Scotland, April 21st, 1910; Educ.: B. Eng. (Civil), McGill Univ., 1940; 1928-33 and 1934-36, gen. contracting work, incl. estimating, dfting., etc.; At present, Pilot Officer, Aeronautical Engrg. School, R.C.A.F., Montreal. (St. 1936).
References: E. Brown, J. G. Dodd, R. E. Jamieson.

LAPOINTE—GERARD MAURICE ALPHONSE AUDET, of 4895 St. Catherine Road, Montreal, Que. Born at Montreal, April 30th, 1912; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1938; R.P.E. Que.; 1934-37 (summer), concrete road inspr. and second res. engr. on concrete roads, Quebec Highway Dept.; 1938 (summer), res. engr., at St. Lambert, Quebec Highway Dept.; 1938 to date, engr., Sewers Commission of Montreal. (St. 1936).
References: I. A. Vallieres, A. Circe, L. Trudel.

MILLER—G. GRANT B., of R.R. No. 1, Saint John, N.B. Born at Cornwall, P.E.I., Apr. 27th, 1910; Educ.: B.Sc. (Elec.), Univ. of N.B., 1932; Summers—1929-30, rodman, instr'man., office, highway surveys; 1934-35, foreman, Dufferin Paving Co.; Winters 1935-36, asst. to chief electrician, C.P.R., West Saint John; 1936 to date, sales engr., E. S. Stephenson & Co. Ltd., Saint John, N.B. (elect'l. & mech'l. equipment). (St. 1932).
References: A. F. Baird, J. Stephens, D. R. Smith, T. S. Moffat, G. A. Booker.

McLEOD—ARTHUR MALCOLM, of Calgary, Alta. Born at Calgary, Oct. 6th, 1912; Educ.: B.Sc. (Elec.), Univ. of Alta., 1936; With the Canadian Westinghouse Company, Hamilton, as follows: 1937, test. dept., 1937-38, correspondence dept., 1938-39, engrg. dept., 1939, factory work, assembly & test, and from March 1940 to date, sales engr., for same company at Calgary, Alta. (St. 1937).
References: H. J. McEwen, W. S. Fraser, J. McMillan, D. W. Callander, W. E. Cornish, W. L. Miller, J. R. Dunbar.

NEUFELD—CORNELIUS, of 250 Pim St., Sault Ste. Marie, Ont. Born at Herbert, Sask., April 30th, 1913; Educ.: B.Sc. (Civil), 1935, M.Sc., 1937, Univ. of Sask.; 1935-36 (summers), geol. survey, Dom. Govt., highway survey, Sask. Govt.; 1935-37 (part time), struct'l. engrg., lab. work, Univ. of Sask.; 1936-37, research in photoelastic stress analysis; 1937 to date, struct'l. engr., Sault Structural Steel Co. Ltd., design, dfting. & price estimating of steel mill bldgs., industrial bldgs., small bridges, etc., with full respons. during last two years in absence of superior officer. (St. 1936).
References: H. J. Leitch, E. K. Phillips, R. A. Spencer, A. R. Robertson, C. J. Mackenzie, A. E. Pickering.

NORMANDEAU—PAUL D., of 35 Duverger Ave., Outremont, Que. Born at Quebec, Que., Dec. 18th, 1912; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1938; 1931-37 (summers), junior & senior asst., geol. surveys, Quebec Bureau of Mines; 1938-39, sales engr., Armstrong Cork & Insulation Co. Ltd., Montreal; Feb. 1939 to Aug. 1940, dftsman., Canadian Car and Foundry Co. Ltd., Montreal, Que.; At present, plant engr., Eagle Pencil Company, Drummondville, Que. (St. 1936).
References: A. O. Dufresne, D. Boyd, A. Surveyer, A. Frigon, S. A. Baulne.

PARKER—EDMUND NORVAL, of 117-34th Ave., Lachine, Que. Born at Lachine, May 24th, 1913; Educ.: B. Eng. (Mech.), McGill Univ., 1937; Summers—1932-34, on constrn. of permanent pavements, 1935, design and constrn. of thermostatic control instruments, Northern Engineering & Development Co., Winnipeg; 1936, instr'man., on constrn., hydro-electric development, Great Lakes Power Co., Sault Ste. Marie, Ont., 1937-39, dftsman., 1939 to date, designer, mech. dept., Dominion Bridge Co. Ltd., Lachine, Que. (St. 1937).
References: A. E. Pickering, N. M. Hall, E. Brown, R. H. Findlay, K. O. Whyte, J. Smith, J. D. Calvin.

RACICOT—JACQUES, of 3834 St. Denis St., Montreal, Que. Born at Montreal, Nov. 21st, 1912; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1939; R.P.E. Que.; 1932-37 (summers), with Quebec Streams Commission and Quebec Roads Dept., 1937 to date, res. engr., Quebec Roads Dept., Montreal, Que. (St. 1938).
References: J. A. Lalonde, S. A. Baulne, L. Trudel, O. O. Lefebvre.

ROSE—PAUL EMILE, of Toronto, Ont. Born at Montreal, Oct. 25th, 1909; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1937; 1932-36 (summers), R.C.A.F., Camp Borden, instr'man, Quebec Streams Commn., mach. ap'tice, Steel Company of Canada; road designer, Quebec Roads Dept.; With the Can. Gen. Elec. Co. Ltd., as follows: 1937-38, on various tests, 1938-39, fractional motor engrg., 1939, lighting service dept., 1939-40, lighting divn., and at present, industrial divn. (St. 1936).
References: O. O. Lefebvre, G. J. Desbarats, A. Frigon, C. E. Sisson, W. E. Ross, E. C. Williams, G. R. Langley, W. M. Cruthers.

WILKINSON—WILLIAM CAMERON, of 3483 Peel St., Montreal, Que. Born at Gagetown, N.B., Jan. 1st, 1913: Educ.: B.Sc. (Elec.), Univ. of N.B., 1937; 1936 (summer), instr'man. on highway constrn.; 1937 to date, transmitter development engr., Canadian Marconi Company, Montreal. (St. 1937).
References J. B. Wilkinson, A. F. Baird, E. O. Turner.

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 23 | OCTOBER 1940 | NUMBER 10

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

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PUBLISHED MONTHLY BY
THE ENGINEERING INSTITUTE OF CANADA
2050 MANSFIELD STREET - MONTREAL

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REGULATION OF GROWTH OF CITIES AND THEIR DECENTRALIZATION

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Paper prepared for presentation at the British-American Engineering Congress, New York, September 4th-8th, 1939

For several generations the expansion and congestion of modern cities have tended to produce over-concentration of population. This may be attributed, among other things, to unsuitable use of land, to inadequate distribution of open spaces, and to poorly planned traffic and transportation; in other words, to lack of foresight. The results have been economic waste and insufficient protection to public health. A remedy or prevention would have been found in the application of the principles of city planning and in the protection and regulation of land by zoning.

In certain countries, blighted areas have been renovated and large scale rebuilding has been effected within city limits. England, where the general feeling favours the development of one house for every family, offers nevertheless a good example of the rebuilding of central areas. In the United States, housing schemes of flats or apartment buildings are generally being built for the lower-wage groups.

The movement towards decentralization, or the abandonment of central areas of urban communities with the advent of satellite towns and garden cities, has been a conscious effort towards diffusion of population, and a check to the continuous uncontrolled suburban growth of cities. In consequence, city planners must correlate their activities, either towards the regeneration of blighted areas, or towards the effective decentralization of urban communities.

Control of Growth of Population

Generally speaking, the control of density of population and land uses, as well as the solution of the housing problem, are related to the overcrowding of dwellings and congestion of public thoroughfares, caused by the rapid development of industries and commerce and the rapid increase of population, which resulted in the growth of cities on vertical lines. The term congestion is used in reference to street traffic and circulation, while overcrowding refers to the number of persons living in a given area and to their distribution therein.

Vertical growth has been found inevitable in the largest cities. The population having been unable to spread out, piled itself up in dwellings, placed one upon another. This cause of congestion can be prevented by zoning, the rational utilization of land by regulating the height, bulk and uses of buildings, which especially determines the disposition of buildings on their sites.

In unzoned and unplanned communities observers have found that development passes through two periods. At first, the nucleus of the city has a power of attraction that causes all the activity of the community to flow towards it. But later, when central congestion has reached a certain stage, the attraction is reversed, there is a tendency for the population to move to the outskirts of the community, and in this case we generally have horizontal building. Later still, if the means of communication are insufficient to accommodate the growth of population of large metropolitan areas, more extensive vertical building may again result. In other words, the forces that acted towards decentralization of population may work in the opposite direction, if economics become a factor, and if people have to live near their work to save time in travelling.

In our age, the regulation of growth of population can be accomplished without undue difficulties, and without having to resort to vertical planning or the piling up of families in tower buildings or skyscrapers. Sir Raymond Unwin has shown that even in England there is plenty of space to plan industrial towns and others, without overcrowding the dwellings or piling families one upon another in tall tenements. If this is true for England it must apply in greater measure to Canada and other countries where the density of population is very low.

With reference to the question of horizontal and vertical building, the general consensus of opinion among city planners, sociologists and hygienists is for a separate dwelling-house for each family, where practicable. Some believe that vertical building is advantageous in certain respects, being more monumental and permitting, at low rental, of better equipped dwellings than would be the case with horizontal building. On the other hand, the present tendency in Europe and in England is to develop on horizontal rather than vertical lines, except in areas where land cannot be obtained at comparatively low cost and where tenants have to be housed near their work.

This question was carefully studied at the Paris International Housing and Town Planning Congress in 1937, by representatives of several nations. The report of the Congress[1] gives a summary of their conclusions.

In regard to vertical building recent studies, reported by George B. Ford[2], indicate that it is impracticable to determine quantitatively the value on health of light and sunlight, as there are so many other contributing factors. Specialists, however, seem unanimous in their opinion that the therepeutic and psychological value of light and sunlight is of the utmost importance. Towers on office buildings, hotels or apartment-houses should therefore be so designed and so located as to give neighbouring buildings plenty of sunlight and light around them. The Alden Park groups of tower apartments, in Philadelphia, illustrate the application of this principle in the provision of spaciousness of surroundings of these buildings.

The same writer believes that there is a need for the determination of an effective height, bulk and form for city buildings that will provide maximum light, air, outlook and freedom of movement consistent with an assured reasonable return on the investment.

Finally it becomes more and more evident that cities must be planned and their activities correlated, in order that their growth may be accompanied by the stabilization of real estate and the preservation of amenities against haphazard developments. This stabilization should be obtained by zoning. In many cities blighted districts are the result of uncontrolled growth, and neighbourhoods have deteriorated in many instances, long before the decay of buildings they contain. Hence the development of a city, which is a changing, usually growing organism, can only be regulated, first by a comprehensive plan, and second by zoning ordinances which should implement the plan.

Zoning and the City Plan

Zoning, which deals primarily with private property, is closely allied to building and sanitary regulations, and its study must be preceded by a definite programme related to all the elements of the city plan. The latter should provide for adequate circulation and transportation lines: streets, roads and parkways, as well as for the methodical and appropriate distribution of open spaces, parks and parking systems, recreation, playgrounds, forest reserves, etc. The plan also makes practicable the interrelationship of different zoning areas.

The above considerations have been well summarized by Thomas Adams[3] who defined city or town planning:

"A science, an art and a movement of policy concerned with the shaping and guiding of the physical growth and arrangement of towns in harmony with their social and economic needs. We pursue it as a science to obtain knowledge of urban structure and services and the relation of its constituent parts and processes of circulation; as an art to determine the layout of the ground, the arrangement of land uses and the ways of communication and the design of buildings on principles that will secure order, health, and efficiency in development; and as a movement of policy to give effect to our principles."

In this connection, John Ihlder[4] of Washington, D.C., is of opinion that so far our cities have not been effectively planned and our zoning has been only tentative. This has been found equally true for building and other regulations which contain frequent inconsistencies and unjustified requirements. We have inherited disorder and confusion.

A recent information bulletin issued by the Regional Plan Association of New York[5], states that there is a need for rezoning in New York and its environs, on account of the shortcomings in existing ordinances. This city, which has been a pioneer in zoning in America, has adopted ordinances which preceded the adoption of a comprehensive plan. The latter, in the light of modern conception in city planning, should logically have preceded the zoning ordinances. It is now realized that zoning should have been framed to implement the plan. The consequences are that with the carrying out of the master plan, the revision of existing ordinances is inevitable, especially in connection with the excessive allowances made for commercial use districts in the original ordinances. Likewise it has also been reported from Chicago that having failed to fit certain individual solutions into a composite whole, the zoning ordinances, which have been too prodigal with industrial, business and apartment areas, are being modified[6].

The examples of the well zoned cities of New York and Chicago, as well as the studies of Harland Bartholomew[7] disclose that reasonable proportions of urban land should be allotted to each required use. Therefore, zoning not related to sound economy policy may cause serious losses. This contention is supported by Edward H. Bassett[8] and various other writers, who are unanimous in stating that zoning ordinances must not be arbitrary, discriminatory or unreasonable but should secure the benefit of their protective features in the conservation of property values.

Zoning ordinances should be, within certain limits, flexible; they must be adapted to the character and social development of the community. Changes of the character of buildings are inevitable in the growth of a city, and proper zoning should prevent these changes from becoming excessive.

Following recent studies and revisions of zoning ordinances, the Regional Plan Association of New York made suggestions for rezoning in New York, based upon the following three important considerations which may serve as a guide to other cities:—

First, zoning should be comprehensive or community-wide, thus avoiding the evils of spot zoning; second, it should be quantitative, that is, the proportions of land or permissible bulk should be related as nearly as feasible to the needs of the present and immediate future; third, the new allotment of areas, densities and other restrictions should be based upon an adequate supply of facts about existing conditions and trends, preferably related to an up-to-date plan.

Satellite Towns and Garden Cities

For several generations, attempts have been made to promote the dispersal of population from congested districts. Railroad and transit lines and highways have largely contributed to this end, but in doing so, have created congestion in the central areas, which could have been prevented by zoning. The decentralization of industries and population from large cities in favour of rural or semi-rural locations is less liable to happen in well-planned communities.

The extensive suburban areas thus developed gave rise to satellite cities, garden cities and dormitory towns which have changed materially the character of civic growth. In England, Hampstead, Letchworth and Welwyn, are classic examples of satellite cities. Wythenshawe is the most recent example of a satellite garden town, planned by the City of Manchester, England, to cover an area that will have a population of 100,000, working partly in the factory district of the area and partly in the mother city. This satellite town as well as Letchworth, and Welwyn (which have been planned for 15,000 and 9,000 respectively) are the most important experiments made in England, to prevent gradual sprawling growth in rural districts.

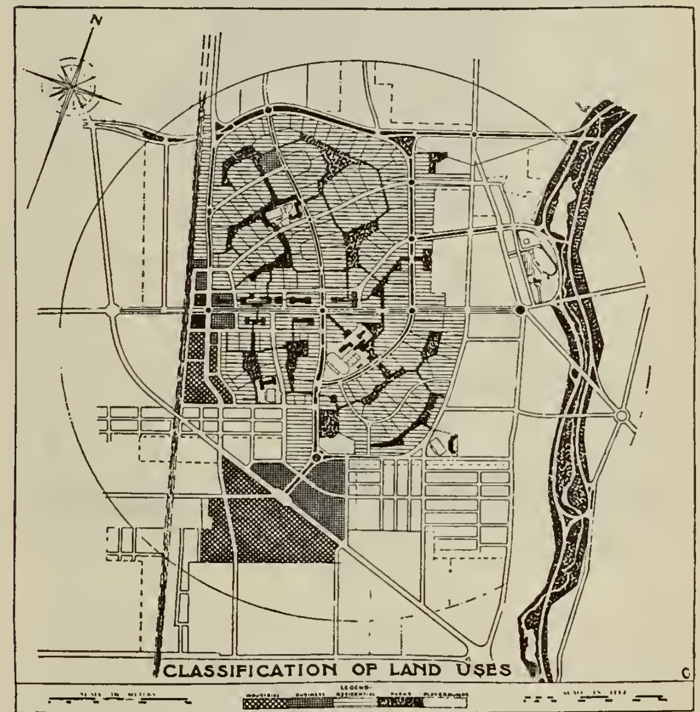

Fig. 1—Radburn, New Jersey, U.S.A., general plan.

Satellite cities and industrial villages have contributed to the improvement of housing conditions and to the dispersal of industries, and have been productive of good results. They are planned in order to preserve an agricultural belt around the mother city and have been operating successfully in England for nearly 25 years.

The building of satellite towns around large cities is an alternative to continuous suburban growth. They constitute a means by which the increasing population can best be provided for. For several decades, the natural growth of cities along new lines of communication has led to the casual development of building estates, and uneconomic and half-developed subdivisions in the suburbs. This unplanned growth has created, among other things, a great number of substandard dwellings.

The meaning of satellite towns has been well explained by C. B. Purdon[9]. Actually they are small communities which have become residential areas for people engaged in business in larger cities near by.

A satellite town is a distinct civic unit, with its own corporate life having a certain relation of dependence upon a great city, but distant enough from it to prevent their merging. A garden city on the other hand, must be a complete self-contained town.

The words garden city have been defined by the Council of the Garden Cities and Town Planning Association of England to mean "a town designed for healthy living and industry; of a size that makes possible a full measure of social

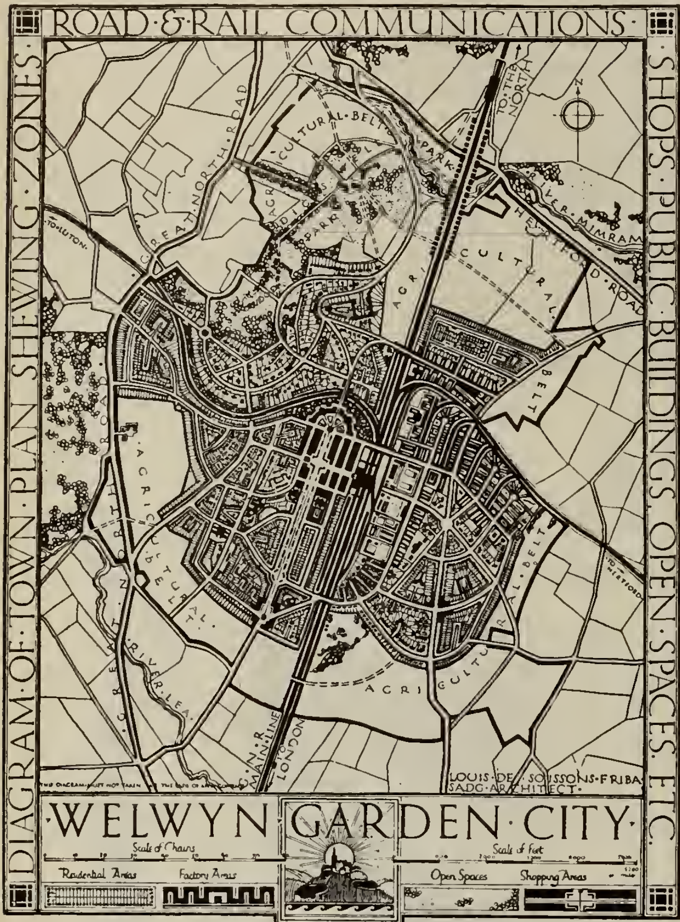

Fig. 2—Welwyn Garden City, Hertfordshire, England, general town plan.

life, but not larger; surrounded by a rural belt; the whole of the land being in public ownership or held in trust for the community." The community ownership of land is not considered essential in America, as the conditions of land tenure there are very different from those that prevail in England. Garden cities can be established without this feature.

From the above definition we see that a garden city is not a suburb nor a village and that it should have distinct civic and corporate life. It should moreover be surrounded by a green belt, so that the benefits of country surroundings can be secured, and agriculture should be established as an integral part of the town's economy.

The establishment of satellite towns is a process of decentralization of the great city; but their sites should be selected in accordance with regional plans. Regional planning is indispensable in fostering joint action between these towns and the mother city, especially as to problems related to ways of communication and land uses.

In this field, the Resettlement Administration of Washington is engaged in building a few rural-industrial communities, on a demonstration basis, on the outskirts of badly crowded cities. Its work is of great interest to city planners as it promotes the decentralization of industry and population. This federal agency has for its basic programme the establishment of one-ownership communities up to about 3,000 families, to demonstrate modern community building and living, with better methods of providing low-rental homes. The areas chosen are protected by encircling green belts, so as to break the traditional lines between town and country, and to enhance the mutual advantages of their inhabitants. Such satellite towns are being built in the following areas:

"Greenbelt," the community on which work was first started, is located seven miles north of Washington, D.C. "Greenhills" lies five miles north of Cincinnati, Ohio; "Greendale" is three miles south-west of Milwaukee, Wisconsin.

These three projects are being supervised by the Farm Security Administration.

A similar community has also been partially carried out in Radburn, N.J., about twenty miles from New York. Although not a garden city like Letchworth or Welwyn, it has some of their attributes. There are super-blocks bounded by motorways, in the centre of which is a park reservation. Houses are grouped around gardens, not located on through arteries. A system of foot paths makes it possible to reach any part of the community without crossing motorways.

Visitors to the 1939 New York World's Fair have viewed a panorama of the *City of Tomorrow* or *Democracity*[10] which embodies certain principles of the Sir Ebenezer Howard Garden City movement in England, as a means of decentralization of industry and population, but is on a larger scale. Sir Ebenezer's dream of an ideal community was realized in the building of Letchworth, Welwyn and other garden cities in England and in other countries. Democracity, conceived by Henry Dreyfus in the light of our present technical knowledge of city planning, represents also an ideal community, but is planned for a million people instead of the 100,000 population suggested by Sir Ebenezer. In the Dreyfus model there is a central city which is almost exclusively planned as an administrative, cultural, business, transportation and recreational centre. There is a green belt beyond this central city in which farms and market gardens are provided. In this belt are located a group of satellite towns in the truest sense of the term, as they depend to a large extent on the central city. A certain number of these satellite towns will be industrial and others will be mainly residential, but the whole is to be planned in accordance with the principles of regional planning.

Regional Planning and Metropolitan Areas

In all large cities the movement of population from the centre to the outlying parts proceeds naturally in accordance with the means of communication, throughout the territory they serve. It depends also on topography and usually results in lineal growth or an incoherent development. Small cities and villages are interspread between large centres and the growth is haphazard.

This applies also to "ribbon developments" which are created on the edges of arterial highways. The means of locomotion, highways and transit facilities generally determine the design of these lineal developments so that there is no scientific city planning.

Suburbs cluster about every large city and constitute a metropolitan area which is not necessarily a political unit. To solve regional planning and zoning problems there should be unity of action and planning in neighbouring communities. The decisions should be conditioned by topography and natural functions, rather than by administrative boundaries.

The committee on Metropolitan Government of the National Municipal League[11] suggests that the limits of metropolitan regions should be such as to enclose:

(a) an area from which people travel daily to and from the central city;

(b) an area served by electric power and light from the central city and by telephone operating from the city as a base;

(c) an area served by city water and other public utilities.

Moreover, it has been observed by the League, that the movement of the population to suburbs is determined by the same fundamental motives or considerations: inexpensive land, low rents, freedom from congestion, opportunities for outdoor life, etc. Hence there is the cityward movement of the population in the morning and towards the suburbs at night.

The same committee further stated that the people of a metropolitan area usually fail to realize that they constitute a real community and have common problems of planning, sanitation, traffic, transportation, water supply, light and power, health administration, police and finance. For the proper development of a metropolitan area the unification or centralization of administration for major problems is necessary, and it also requires provision for the decentralization of population by regulated growth already referred to. In a word, to put into effect the decentralization of industry and population, the best available means consist in the centralization of administration for major problems, as practised in Greater London and Greater New York.

Decentralization vs. centralization

In discussing the problem of decentralization vs centralization, Thomas Adams is quoted by the authors of Our Cities of To-day and To-morrow,[12] as saying that the difficulties of overcoming overcrowding, in congested and overbuilt neighbourhoods, can in part be attributed to the persistence of the fallacy that transit facilities promote decentralization. For a time they enable people to spread their homes over wider areas, but ultimately they become a new cause of centralized congestion.

The only way to promote decentralization as suggested by Adams is by a properly balanced distribution of both industries and population over wider areas, with a lessening of the necessity to travel from the home to the place of work.

The trends induced by city planning and zoning cannot fail to result in better distribution of population. In unplanned and unzoned cities or in those having neither effective laws or efficient organizations to put them into effect, the direction and intensity of growth is often established by public utility companies but only for their particular needs. Such conditions encourage haphazard growth and the consequent lowering of land values already referred to.

Fig. 3—Welwyn Garden City. Airview of part of the residential section showing individual gardens and public recreation spaces.

Finally, it has been found that in cities provided with a comprehensive plan, the public is sympathetic to the movement, as soon as it realizes that the future needs and the direction of the city growth can be foretold, economic waste prevented, the element of beauty and the amenities preserved and finally public health safeguarded.

Zoning Regulations Established for Marseilles

In the light of the above general considerations, it will be of interest to consider the cases of Marseilles and of Montreal, the world's largest French cities, outside of Paris.

Following the comprehensive planning studies of Marseilles by Jacques Gréber,[13] provisions have been made in that city for the continued enforcement of existing regulations relating to the height and form of buildings. The permissible height of buildings depends on the size of the building lots and the width of streets on which they abut. In general the height of the vertical walls of buildings must not be greater than the width of the streets. On streets running north and south, however, this height may be increased to one and a quarter times the width of the street, provided this maximum does not exceed 25 meters.

The total height of buildings may be as much as 35 meters, but the portion of the building above the vertical wall must be within a profile bounded by two lines, one rising from the top of the vertical wall at 80 deg. with the horizontal, and one sloping down from the highest point of the building at an angle of 45 deg. with the horizontal.

This arrangement results in buildings with vertical setbacks, joined together by terraces or nearly flat roofs. Mansart roofs, which on account of the height of vertical walls on which they stand are out of scale and require roofing materials not in harmony with the character of the region, are thus avoided.

In certain residential zones, buildings are limited to a maximum height of 15 meters, of which the vertical walls cannot take more than 10 meters. From the upper point of the vertical, a slope of 30 deg. with the horizontal is allowed in order to reach the maximum allowable height. On large plots, the height may attain 21 meters, provided equivalent distances are left at the front and at the rear of buildings.

Zoning Regulations in Force in Montreal

Montreal building regulations,[14] which are also based on modern research and recognized standards, limit the number of storeys to 12, the height of buildings to 130 feet and to 1½ times the width of the street on which they abut, except for the central areas of the city where the maximum height allowed is twice the width of the street. This does not apply to streets of less than 50 feet, where buildings cannot be more than 100 feet in height. In the central area, the permissible maximum height of buildings is 140 feet, on streets having not less than 66 feet in width between homologated lines, provided with set-backs of not less than 10 feet. In all cases the set-backs are counted in the effective width of streets.

Tower buildings can, however, be erected in Montreal, provided that above the permissible heights, the front and rear walls be set back one foot for every four feet additional height, and also provided the total floor areas of the building do not exceed 12 times the area of the part of the lot which may be lawfully built upon. Still another concession is made for buildings fronting a square or a public park, provided towers do not exceed in width and in depth 40 per cent of the width of that part of the lot which may be lawfully built upon, nor, in any case, 50 feet in depth and 50 feet in width. In these cases the height should not exceed the permissible heights by more than 200 feet, and no part of such towers should be at less distance than 25 feet from the face of the rear wall of the building. No restriction is imposed on the number of storeys if these conditions are fulfilled.

Although interim and piecemeal ordinances are not desirable, the compilation of all existing building restrictions of about half of Montreal territory, effected in the last few years with the differentiated regulations, will be of great help in the preparation of the comprehensive zoning of the Montreal metropolitan area. The work already undertaken is but preparatory to this desired result, which cannot be attained without the preparation of a comprehensive plan.

Montreal has a great opportunity for city planning

In 1883, the city of Montreal covered about ten square miles; it now has fifty square miles and includes twenty municipalities, annexed to the original territory since that year. The city is subdivided into 35 wards, varying in density of population (1931), from 3.2 to 139 persons per

Fig. 4—Airview of Greenhills, Ohio, U.S.A .

acre, while the average density for the whole territory is 27.4.

An unusual, rapid, but inevitable growth has taken place, attributable to rural depopulation. This was observed by Raoul Blanchard, professor of geography of Grenoble University, France,[15] in his recent book, entitled "La Plaine de Montréal," which forms part of a series of similar studies for the other regions of the province of Quebec. This author found that the territory included in the twenty counties (or parts thereof) surrounding the Montreal region (the latter including the three islands of Montreal, Jesus and Bizard, and the territory on the south shore of the St-Lawrence river, with the two suburbs of St-Lambert and Longueuil), had a smaller population in 1931 than in 1861. In the latter year, the population amounted to 272,000, while the last 1931 census recorded it as 260,000, thus giving a loss of 12,000 in seventy years. The total population of the plain of Montreal, including the region, was estimated at 1,300,000 for the year 1931.

The above data and past experience serve to demonstrate that this city has great opportunities to regulate its future growth. 1942, the year of the celebration of her 300th anniversary would be an exceptional occasion to offer to the population of Greater Montreal a careful studied master plan for its territory.

Montreal has made steps in the right direction in the last few decades, in the provision for certain main arteries and grade separations, adequate and pure water supply, the construction of a few trunk sewers, but all future important and necessary public works should be planned in accordance with a master plan, correlated with a regional plan for the whole island and its immediate surroundings, or for the region of Montreal as above described.

Opportunities would be given in the preparation of this master plan for the creation or extension of parks and recreational facilities, to supplement those already existing, of which a certain number are of exceptional beauty. These include the Mount Royal Park, an elevated area about 1½ miles west of the central part of the city, whose summit is over 700 feet above sea level; historic St. Helen's island with its old forts; Lafontaine park and its artificial lakes; and Maisonneuve park with its botanical gardens, its municipal golf course and its sporting centre for recreation and major events in athletics. Lastly, other opportunities would be given in the preparation of a master plan, as suggested for Marseilles, for more practical intercommunications between the city and the port.

In this line of thought, Hubbard & Hubbard[12] in their survey of planning activities in the United States, point out that the independent position which rail and water carriers have heretofore occupied has inevitably caused the transportation elements of the city structure to expand with little regard to the other elements of the city plan. Thus, the early developments of transportation lines uncoordinated with the unregulated growth of the city caused, in Montreal as in other large cities, a situation which can only be remedied by comprehensive planning.

THE MONTREAL REGION AND ITS OPPORTUNITY FOR CONTROL OF GROWTH

In addition to the city of Montreal, the Montreal region contains fourteen autonomous municipalities which are subject to financial control by the Montreal Metropolitan Commission. The two richest of these municipalities are Westmount and Outremont, which are in a broad sense, satellites of the city of Montreal, as they depend upon it for their major public services. There are, moreover, twenty other municipalities on the island of Montreal. The city covers about 28 per cent of the 177 square miles of the island of Montreal, while 85 per cent of the total population of the island resides within the city of Montreal limits.

In addition to the zoning ordinances referred to above, the regulation of population growth and land uses in the city of Montreal is exercised through the provisions of building and sanitary by-laws, and the Quebec provincial regulations relating to dwellings in general. It has been realized, as in other large cities, that a new conception should be given to these regulations, but in the light of a progressive developing a city plan. Their advantages would become more evident if the co-operation of land owners with the enforcing authorities were assured.

In the near future there will be available, as a model for all Canadian municipalities, a scientific building code which is being prepared under the auspices of the National Research Council of Canada. It will secure uniformity of standards and flexible building methods to suit varying climatic conditions and established customs. It will set up general principles on structure soundness, sufficient fire protection and adequate sanitation, and will provide guidance to municipalities in all technical matters, including zoning.

It is hoped that the Council's guidance to municipalities will continue its sponsorship, in the matter of city planning, and will implement in this field the valuable work accomplished several years ago by two organizations, no longer in existence, the Commission of Conservation and the Town Planning Institute of Canada.

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CITY DECENTRALIZATION BY APPROPRIATE DISTRIBUTION OF OPEN SPACES

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Abridgement of a paper prepared for presentation at the British-American Engineering Congress, New York, September 4th-8th, 1939

The benefit of decentralization needs no long explanation. It is properly a commonplace, but we often notice that a misconception of modern life gives the most obvious commonplaces the appearance of paradoxes, and it is a privilege, amongst many others, of the city planner, to have to preach (generally in vain), the value of commonplaces, such as:

Good housing is the foundation of social peace.

Pure air and sunshine promote health and working power —or,

Methodical distribution of open spaces increases the value of real-estate.

In our century of speculation, it may even be said that decentralization is the most paying investment of public money.

The congestion of cities is due to a combination of the following physical and financial causes:

1. Insufficient arterial system and poor transportation facilities.
2. High cost of commuting from home to business and vice-versa.
3. Lack of rational planning and zoning.
4. Excessive cost of building lots due to land speculation.
5. Inadequate distribution of shopping districts and of recreational places.

Decentralization does not mean necessarily that great distances should separate the various centres of urban activity. On the contrary, a harmonious system of commercial and civic groups of a relatively dense character should line or frame the main arteries and the most active intersections, while the intervals between main arteries should be treated as quiet and green spots for residential subdivision, schools and recreation.

A gradual decrease of density from the central nuclei, in brief, a natural transition from city to country, is the ideal law of modern planning.

Hilversum, in Holland, with its wide open views from the heart of the residential districts towards the fields, gives the impression that the city's plan is just the opposite of the average town plan: instead of a built up mass of city blocks with scattered open spaces, Hilversum is positively a part of the surrounding country, an open space with a system of residential, commercial and industrial blocks logically distributed over it: it is the perfect type of decentralized urban unit, without the excessive waste of land, time and money, resulting from the principle of real satellite decentralization.

Here comes the consideration of the size of urban territory. The city planning principles cannot be absolute, if efficient results must be achieved. Ideal planning applies to a theoretical territory and to unlimited financial means of creation and maintenance; while the practical case is unfortunately subject to variations or material impossibilities. We generally have to work on existing ill-planned and imperfect towns. Their delimination is the result of many factors, but there is one, that has never been considered: town planning. Moreover, the new notion of regional planning is still considered as a luxury. Very few are those who understand its real-estate value, or if they do, who act accordingly. In most cases, we have to work within the limits of a municipal territory, nursing the hope that at some future time, joint work may be possible for the benefit of neighbouring communities.

If the municipal territory is larger than the eventual needs of urban extension, we are able to apply a logical decentralization by avoiding congestion through a preconceived system of organized open spaces, carefully designed, as a result of the comprehensive survey of existing conditions. In such a case, rational zoning can be established under the jurisdiction of one municipality.

But, if the urban agglomeration spreads and covers parts of adjoining municipalities, as it often does in fast growing modern centres, and if the annexation of those extensions is impossible or remote, a different planning principle must be applied: vertical extension and greater density of construction, provided that they are combined with a corresponding acreage of additional open spaces and street widths. This particular case occurs when the spontaneous exodus of certain classes of land users, commercial, residential or industrial, has proved that the point of saturation has been reached, resulting in a loss for the central city, whereas the apparent gain for its suburbs has been eliminated by the lack of comprehensive organization. Consequently, regional planning, or at least joint planning by grouping several municipal problems, are the only logical ways of avoiding blighted areas and of preparing a gradual decentralization and stabilization of land occupancy, a result which is not necessarily obtained only by legal restrictions and zoning by-laws, but is equally helped by the appropriate layout of the master plan.

Fig. 1—Airview of Fairmount Parkway, Philadelphia, U.S.A.

The easy growth and the prosperity of a city, the physical comfort of its inhabitants, their moral well-being and their social equilibrium, are all conditioned by a minimum percentage of green, of sunshine, of natural beauty and of recreational possibilities.

To reach this aim, the imagination of the engineer and of the city planner, working in close co-operation, is more effective than intricate legal dispositions and restrictions. As an example, parkways are attractive and safe, while common roads are generally tedious, ugly and dangerous. This shows that proper design has far reaching possibilities.

The development of automobile traffic is the main reason for the particular layout of the plan of Radburn, New Jersey. Drives and service roads leading to garages and

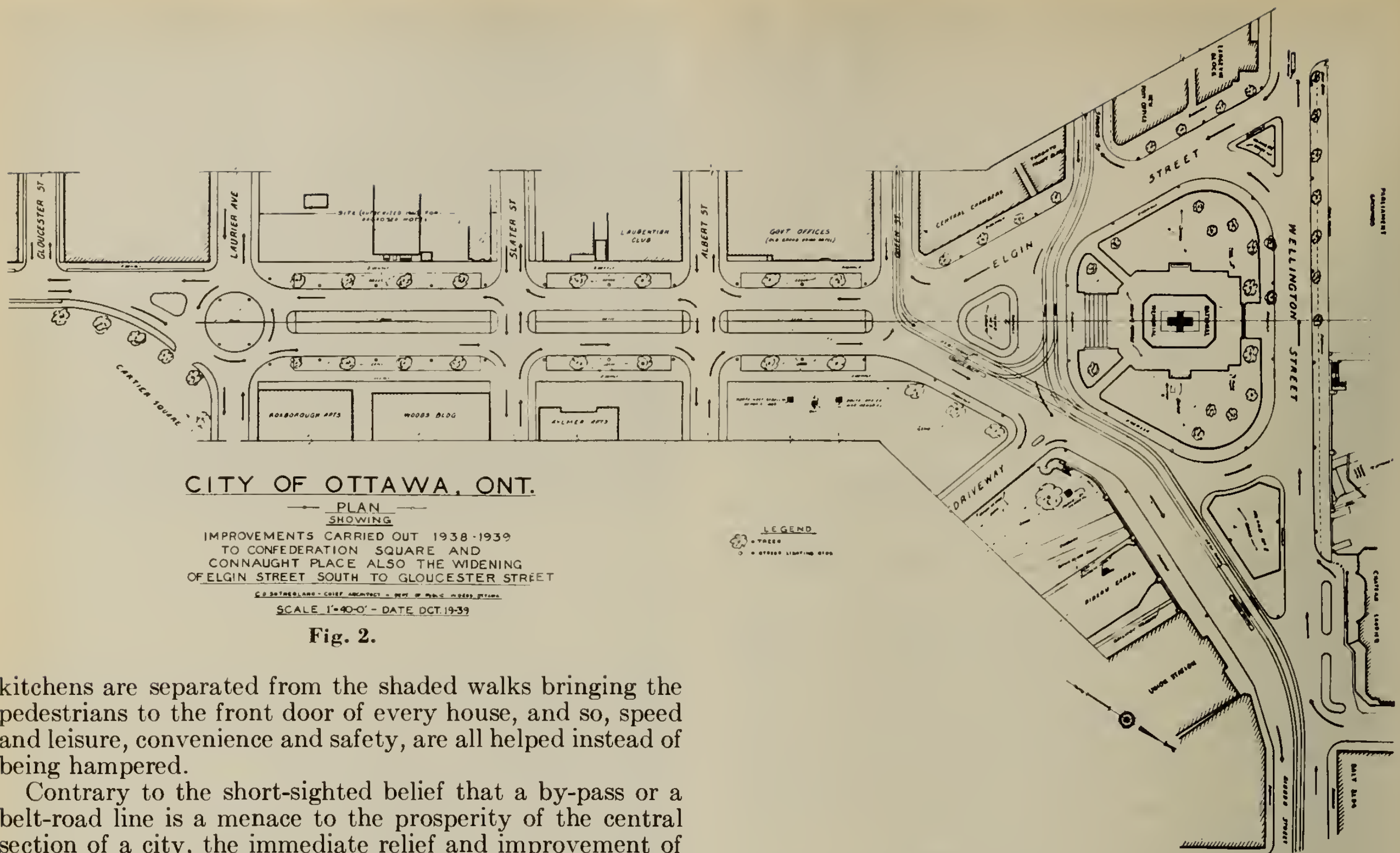

Fig. 2.

kitchens are separated from the shaded walks bringing the pedestrians to the front door of every house, and so, speed and leisure, convenience and safety, are all helped instead of being hampered.

Contrary to the short-sighted belief that a by-pass or a belt-road line is a menace to the prosperity of the central section of a city, the immediate relief and improvement of traffic conditions obtained by the creation of such arteries brings a considerable increase of general traffic, and consequently promotes the commercial activity of the city. Examples are particularly convincing in the United States. More than 300 million dollars, spent only for the city of New York and for the betterment of radial and circumferential circulation throughout its immense territory, always combined with addition of parkways, parks, recreational grounds, i.e., organized lost spaces, is the best proof that decentralization is as much a matter of planning and engineering as one of legislation.

The Park Department of the City of New York, Commissioner Moses and his staff, and the magnificent work already completed by the various authorities of the City and State, have done more for the success of modern city planning conceptions than any other organization in charge of a great metropolis.

The beautiful 1,200 acres Flushing Park (for which Greater New York will be indebted to the New York World's Fair), is perhaps the most striking example of long range decentralization. With its remarkable equipment of high capacity arteries, bridges and transportation lines binding it to Manhattan, Brooklyn and the Bronx, it will gradually create new centres of urban life on its eight miles long perimeter, and will improve the badly planned and rather blighted agglomerations already existing in its vicinity.

In Philadelphia, a similar improvement, of a more local character, has been the construction of the Fairmount Parkway, a diagonal artery two miles long, bringing a wedge of green, a quarter of a mile wide and one mile long, right into the heart of the city. With the planting of the Schuylkill river embankments, to be completed by the Belt Park from West Philadelphia to the east side on the Delaware river front which was first recommended in 1930, the whole system will form a ribbon park throughout the centre of the city, and will relieve the congestion created by the present bad distribution of traffic, business and residence.

In Ottawa, federal capital of the Dominion of Canada, three main problems were considered, remembering the importance of the city in the life of the nation and the natural beauty of its site.

1. Practically, the whole city is in a mass of green, with a wild cliff on the Ottawa river. The public buildings of the Dominion Government form a long civic centre extending about a mile and a half from east to west. The general appearance is dignified, beautiful, simple and welcoming.

Here the problem for the city planner is less to create than to preserve.

2. However, modern circulation and general parking facilities are also essential needs of the city, just as they are in Washington. Thus the principal feature of the master

Department of Public Works, Ottawa

Fig. 3—Ottawa, Ont.—View of the widened portion of Elgin Street looking from Laurier Avenue towards the National Memorial.

plan proposed for Ottawa consisted in emphasizing its beauty without neglecting the practical improvements necessary for its future development.

3. The centre of the city is now occupied by a blighted area, a freight yard, just back of the passenger station. On this site, it is possible to create a business plaza with

diagonal radiations, which will give the city a real centre of circulation, which now is completely lacking. The entire improvement of the street system of the city depends on this first operation.

But the key-note is to keep the blanket of green which extends over the whole city.

After noting this inspiring Canadian example, one may mention a somewhat timid application in France of similar city planning conceptions for the plan of Marseilles. Here, a beautiful natural setting, and a large municipal territory (60,000 acres), almost offered the possibility of a regional plan within the municipal limits. But the circulation in the city, the housing rehabilitation and the equipment of the port (the largest in France and in the Mediterranean), made the task more difficult than in the case of Ottawa.

Along the same lines of broad decentralization, the conceptions of the new housing developments in Westchester County in New York, in Radburn (New Jersey) or in Philadelphia (Alden Park), as well as in Hampstead, Welwyn and Well Hall in England, and Abbeville, France, are also based on the simple principle of losing as much ground as possible to make the urban residential districts look like parts of the open country.

Perhaps still more beneficial to the future of the race, is the idea of having schools built in the middle of gardens—(Chicago, Hilversum).

In Marseilles, playgrounds were suggested adjacent to all schools and scattered over the densely built centre of the city.

The organization of camping grounds, forest reservations and recreational camps all through New York State as at Bear Mountain Park, at a short distance from the larger agglomerations, has great influence on city life. It may even affect the summer resorts in the mountains or on the seaside. If vacation camps are possible near the cities, a change may occur which will avoid great transportation expenses and the usual summer mass exodus to unprepared boarding places.

This result would have the advantage of solving a very difficult planning problem. Most summer resorts are villages, with a small number of permanent residents, and become for a short time, in the summer, large agglomerations, where proper sanitary conditions and even elementary comfort are impossible. If proper equipment for the peak season is installed, the cost of the work makes its operation a failure, either for the township, the state or a private company.

Dudok, the Dutch city planner, has truly said that the most practical, and economically most successful city plan is the one where all urban facilities exist, but are apparently concealed by the dominating appearance of country-like atmosphere.

Notes and Figures

POPULATION DISTRIBUTION

The U.S. Census Bureau, surveying 95 cities of more than 100,000, has shown that they contain a total of 55 million inhabitants, or 44.7 per cent of the whole population of the U.S., living on one-eighth of the national territory.

Of this number, 70 per cent live in the central portions of the cities, and 30 per cent in the suburbs.

Between 1920 and 1930, in the Philadelphia region, the proportional increase of population in the cities was 5.9 per cent and in the outlying areas (suburbs) 40 per cent or seven times as great.

POPULATION DENSITY

In the New York region, population density varies from 16 to 261,000 persons per square mile within a territory of 5,528 square miles, with a total of about 10 million inhabitants.

The urban population of the region, which in 1850 was less than 50 per cent of the total, in 1932 reached 83 per cent in 74 urban centres, covering only 7.3 per cent of the total area.

Density of population is more a question of logical distribution than a question of maximum number.

Comprehensive planning and zoning promote orderly land occupancy, reasonable saturation under healthy conditions and real estate prosperity.

An average of 150 inhabitants to the acre is satisfactory for moderate cost housing, and 100 for higher class developments, but the type of buildings, number of storeys and the

Department of Public Works, Ottawa

Fig. 4—Ottawa, Ont.—View looking west from Union Station across Connaught Place and Confederation Park, during the carrying out of improvements.

Department of Public Works, Ottawa

Fig. 5—Ottawa, Ont.—View looking west from Union Station across Connaught Place and Confederation Park, on completion of improvements.

character of the town, its park rate, and its climate, may easily justify a variation of from 25 to 250 people per acre.

BLIGHTED AREAS

Blighted areas are due to the lack of survey and previous planning and zoning. Depreciation of property values, desertion, and misuse are the results.

The tax returns soon become insufficient for improvements; the public utilities are operated at a loss.

HOUSING DEVELOPMENTS

Only large units can be self supporting and encourage new settlers, as they are operated at lower cost than small subdivisions and offer independent and immediate facilities for schools, churches, libraries, shopping, recreation, sport, hospitals, fire protection, etc. They form complete and appealing residential villages.

To avoid disorderly blanket growth of suburban developments, rural existing zones must be protected against undesirable, and generally badly planned and speculative developments.

With large lots (two acres minimum for example), no public service or utility distribution is possible, and construction covers only 5 per cent of the land. Then only farms or large estates with independent water supply, lighting and sewage plants can be worked, but the country-like character is preserved.

CIRCULATION

Traffic and transportation are the lifeblood of modern civilization.

The layout and equipment of traffic and transportation must not follow the needs, when the territory is already congested, but must look ahead and prepare for the logical use of the land; public thoroughfares ought to be established on low cost land to promote increase of value, instead of being cut too narrow and at high cost through congested blocks, with no prospect of increase of land values.

If roads are built previous to the saturation of the territory, a proper system is possible, with separation of heavy and commercial traffic from passenger and pleasure travel.

This permits better speed and more efficient service, leading to better land use and value.

Existing country roads should be kept, in their picturesque and attractive character, without being widened or even straightened, but this requires the creation of wider roads for utilitarian through-traffic more or less parallel to the old roads, which become naturally a renovated centre of quiet residential or recreational use.

On the new roads the roadside must be landscaped, and the pavement must be separated from the sidewalks or pedestrian ways.

WATERFRONTS

The use of waterfronts and creek villages for ribbon parks and parkways has many advantages of beauty, convenience, and the use of water for bathing, canoeing and fishing. Protection must be afforded against pollution by uncontrolled sewage outlets, industrial misuse, and loss of land value in the adjoining districts.

When it is possible, the use of ribbon parks for parkway circuits helps decentralization and relieves traffic congestion on existing streets and roads.

CITY PARK RATIO

The present ratio varies from 1 to 10 acres per 1,000 inhabitants in most of the largest cities in the world.

In 1932, the following figures applied:—

Philadelphia Region—15,000 acres or 4 acres per 1,000 inhabitants.

New York Region—108,000 acres or 9 acres per 1,000 inhabitants.

Chicago Region—53,000 acres of 10 acres per 1,000 inhabitants.

The Philadelphia Regional Plan calls for an increase of parks and reservations of 115,000 acres (or nine times the present acreage), to bring the ratio up to 20 acres per 1,000 inhabitants, in 1970. (The population was 3,520,000 in 1932 and is estimated at 5,860,000 in 1970).

INCREASE OF LAND VALUE DUE TO DECENTRALIZATION

A striking example of this is furnished by Westchester County, New York. The decentralization work carried out in 1924 cost 60 million dollars. Fifteen years later the assessed valuation of the county had increased by 500 million dollars. This was accomplished by a great improvement in the class of real estate, and inestimable benefit to public health and well-being.

It is impossible to separate the study of decentralization from the comprehensive work of planning, and again we repeat that circulation, population density, housing, public health and welfare, business and industry, recreation and urban beauty, are the equally vital components of a happy and prosperous city. If one of them is missing, deficient or neglected, the whole body is endangered.

NEW REINFORCING MEDIUM FOR CONCRETE*

The successful use of glass in place of steel as reinforcement for concrete has recently been announced. Developed as a result of research put in hand at the outbreak of war it has opened up a field of investigation which may well lead to the use of glass reinforcement on account of its own particular qualities and not merely as a war-time substitute.

Mr. A. W. Soden, A.R.I.B.A., and Mr. J. A. Lincoln who carried out the research submitted the results to Mr. E. H. Paisley, A.R.P. engineer to the Borough of Kensington, for consideration as a reinforcing medium for concrete in air raid shelters. Independent tests were subsequently carried out at the City and Guilds College Structural Laboratory.

The results of these tests have shown that slabs of glass-reinforced concrete would carry four times the maximum load required by the Home Office for street and other air raid shelters.

In reinforced concrete beams steel rods are embodied in the lower edge to take the whole of the tension which is equal to the compression taken by approximately the top third of the concrete. The remaining two-thirds of the concrete is mechanically wasted as regards load-bearing and merely acts as a binding agent and shear. It has been found, according to the report of the investigators, that by substituting glass-reinforcement for steel the neutral axis is lowered and more concrete is brought into play for compression. And as the glass cross-sectional area is three times as much as steel, little concrete is wasted.

The glass reinforcement so far used is in strips $\frac{5}{16}$ in. thick, the depth being half the depth of the beam which it is to reinforce. An important feature is that one edge of the glass is not cut but is the fire-finished edge, known as the selvedge, in the state in which it comes from the process.

For reinforcement requirements, it is stated, polishing and refining weaken the glass, and the cut edge is incapable of taking strain. By placing the glass strips in the beam or slab so that the cut edge is at the neutral axis and the selvedge lowermost, the stress taken by the glass, although only half that of rod form is practically and scientifically balanced. In this form also, shear does not need to be provided for.

In these early stages there are, of course, certain disadvantages, notably the present limit in span and a lower impact load than steel reinforcement. Impact load, however, is mainly concerned with the problem of surface air raid shelters and here the difficulty is easily overcome by a number of methods. Finally, there is the absence of yield

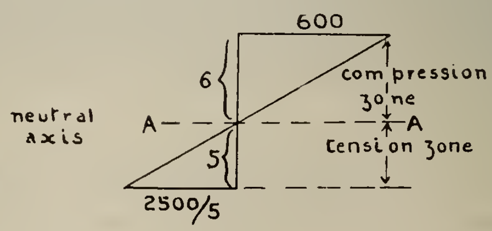

Fig. 1.

*Reproduced from *Civil Engineering And Public Works Review*, (London, Eng.).

before failure. These disadvantages revealed by initial tests will be subjected to further research.

1. Position of Neutral Line.

In calculating proportions to be adopted in cross-section the limiting stresses which can be allowed in the top and bottom of the section are used to give the proper position for the neutral line.

The data assumed for concrete and glass are as follows:—

Young's Modulus:—

Concrete—2,000,000 lb./sq. in.

Glass—10,000,000 lb./sq. in.

Limiting Safe Stresses:—

Concrete—600 lb./sq. in. (in compression).

Glass—2,500 lb./sq. in (in. tension, fire-finished surface).

In a beam of depth d in., the neutral line will be at a depth from the top such that when the compression in the top layer introduces a compressive stress 600 in that layer, the tensile stress in the bottom layer will be 2,500. Since glass has a Young's Modulus five times that of concrete, the relative compression and extension to give these stresses will be proportional to 600 and 2,500/5, i.e. 600 and 500. This compression and the corresp nding extension are proportional to the distances of the upper and lower surfaces of the beam from the neutral line, consequently if the full depth of the beam is represented by 11, the compression zone (from the top down to the neutral line) will be represented by 6, and the tension zone (from the neutral line to the bottom of the beam) is of depth 5.

2. Cross-sectional Areas of Concrete and Glass.

Since glass is so much weaker than steel a relatively large cross-sectional area will be needed, and it cannot be assumed that the glass can be introduced as a thin rod with its centre at the lower limit of the tension zone. No part of the glass must lie below this limit, otherwise it will be stressed to an amount greater than 2,500 lb./sq. in. when the concrete is loaded to 600 lb./sq. in.

It is, therefore, necessary to imagine the glass to be distributed throughout the full depth of the tension zone in order to find what cross-sectional area may be needed. This gives in effect a composite beam of theoretical cross-section shown in Fig. 2. The breadth at the top can be denoted by b, and the breadth at the bottom by y.

When the beam is loaded, the neutral axis being at AA, the compressions in the concrete must just balance the tensions in the glass, i.e. $\frac{1}{2}\,600 \times 6b = \frac{1}{2}\,2{,}500 \times 5y$, which gives $36b = 125y$, or

$$y = \frac{36b}{125} = .288b$$

The stresses will be balanced, therefore, if the width of the glass section is only 0.288 times the width of the concrete. For convenience it will be taken that $y = 0.3b$.

3. Suggested Construction.

The foregoing results indicate that the most economical construction would be to construct the beam of uniform cross-section throughout, the upper half being solid concrete and the lower half being made with vertical strips of glass embedded in the concrete at distances such that the separation between the strips is $2\frac{1}{3}$ the thickness of each strip. The vertical dimensions of the strips would be not quite equal to the half-depth of the beam, this would be made up allowing a small "cover" for the under edges of the glasses. The proportions are indicated in Fig. 3.

It would be of some advantage to allow the glass to penetrate a little way *above* the neutral line AA so as to ensure the top (cut) edge being in compression.

4. Strength of Glass-Reinforced Girder.

If the stresses across 1 in. of the section are considered to obtain the limiting bending moment, it must be assumed that the depth of the girder has some value d inches, including the "cover" of concrete on the underside below the glass. This "cover" will be considered to be of thickness $1/1d$.

Then equivalent force (compression) in concrete $= \frac{1}{2}d\ 600 \times .5d = 150d$. The effective line of action of this force is at a depth $1/6d$ below the top surface, i.e. at a distance $\frac{1}{3}d$ above the neutral level.

Equivalent force (tension) in glass $= \frac{1}{2}\,2{,}500 \times \frac{5}{12}d \times \frac{3}{10}$.

(The $\frac{3}{10}$ factor comes in because the glass occupies only $\frac{3}{10}$ the full width of the girder, the rest being concrete of no tensile strength.) So equivalent force in glass $= 156.5d$.

The discrepancy between this value and $150d$ is due to taking the strip as occupying $\frac{3}{10}$ the width instead of $\frac{36}{125}$; both values will be taken as $150d$.

TABLE I

Detailed of Reinforcement of Specimens

Specific-No.	Cross-section	Length	Reinforcement
1	12 in. × 4½ in.	4 ft. 6 in.	10 strips at 1⅛-in. centres.
2	12 in. × 4½ in.	4 ft. 6 in.	10 strips at 1⅛-in. centres.
3	12 in. × 4½ in.	4 ft. 6 in.	6 strips at 2-in. centres.
4	12 in. × 4½ in.	4 ft. 6 in.	6 strips at 2-in. centres.
5	12 in. × 4½ in.	4 ft. 6 in.	10 strips at 1⅛-in. centres.
6	12 in. × 4½ in.	2 ft. 3 in.	10 strips at 1⅛-in. centres.
7	12 in. × 4½ in.	2 ft. 3 in.	6 strips at 2-in. centres.

TABLE II

Results of Bending Tests

Specimen No.	Bending Moment		Design Moment (Soden)	Factor of Safety
	First Crack	Failure		
	lb./in.	lb./in.	lb./in.	
1	56,300	64,800	26,700	2.43
2	60,500	61,800	26,700	2.31
3	34,500	45,300	16,000	2.83
4	43,800	45,100	16,000	2.82
5	57,000	63,600	26,700	2.38

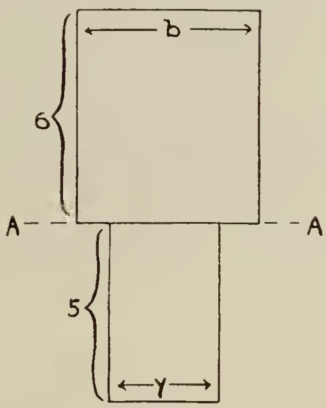

Fig. 2.

Effectively the force in the glass acts at a distance of $\frac{2}{3} \times \frac{5}{12}d$ below the neutral line.

The total bending moment is thus equal to:

$$150d \times \left(\frac{1}{3} + \frac{10}{36}\right)d \text{ lb./in.}$$

$$\text{or } 150 \times \frac{22}{36}d^2 \text{ lb./in.}$$

If d is 6 in. this gives:—

Total B.M. per in. width $= 150 \times \frac{22}{36} \times 36$ lb./in. $=$ 3,300 lb./in.

For a beam 1 ft. wide limiting B.M. $=$ 39,600 lb./in.

A girder for A.R.P. shelters must be capable of withstanding a uniform static load of 450 lb. per sq. ft. (in addition to its own weight).

The maximum bending moment due to a distributed load of 450 lb. per sq. ft. would be given by $\frac{wl^2}{8}$ where w is the load per sq. ft. and l the length of the span.

For a 4 ft. 6 in. span this gives:—
Maximum bending moment

$$= \frac{450 \times 4.5^2}{8} \text{ lb./ft.}$$

$$= \frac{9,112}{8} \text{ lb./ft.} = \frac{12}{8} \times 9,112 \text{ lb./in.}$$

$$= 13,668 \text{ lb./in.}$$

The weight of the girder itself would be about 90 lb. per ft. run if the depth were 6 in., consequently the total bending moment would be about 13,668 + 2,734 lb./in., or, say 16,500 lb./in.

According to these calculations, therefore, a girder constructed as suggested in Section 3 would be more than twice as strong as is necessary according to the A.R.P. Specification (revised code) for shelter roofs.

If the depth of the girder were reduced to 5 in., keeping the proportions the same, the limiting bending moment would be reduced to 27,500 lb./in. Reduction to 4 in. (too thin for A.R.P. specification) would still give a limiting bending moment of 17,600 lb./in., which would be more than sufficient to withstand the load specified.

Allowing for the reduced weight of the girder itself, the bending moment would be about 15,500 lb./in. in this case.

A 6-in. steel-reinforced concrete girder with centre of reinforcement 5 in. from the underside would give values as follows:—

Force in concrete $\frac{1}{2}$ 600 × .36d = 108d.

Mean line of action is .12d below top of girder.

Force in steel is also 108d, or should be, and it acts at a distance d from the top.

Maximum bending moment is thus 108d × .88d = 108 × .88d^2.

For a 6 in. girder, the effective value of d is 5 in., so:—
Maximum bending moment for 6-in girder

= 108 × .88 × 25
= 950.4 × 25
= 2,375 lb./in. per in. width.
= 28,400 lb./in. per ft. width.

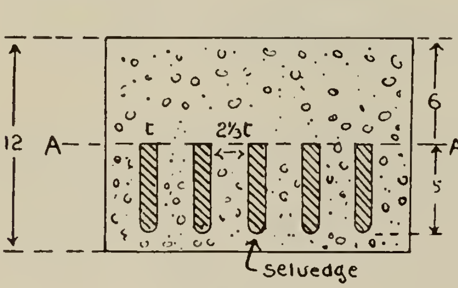

Fig. 3.

This steel reinforced girder would be approximately 72 per cent stronger than is necessary to carry the 450 lb. load per sq. ft. The 6-in. glass-reinforced girder, on the other hand, would be 140 per cent stronger than necessary.

The concrete used throughout the tests, which were carried out at the City and Guilds College Laboratories under the direction of Mr. W. J. Marshall, B.Sc., Ph.D., A.M.Inst.C.E., A.M.I.Struct.E., was a 1:2:3 mix of rapid hardening Portland cement, well-graded clean river sand and ¾-in. ballast, except for specimen 5 where a ¼-in. ballast was used for the concrete between the glass strips. A wetter mix was used for the lower part of the beams to facilitate consolidation.

The glass reinforcement was supplied by Pilkington Brothers, Ltd., and consisted of strips averaging $^5/_{16}$ in. thick by 2¼ in. deep. Details of the specimens are given in Table I.

In each case the glass was placed vertically with the bevelled edge flush with the underside of the slab. Test cubes were also made to give the crushing strength of the concrete used. The specimens were in all cases tested after seven days.

The tests carried out were of two types (a) bending, and (b) impact.

The bending test was carried out on specimens 1 to 5 in a Riehlé test machine. The beams were supported at 4-ft. centres, plywood strips being placed over the knife edges to eliminate local crushing on the glass. Point loads were applied at a distance of 15 in. from each support.

The results of the tests are summarized in Table II.

Deflection readings taken during the test showed no appreciable deflection at one-third of the failing load and at about 60 per cent of the failing load the deflection was .02 in. Failure came suddenly and was of the type usually obtained with brittle materials: on reaching the maximum load complete collapse occurred as distinct from ordinary reinforced concrete, where complete collapse does not occur until some time after the maximum load has been reached.

The impact tests were carried out by dropping a 16-lb. weight from various heights on to the specimen which was supported at 1 ft. 9 in. centres on a plaster of paris bed 1 in. wide. The results of the tests were as follows:—

Specimen No. 6.—Ball dropped from 6 ft. height caused slight cracking on some of the glass strips; on again dropping the ball from this height very appreciable cracking of the glass occurred, the upper surface of the concrete was not damaged.

Probable ultimate momentum absorbed, 112 ft./lb.

Specimen No. 7.—Ball dropped from 4 ft. height had no effect; ball dropped from 6 ft. height caused complete failure.

Probable ultimate momentum absorbed, 88 ft./lb.

It is realised that these tests as they stand have little value, due to lack of figures for an ordinary reinforced concrete slab under similar conditions, but a summary of certain impact tests on reinforced concrete may provide useful comparison.

A concrete slab 2½ in. thick reinforced with .094 sq. in. of steel and supported at 2 ft. 6 in. centres absorbed 144 ft./lb. of momentum and showed failure by crushing of the concrete at the point of impact and spalling-off on the underside.

The crushing tests on the concrete cubes gave an ultimate strength in direct compression of 3,920 lb./sq. in.

The report on the tests concludes that the factor of safety for specimens 3 and 4 is comparable with ordinary reinforced concrete under similar tests, that for specimens 1, 2 and 5 is somewhat lower. The safe moment was based on the values given by Mr. Soden. The impact tests compare unfavourably with ordinary reinforced concrete. Mr. Marshall's recommendations are that for static loading of such an intensity that the reinforcement need not be placed closer than 2-in. centres, glass provides a good substitute for steel; in cases, however, where there is any likelihood of impact loading it should not be used.

WILDFOWL AND THE ENGINEER

R. J. DURLEY, M.E.I.C.
Secretary-Emeritus, The Engineering Institute of Canada, Montreal, Que.

For untold years the unsettled northern regions of Canada were the favourite breeding grounds of the millions of wild ducks and geese of North America. Crowding the sloughs, marshes and waterways, the domestic affairs of these great hosts were carried on under ideal conditions. Food, water, shelter, congenial company and in fact every amenity needed for pleasant family life or desired by the most fastidious bird, were available for any duck endowed with strength of flight and an affectionate disposition.

But a change was at hand. The settlement of the western farm lands and the exploration of the Canadian northland had been accompanied by a cycle of years of low precipitation and a period of over-enthusiastic ploughing and drainage of low lying areas in the prairies. For many ducklings the happy days of dabbling were over. Anxious parent ducks and geese contemplating home life found their nesting sites gone or burnt, and their feeding grounds dried up. The crowds of wildfowl migrating to their winter homes in the South soon began to diminish. Each year fewer birds turned their bills northward in the spring. Both in Canada and in the United States sportsmen and lovers of wild life realized that they had a crisis on their hands.

From information now available it appears that this point was reached about five years ago. Active interest was aroused in the task of restoring and multiplying the waterfowl population. Since 1938 an organization of United States sportsmen has been providing funds for the study and solution of this problem. They have formed two affiliated bodies, "Ducks Unlimited Incorporated" in the United States and "Ducks Unlimited (Canada)" in our Dominion. They have enlisted the active support of thousands of people interested in wild life; they have secured the co-operation of game and fish associations, of Dominion and provincial government authorities, of biologists in the United States and Canada. Already with the assistance of over three thousand co-operators (largely residents in the districts affected) they have gathered valuable information as to the numbers and distribution of our duck population. Finally they have embarked on a carefully studied programme of restoring, as far as is now possible, the feeding and breeding grounds of ducks and geese in North America.

A report* of these activities up to the end of 1939 has recently been issued. It contains figures as to duck census work in 1935, 1938 and 1939, an account of the construction work at 34 sites (which has already improved 640,000 acres of water and nesting grounds), the story of the census methods employed by air and water, and a sketch of the restoration programme which it is hoped will eventually increase the duck population over the 600,000 square miles of our duck production range.

Ducks Unlimited is an international non-profit organization. The duck census was begun in 1935, and continued on a more complete scale in 1938 and 1939. It was based on the map sheets of western Canada issued by the Topographical Survey at Ottawa and covered the prairie provinces, the Northwest Territories, and a portion of the Precambrian area. The northland region survey was carried out by aeroplane. The duck population, number of broods, and total young were estimated on each section by trained observers. The bulk of Canada's duck crop is produced in six main blocks around Lakes Winnipeg, Manitoba and Winnipegosis; the deltas of the Saskatchewan river near the Pas; the central lakes in Saskatchewan and Alberta; Lake Claire and the Athabaska delta; the Slave river; and the Great Slave lake area.

*Ducks Unlimited (Canada)—Census 1938 and 1939 and Kee-man Record Book—Ducks Unlimited (Canada), Bank of Commerce Building, Winnipeg; T. C. Main, M.E.I.C., general manager.

The trend of duck population thus estimated shows an increase of 47 per cent in 1939 over 1935, with a total of some 60 million ducks, of which only about 15 million bred in the farmland region.

The report states that "What is now the agricultural belt of the Canadian West pr bably produced more waterfowl than any other part of their breeding ranges, before the face of nature was changed by the plough. The longer breeding season, abundance of natural foods and innumerable small shallow waters provided ideal conditions, especially for the pond ducks. In this area the duck decline has been precipitous, due to loss of water areas, nesting cover and hunting pressure. Since 1930, drought has taken a heavy toll of adult and young; has been a major factor in the decline; and is suspected also as being partly responsible for the unbalanced sex ratio which has been observed on both the wintering and breeding grounds."

Map showing the important duck breeding grounds in western Canada.

Losses of waterfowl population in the farmland area have been principally due to the disappearance of former breeding grounds from drainage, agriculture, and drought; also to fires, haying, grazing and farm operations.

In "no-man's" land the losses were chiefly caused by the disappearance of the beaver; by muskeg, marsh, and forest fires; by jackfish and by fluctuating water levels. Restoration of the beaver will do much to put this right; they will rebuild their dams, store water at controlled levels and make large areas safe breeding grounds for waterfowl.

But the beaver's efforts can only furnish a portion of the engineering activity that is needed. Restoration works

Fires like this one in Manitoba destroy countless ducks' nests and ruin vast expanses for duck nesting.

are being carried out by human engineers also. Water is being impounded by building dams and dykes; streams are being diverted; sloughs and potholes are being deepened by dynamite or drag-line to ensure permanent pondage during droughts; fencing must be provided to protect nesting cover from grazing and trampling by cattle; fire guards and fire control are needed to save the marsh vegetation in which the birds are nesting; finally much can be done to encourage the growth of suitable plants for food and cover.

A recent letter from the general manager of the Canadian organization gives some idea of the scope of the engineering work which is now in progress. In northern Saskatchewan, for example, a number of dams are being built in co-operation with the Northern Saskatchewan Conservation Board and the provincial government. In Alberta one dam is already completed, another is under construction east of Hanna. Several small dams are being built by the organization on the Qu'Appelle and Arm rivers. A concrete dam 160 feet long with two 18-foot taintor gates and stop-logs is contracted for on the Saskeram river near the Pas, Manitoba. Here it has been necessary to make provision for flood control.

All this is being brought about under the direction of competent engineers and biologists, with the willing help of the sportsmen, farmers, ranchers and others who have the welfare of our wild life at heart.

The conservation work, which is being done by this non-profit-making agency deserves and will receive commendation and support from the Canadian public. It is refreshing to find such guardianship assumed by people who are not actuated by the hope of monetary gain, but by a desire to save and perpetuate the water fowl of North America.

Abstracts of Current Literature

Contributed abstracts of articles appearing in the current technical periodicals

ULTRASONICS AND ELASTICITY

"Ultrasonics and Elasticity," an article by H. F. Ludloff, Westinghouse research instructor in the School of Civil Engineering, Cornell University, has been issued as Reprint No. 11 by the Cornell University Experiment Station. Ludloff has previously published in Europe an exact method of determining the elastic properties of solids by ultrasonic means. The present paper deals with his further studies in applying the method to determination of elastic properties over a wide range of temperature.

The basis of his analysis is the property possessed by some crystals to vibrate with a frequency beyond the audible range when an alternating electric current is applied to them. When one of these crystals is attached to a solid, of which it is desired to determine the elastic properties, the ultrasonic vibration is transmitted and the whole system vibrates, a beam of light is directed then on the solid. If the specimen is transparent, its ultrasonic vibration is sufficient to disturb a beam of light passed through it so as to produce an interference pattern of light and dark lines. This pattern can be recorded on a photographic plate at the opposite side from the source of light. If the solid is opaque, a similar pattern can be secured as the result of reflection from the surface. The form of interference figure recorded on the plate depends solely on the elastic properties of the vibrating solid.

Other methods of testing elasticity are difficult to use at any but room temperature. The ultrasonic method, however, gives accurate results over a wide range extending nearly to the melting point of the solid. Ludloff proves this by showing that experimental data obtained by himself and others verify the mathematical results he has obtained by theoretical analysis. Copies of the paper may be obtained without charge from the Engineering Experiment Station.

EMERGENCY WORKS DIVERSION OF LABOUR AND MATERIALS

Extract from *Trade and Engineering* (London, Eng.), August, 1940

Recent statements in the House of Commons have revealed that the Government building programme has been reviewed for the purpose of concentrating the available sources of labour and materials upon the acceleration of vital works that are nearing completion. Other Government works of less urgency are to give way, in order that the labour and materials may be diverted to building works of urgent national importance. Emergency defence works have absolute priority over all other building operations, and arrangements are now in force to supply the labour and materials required for these works by transferring them as necessary from private building and other works. The Government has decided to institute as soon as possible a system under which private building might proceed under licence. This follows a recent order prohibiting, with certain exceptions, the use of iron and steel for buildings except under licence.

The Government has under consideration plans for the establishment of a Ministry of Building. This has long been urged by the leaders of the industry. The Government, it is learned, has in mind plans for a programme of rebuilding and reconstruction after the war.

Plans for new factories and extensions to existing ones, principally for private firms concerned with the war effort, show little sign of diminishing. A number of local authorities last month received Ministry of Health sanction to complete their housing schemes.

THE GRAND COULEE DAM AND THE COLUMBIA BASIN RECLAMATION PROJECT

From *Mechanical Engineering* (New York), September, 1940

The Grand Coulee dam is the most spectacular, the best known, and the most important engineering feature of both the Columbia Basin Reclamation Project and the programme for developing the Columbia river, the greatest power stream in North America. It is the greatest of all dams in volume—three times the size of the next largest man-made structure in the world; but, more important than that, it is the greatest of all dams in economic value, for it will create employment opportunities and better living conditions for hundreds of thousands of people.

Specifically, the Grand Coulee dam will create farm homes and towns on a million-two-hundred-thousand-acre tract of rich soil, in an excellent climate, within the next twenty-five to fifty years; it will capture, annually, billions of kilowatt-hours of energy now running to waste; it will increase the firm-power capacities of present and future downstream power plants; and it will conserve wasting natural resources.

Development of the Upper Columbia River

In its plan for the ultimate development of the Columbia river, the Engineers Corps proposes ten dams along the 750-mile course of the Columbia within the United States, the uppermost of which is the Grand Coulee dam. It will develop 27 per cent of the 1290-ft. fall of the river between the Canadian border and tidewater below the Bonneville dam, and it will have a generating capacity of nearly two million kilowatts.

The essential features of the Columbia Basin Reclamation Project are the Grand Coulee dam; a storage reservoir of ten million acre-feet capacity above it, extending up the Columbia river canyon to the Canadian border; a pumping plant at the dam; a 27-mile balancing reservoir, formed in the Upper Grand Coulee, 600 ft. above the river bed, by two earth-fill dams; and a system of distributing canals, drops, wasteways, and auxiliary power and pumping plants, to be built as the project develops.

Above the Coulee dams, the drainage basin of the Columbia and its tributaries covers an area of 74,100 square miles, of which 39,000 are in Canada. Of the three most important contributors, the Clark Fork, rising near Butte, and draining western Montana, releases its flood waters earliest. Then the Kootenai and Columbia main stem follow, in order, causing the flow at the dam to reach a maximum in June or July. It is high throughout the summer; and all the water for irrigation purposes and all power for pumping irrigating water, will be furnished by surplus summer flood water, originating in extensive ice fields in the Selkirks and Canadian Rockies. This unique feature of the upper Columbia will make it a valuable complement to other Northwest power streams which are low in the summer.

With the Grand Coulee dam of such height as to back stored water up to the Canadian border, 151 miles away, the head available for power at the dam varies from 256 to 358 ft., with a weighted average of 333 ft. The energy economically available annually will be 12,510,000,000 kwhr. Billions of kilowatt-hours will go to waste in the summer flood periods.

It is estimated that 1,970,000,000 kwhr of off-peak energy will be used ultimately in pumping water for irrigation, and that 85,000,000 kwhr will be used in the plant, on the dam, and in the associated towns. There will be for sale annually, when the plant is completed, 10,455,000,000 kwhr, firm energy not falling below 8,100,000,000 in years of estimated lowest runoff.

The planned installation includes 18 generating units rated 108,000 kva each, and three units for local service, each rated 10,000 kw at 80 per cent power factor.

The Francis reaction-type main turbines are rated 150,000 hp. at 330-ft. head, and 90,000 hp. at 263 ft., at a speed of 120 rpm. The water entrance diameter is 15 ft., and the scroll case, normal to the entrance, is 51 ft. 5½ in. wide. Runners are 16 ft. 5 in. in diameter, with an entrance height of 34⅜ in. An efficiency of 90 per cent is guaranteed at outputs of 120,000 to 130,000 hp.

Shafts are 44 in. in diameter, and 74 ft. long, with 6-in. axial holes for inspection after fabrication and to admit air to possible vacuum spaces in the turbines, to minimize vibration and cavitation. Each shaft runs in three guide bearings one at the turbine, one below the generator rotor, and one above the generator, the latter inclosed with the thrust bearing in a common oil reservoir. Bearings are of the adjustable segmental-shoe type; those at the generator self-lubricating, that at the turbine pressure-lubricated. Each thrust has approximately 5,250 sq. in. of bearing surface, giving a unit pressure of 400 psi with a load of 1,300 tons. Upper guide-bearing areas are each 600 sq. in., and the turbine guide-bearing area is 3,450 sq. in. Water will pass through a fully loaded main turbine at the rate of about 140 tons per second.

Large Generators and Transformers

The large 60-cycle, 3-phase, star-connected generators will run at 120 rpm. and generate 13,800 volts. Rotors will be about 31 ft. in diameter, and will have flywheel effects of 150,000,000 lb. at a one-foot radius. On the lower side of each will be a break ring. Air-operated brake cylinders will bring the rotors to a standstill from half normal speed in 7½ min. The brake cylinders can be made to serve as hydraulic jacks to lift the rotors sufficiently to permit the removal or adjustment of thrust-bearing parts. The estimated shipping weight of each generator is 2,367,000 lb. Over-all, the assembled generators will be 45 ft. in diameter and 22 ft. high, above the operating floor. Guaranteed generator efficiencies range from 93.4 per cent at quarter capacity to 97.4 per cent at full load.

A bank of three 36,000-kva., 13,800 to 132,800/230,000-Y-volt transformers will be connected to each generator through circuit breakers. The transformers are to be outdoor type, oil-immersed, water-cooled, gas-filled, designed for delta-star connection, with high-voltage neutrals grounded. They will be located between the power houses and the dam. Provisions will be made for connecting each of the first six generators with either a bank of three transformers and outgoing lines or two 65,000-hp. synchronous motors in the pumping plant behind the dam.

The dam is of the gravity type, extending straight across the river canyon. At the base, it is 500 ft. wide and 3,000 ft. long; and at the crest 30 ft. wide and 4,300 ft. long. From the lowest bedrock to the crown of the 30-ft. roadway on top of the dam, the height is 550 ft. The volume will exceed 10,500,000 cu. yards.

Removing 15,000,000 cu. yards of overburden from the sites of the dam forebays, and tail bays was a major feature of the job.

Material, excavated by large electric shovels, was hauled in 8 to 12 cu. yard trucks and 12 to 20 cu. yard tractor-drawn buggies to grizzlies over feeder pits, where bulldozers pushed off boulders over 13 in. in size, to be hauled away later in trucks, and forced other materials through the grizzlies.

More than 13 million cu. yards of overburden were dumped in Rattlesnake canyon a mile away and 500 to 600 ft. above the excavated area, at the rate of a million cu. yards a month—50,839 cu. yards in one 21-hr. day. About 3 million cu. yards of overburden from the east shore were carried by a belt across the river on a temporary pile bridge to the main conveyor. Overburden excavation in the vicinity of the dam site exceeded 20 million cu. yards.

The freezing of the toe of a mass of plastic clay, to prevent its movement, was a novel feature of the project.

THE BEYER-GARRATT ARTICULATED LOCOMOTIVE

From Robert Williamson, London, Eng.

One of the most remarkable developments in the steam locomotive of recent years has been the introduction of engines designed on a principle invented by H. W. Garratt, a British engineer, examples of which are now working successfully in many parts of the world where the conditions are most difficult, such as the Andes and the mountains of India and Africa.

In this invention there are two power units, which may have any wheel arrangement, spaced at a considerable distance apart; the boiler being slung between them, so that there is perfect freedom for its design. By this means any degree of flexibility for running on curved lines is obtained and a great power can be combined with moderate axle-loading.

Generally speaking, it may be said that on any line where the gradients and curves are severe, a Beyer-Garratt engine will haul rather more than two ordinary ones on considerably less fuel. It overcomes the drawbacks of light axle-loads, weak bridges and narrow gauges. The capacity of any line or gauge can be doubled; that is to say, twice the tonnage can be hauled with the same number of locomotives and staff, with a 25 per cent reduction in the consumption of fuel.

Owing to their great length and flexibility, these engines are not only suitable for hauling immense loads, but, unlike other forms of articulated locomotives, they are also capable of high speeds; one at least having attained 80 m.p.h. with a train. The ease with which they run saves shocks and wear to both track and flanges.

Examples have been built for all gauges, from 2 ft. up to 5 ft. 6 in., and in many cases are the most powerful engines ever made for the particular gauge.

One of the latest engines built for the Kenya and Uganda Railways, which are of metre gauge has the following characteristics. The engine is carried on no less than thirty-two wheels. Although the total weight is 186 tons, the maximum on any one axle is only 12 tons. They are running on rails weighing only 50 lb. to the yard and traversing curves of 573 ft. radius on the main line and 275 ft. in sidings.

The four cylinders are each 16 by 26 in., with 9 in. piston valves. The driving wheels are 4 ft. 6 in. diameter, the bogie wheels being fitted with roller bearings. The boiler would be a remarkable one even on the broadest gauge in use. Its outside diameter is 6 ft. 6¼ in., and the grate area 48.5 sq. ft.; pressure 220 lb. per sq. in. The total heating surface, including superheater, is 2,750 sq. ft. The arrangements for lubrication, grease wherever possible, allow round trips of 1,100 miles, and as much as 7,000 miles per month. Gradients up to 2 per cent have to be climbed, the line rising from sea-level to nearly 9,000 feet.

On the South African Railways, the gauge is 3 ft. 6 in., the rails weighing 60 lbs. to the yard. The ruling gradient is 1 in 40 and the sharpest curve, 477 ft. radius. The engines take loads of as much as 670 (British) tons up these grades and are used both for passenger and goods trains, maintaining with the former a speed of 45 m.p.h. On a continuous grade of 1 in 100 they can haul 2,700 tons. Sixteen of the Garratt engines have increased the capacity of the line by over 50 per cent and have reduced the coal consumption per ton-mile hauled by 25 per cent. The maximum axle-load permitted in this case was 18½ tons, which gave the builders an opportunity of putting a monster of just over 214 tons on the 3 ft. 6 in. gauge. The dimensions read like those of a large American engine on the standard gauge: four cylinders 22 by 26 in.; total heating surface 4,185 sq. ft.; grate area 74.5 sq. ft.; coal capacity 12 tons; water, 7,000 gallons.

They each displaced two "mountain" type engines of normal design. The following comparisons are interesting. The tractive effort of the Beyer-Garratt (at 85 per cent boiler pressure) is 89,130 lb., while that of two "mountains" is only 84,700; their combined weight being 280 tons, as against the 214 of the new engine, which develops 416 lb. of tractive effort per ton of its weight, the "mountain" type only producing 302; thus the Beyer-Garratt gives 38 per cent more power for its weight. The two "mountain" type boilers weigh 56 tons, while the Garratt boiler, supplying steam to the same size cylinders, only weighs 36, yet it amply supplies the demand, and does so more economically.

An example on the 5 ft. 6 in. gauge is an engine for the Bengal-Nagpur Railway of India. Although the total length over buffers is 101 ft. 6 in., the rigid wheel base is only 10 ft. 4½ in., the driving and intermediate wheels having thin tires and the inner coupled wheels having a side-play of 7/16 in. The cylinders are 20½ by 26 in.; driving wheels 4 ft. 8 in.; total heating surface 4,114 sq. ft.; grate area 70 sq. ft. The bogie and radical truck wheels have roller bearings.

The particular section of the line for which these engines have been built is laid with 75.lb. rails, on which the maximum axle-load permitted is 17 tons. The curvature is considerable and severe, being as bad as 716 ft. radius on a gradient of 1 in 91. Elsewhere, there are curves of 570 ft. The introduction of these engines made it unnecessary to relay the line with 90 lb. rails. They also eliminate "double-heading," reducing the number of engine-men.

VARIABLE-PITCH AIRSCREWS

Extract from *Trade and Engineering* (London, Eng.), August, 1940

At no time in the history of aviation has there been greater international interest in aircraft construction than now. Anything that improves speed, range, and flexibility is of immediate concern in almost every part of the globe, and aero engineers of all countries are devoting their efforts to exploring these three main lines of research with special attention to flexibility.

One of the greatest contributions towards attaining the utmost degree of manoeuvrability in aircraft was the variable-pitch airscrew, an invention that since its introduction has been subject to several refinements adapted by engineering skill. Probably its highest development is to be seen in the Rotol hydraulic constant-speed variable-pitch airscrew, which has a pitch range of 35 deg. and is of the external cylinder type. It is the only airscrew of this type which can be supplied with either metal or wooden blades.

The main feature of this airscrew is that each blade is so mounted in the hub that it can be turned about its axis during flight. This turning movement is operated by the motion of a sliding hydraulically controlled cylinder situated in front of the airscrew hub and working about a fixed piston arranged on the airscrew shaft. A small pin at the root end of each blade engages with a floating sleeve in one of the three lugs on the cylinder. The position of the blades is varied by oil pressure on both sides of the fixed piston. The oil coming from the engine is warm and prevents freezing up. This method of operation not only permits of sensitive control of pitch change throughout the available range, but eliminates the necessity for centrifugally operating weights and enables an extremely light airscrew to be produced.

Rotol constant speed airscrews (whether they are hydraulically or electrically operated) are automatically controlled by an engine-driven constant-speed unit which is itself set by the pilot to govern the engine at any predetermined speed. Thus the pilot has a choice of engine r.p.m. at any given boost. Each setting of the airscrew governor control will maintain a definite engine r.p.m. each setting of the throttle a definite boost pressure, and adjustment of these controls provides any desired combination of boost pressure and engine r.p.m., irrespective of the attitude or altitude of the aircraft.

WALES

Extract from *Trade and Engineering* (London, Eng.), August, 1940

Of particular interest at present in view of the increasing needs of the aircraft industry for aluminium is the report that there are large deposits of alumina (oxide of aluminum) in the slate strata in North Wales. Much of it occurs in the slate waste which, like the slag tips in the South Wales coalfield, cover much of the land. Successful experiments in extracting the alumina were conducted at University College, Bangor, over 20 years ago, but the process was not commercially practicable since it was too expensive compared with the cost of obtaining alumina from bauxite. As the main European supply of bauxite from France has been eliminated it seems possible that steps may be taken to follow up these old experiments.

BOFORS 40-Mm ANTIAIRCRAFT GUN

From *Mechanical Engineering* (New York), September, 1940

One of the most effective weapons being used by the British against German dive bombers and low-flying, machine-gunning airplanes is the Bofors antiaircraft gun, designed in Sweden and manufactured by the hundreds at government ordnance factories and privately owned plants in Great Britain. The brief description which follows is taken from an article in Machinery (Great Britain), June 27, 1940, which discusses the gun's manufacture and operation.

The Bofors gun fires shells of 40-mm. diameter in rapid bursts, and at speeds of approximately 120 rounds per minute. It is regarded as a highly efficient antiaircraft weapon for duties intermediate between those of the high-altitude (40,000 ft.) guns of the 3.7-in. class and the machine guns of the Vickers, Bren, or Lewis type, which are capable of firing rifle bullets at rates up to 600 rounds per minute.

The design of the 40-mm. gun provides for rapid movement from place to place when towed by a high-speed tractor. In action the gun is controlled by two members of the crew, one sitting on either side of it. With the help of double cranks, the elevating mechanism is operated from one side, and the turning motion from the other. The four pneumatic-tired wheels are spring-loaded, and the gun can be brought rapidly into action by lowering it, together with its platform, to the ground. Four screw-operated jacks provide support for the platform, and spirit levels are fitted to insure correct setting in the horizontal plane. For anchoring the equipment, four pickets, each about two feet in length, are driven into the ground with a maul. A withdrawing bar is used for their rapid removal.

Interposed between the gun mounting and the platform is a turntable fitted with ball bearings. A gear ring of large diameter is used for turning the gun to give the required direction of fire, and is connected by gearing to the double-crank handles at the right-hand side. Bolted to the underside of the breech casing is the elevating arc, which is, in turn, geared to the elevating cranks at the left-hand side of the gun for controlling the angle of fire.

The gun assembly proper comprises the barrel, the breech casing, and the breech ring and mechanism. The barrel is machined from a heat-treated forging of chrome-nickel steel, and the rear end has external interrupted threads to enable it to be assembled rapidly in the breech ring. Near the middle of the gun barrel is a collar which is screwed into position and holds the recuperator spring in compression. The forward end of the barrel is screwed to receive a funnel-shaped flame-guard which is screwed against a copper ring and retained by three setscrews. There are 16 rifling grooves with a twist increasing from one turn in a length equal to 45 diameters at the breech end to one in 30 at the muzzle. The breech casing forms a chamber for the breech ring, breech block, and loading mechanism, and is of a general rectangular shape at the rear, while the front is cylindrical and slotted. Near the rear end of the casing are flanged trunnions which fit into trunnion bearings carried by the gun mounting.

It is possible to set the gun for single-shot firing or for continuous fire by moving a small lever. With the lever in the continuous position, firing is automatic until the rounds in the magazine are exhausted. With continued loading, therefore, the burst of fire can be maintained indefinitely, the limiting factor being the heat generated in the barrel. The shock of discharge is absorbed by the recoil system, which not only brings the gun to rest after the recoil and restores it to its firing position, but also provides for the opening of the breech, the ejection of the spent-cartridge case, and reloading. Spent-cartridge cases are ejected from the breech at considerable velocity, and are directed toward the front of the gun by a system of troughing.

A MESSAGE TO ENGINEERS IN NATIONAL SERVICE

From the President of the Institution of Civil Engineers (Great Britain) to all Members, Associate Members, Associates, and Students engaged in National Service

Extract from *Journal of the Institution of Civil Engineers*, April, 1940

A very large number of those on the roll of the Institution are serving their country in various capacities. To all these, in whatever sphere they may be employed, the Institution looks with pride and with the confidence that they will exert themselves to the uttermost in this life-and-death struggle with the enemies of freedom.

Modern warfare depends in almost every one of its activities on the work of the engineer, and amongst the most important factors in obtaining victory are the skill, the experience, and the energy of those who have been trained in the high standards of our profession.

To those whose technical knowledge and skill are needed in the vast organization working on preparation and production for the needs of the fighting services, we would recall that in a national struggle of this magnitude, such work is of no less vital importance than the duty which falls to those engaged in the fighting line. The maintenance of adequate supplies of high standard not only demands continuous effort in design and manufacture to a high degree of accuracy and reliability, but also involves the construction of depots and factories, of transport facilities and housing on an unpredecented scale, and the production of raw materials from every part of the Empire. To some this may mean merely a continuance, at high pressure, of work which has been customary in peace-time, and it requires perhaps some special effort of self-control to realize the vital nature of the work and to be content to regard it as national service, demanding the same spirit of self-discipline and self-sacrifice as the nation expects from those who have the honour to wear the King's uniform. It should be remembered that lives, and ultimate victory, may depend as much on the reliability of material and construction, and therefore on the engineer's skill and devotion to duty, as on the valour of those on active service.

There are also those of our number who have been assigned to duty in the defence of our civil population and our national home. Here it needs no great imagination, in view of what has happened to the inhabitants of other free countries to realize the importance of the duty of civil defence. Not only is this an essential part of the nation's war effort, but it is a duty owed to those at the front so that they may be confident that their families and homes are being given all possible protection from the horrors of war.

Lastly, there are those of our younger members and students who are still undergoing preparation or training for future national service. We would ask them to use the time that is available to concentrate with utmost energy on the acquisition of such knowledge and experience as is essential to enable them to take their places in due course in this great national enterprise.

To all our members, wherever they may be serving or preparing to serve, we send greetings and encouragement, and we ask them to remember that they carry with them the honour and the high traditions of our profession and Institution, and that they are fighting for the preservation of our freedom, which is in greater jeopardy than it has ever been in the history of our country.

This is no struggle for mastery between great empires and rulers, or even between rival creeds or political systems. It is the revolt of free men against slavery, oppression, tyranny, and cruelty, and the fouling of the wells of truth. There could be no higher cause and none that makes a stronger appeal to men of our calling.

THE LARYNGOPHONE

By J. de Boer and K. de Boer, (From Philips' *Technical Review*, January 1940)

Abstracted by The Engineers' Digest, August, 1940

In places with high disturbance level, for example, the cabin of an aeroplane, a boiler factory, a shipbuilding yard, a mine shaft, etc., telephoning can be made possible, if the speech vibrations are picked up not out of the noisy air, but from the throat of the speaker. This is accomplished by the "laryngophone." It is based on the fact that the vibrations, by which the sound of speech is transmitted, are not only radiated through the mouth and by the air, but that they are communicated to the surrounding fleshy and bony parts of face and neck, too. The most suitable spot for picking up these vibrations is the throat. Vibrations excited farther forward in the mouth, like the "explosive" consonants p, t, and k, and the s sounds, are poorly represented in the throat vibrations. Most of the other consonants and the vowels, which are practically the conveyors of the speech, are formed chiefly with the collaboration of the resonating cavities of the mouth and will contribute effectively to throat vibrations, which proved, therefore, as a very acceptable substitute for actual speech vibrations.

Through the relatively small opening of the mouth, high frequencies radiate better as slow ones. On the other hand the vibrations in the oral cavity also experience a change in "timbre," when transmitted through flesh and bone to the skin of the throat due to a certain dependence of the damping on the frequency. In order to make the voltage alternations originating from picking up the vibrations of the throat resemble as much as possible the voltage variations derived from speech vibrations, an element must be included in the circuit of the laryngophone, which has a frequency characteristic similar to that of the resonating cavities of the mouth, or provision must be made that the laryngophone itself possesses a sensitivity curve which guarantees the required change in timbre. By comparison of records of microphones and laryngophones it was stated that in the frequency range from 200 to 3,000 cycles, if the laryngophone gives a voltage proportional to the velocity of the throat, then an amplifier must be used with a frequency characteristic which increases quadratically with the frequency. One has succeeded to construct laryngophones, which already possess the desired characteristic, and which, therefore, can be used with normal amplifiers of flat characteristic or without any amplifier. Quadratical frequency characteristic can be attained by indirect excitement of the microphone through a resonating system. The frequency characteristic of such a system has the quadratic character for exciting frequencies, which are lower than the resonance frequency of the system. For the reproduction of speech a suitable value for the resonance frequency is in the neighbourhood of 2,000 c/sec.

Two systems have been chosen for actual construction: the crystal microphone, in which particular attention has been paid to the quality of the reproduction, and a carbon microphone, in which the main effort has been to attain the greatest possible sensitivity.

The action of the crystal microphone is based on the piezo-electric effect. Certain kinds of crystals, such as Rochelle salt, assume an electric charge, when they are deformed. When two plates, cut from such a material at a certain angle to the crystal axes, are stuck together in a suitable manner, a plate is obtained, which, by bending, exhibits a certain electrical tension between the upper and the lower sides. In the Philips crystal microphone such a plate is clamped in a holder at one end. The voltage alternations occurring when the plate is in vibration are taken up by the electrodes. The piezo-voltage is proportional to the displacement of the plate, so that at constant velocity amplitude of the vibrations of the throat, against which the holder of the microphone is pressed, the microphone voltage is proportioned to the frequency ω instead of to ω^2. The required correction of the microphone characteristic is obtained by connecting a relatively low resistance in parallel with the crystal.

The microphones have a very compact and sturdy construction. The manner in which such a microphone can be fastened into an aviator's helmet is shown in Fig. 1.

Fig. 1.

In the construction of the carbon microphone use is made of the principle of indirect excitation. The vibrating system is a circular membrane. Between the membrane and the metal plate there is a layer of granulated carbon. Upon vibration of the membrane with respect to the holder, the carbon is compressed to different degrees and the resulting resistance variations lead to variations in an electric current sent through the carbon. The variations are, as in the case of the piezo-crystal, proportional to the amplitude of the membrane. The too great intensity of the low tones can here also be corrected in a simple manner. By choosing appropriate dimensions for the microphone it was possible to obtain at a frequency of 1,000 c/sec a sensitivity about 200 times as great as that of the crystal laryngophone. At normal speech intensity and in normal connections an average power of 0.2 mW is obtained.

The effect of noise on the laryngophone is negligible. For instance in a cabin of an aeroplane with an average disturbance level of 114 phons the voltage obtained in a crystal microphone from this noise may be about 4 mV, whereas this microphone will give an output voltage of 20 mV in normal speech.

Tests showed an intelligibility of 80 per cent for the crystal microphone and of 68 per cent for the carbon microphone when used in a room with a noise of 123 phons. The intelligibility of an ordinary telephone diminishes to zero when the speaker is in a room of only 90 phons.

Besides the possibilities of application for the laryngophone mentioned in the beginning, another application would be the use of the laryngophone in combination with gas masks. An air microphone cannot be used with a gas mask. When a laryngophone is used, this difficulty is met with the added advantage that the microphone can be passed from one speaker to another without it being necessary to open the mask.

BRITISH ENGINEERS DINE

From the *Journal of The Institution of Civil Engineers*, June 1940

A luncheon was held by The Institution at the Savoy Hotel, Strand, on Friday, 19 April, 1940, when 268 members and guests were present. Sir Clement D. M. Hindley, K.C.I.E., M.A., president, was in the chair.

The toasts of "The King" and "The President of the French Republic," proposed by the president, having been honoured, the Rt. Hon. Sir John Anderson, G.C.B., G.C.S.I., G.C.I.E., M.P., Secretary of State for the Home Department and Minister of Home Security, proposed the Toast of "The Institution of Civil Engineers." He said: "I am very grateful to the president for the honour that he has done me in asking me to propose the toast of this great Institution. I am grateful partly because it gives me the opportunity of paying a debt. The payment of debts is one of the processes that ought to give equal satisfaction to the giver and to the recipient. Both in the work that I have been called upon to do since I entered the Government 18 months ago, and previously during six years of service in India, I have had to make very many calls upon the services of engineers and I want to acknowledge the very valuable help that I have received. In India the work that engineers had to do for me was perhaps more spectacular; a great irrigation scheme or a bridge of record dimensions is more impressive in the command that is secured over the forces of nature than the sort of work that engineers have been called upon to do in connection with civil defence. Both, however, are equally valuable."...

Sir Clement D. M. Hindley, K.C.I.E., M.A., president of The Institution responded: "The Institution, like many other professional bodies in war-time, is experiencing a good many difficulties, but at the outbreak of war we took the decision that we would carry on with our essential activities to the best of our ability and as circumstances would permit. A good deal of what might be called the superficial ritual of an Institution's life had to be cut out, for the time being at any rate, but we have concentrated on certain things. For one thing, we have determined that during this war, however long it may last, we will not let our standards down in any way, and we will carry on as well as we can with the object of seeing that our young men—our Students and our young members—have no interruption, or as little interruption as possible, in their studies and training, and that when they are trained they will be used to the best advantage in the national interest. We realize the vital necessity of providing a continual flow of young men into the profession, both for the prosecution of the war and for the time afterwards. In that connection, I think we ought to pay some tribute to the vision—I might almost say the unusual vision—which is being displayed by the Government in the regulations and arrangements which they have made for the calling-up of young men, so that our Students and those who are going to enter the profession will not be interfered with unduly. We have kept in close contact with those who control these matters, and we have also formed a very close liaison with the military authorities, so that we know that our Students, when they are called-up, will be used in such a way as to take advantage of their technical training . . .

...I feel a little nervous about saying it, but I believe that I am sitting to-day between two of the most courageous men in public life that we have seen for many years. Anyone who takes on the job that Sir John Anderson has taken on must be full of courage, and we know from his previous record in public life that he is a great and courageous man. On my left, I have another lion-hearted man, a man of great courage, Sir John Reith, one of our Members whom we have the proud privilege to entertain as our guest. We are particularly pleased at his recent appointment; in fact, I have heard it described as, up to last week, one of the finest things that the Government had done since the beginning of the war. Sir John Reith will forgive me if I say that we, as engineers, feel specially proud that one of our number has been recognized as a great administrator, because too often, and indeed generally, in the past engineers have been relegated to positions where they carry out the orders of lawyers and financiers and politicians. We believe ourselves that the experience which we have, not only in controlling the great forces of nature but in controlling the great human forces with which we have to contend in our work, gives us some experience and enables us to act as administrators. We shall all feel that that much-maligned department, the Ministry of Information, is in good hands with Sir John Reith in charge of it. I hope that if and when he gets control of the censorship he will see that the work of the engineer is not blue-pencilled because a great deal can be said about the work of engineers—not only of civil engineers, but of all other engineers as well—in this war.

I feel that, although I have perhaps no right to speak for the other great Institutions of engineers, there is one sentiment which I can safely express as their representative, speaking for some fifty or sixty thousand qualified engineers in the various branches of engineering, and that is that we are determined during this war to do everything that is in our power, without regard to any self-interest or sectional feeling, to help the Government in the prosecution of the war."

The Rt. Hon. Sir John C. W. Reith, P.C., G.C.V.O., G.B.E., D.C.L., LL.D., M.P., M.Inst.C.E., Minister of Information, who responded said: "I feel at home in this gathering, but I wish that the eminent place I occupy now on the left of your chairman were due to some achievement in the profession rather than to the fortuitous, transitory, and very indefinite authority of Government office. I should be glad to speak about the Ministry of Information—if there were time. The president has certainly given me an opening. I will tell you one function of it, and one only; and it is one which may not have occurred to you. The head of one of the other Government departments said to me recently that he was profoundly grateful, and that all his colleagues ought to be equally grateful, to the Ministry of Information, because it attracted so much criticism that we diverted attention from them. In fact, we were a sort of Governmental sump—a Governmental sump for criticism. As such I have no doubt the Ministry of Information is fulfilling quite a useful purpose, in addition to those other functions which we are endeavouring with greater or lesser success to fulfil...

...I agree with what the president has said as to the value of engineering training. In peace and in war the engineer has been overlooked. How high is the service he can render when, with all the detail and the care of his training, there goes administrative knowledge and experience. I agree with the president that the place of the engineer in the administration of the country is not what it might be. In replying to this toast, I am sure we are still ready to remove mountains and to make crooked paths straight. I envy you the opportunity for doing so. As a Member, I say 'Good luck to us,' and as one of your guests, I say 'Good luck to you, and thank you.' "

From Month to Month

News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

CO-OPERATION IN ALBERTA

At the time of going to press the figures for the ballots of the co-operative agreement between the Institute and the Association of Professional Engineers of Alberta have just been made available. The results are as follows:

Engineering Institute Ballot	
Ballot of Members of Council	
Total ballots received	30
Votes approving agreement	30
Ballot of Corporate Members in Alberta	
Total ballots received	90
Votes approving agreement	87
Contrary votes	1
No vote recorded	2
	— 90
Association Ballot	
Votes approving agreement	151
Contrary votes	13

EVACUEES AND TORPEDOES

The foul crime of torpedoing ships conveying innocent children from the field of murder in England has affected directly the engineers' proposal to care for the children of fellow engineers in the Old Country.

When the *Volendam* was torpedoed on August 30th, it was carrying the first children sent to Canada under the Canadian engineers' scheme. Fortunately no lives were taken on that occasion, which must have been a bitter disappointment to the enemy. Such vile methods of waging war will serve to bind the Empire closer together, and to increase the intensity of our determination to wipe this bestiality from the earth forever.

The more successful later attack on the *City of Benares*, which made possible the murdering of eighty-seven children at one time, may deal another blow to the engineers' proposal. No news has arrived to indicate if engineers' children were in the party, but it may readily be so. In any event the proposals still stand, and Canadians will be more eager than ever to offer sanctuary to these innocent victims who have already suffered so much at the hands of the ruthless Hun.

Throughout the world, with the exception of Germany itself, news of this vile deed will be received with sickening sadness. What better proof is required of the peculiar, and perverted mentality of these beasts who would rule the world ? What greater inspiration can there be to fight to the end, this "evil thing" that would destroy everything that civilization holds dear ?

The *Montreal Star* speaks for all of us in its editorial of September 23rd—"The monstrous abomination of this crime has filled the entire civilized world with horror and with loathing. There was no reason, no conceivable justification... To-day the hell-hounds of the fiend who rules over Germany are rubbing their hands in shameful glee... We know now that this Fatherland is the source of the foulest crime that has ever caused a surge of sickening hate to rise in the hearts of all men and women capable of a spark of human affection,... Let there be no mistake. Our job is to destroy beyond all hope of revival a power so soaked in lust for murder... This horrible crime may be taken as a measure of the desperation that is steadily making itself felt among those who fight and murder 'Under the Sign of the Swastika.' General Pershing warned us twenty-two years ago against an armistice until the power of Germany had been destroyed. The British Air Force was ready and waiting to swoop down upon Berlin when the mealy-mouthed counsel of political leaders prevented it from teaching the Huns a lesson not to be forgotten so long as memory endured. To-day we are paying the price for having ignored that warning. Heaven send that when the hour again arrives, our leaders will not once more allow themselves to be prevented from crushing, in such a manner as posterity will never forget, the powers of Hell that are now arraigned in their might against the forces of civilization, of humanity and love of little children.

THE INSTITUTE AND NATIONAL REGISTRATION

The Minister of National War Services sent a request to many national organizations for assistance in the recently completed National Registration. The Engineering Institute was one of these. This request was communicated to all branches, and while at the time of writing all reports have not been received, a sufficient number have arrived to make it evident that the Institute was able to render material assistance.

As an example of the desire to help, an account of the action taken by the Montreal Branch may be interesting. It will serve to illustrate the action of several branches. Two special meetings of the executive were held. The first one was to discuss methods by which the branch could help, and the second was to complete plans and to organize along the required lines. Over one hundred and fifty members responded to the post card inquiry and took part in the registration. The following letters express appreciation from different parts of the country. It would be interesting to know of any similar letters received by other branches.

Ottawa, 29th July, 1940.

L. AUSTIN WRIGHT, ESQ., *General Secretary.*
THE ENGINEERING INSTITUTE OF CANADA,
2050 MANSFIELD STREET, MONTREAL, P.Q.

Dear Mr. Wright:

I am in receipt of yours of recent date in reply to my circular letter of July 16th addressed to various organizations and associations throughout Canada in my capacity of Minister of National War Services, requesting the co-operation of the citizens of Canada in the forthcoming registration.

The splendid response to your Government's appeal is indeed gratifying and is in itself a tribute to the loyalty and fine spirit of our people.

Yours very truly,
JAMES G. GARDINER,
Department of National War Services.

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231 St. James Street, West,
Montreal, 26th August, 1940.

L. A. DUCHASTEL, ESQ., *Secretary-Treasurer,*
THE ENGINEERING INSTITUTE OF CANADA,
40 KELVIN AVENUE, OUTREMONT.

Dear Mr. Duchastel,—

The carrying out of National Registration in St. Lawrence-St. George Division by over a thousand voluntary workers, in premises gratuitously supplied, was alone made possible by the public-spirited co-operation of everyone concerned.

I must express to you personally my own very real appreciation of the very splendid services rendered by the people made available through the Institute. I visited the registration offices on several occasions and was struck by the efficient way in which they devoted themselves to this work.

It is impossible to express this appreciation to each of them personally, but I would be glad if you would pass this on to them if an opportunity presents itself.

Yours faithfully,
BROOKE CLAXTON,
Member, St. Lawrence-St. George.

MINISTER OF NATIONAL REVENUE
CANADA

Ottawa, September 9th, 1940.

Dear Mr. Hannaford,

I would like to express my appreciation, on behalf of the Dominion Government, to the members of the Engineering Institute who so generously assisted the Hamilton Committee for National Registration.

The Voluntary assistance enabled the Registration to be carried out efficiently and was much appreciated by the Registrar.

Yours sincerely,

Colin Gibson, M.P. for Hamilton.

Mr. A. R. Hannaford,
City Engineer's Department,
City Hall, Hamilton, Ontario.

"TIMBER OF CANADA"

The launching of a new technical magazine devoted to the interests of one of Canada's basic industries is a notable event. We welcome the first number of *Timber of Canada* a publication issued by the Lumber Trade to promote the welfare of the industry which converts and sells our forest products. In addition to the firms manufacturing and selling lumber, it will reach the users of timber and the public interested in Canada's forest resources. It will be financed from advertising receipts.

The scope of the magazine's editorial aims is indicated by the varied contents of the first issue—housing and city zoning, financial matters such as the excess profits tax, technical questions regarding the seasoning of lumber, war measures such as the British Timber Control orders, or the establishment of the Board which control Canadian industry, architectural notes bearing on the intelligent use of timber for house construction, all these are examples of topics on which authoritative data are of value to the general public as well as to the industry itself. Up-to-date manufacturing information with statistics as to production, exports and prices add to the completeness of the magazine's programme.

Under the direction of W. J. LeClair, M.E.I.C., the general manager of the Canadian Lumbermen's Association, the new venture deserves the success which we anticipate for it.

ERRATUM

Western Water Problems

A substitution of names occurred on page 400 of the September issue of the Journal in the list of those present at the meeting held at Calgary, last July, by the local subcommittee of the Institute's Committee on Western Water Problems.

The list carried the name of Mr. D. W. Houston, superintendent of the Street Railway Department of the City of Regina, who not being a member of the Committee was not present, and it made no mention of Mr. G. N. Houston, C.E., consulting engineer of Olds, Alta., who submitted to the meeting a complete report on the international aspects of the Milk and St. Mary rivers problem in southern Alberta.

Mr. G. N. Houston was formerly Acting Commissioner of Irrigation for the Dominion and superintendent of maintenance and operation, Department of National Resources, Canadian Pacific Railway. He is very active in engineering societies, and was a Councillor of the Institute for Alberta in 1924 and again in 1930-1931.

CORRESPONDENCE

London, 9th July, 1940.

T. H. HOGG, ESQ., B.A.Sc., D.Eng., *President*,
THE ENGINEERING INSTITUTE OF CANADA.

Dear Dr. Hogg,

The very generous offer of professional engineers in Canada to receive into their homes for the period of the War the children of British Engineers who are being evacuated to that country which has been made through the medium of the Engineering Institute of Canada, has been very gratefully received here, and we wish to express to you our very warm appreciation of this action, which exemplifies the close bonds which unite engineers on both sides of the Atlantic.

Steps have been taken to notify members of the Institutions concerned of this proposal and applications are already being received. These are expected, for the time being at any rate, to be limited in character, having regard to the fact that in view of the large number of children already registered, the Government on Friday last decided that no further children could be accepted, and that consequently only those children of engineers who have been already registered can be considered under the scheme.

We should be very glad if you would convey to all those Canadian engineers who have opened their homes in this way to the children of British engineers our warmest thanks.

Yours sincerely,

CLEMENT D. M. HINDLEY, *President*,
The Institution of Civil Engineers.

ASA BINNS, *President*,
The Institution of Mechanical Engineers.

JOHNSTONE WRIGHT, *President*,
The Institution of Electrical Engineers.

Toronto, August 26, 1940.

SIR CLEMENT D. M. HINDLEY, *President*,
THE INSTITUTION OF CIVIL ENGINEERS.

MR. ASA BINNS, *President*,
THE INSTITUTION OF MECHANICAL ENGINEERS,

MR. JOHNSTONE WRIGHT, *President*,
THE INSTITUTION OF ELECTRICAL ENGINEERS.

Gentlemen,

Thank you very much for your kind letter of July 9th. I shall be very glad indeed to convey the thanks of your Institutions to the several Canadian engineering societies that have joined together to offer hospitality to the children of engineers of the United Kingdom.

It is doubtful if Canadian engineers have ever responded more enthusiastically to any project of national or international importance, and I am sure it will be of interest to you to know that great encouragement has come to the officers of our organizations from the memberships in all parts of Canada.

A copy of your letter has been sent to the president of each co-operating organization, and if I may take it upon myself in this instance to speak for all of them, I would like to assure you that any children you may send to us will be very welcome and will be cared for to the best of our abilities. We consider it a privilege to co-operate with our fellow engineers in this manner in the defence of Great Britain.

Yours sincerely,

T. H. HOGG, *President*,
The Engineering Institute of Canada.

INSTITUTE BROADCASTS

PROGRAMME AND TIME SCHEDULE

The Council of the Engineering Institute of Canada, having decided at its meeting of July 6th, that it would be in the interests of our profession and the public generally to present to the people of Canada at this time a series of broadcasts by prominent members of the Institute, the Radio Broadcasting Committee has completed arrangements for the programme outlined in the following schedule.

These broadcasts entitled "The Engineer in War Time" are designed around the central theme of the contribution which the Canadian engineer is making to his country in the present crisis. They will set forth the soundness and adequacy of his fundamental education, his high standard of development in all general and special branches of scientific knowledge, the unity in the organization of the profession, and its singleness of purpose in its war effort. They will emphasize the confidence which the people of Canada are justified in placing in the ability of our engineers to develop all scientific means for the effective prosecution of the war and the protection and defence of both the soldier in the field and the Canadian at home.

This is an engineers' war and the successful outcome depends on the ingenuity, skill and efficiency of our engineers.

These talks are also intended to stimulate in the minds of engineers themselves a definite professional consciousness,—a sense of professional responsibility and opportunity.

They will provide a most favourable medium for bringing together the people of Canada and outstanding members of our profession in a very personal and intimate way, which in itself, is a most effective means of stimulating public confidence and appreciation.

Programme of Broadcasts

Time: 7.45 p.m. Eastern Daylight Saving Time. (See Time and Station schedule below.)
Day: Wednesday.
Dates: October 16th to November 20th, inclusive.
Period: 15 minutes.

Broadcast No. 1—Speaker: **Dr. T. H. Hogg**, c.e., d.eng. (Toronto), President of The Engineering Institute of Canada.
Oct. 16th. Subject: **Engineers in the War.**

Broadcast No. 2—Speaker: **Dean C. J. Mackenzie**, m.c., m.c.e. (Ottawa), Chairman of the National Research Council.
Oct. 23rd. Subject: **War Research—an Engineering Problem.**

Broadcast No. 3—Speaker: **Miss Elizabeth M. MacGill**, m.s.e. (Fort William), Chief Aeronautical Engineer, Canada Car and Foundry Co. Ltd.
Oct. 30th. Subject: **Aircraft Engineering.**

Broadcast No. 4—Speaker: **Dr. Augustin Frigon**, c.e., d.sc. (Montreal), Assistant General Manager, Canadian Broadcasting Corporation.
Nov. 6th. Subject: **Radio in Canada.**

Broadcast No. 5—Speaker: **William D. Black** (Hamilton), president, Otis-Fensom Elevator Co. Ltd.
Nov. 13th. Subject: **Industrial Development in Canada to meet the War Emergency.**

Broadcast No. 6—Speaker: **Armand Circé** c.e., (Montreal), Dean of the Ecole Polytechnique, Montreal.
Nov. 20th. Subject: **The Training of Engineers at the Ecole Polytechnique.**

Time and Station Schedule of Broadcasts

Institute Branch	Time of Broadcast		Heard over Station
Halifax	7.45 p.m.	Atlantic Standard	CBA or CHNS*
Cape Breton	7.45 p.m.	Atlantic Standard	CBA or CJCB*
Saint John	7.45 p.m.	Atlantic Standard	CBA or CHSJ*
Moncton	7.45 p.m.	Atlantic Standard	CBA
Saguenay	7.45 p.m.	Eastern Daylight Saving	CBJ
Quebec	7.45 p.m.	Eastern Daylight Saving	CBM
St. Maurice Valley	7.45 p.m.	Eastern Daylight Saving	CBM
Montreal	7.45 p.m.	Eastern Daylight Saving	CBM
Ottawa	7.45 p.m.	Eastern Daylight Saving	CBO
Peterborough	7.45 p.m.	Eastern Daylight Saving	CBL
Kingston	7.45 p.m.	Eastern Daylight Saving	CFRC*
Toronto	7.45 p.m.	Eastern Daylight Saving	CBL
Hamilton	7.45 p.m.	Eastern Daylight Saving	CBL
London	7.45 p.m.	Eastern Daylight Saving	CBL
Niagara Peninsula	7.45 p.m.	Eastern Daylight Saving	CBL
Border Cities	7.45 p.m.	Eastern Daylight Saving	CKLW*
Sault Ste. Marie	7.45 p.m.	Eastern Daylight Saving	CJIC*
Lakehead	7.45 p.m.	Eastern Daylight Saving	CKPR*
Winnipeg	5.45 p.m.	Central Standard	CKY*
Saskatchewan	4.45 p.m.	Mountain Standard	CBK
Lethbridge	4.45 p.m.	Mountain Standard	CBK
Edmonton	4.45 p.m.	Mountain Standard	CBK or CFRN*
Calgary	4.45 p.m.	Mountain Standard	CBK or CFCN*
Vancouver	3.45 p.m.	Pacific Standard	CBR
Victoria	3.45 p.m.	Pacific Standard	CBR

*These local broadcasting stations, not being on the Canadian Broadcasting Corporation network, may not carry these programmes. In which case they will be heard over the nearest Corporation station as noted.

Members of the Institute are requested to make careful note of the dates, station and hour at which these broadcasts will be heard in their localities.

Gordon M. Pitts, m.e.i.c.,
Chairman, Radio Broadcasting Committee.

MEETING OF COUNCIL

A regional meeting of the Council was held in the board room of the Hydro-Electric Power Commission of Ontario, Toronto, Ontario, on Saturday, September 7th, 1940, at ten thirty a.m.

There were present: Vice-President Fred Newell (Montreal) in the chair; Past-President G. J. Desbarats (Ottawa); Councillors J. L. Busfield (Montreal), J. G. Hall (Montreal), W. R. Manock (Niagara Peninsula), A. U. Sanderson (Toronto), C. E. Sisson (Toronto), and J. A. Vance (London); Secretary-Emeritus R. J. Durley and General Secretary L. Austin Wright. The following were also present by invitation—Past-Presidents O. O. Lefebvre (Montreal) and C. H. Mitchell (Toronto); Past Vice-Presidents E. V. Buchanan (London) and R. L. Dobbin (also chairman of the Peterborough Branch); Past-Councillors J. R. W. Ambrose, J. R. Cockburn, E. G. Hewson, O. Holden and J. J. Traill, all of Toronto; Professor Robert W. Angus, hon.m.e.i.c., Toronto; Branch Chairmen H. F. Bennett (London), Major G. G. Carr-Harris (Kingston), Nicol MacNicol (Toronto), and A. R. Hannaford, representing Alex. Love (Hamilton). Dr. A. E. Berry, past-chairman, H. E. Brandon, vice-chairman, and J. J. Spence, secretary-treasurer of the Toronto branch; J. W. Rawlins, president, and W. P. Dobson, past-president of the Association of Professional Engineers of Ontario; L. E. Westman, associate secretary of the Canadian Institute of Chemistry.

Mr. Newell explained that President Hogg, at whose invitation the meeting was being held in the Hydro Building, had been called to Montreal on important government business, and was unable to take the chair as he had planned.

Mr. Bennett explained the interim report which he had prepared for Council giving an account of the work done by the Committee on the Young Engineer and stating ten recommendations for branch activities. He referred to the booklet "Engineering as a Career," which had been prepared by the Engineers' Council for Professional Development in the United States, and thought the material could be changed in order to make it more applicable to Canada. He suggested, however, that a separate booklet might be produced in Canada by the Institute. After discussion, it was felt that a less elaborate pamphlet might suit Canadian conditions better. Mr. Bennett's report was then adopted, with the suggestion that his committee be authorized to have a plenary meeting if the financing can be arranged.

The secretary made a brief report as to the situation regarding the register of technically trained men which had been prepared some time ago by a group of engineering bodies. The attention of the Department of National War Services had been drawn to the difficulties attending the use of this register, but at present there was no indication that progress had been made.

The secretary also reported the organization of a central committee to deal with the children evacuated under the arrangements with the British engineering societies. In England, the Children's Overseas Reception Board (CORB) was handling the children who would be sent out under the fully sponsored government scheme. Engineers' children can also be sent out privately, the parents paying the transportation. In regard to finance, over two hundred offers of financial assistance had been received from Institute members, and homes for over four hundred children had also been offered. The secretary read a joint letter from the presidents of the Institutions of Civil, Mechanical and Electrical Engineers of London, expressing their thanks and appreciation of the action of the Canadian engineers in offering to take these children.

Mr. Westman, speaking for the Canadian Institute of Chemistry, said that they would be glad to offer the fifty or sixty homes they have available to any children, no matter with what branch of engineering their parents may be associated.

The satisfactory nature of the financial statement was noted with appreciation, income being over the budget and expenses somewhat less than the budgeted amount.

Six resignations were accepted; two reinstatements were effected; three Life Memberships were granted; the names of fourteen members in arrears were removed from the list, and a number of special cases were considered.

It was agreed that the regulations regarding the remission of annual fees of members on active service overseas would apply also to members ordinarily domiciled in Great Britain who are now in the active service forces.

The list of nominees for officers for the year 1941, as presented by the chairman of the Nominating Committee, Mr. E. V. Buchanan, was accepted and approved.

Deep regret was expressed on the announcement of the death of Councillor Archie B. Gates, of Peterborough, and a telegram of condolence was sent to Mrs. Gates.

With regard to the work of the Committee on Professional Interests, the secretary reported on the progress of negotiations in Alberta. It was noted that a draft agreement had been agreed upon by the members of the local joint committee and by the Council of the Association, and that it would be sent out to ballot in September. It was unanimously resolved that the president and the general secretary be duly authorized to sign this agreement, if and when accepted on ballot, by the Institute Members in Alberta and the Council of the Institute.

It was also noted that progress had been made in New Brunswick in the preparation of a revised draft of an agreement with the Association in that province.

The appointment of Mr. J. F. Harkon as the Institute's representative on the newly formed Canadian Engineering Standards Association Committee on the Preservative Treatment of Timber was noted and approved.

A number of applications were considered, and the following elections and transfers were effected:

Elections

Members	12
Juniors	8
Affiliates	3
Students	4

Transfers

Junior to Member	2
Student to Member	1
Student to Junior	3

The Council rose at three thirty p.m.

LIST OF NOMINEES FOR OFFICERS

The report of the Nominating Committee was presented to and accepted by Council at the meeting held on September 7th, 1940. It is published herewith for the information of all corporate members as provided by Sections 68 and 74 of the By-laws.

List of Nominees for Officers for 1941 as Proposed by the Nominating Committee

President	C. J. Mackenzie, M.E.I.C.	Ottawa
Vice-Presidents:		
*Zone "A" (Western Provinces)	A. L. Carruthers, M.E.I.C.	Victoria
*Zone "B" (Prov. of Ont.)	K. M. Cameron, M.E.I.C.	Ottawa
	J. L. Lang, M.E.I.C.	Sault Ste. Marie
	W. R. Manock, M.E.I.C.	Fort Erie North
	E. P. Muntz, M.E.I.C.	Hamilton
*Zone "C" (Prov. of Que.)	deGaspé Beaubien, M.E.I.C.	Montreal
Councillors:		
†Vancouver Branch	H. N. Macpherson, M.E.I.C.	Vancouver
†Edmonton Branch	J. Garrett, M.E.I.C.	Edmonton
†Saskatchewan Branch	I. M. Fraser, M.E.I.C.	Saskatoon
†Lakehead Branch	J. M. Fleming, M.E.I.C.	Port Arthur
†Border Cities Branch	Boyd Candlish, M.E.I.C.	Sandwich
	E. M. Krebser, M.E.I.C.	Walkerville
†London Branch	J. A. Vance, M.E.I.C.	Woodstock
†Toronto Branch	A. E. Berry, M.E.I.C.	Toronto
†Kingston Branch	D. S. Ellis, M.E.I.C.	Kingston
†Ottawa Branch	W. H. Munro, M.E.I.C.	Ottawa
‡Montreal Branch	G. McL. Pitts, M.E.I.C.	Montreal
	H. J. Vennes, M.E.I.C.	Montreal
†St. Maurice Valley Branch	J. H. Fregeau, M.E.I.C.	Three Rivers
†Saguenay Branch	J. Shanly, M.E.I.C.	Kenogami
	M. G. Saunders, M.E.I.C.	Arvida
†Saint John Branch	H. F. Morrisey, M.E.I.C.	Saint John
†Halifax Branch	S. W. Gray, M.E.I.C.	Halifax
	J. R. Kaye, M.E.I.C.	Halifax

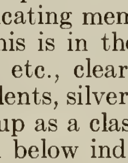
*One vice-president to be elected for two years.
†One councillor to be elected for two years.
‡Two councillors to be elected for three years each.

BADGES AND CERTIFICATES

A substantial reduction in the price of membership certificates was authorized at the September meeting of Council. These certificates are engraved on parchment vellum and indicate the full name of the member, his classification, and the dates of his election or transfer. They measure approximately nine by twelve inches.

Council has been influenced in the decision by a desire to make new certificates available at the minimum cost to all those Members who were automatically transferred from Associate Member by the recent by-law amendment. The new certificates will contain a complete history of the individual's Institute membership from Student to Member.

Another form for indicating membership in the Institute is the official badge. This is in the shape of the standard shield with the beaver, etc., clearly indicated thereon. It comes in bronze for Students, silver for Juniors, and gold for Members, and is made up as a clasp pin, watch charm and button. The illustration below indicates the size and style of the insignia.



Prices are shown on the following list:

Badges—
- Members, gold, $4.00.
- Juniors, silver, $2.25.
- Students, bronze, $1.50.

Membership certificates, $1.25.

Members may secure either a badge or a certificate by communicating with Headquarters and remitting the correct amount. Postage and sales tax are included in the prices quoted.

THE JULIAN C. SMITH MEMORIAL MEDAL

To perpetuate the memory of the late Julian Cleveland Smith, the thirty-ninth president of the Institute, an engineer distinguished in the industrial, banking, utility, transportation, scientific and academic life of the Dominion, a foundation has been set up by a small group of senior members of the Institute to be used by the Council for a memorial medal to be awarded "for achievement in the development of Canada."

Based on models executed by the well-known Toronto sculptor, Emanuel Hahn, R.C.A., S.S.C., dies for the medal have just been delivered from the Royal Mint in London. Council has entrusted a committee of past presidents with the responsibility of recommending the terms and conditions under which the medal will be awarded. It is expected their report will be available for the consideration of Council in good time for appropriate action prior to the next Annual Meeting of the Institute. It has been suggested that several awards be made for the inaugural year, although it is intended that not more than one award will be made annually thereafter.

ELECTIONS AND TRANSFERS

At the meeting of Council held on September 7th, 1940, the following elections and transfers were effected:

Members

Atkinson, Charles Clifford, B.Sc. (Forestry), (Univ. of N.B.), pulpwood supt., Fraser Companies Limited, Edmundston, N.B.

Clarke, Lorne MacKay, B.Sc. (Mech.), (N.S. Tech. Coll.), 2150 Tupper St., Montreal, Que.

Kellogg, Paul, B.Sc., (Mass. Inst. Tech.), president, Stevenson & Kellogg, Ltd., management engrs., Montreal, Que.

Linton, William Reginald, B.A.Sc., (Univ. of Toronto), radio inspr., Dept. of Transport, Toronto, Ont.

Mathewson, Philip Lavens, B.A.Sc. (E.E.), (Univ. of B.C.), asst. engr., office of the chief elect'l. engr., C.N.R., Montreal, Que.

Merrett, Joseph Stephen, B.Sc. (C.E.), (Univ. of Man.), engr. and chief dftsman., Western Steel Products Corpn. Ltd., Winnipeg, Man.

McWilliams, David Burrell, C.E., (Lafayette Coll.), managing director, Dresser Manufacturing Co. Ltd., Toronto, Ont.

Proudfoot, Charles Alexander, B.Sc. (C.E.), (Univ. of Man.), airways engr., Trans-Canada Air Lines, Winnipeg, Man.

Rousseau, Francois Paul, B.Sc. (Arch.), (Mass. Inst. Tech.), asst. res. engr., Dufresne Engineering Co. Ltd., Cadillac, Que.

Thistlethwaite, Robert, B.Sc. (C.E.), (Univ. of Man.), land surveyor, Tropical Oil Company, Barranca Bermeja, Colombia, S.A.

Wanek, Alexander Thomas Eric, aeronautical engr., British Air Ministry, Montreal, Que.

Wright, Claude Percival, B.Sc., M.Sc. (E.E.), (Univ. of Man.), inspecting engr., Western Canada Insurance Underwriters' Association, Winnipeg, Man.

Juniors

Beard, George Francis, B.A.Sc. (Univ. of Toronto), metallurgist, Canada Metal Company, Toronto, Ont.

Boux, Joseph Francis, B.Sc. (C.E.), (Univ. of Man.), demonstrator in civil engrg., Univ. of Manitoba, Winnipeg, Man.

Butcher, Stanley Joseph, B.Sc. (E.E.), (Univ. of Man.), 1017 Ouellette Ave., Windsor, Ont.

Hoch, Norman Frederick, B.Sc. (Mech.), (Queen's Univ.), dftsman., Spruce Falls Power & Paper Co., Kapuskasing, Ont.

Jackson, William Hayes, B.A.Sc. (Univ. of Toronto), designing engr., DeHaviland Aircraft of Canada Ltd., Toronto, Ont.

Leach, Tronson Alfred James, B.Sc. (Civil), (Univ. of Sask.), instr'man., Dept. of Civil Aviation, Moose Jaw, Sask.

Scott, Robert Clare, B.Sc. (Mech.), (Univ. of Sask.), dftsman., Spruce Falls Power & Paper Co., Kapuskasing, Ont.

Torell, John David, (Univ. of Man.), Lieut., R.C.C.S., Norwood, Man.

Affiliates

Bonenfant, Joseph, roads and bridges supt., Colonization Dept., Province of Quebec, La Sarre, Que.

Harding, Laurenz Foster, city electrician, Saint John, N.B.

MacDonald, Martin John, asst. engr., Western Air Command, R.C.A.F., Victoria, B.C.

Transferred from the class of Junior to that of Member

Capelle, William Abram, B.Sc. (C.E.), (Univ. of Man.), Major R.C.E., Officer Commanding, 1st Corps Field Park Coy., Winnipeg, Man.

Stewart, John Rufus, B.Sc. (Mech.), (McGill Univ.), welding engr., Canadian Liquid Air Co. Ltd., Montreal, Que.

Transferred from the class of Student to that of Member

Lupton, -Mac Joseph, B.Sc. (C.E.), (Univ. of Man.), M.Eng. (McGill Univ.), struct'l. designer, Dominion Bridge Co. Ltd., Winnipeg, Man.

Transferred from the class of Student to that of Junior

Armstrong, John Lloyd, B.Eng. (Elec.), (McGill Univ.), engr. in office of manual apparatus engr., Northern Electric Co. Ltd., Montreal, Que.

Elford, Wesley Fred, B.Sc. (E.E.), (Univ. of Alta.), asst. chief inspr., Massey Harris Co. Ltd., Toronto, Ont.

Stevens, Robert Leonard, B.Sc. (E.E.), (Univ. of Alta.), M.Sc. (E.E.), (McGill Univ.), engr., Canadian Industries Ltd., Montreal, Que.

Students admitted

Codd, Percy, B.Sc. (Chem.), (Univ. of Sask.), P.O. Box 801, Flin Flon, Man.

Fraresso, Marino, B.A.Sc. (Univ. of B.C.), 515 Bolivar St., Peterborough, Ont.

McArthur, Donald Stewart, B.Sc. (Chem.), (Univ. of Alta.), 510-13th Ave. West, Calgary, Alta.

Newman, Harvey Elliott, 13 21st Field Battery, R.C.A., 6th Field Regiment, C.A.S.F., Base P.O., Canada.

The Julian C. Smith Medal

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

Colonel E. C. G. Chambers, M.C., M.E.I.C., has been appointed director of engineer services in the Department of National Defence at Ottawa. He had been assistant director since 1936, coming to Ottawa from Victoria, B.C., where he was district engineer from 1930. Prior to that time he held a similar position with Military District No. 1. Headquarters at London, Ont. He joined the non-permanent active militia Second Field Company, Royal Canadian Engineers, in 1915 and the Canadian Expeditionary Force in 1916, serving overseas until the end of the Great War. While stationed at Victoria, B.C., Colonel Chambers made an extensive survey for the establishment of aerodromes and other services pertaining to aviation in British Columbia.

Squadron Leader T. R. Loudon, M.E.I.C., professor of applied mechanics at the University of Toronto and now in command of the Royal Canadian Air Force school of aeronautical engineering in Montreal, has been accorded the special designation of fully qualified aeronautical engineer. He is one of a few men in Canada who are so rated.

Lieutenant-Colonel L. F. Grant, M.E.I.C., formerly associate professor of engineering at Royal Military College, Kingston, has been appointed General Staff Officer at Headquarters of Military District No. 3, Kingston, Ont.

Major J. F. Plow, M.E.I.C., who commanded the 1st Medium Battery, 2nd Montreal Regiment, R.C.A., at the outbreak of the war and later was appointed to command the 1st-57th Battery, has been posted to second-in-command of the 2nd Medium Regiment. Major Plow graduated from Royal Military College, Kingston, in 1921 and has been a gunner during the whole of his military career. He joined the famous 7th Field Battery on graduation and also served in the 66th Field before being promoted captain in 1931. He was promoted major and appointed to command the 1st Medium Battery in 1934. He passed his militia staff course in 1937 and in the following year qualified for the rank of lieutenant-colonel.

Major Plow was assistant general secretary of the Institute from 1930 until 1938 when he accepted a position in Montreal with Charles Warnock and Company, Limited.

V. S. Chesnut, M.E.I.C., senior engineer, National Harbours Board, Saint John, N.B., has been appointed to act as secretary-treasurer of the Saint John Branch of the Institute, replacing F. L. Black, Jr.E.I.C., who is now located in Shawinigan Falls, Quebec. Mr. Chesnut has been with the Saint John Harbour since 1930, having previously acquired extensive experience on various construction jobs with private contractors.

W. J. Leclair, M.E.I.C., is the managing editor of *Timber in Canada*, the new monthly publication devoted to the lumber industry and published by the White Pine Bureau, the Canadian Hardwood Bureau and the Lumber and Timber Association of Ontario.

G. H. Kirby, M.E.I.C., is now with Canadian Car Munitions Limited in Montreal. Upon graduation from McGill University in 1922 he went with the Bell Telephone Company for a few months, and early in 1923 joined Price Brothers & Co. Ltd., Kenogami, as assistant designing engineer. He was engaged in various phases of electrical construction until 1925 when he became electrical superintendent of the Riverbend mill of the company, a position which he left to accept his new appointment.

Dan Anderson, M.E.I.C., has joined the staff of Allied War Supplies Corporation in Montreal. He was chief electrical engineer of Quebec North Shore Paper Company, Limited, at Baie Comeau, Que., having been responsible, as an electrical engineer, for the design and construction of the development prior to commencement of operation.

A. Watson, M.E.I.C., has been promoted to acting marine superintendent in the Department of Transport at Ottawa. He has been with the Department since 1931, having previously been chief engineer of the Marine Department of Canadian Vickers Limited, Montreal.

G. W. Waddington, M.E.I.C.

G. W. Waddington, M.E.I.C., has been appointed professor of mining engineering at the Faculty of Science of Laval University, at Quebec. He received his engineering education at the University of British Columbia from which he was 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. In 1920 he was appointed engineer for the Middlesboro Collieries Limited, at Merritt, B.C. He became mining engineer with the Iron Mask Mine, Kamloops, B.C., in 1927 and in the fall of the year he became connected with the International Nickel Company at Creighton Mine, Ont. Mr. Waddington joined the staff of Britannia Mining and Smelting Company Limited, at Britannia Beach, B.C., in 1931. He resigned the position of chief engineer in this firm to join the staff of Laval University.

René Dupuis, M.E.I.C., has been appointed a lecturer in the department of mining engineering at the Faculty of Science, Laval University, Quebec. He was educated at McGill University, Montreal, and at the Université de Nancy, France, where he was graduated in 1924 as an electrical engineer. From 1925 to 1927 he was an apprentice with the Canadian Westinghouse Company, in Hamilton. In 1927 he went with Electrical Service Corporation at Shawinigan Falls, Que., and a year later joined the staff of the Shawinigan Water & Power Company at Three Rivers, Que. In 1930 he became assistant superintendent of the power division of Quebec Power Company, at Quebec. He is now assistant general superintendent of the company.

Raymond F. Leblanc, S.E.I.C., has received the appointment as assistant professor of mining and metallurgy in the department of mining engineering of the Faculty of Science at Laval University, Quebec. He received from the Ecole Polytechnique the degree of bachelor of applied sciences in 1937 and the degree of chemical engineer in 1938. He also holds from McGill University the degree of bachelor of engineering, 1939, and the degree of master of engineering in mining and metallurgy, 1940. Mr. Leblanc's practical experience was obtained with the LeRoy Mines

Limited, County of Abitibi, Que., the Bell Asbestos Mines, Thetford, Que., the Noranda Mines Limited, Noranda, Que., and the Francoeur Gold Mines Limited, Que.

J. P. Fraser, M.E.I.C.

J. P. Fraser, M.E.I.C., has recently been appointed superintendent of hydroelectric plants for the British Columbia Electric Railway Company, Limited, with headquarters at Vancouver, B.C. For the past eight years he had been associated with the Manitoba Power Commission at Winnipeg, Man., having been chief engineer and general superintendent since 1936.

A. Sandilands, M.E.I.C., is now located in Regina, Sask., as branch manager of Canadian Telephones and Supplies, Limited. He was graduated in electrical engineering from the University of Manitoba in 1934, and followed an apprenticeship course with Crompton Parkinson Company, at Chelmsford, England. From 1936 until 1939 he was sales and erection engineer with Power & Mine Supply Company, Winnipeg, Man. For the past year, Mr. Sandilands was assistant secretary of the Industrial Development Board of Manitoba.

J. D. Chisholm, M.E.I.C., is now with the Allied War Supplies Corporation in Montreal. He was graduated in electrical engineering from McGill University in 1923. Upon graduation he became engaged in electrical design on paper mills with the Newfoundland Power & Paper Company, Limited, and later with the Lake St. John Power & Paper Company. In 1930 he became sales and service engineer with Bepco Canada Limited, in Montreal. He resigned the position of assistant to the chief engineer in this firm to accept his new appointment.

W. R. G. Ray, M.E.I.C., has accepted a position with the Dominion Arsenal at Lindsay, Ont. A graduate from McGill University in 1925, he was with Price Brothers Company, Limited, until 1930, when he went with Canadian Fairbanks Morse. For the past few years he had been located in Quebec.

C. J. Jeffreys, M.E.I.C., has joined the staff of Allied War Supplies Corporation in Montreal. For the past two years he had been resident engineer with Powell River Company in British Columbia. Previous to that he has had extensive experience in mechanical designing with various industrial firms.

A. T. Cairncross, M.E.I.C., has joined the engineering staff of the Aluminum Company of Canada, Limited, at Arvida, Que.

G. R. Connor, M.E.I.C., has been transferred from the Toronto office of Aluminate Chemicals Limited to the Hamilton office.

J. H. Legg, M.E.I.C., has joined the staff of Defence Industries, Limited, at Nobel, Ont. For the last few years he had been general superintendent with Canadian Kaolin Silica Products Limited, St. Remi d'Amherst, Que.

W. H. Stuart, M.E.I.C., is presently located as a flying officer in the Eastern Air Command, Royal Canadian Air Force, Halifax.

H. J. Leitch, M.E.I.C., who was manager of the Sault Structural Steel Company, Limited, at Sault Ste. Marie, Ont., is now located in Montreal as general sales manager of Algoma Steel Corporation, Limited. Mr. Leitch was chairman of the Sault Ste. Marie Branch of the Institute.

C. C. Parker, M.E.I.C., has obtained a leave of absence from the Department of Highways, Ontario, to accept a position as structural designer with the Hamilton Bridge Company Limited at Hamilton. A graduate of the University of Toronto in 1929, Mr. Parker was for some time with the Manitoba Bridge and Iron Works Ltd., Winnipeg, Manitoba.

E. B. Horton, M.E.I.C., has accepted a position with the Factory Mutual Fire Insurance Company, and is now undergoing a period of training in Boston, Mass., in preparation for his work in Canada. Mr. Horton was graduated in mechanical engineering from the University of Toronto in 1931. For the past three years he had been located at Riverbend, Que., with Price Brothers Limited.

G. A. Sutherland, Jr.E.I.C., has been appointed as junior research physicist in the Department of Physics and Electrical Engineering of the National Research Council, at Ottawa. He was graduated from the University of Manitoba in electrical engineering in 1934. Upon graduation he went with Fetherstonhaugh & Company in Winnipeg. From 1935 to 1937 he was a technical instructor at the Chicago Institute of Diesel Engineering in Winnipeg. In 1937 he joined the staff of Kipp-Kelly Limited in Winnipeg as a designing engineer. Last year Mr. Sutherland became located in Montreal on the staff of George W. Reed & Company.

P. L. Climo, Jr.E.I.C., has joined the staff of Gaspesia Sulphite Company, Limited, at Chandler, Que. He was graduated in mechanical engineering from Queen's University in 1932. He acted as municipal engineer for the town of Cobourg until 1934, when he joined the staff of Hollinger Consolidated Gold Mines, Limited, at Timmins, Ont.

N. J. Paithouski, S.E.I.C., has taken a position with Canadian Kellogg Company on construction work in Sarnia, Ont. He was graduated in civil engineering from Queen's University last spring.

Flying-Officer A. D. Nesbitt, S.E.I.C., was reported as slightly wounded in an air battle over Britain last month. He has been a member of the R.C.A.F. from the outbreak of the war, and was formerly one of the active members of the Montreal Light Aeroplane Club. He was graduated in electrical engineering from McGill University in 1933, and became connected with Nesbitt, Thompson & Company Limited, Montreal.

R. A. Kerr, S.E.I.C., has been appointed as assistant to the electrical superintendent in the Valleyfield, Que., plant of the Montreal Cottons Limited. He was graduated in electrical engineering from McGill University in 1934, and from 1935 to 1938 he was with Price Brothers & Company at Riverbend and Kenogami, Que. In 1938 he joined the staff of Abrasive Company of Canada at Arvida, and acted as assistant to the superintendent.

N. A. M. Mackenzie, professor of public and private international law at the University of Toronto, who was a luncheon speaker at this year's annual meeting of the Institute, has been appointed president of the University of New Brunswick to succeed C. C. Jones.

Frederick Southam Ker, eldest son of Frederick I. Ker, M.E.I.C., vice-president and managing director of *The Hamiton Spectator* has been reported missing and is believed killed in action with the Royal Navy in which he was serving as a sub-lieutenant.

Sub-Lieutenant Ker was born in Vancouver on April 8th, 1920. He attended Hillfield School, Upper Canada College and Trinity College, Toronto University, where he was in third year honour course in economics and political science at the time of his enlistment.

He went overseas on April 24th in the first group of 50 junior Canadian naval officers seconded to the Royal Navy for training and service for the duration of the war, and had already seen considerable service with the fleet.

Flight-Lieutenant G. P. Christie, son of Professor C. V. Christie, M.E.I.C., of McGill University, was awarded the Distinguished Flying Cross last August and was subsequently wounded in action on September 5th. It is understood that he is recovering rapidly. Flight-Lieutenant Christie went over to England to join the Royal Air Force in 1937. He was given the rank of Flying-Officer in February of this year and was promoted to Flight-Lieutenant after being awarded the D.F.C.

VISITORS TO HEADQUARTERS

W. G. Reekie, M.E.I.C., resident engineer, Quebec North Shore Paper Co., Ltd., from Baie Comeau, Quebec, on August 26th.

Professor N. M. Hall, M.E.I.C., of the University of Manitoba, from Winnipeg, Man., August 27th.

W. L. McFaul, M.E.I.C., engineer and manager of waterworks of the City of Hamilton, and Councillor of the Institute, from Hamilton, Ont., August 29th.

C. H. White, S.E.I.C., of Parsons and Co. Ltd., Toronto, Ont., from Winnipeg, Man., August 30th.

Professor G. W. Waddington, M.E.I.C., of Laval University, from Britannia Beach, B.C., on September 5th.

W. E. Taylor, Jr.E.I.C., from Brockville, Ont., on September 9th.

R. L. Christie, S.E.I.C., engineer, Canadian Kodak Co., Toronto, Ont., from Toronto, Ont., September 10th.

W. W. Preston, Jr.E.I.C., from Edmonton, Alberta, September 10th.

Frank Binns, M.E.I.C., instructor in engrg. drawing at Mount Allison University, from Sackville, N.B., on September 10th.

C. A. Robb, M.E.I.C., consultant on power, Munitions Branch, Department of Munitions and Supply, Ottawa, Ont., on September 11th.

Lieut.-Commdr. W. S. E. Morrison, M.E.I.C., from Halifax, N.S., September 12th.

J. L. Shearer, M.E.I.C., instrumentman, Department of Highways, Ottawa, Ont., on September 12th.

H. M. Scott, M.E.I.C., from Toronto, Ont., September 17th.

R. R. Oulton, Jr.E.I.C., of Canadian Broadcasting Corporation, Sackville, N.B., from Sackville, September 17th.

A. A. Swinnerton, M.E.I.C., of Dominion Fuel Board, Ottawa, from Ottawa, Ont., September 17th.

Commander A. C. M. Davy, M.E.I.C., of the Royal Canadian Navy, from Ottawa, Ont., September 18th.

James Ruddick, M.E.I.C., consulting engineer, from Quebec, Que., on September 24th.

Obituaries

William Morley Ogilvie, M.E.I.C., died in St. Louis, Mo., on July 8th. He was born at Ottawa on January 10th, 1873, and received his education at McGill University, where he was graduated in 1897. One of the earliest pioneers of the Yukon, he was in the party of surveyors who determined the Canada-Alaska boundary in 1895. He spent many years in the Yukon, and was there during the gold rush of 1898 as an engineer for the Montreal London Gold and Silver Development Company in charge of placer mining operations. In 1905 he came back to Ottawa and was in charge of hydrographic surveys on the Ottawa river. In 1908, he became engineer with the Larder Lake Mines in Ontario and later became superintendent. In recent years he had been mining engineer with Consolidated Mining and Smelting Company Limited, and, lately, was located at Fort St. James, B.C.

Mr. Ogilvie joined the Institute as a Student in 1895 and he was transferred to Associate Member in 1911.

This picture of C. S. Gzowski, M.E.I.C., which was taken in front of his home in Westmount, Que., is his most recent photograph

Casimir Stanislaus Gzowski, M.E.I.C., died in the hospital at Montreal on September 7th. He was born at Toronto, on May 1st, 1876, and was educated at Bishop Ridley College, St. Catharines, and at the School of Practical Science, Toronto. During college vacations he engaged in the practical field work of engineering as rodman, chainman, topographer and draughtsman on various railways. After graduation, Mr. Gzowski became topographer and assistant to the divisional engineer on the Crow's Nest Railway, after which he occupied various positions in field engineering work with the Canadian Pacific Railway, with a brief interlude in 1900, when he acted as instrumental expert during the improvement surveys on the Canadian Sault Ste. Marie canal.

During a three-year period he did a considerable amount of work in western Canada on location. In 1905 he began private practice in the partnerships of Ross, Macdonnell & Company, and Macdonnell Gzowski & Company, and the following years found him engaged in varied engineering projects, on both sides of the international boundary.

In January 1919, Mr. Gzowski joined the Canadian National Railways, and in April of that year was appointed special engineer to the vice-president of operation, maintenance and construction. A year later he was appointed assistant to the vice-president of construction, and in March 1923, became chief engineer of construction, a position which he occupied until his death.

He was a grandson of the late Sir Casimir Gzowski, K.C.M.G., A.D.C., a distinguished Canadian engineer, one of the founders of the Institute as the Canadian Society of Civil Engineers, and one of its past presidents.

Mr. Gzowski joined the Institute as a Student in 1897, and was transferred to an Associate Member in 1904. He became a Member in 1909.

A. B. Gates, M.E.I.C.

Archibald Bland Gates, M.E.I.C., died suddenly at his home in Peterborough, Ontario, on September 7th. He was born at Kingston, Ont., on February 9th, 1888, and received his education at Queen's University, where he was graduated in 1911 with the degree of bachelor of science in electrical engineering. His first employment was with the Canadian General Electric Company in Peterborough, where he started in the test course. In 1913 he was transferred to the engineering department where he worked until 1915, when he became assistant engineer on the construction and operation of Seven Falls hydro electric plant and transmission line for the Laurentian Power Company at Beaupré, Que. He came back with the Canadian General Electric in 1916 as a sales engineer in Toronto. He returned to Peterborough in 1917 as a transformer designer. Later he became assistant works manager, and at the time of his death he was a general engineer in charge of searchlight and refrigeration engineering.

Mr. Gates was president of the Kiwanis Club of Peterborough in 1935, and at the time of his death he was a Councillor of the Institute. He joined the Institute as an Associate Member in 1919.

Robert Archer Baldwin, M.E.I.C., died at Toronto on September 9th. Early this year he had retired on pension as engineer on construction with Canadian National Railways. He was born at Ottawa on January 10th, 1875, and received his education in the local institutions. He entered the service of the Grand Trunk Railway at Toronto in March 1899, as draughtsman in the engineering department. In September 1900, he was employed on the construction of the Algoma Central Railway, as transitman and draughtsman at Sault Ste. Marie, Ont. In September 1901, he entered the employ of the New York Central Railway as transitman at Buffalo, N.Y., and became chief draughtsman of the Wabash Railway at St. Louis, Mo., in April 1904. In August 1905, he returned to Canada to join the engineering staff of the Canadian Northern Railway, as chief draughtsman at Toronto, Ont., and was later appointed assistant engineer, district engineer, and engineer, maintenance of way. He was appointed engineer of construction in January 1922, having held that position to the date of his retirement. During this period, he had been connected with practically all of the railway construction and grade separation work carried out by the Canadian National Railways in Ontario and Quebec, and had, during the last three years, had charge of the construction of the new line, one hundred miles in length, from Noranda to Senneterre, through the northern Quebec mining district.

Mr. Baldwin joined the Institute as a Member in 1919.

Frank Lawrence Smith, M.E.I.C., died at his home in Hamilton, Ont., on September 15th. He was born at Liverpool, England, on December 18th, 1890, and was educated at the University of Liverpool. He came to this country in 1913, and was employed as a draughtsman with the Dominion Bridge Company, Limited, until 1920, when he went with the Hamilton Bridge Company, at Hamilton with whom he stayed until his death. His latest position was that of assistant chief draughtsman.

Mr. Smith joined the Institute as an Associate Member in 1921.

John Thomas Johnston, M.E.I.C., controller of the Dominion Water and Power Bureau, Department of Mines and Resources, died in the hospital at Toronto on September 16th. He was born at Kincardine, Ont., on February 23rd, 1883, and was educated at the University of Toronto, where he was graduated in 1910. His whole professional career was spent in the Dominion government service. He joined the water power branch of the former Department of the Interior in 1911 as a hydraulic engineer. He succeeded J. B. Challies, M.E.I.C., as head of the branch when the latter resigned in 1925 to take up a position with the Shawinigan Water & Power Company.

In addition to his responsibilities as head of the Dominion Water & Power Bureau, Mr. Johnston was for many years technical adviser to the Department of External Affairs on international waterway matters. He was a member of a number of control boards established to control the flow and level of various international rivers and lakes.

Mr. Johnston joined the Institute as a Student in 1908 and was transferred to Associate Member in 1912. He became a member in 1917.

COMING MEETINGS

American Institute of Steel Construction—Eighteenth Annual Convention, The Greenbrier, White Sulphur Springs, W.Va., October 15th to 18th.

American Welding Society—Twenty-first Annual Meeting, Cleveland, Ohio, October 20 to 25.

Canadian Good Roads Association—Special convention, Château Frontenac, Quebec, October 22 to 24.

Canadian Institute on Sewage and Sanitation—Annual Meeting, Royal York Hotel, Toronto, October 24 to 25.

American Society of Mechanical Engineers—61st Annual Meeting, Hotel Astor, New York, December 2 to 5.

Library Notes

Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

Manual of Soil Science Applied to Subgrade and Base Course Design:
By Norman W. McLeod of Department of Asphalt Technology, Imperial Oil Limited, 1939. 49 pp., 11¾ by 8¾ in.

The Stadium:
By Myron W. Serby, New York, American Institute of Steel Construction, c1940. 64 pp., 6¼ by 9¼ in.

Statistical Year-Book of the World Power Conference:
By Frederick Brown, London, World Power Conference, 1938, 138 pp., 11 by 8¾ in.

Steel Construction:
Published by the American Institute of Steel Construction, New York. A Manual for architects, engineers and fabricators of buildings and other steel structures. 3rd edition, 1940. 392 pp., 6 by 9¼ in.

Steel Dams:
By Otis E. Hovey, New York, American Institute of Steel Construction, 1935. 122 pp., 6 by 9¼ in.

Suspension Bridges of Short Span:
By F. H. Frankland, New York, American Institute of Steel Construction, 1934. 128 pp., 6 by 9¼ in.

SPECIFICATIONS

British Standards Institution:
Brass Bars and Sections (suitable for forging) and Drop Forgings, 21B-1940; Brass Bars (high speed screwing and turning), 249-1940; High Tensile Brass Bars and Sections (grades A and B), 250-1940; Naval Brass (admiralty mixture) Bars and Sections (suitable for machining and forging) and Forgings, 251-1940; Naval Brass (special mixture) Bars and Sections (suitable for machining and forging) and Forgings, 252-1940; Phosphor Bronze Bars and Roads for General Purposes, 369-1940; Bronze (gunmetal) Ingots and Castings for General Engineering Purposes, 382-1940 Bronze (gunmetal) Ingots, 383-1940 Bronze (gunmetal) Sand and Chilled Castings; Leaded Gunmetal Castings and Ingots, 897-1940 Leaded Gunmetal Ingots, 898-1940 Leaded Gunmetal Castings; Cold Rolled Copper Sheets and Strip (half-hard and annealed) for General Purposes, 899-1940; Leaded Gunmetal Castings and Ingots, 900, 901-1940, 900-Leaded Gunmetal Ingots, 901-Leaded Gunmetal Castings.

Canadian Engineering Standards Association:
Approvals Manual respecting inspection, test and approval of Electrical Equipment, (first edition) 1940.

Canadian Engineering Standards Association—Specifications:
Established lists of nominal sizes and dimensions of wood screws, B65-1940; Canadian Electrical Code, Part 3, Overhead Systems, C22.3 No. 1 (A); Canadian Electrical Code, Part 3, Overhead Systems, C22.3 No. 1 (B); Metallic Arc Welding (Bridges and Buildings) S59-1940; Steel Structures for Buildings, S16-1940.

REPORTS

Association of Professional Engineers of Alberta:
History of the Association and Alberta Engineering Profession Register, August 15th, 1940.

American Institute of Steel Construction
Recommended Fundamental Principles, Tentative Minimum Requirements and Tentative Standard Welded Connections for Tier Buildings; The Welding of St 52 by Dr. Ing. Roland Washmuht; Progress Report of a Traffic Test of a Thin Asphaltic Roadway Surfacing for Battledeck Floors for Highway Bridges; Prize Designs submitted in the Elevated Highway Competition 1938; The Battledeck Floor for Highway Bridges; Building to Resist Hurricanes in the West Indies by George E. Howe; Requirements for Buildings to Resist Earthquakes by George E. Howe.

Bell Telephone System—Technical Publications:
Constants of Heavy-water Rochelle Salt; Molecular Rotation in Non-Aromatic Crystals; Porous Structure of Paper in Relation to Drying and Impregnation; Ash-Forming Constituents of Insulating Papers; Spectrochemical Analysis; Spectrophotometry and Colorimetry; Apparatus for Determining Orientation of Crystals by X-Rays; Nuclear Fission; Electrical Wave Filters Employing Normal and Divided Crystals; Advances in Carrier Telegraph Transmission; A Musa Receiving System; Lead-Tin-Arsenic Wiping Solder; The Coronaviser; A Solution for Faults at Two Locations in Three-phase Power Systems; Electrical Drying of Telephone Cable; Thermionic Emission, Migration and Evaporation of Barium on Tungsten; Disintegration of Face Brick by Crystallization of Soluble Salt; Wave Shape of 30- and 60-Phase Rectifier Groups; Rockwell Hardness of Cylindrical Specimens; Analysis of Rockwell Hardness Data; Electrical Conductance Measurements of Water Extracts of Textiles; High-Precision Frequency Comparisons; Spectrochemical Analysis of Dilute Solutions; Room Noise at Telephone Locations—2; Investigation of Synthetic Linear Polymers by X-Rays; A New Quartz-Crystal Plate.

Canada Department of Mines and Resources—Mines and Geology
Branch—Geological Survey:
Mineral Resources, Hazelton and Smithers Areas, Cassiar and Coast District, British Columbia. Memoir 223.

Canadian Government Purchasing Standards Committee:
Specification for Liquid Paint Drier, Types 1 and 2; Marine Paint, Solid Colours; Gasoline; Worsted Serge for Uniforms, Extra Heavy Weight; Frieze (19 ounce) for Uniforms; Frieze (21 ounce) for Overcoating; Safety Glass; Liquid Petroleum Asphalts for Road Purposes.

Civil Service Commission of Canada:
Thirty-First Annual Report for the year 1939. Ottawa, 1940.

Edison Electric Institute:
Suggestions for Specifications for Co-ordinated and Standardized Low Voltage Metering Current Transformers; Standard Dial Constants for Alternating Current Watthour Meters.

Electrochemical Society—Preprints:
A Study of the Kinetics of the Reactions in the Zinc-Hydrogen Irreversible Cell; Production of Ductile Titanium; Glycerine "Foots" as Brightening Agent in Cadmium Cyanide Baths; Electrodeposition of Bright Copper; Electrodeposition of Indium from Sulfate Baths. Preprints Nos. 78-10 to 78-14.

Illinois State Water Survey:
Bulletin No. 21, supplement 2. Urbana, State Water Survey Division, 1940.

Institution of Civil Engineers:
Deterioration of Structures of Timber, Metal, and Concrete exposed to the action of Sea-water—Eighteenth report of the Committee of the Institution of Civil Engineers. London, Institution of Civil Engineers, 1940.

Quebec—Department of Mines— Geological Division:
Launay Township Abitibi County. Geological Report No. 1, Quebec, 1939.

U.S. Department of Commerce—Building Materials and Structures:
Structural Properties of "Tilecrete Type A" Floor Construction Sponsored by the Tilecrete Co., BMS51; Structural Properties of a Masonry Wall Construction of "Munlock Dry Wall Brick" Sponsored by the Munlock Engineering Co., BMS53.

U.S. Department of Commerce—National Bureau of Standards — Research Papers:
Strength of Riveted Steel Rigid Frame having a Curved Inner Flange RP1161; Strength of a Welded Steel Rigid Frame, RP1224.

U.S. Department of the Interior—Bureau of Mines—Bulletins:
Mineral Industries Survey of the United States, California, Bulletin 424.

U.S. Department of the Interior—Bureau of Mines—Technical Papers:
Explosion Hazards in Storage-battery Rooms, Technical Paper 612.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

APPLIED X-RAYS

By G. L. Clark. 3 ed. McGraw-Hill Book Co., New York, 1940. 674 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $6.00.

This book is intended for the industrial executive who wishes to know what X-rays are, how they may be used, and the ways in which they can be applied to practical industrial problems. The first section discusses the general physics and applications of X-radiation, the second covers the analysis of the ultimate structures of materials. The book has been completely rewritten in consideration of the great advance since the previous edition.

BILWSORT DEUTSCH Technische Sprachhefte

1. Ingenieurbau. 32 pp., 1.50 rm.
2. Heben und Ferdern. 36 pp., 1.50 rm. VDI-Verlag, Berlin, 1940. Illus., diagrs., 8½ x 6 in., paper.

These pamphlets are intended to assist engineers who wish to increase their ability to read technical German publications. Each pamphlet contains a descriptive article upon some subject, in German, with numerous drawings upon which the German names are written, so that the drawings act as vocabularies. Subject indexes are provided. The first of the pamphlets is on structural engineering; the second on hoisting and conveying machinery.

(The) CALCULATION OF HEAT TRANSMISSION

By M. Fishenden and O. A. Saunders. Great Britain, Dept. of Scientific and Industrial Research. London, His Majesty's Stationery Office, 10 x 6 in., paper, 7s. 6d. (obtainable from British Library of Information, 50 Rockefeller Plaza, New York, $2.15).

A large amount of published material on the transmission of heat has been critically analyzed and is presented here for practical use. Heat transfer coefficients are given for a wide range of conditions, and the application of specific information to certain simple cases is illustrated. Original sources are listed in a large bibliography.

CIVIL ENGINEERING HANDBOOK

By L. C. Urquhart. 2 ed. McGraw-Hill Book Co., New York, 1940. 877 pp., illus., diagrs., charts, tables, 9 x 6 in., flex. lea., $5.00.

The principal purpose of this work is to provide the practicing engineer with a compact, comprehensive book, to which he can refer when confronted with a problem outside a specialized field. Civil engineering is covered in ten sections: surveying, railway and highway engineering, mechanics of materials, hydraulics, stresses in framed structures, steel design, concrete, foundations, sewerage and sewage disposal, water supply and purification. Each section is written by a well-known authority. Fundamental theory is stressed and tabular material is kept to a minimum. The new edition has been revised to conform with present practice.

COAL, Its Properties, Analysis, Classification, Geology, Extraction, Uses and Distribution

By E. S. Moore. 2 ed. John Wiley & Sons, New York, 1940. 473 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $6.00.

In a single volume, Dr. Moore provides a comprehensive summary of our knowledge of coal. Physical and chemical properties, classification, origin, structural features, mining, preparation and uses are discussed with sufficient detail for the average reader. The coal deposits of the world are also described. This edition has been thoroughly revised and new material added.

CURRENT POLICIES IN PERSONNEL RELATIONS IN BANKS

By H. Baker. Princeton University, Industrial Relations Section, 1940. 50 pp., 10 x 7 in., paper, $1.00.

Developments during 1934-1939 are summarized and current policies with regard to employment procedures, salaries, educational plans, financial, medical and health services, employee organization, and hours of work and vacations are discussed briefly.

(A) DETAILED PROOF OF THE CHI-SQUARE TEST OF GOODNESS OF FIT. (The Harvard Phi Beta Kappa Prize Essay for 1939)

By E. R. Greenwood, Jr. Harvard University Press, Cambridge, Mass., 1940. 61 pp., diagrs., charts, 7 x 4½ in., cloth, $1.25.

The chi-square curve, a specific frequency curve, is derived from considerations of the chi-square test of goodness of fit in order to demonstrate the validity of the use of the curve in the test. Limitations in the application of the test are discussed.

DEUTSCHE AKADEMIE DER LUFTFAHRTFORSCHUNG, SCHRIFTEN. Hefte 11, 13 and 14

R. Oldenbourg, Munich, 1939-1940. Illus., diagrs., charts, tables, 10 x 7 in., paper.
Heft 11. Zur Sauerstoffbestimmung auf physikalischem Wege, by H. Rain. 7 pp., .50 rm.
Heft 13. Biologische Probleme des Hochgeschwindigkeitsfluges, by S. Ruff. 22 pp., 1.40 rm.
Heft. 14. Das Widerstandsproblem der Flugmotorenkühlung, by H. Helmbold. 14 pp., .90 rm.

These three German aeronautical research papers discuss the following topics: 11. Physical methods for oxygen determination. 13. Biological problems in connection with high speed flight. 14. The problem of resistance in airplane engine cooling.

ELECTRIC CIRCUITS, a First Course in Circuit Analysis for Electrical Engineers. (Principles of Electrical Engineering Series)

By Members of the Staff of the Department of Electrical Engineering, Massachusetts Institute of Technology; a publication of the Technology Press, Massachusetts Institute of Technology; John Wiley & Sons, New York; Chapman & Hall, London, 1940. 782 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $7.50.

The staff of the Department of Electrical Engineering at the Massachusetts Institute of Technology has for some years been engaged in a programme of revising as a unit substantially its entire presentation of the basic technological principles of electrical engineering. This volume is the first of a projected series covering this revised presentation. It contains a broad, unified text on electric circuits, which should be adequate for all students of electrical engineering, regardless of their ultimate specialty. Circuit theory and analysis are discussed, with many problems. Appendixes contain tables of the electrical properties of metals, methods of solving linear algebraic equations, tables of units, standards, etc., and a good selective bibliography.

ELECTRIC RAILWAYS IN INDIA

By Shiv Narayan, printed by V. H. Barve at the Aryabhushan Press, 915-1 Bhamburda Peth, Poona City, and published by Brij Narayan, 45 Wellesley Road, Poona, India, 1940. 128 pp., illus., diagrs., charts, tables, maps, 10 x 6½ in., paper, Rs. 4-8.

Historical, statistical and technical information is given concerning the electric railways, vehicles and trolley busses in India. Some space is devoted to electric traction in other countries, and there is a glossary of electric traction terms.

ELEMENTS OF UTILITY RATE DETERMINATION

By J. M. Bryant and R. R. Herrmann. McGraw-Hill Book Co., New York, 1940. 464 pp., charts, tables, 9½ x 6 in., cloth, $4.50.

The purpose of this book is to cover the field of public-utility rate determination, service, and discrimination from the viewpoint of the engineer and manager rather than from that of the lawyer or economist. The authors discuss reasons for the regulation of utility rates, describe the methods used to accomplish such regulation, and outline the practical limitations involved. Reference is made to many actual cases.

GENERAL ENGINEERING HANDBOOK

Ed. by C. E. O'Rourke. 2 ed. McGraw-Hill Book Co., New York, 1940. 1120 pp., illus., diagrs., charts, tables, 8½ x 5½ in., flex. lea., $4.00.

The purpose of this reference book is to present in one volume the fundamental data relating to all branches of engineering. The data are arranged in nineteen sections: mathematics; mathematical tables; physical tables; engineering materials; theoretical mechanics; hydraulics; structural theory and design; plain and reinforced concrete; foundations; topographical and geodetic surveying; route surveying and earthwork; highways; municipal sanitation; machine elements; pumps, compressors and hydraulic turbines; engineering thermodynamics; heating and air conditioning; fundamentals of electrical engineering; electrical measurements. This edition has been thoroughly revised and rearranged.

GEOLOGY FOR CIVIL ENGINEERS, as Related to Highway Engineering

By D. G. Runner. Gillette Publishing Co., Chicago, 1939. 299 pp., illus., diagrs., charts, maps, tables, 9 x 6 in., cloth, $5.00.

This book, the outgrowth of a series of articles published in "Roads and Streets," is intended as a textbook for students of highway engineering. It discusses the origin, formation and characteristics of the various rocks, and describes the road-building properties of the principal types in considerable detail. Chapters are devoted to clays, blast-furnace slag, rock weathering, sand and gravel, soils and soil tests and low-cost road surfaces. Glossaries of geological and highway terms, lists of state geological and highway offices, standard tests and a list of works on geology are appended.

Great Britain, Dept. of Scientific and Industrial Research. FOOD INVESTIGATION Special Report No. 49. THE FUNCTION OF NITRATE, NITRITE AND BACTERIA IN THE CURING OF BACON AND HAMS.

By J. Brooks, R. B. Haines, T. Moran and J. Pace. His Majesty's Stationery Office, London, 1940. 32 pp., charts, tables, 10 x 6 in., paper, 9d. (obtainable from British Library of Information, 50 Rockefeller Plaza, New York, $.25).

Procedures, data and conclusions are given for an investigation on the effect of direct use of nitrites in curing bacon and hams as compared to the action of bacteria in combination with nitrates. The object is to increase the control over the quality of the product.

MECHANISM AND THE KINEMATICS OF MACHINES

By W. Steeds. Longmans, Green & Co., London, New York and Toronto, 1940. 319 pp., diagrs., charts, tables, 9 x 5½ in., cloth, 18s., $5.00.

As a practical aid in the study of mechanisms as mechanical contrivances the author treats only of the kinematics of machines, omitting statics and dynamics. Specific mechanisms considered include straight-line actions, gearing, belts and chains, variable-speed gears, cams, universal joints, and ratchets. Exercises accompany each chapter.

(The) MUSICAL EAR

By L. S. Lloyd, Oxford University Press, London, New York and Toronto, 1940. 87 pp., diagrs., charts, tables, 9 x 6 in., cloth, $1.50.

A collection of seven essays on musical acoustics in which the author brings out the importance of approaching the subject from the physiological viewpoint of aural perception rather than from the theoretical mathematical determination of vibration rates, Helmholtz, church bells, and harmonic series are among the topics discussed.

(*Continued on page 446*)

PRELIMINARY NOTICE

of Applications for Admission and for Transfer

September 27th, 1940

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

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

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

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

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

The Council will consider the applications herein described in November, 1940.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

A 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 attainment 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

BLOOM—DAVID, of 352 St. Joseph Blvd., Montreal, Que. Born in Russia, Feb. 15th, 1909; Educ.: B.Eng. (Elec.), McGill Univ., 1935; 1936-39, gen. mgr., supervision work on constrn. jobs, estimating and management, Construct Rite Co. Ltd., Montreal.

References: C. V. Christie, G. A. Wallace, E. Brown, R. DeL. French, C. M. McKergow.

MACLAREN—WILLIAM OFFICER, of Risley, nr. Warrington, Lancs., England. Born at Coatbridge, Scotland, Nov. 22nd, 1907; Educ.: 1921-23, Archbishop Holgates (Secondary School), York, England; one year, University College (London University), no degree; 1924-26, archt'l. dftsman. and asst. to Norman Mann, Reg'd. Architect, Niagara Falls, Ont.; 1926-28, American Carborundum Co., Niagara Falls, U.S.A., asstng. in design and drawing of expansions to factory bldgs., etc.; 1928-33, structl'. designer and civil engr. with H. G. Acres & Company, Niagara Falls, Ont.; 1933-35, own practice as civil and struct'l. engr., also engaged by the British Pacific Trust Ltd. for estate design both in England and Canada. Designing and supervising roads, layouts for estates and complete drainage schemes for same; 1935-36, Taylor Engineering and Construction Company, Toronto. Asst. to Mr. E. G. Taylor, complete design and supervision of factory bldgs., reinforced concrete silos, and asstng. in design of boilerhouses. Also specialized design in precast concrete units; 1937-39, own practice, civil engr. and architect. Design and supervision of factory bldgs. and estate development work; at present, civil engr., Sir Alexander Gibb & Partners, Risley, nr. Warrington, England.

References: H. G. Acres, R. L. Hearn, L. L. Gisborne, A. W. F. McQueen, S. R. Frost, T. A. Barnett.

WINCH—EDMUND M. P., of Montreal, Que. Born at Montreal, May 18th, 1918 Educ.: 1932-36, Montreal Technical School; 1935 (summer), dftsman., Canadian Potteries Ltd.; with Bepco Canada Limited, as follows: 1936-37, dftsman., Montreal, 1937-40, estimator, Montreal and Toronto, 1940, asst. service mgr., Toronto, and at present, dftsman., Montreal.

References: A. Matheson, R. A. Yapp, R. M. Morton, H. Lillie.

FOR TRANSFER FROM JUNIOR

FOTHERINGHAM—WILLIAM WEBSTER, cf Ste. 21, Emily Apt., Winnipeg, Man. Born at Winnipeg, March 4th, 1911; Educ.: B.Sc. (Civil), Univ. of Man., 1933; 1935, gen. field and shop work, 1936, shop inspr., Manitoba Bridge & Iron Works Ltd., Winnipeg; 1936-38, sales engrg., estimating, designing, foundry supervision, Standard Iron Works Ltd., Edmonton; 1938-40, cost accounting, and at present, estimating, Manitoba Bridge & Iron Works Ltd., Winnipeg. (Jr. 1937).

References: R. M. Dingwall, J. N. Finlayson, D. M. Stephens, J. H. Edgar, G. H. Herriot.

MacDONALD—MURRAY VICKERS, of Beloeil, Que. Born at Fort William, Ont., June 16th, 1910; Educ.: B.Sc. (Civil), 1931, M.Sc. (Geol.), 1938, McGill Univ.; 1925-29 (summers), municipal engrg., land surveying, highway engrg.; 1930 (summer), partner, Reilly & MacDonald; 1931-32, city engr., Swift Current, Sask.; 1933, mining engr., 1934, miner, Froud Mine, International Nickel Co.; 1935, asst. engr., 1936-37, mine engr., Arntfield Gold Mine; 1938, chemist, 1939 to date, constrn. engr., Beloeil works, Canadian Industries Ltd., (St. 1931, Jr. 1932).

References: C. J. Mackenzie, G. M. Williams, R. A. Spencer, J. K. Sexton, W. G. McBride, B. A. Evans.

MACKAY—LESLIE, of 841 Somerset Ave., Fort Garry, Winnipeg, Man. Born at Winnipeg, Nov. 17th, 1901; Educ.: B.Sc. (Civil), Univ. of Man., 1927; 2 summers, rodman and instr'man., C.N.R. constrn.; 1 year, inspr. C.P.R. piers, for Sidney E. Junkins; 1929-31, asst. res. engr. on constrn., Slave Falls power house; 1932 to date, secretary and asst. to manager, Manitoba Power Commission. (St. 1924, Jr. 1930).

References: J. W. Sanger, J. P. Fraser, N. M. Hall, J. N. Finlayson, J. A. MacGillivray, A. J. Taunton.

FOR TRANSFER FROM THE CLASS OF STUDENT

BAIRD—MALCOLM FRANCIS, of 144 Hyde Park Ave., Hamilton, Ont. Born at Fredericton, N.B., March 8th, 1916; Educ.: B.Sc. (Elec.), Univ. of N.B., 1937; 1937-39, elect'l. ap'tice, 1939 to date, lamp engr., Canadian Westinghouse Company, Hamilton, Ont. (St. 1937).

References: G. W. Arnold, E. O. Turner, J. T. Thwaites, A. F. Baird, D. W. Callander.

BEAULIEU—GERARD OLIVIER, of 3679 Laval Ave., Montreal, Que. Born at Montreal, Jan. 1st, 1912; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1936; summers 1934-35, estimates and dwg. with private contractor, surveying and sounding with Quebec Streams Commn.; 1936-37, struct'l. designer, Dominion Bridge Co. Ltd.; 1937-38, mech. designer, Plessisville Foundry; 1938 to date, struct'l. designer, Dominion Bridge Co. Ltd. (St. 1935).

References: F. Newell, R. S. Eadie, D. B. Armstrong, A. Frigon, J. A. Lalonde, A. Duperron.

BONNEY—ALBERT J., of 162B Parkhill Road, Peterborough, Ont. Born at Oshawa, Ont., March 8th, 1911; Educ.: B.Sc. (Mech.), Queen's Univ., 1935; summers 1932-34, residential and industrial wiring; 1935-36, asst. to chief electrician, 1936 to date, asst. chief engr., Quaker Oats Company, Peterborough, Ont. (St. 1935).

References: V. R. Currie, R. L. Dobbin, W. T. Fanjoy, L. M. Arkley, L. T. Rutledge.

HEWITT—ROBERT, of 164 Dupont St., Toronto, Ont. Born at Toronto, June 22nd, 1913; Educ.: B.A.Sc. (Civil), Univ. of Toronto, 1935; summers 1929-30-31-33, gen. bld. constrn.; 1932, surveying,; 1934, transitman and leveller, highway work, Dept. of Nor. Development; 1935, engr's. asst. for contractor on highway grading, Dufferin Paving Co. Ltd., Kenora; 1936 to date, sales engrg. work on heavy constrn., mining and industrial machy. and equipment, General Supply Co. of Canada Ltd., Toronto (St. 1933).

References: R. E. Hayes, D. Forgan, C. Johnston, R. E. Smythe, C. H. Mitchell.

KAZAKOFF—JOHN, of La Paz, Bolivia. Born at Kamsack, [Sask., March 14th, 1913; Educ.: B.Eng. (Elec.), McGill Univ., 1935; 1935-38, dftsman. and machine designer, Canadian Ingersoll Rand Co. Ltd., Sherbrooke, Que.; 1938-39, constrn., elec. and mech. hydro plants, 1939-40, asst. supt., and at present, supt., Bolivian Power Co. Ltd., La Paz, Bolivia. (St. 1935).

References: G. A. Gaherty, J. H. McLaren, E. Dickinson, C. V. Christie, E. Brown, S. R. Newton.

LEAHEY—JAMES C. P., of Montreal, Que. Born at St. John's, Nfld., Dec. 31st, 1910; Educ.: B.Eng. (Elec.), McGill Univ., 1935; 1934 (3 mos.), radio dept., National Research Council, Ottawa; 1936-39, i/c inspection dept., Schick Shaver Co. Ltd., St. Johns, Que.; 1939 to date, sales engr., Canadian SKF Co. Ltd., Montreal. (St. 1935).

References: C. V. Christie, G. A. Wallace, R. W. Boyle, D. Giles, R. DeL. French.

LEMIEUX—ROLAND A., of 22 Belvedere Ave., Quebec, Que. Born at Charny, Que., Oct. 27th, 1909; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1937; summer 1936, surveying; with Dept. of Roads, Prov. of Quebec, as follows: summer 1935, res. engr., 1937 (May-Aug.), surveying, chief of party, 1937-38, res. engr., 1938 (Jan.-Apr.), surveying, locating engr., 1938-40, technical asst., Quebec-Portneuf and Montmorency Divn., Aug. 1940 to date, asst. to the principal engr., District No. 1. (St. 1937).

References: E. Gohier, A. Duperron, A. Frigon, J. O. Martineau, L. Trudel, P. Vincent, A. Lariviere, H. Cimon.

L'HEUREUX, PAUL-EMILE, of Sherbrooke, Que. Born at Montreal, March 23rd, 1913; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1936; R.P.E. of Que.; 1936-38, asst. on survey and constrn. of roads, and 1938-39, asst. and i/c of survey for location of new roads, "The Associated Engineers' Ltd."; 1939-40, Quebec Roads Dept., at present, asst. divn. engr., at Lennoxville, Que. (St. 1936).

References: E. Gohier, J. A. Lalonde, G. J. Papineau, A. Circe, A. Bolduc.

LOOMIS—JAMES GORDON MANN, of 333 Metcalfe Ave., Ottawa, Ont. Born at Montreal, March 14th, 1912; Educ.: B.Eng. (Mech.), McGill Univ., 1936; R.P.E. of Que.; 1932-36, summer work on road constrn.; 1936-37, asst. engr., 1937-39, sec.-treas., office management, plant operation, Bitumen Products Corpn., Montreal; 1939-40, shop experience, Fairchild Aircraft Ltd., Longueuil, Que.; March, 1940 to date, engrg. dftsman., Canadian International Paper Company, Gatineau Mills, Que. (St. 1936).

References: E. Brown, R. DeL. French, C. M. McKergow, R. E. Jamieson.

MAYHEW—EARLE CHANDLER, of 337 MacLaren Street, Ottawa, Ont., Born at Moose Jaw, Sask., July 22nd, 1912; Educ.: Grad. R.M.C., 1934. B.Sc. (Mech.), Queen's Univ., 1936; 1937-38, Ordnance Mech. Engrs. Course, Military College of Science; 1929-30, Swift Canadian Company, Moose Jaw; 1934-39, Ordnance Mech. Engr., 4th Class and Lieut., 1939, Ordnance Mech. Engr., 3rd Class and Capt., and at present, Deputy Chief Inspr. of Armaments (Guns), Dept. of National Defence, Ottawa, Ont. (St. 1935).

References: N. C. Sherman, L. T. Rutledge, L. M. Arkley, H. H. Lawson, L. F. Grant, D. S. Ellis.

MITCHELL—ROBERT WALTER, of 51 Balfour Ave., Town of Mount Royal, Que. Born at Montreal, July 13th, 1911; Educ.: B.Eng. (Chem.), McGill Univ., 1933; 1934 to date, dept. head., Merck & Company, mfg. chemists, Montreal, Que. (St. 1933).

References: R. E. Heartz, D. M. Chadwick, G. J. Dodd, H. F. Finnemore, J. B. Phillips.

RICE—JOSEPH DONALD, of Negritos, Peru. Born at Montreal, Que., Jan. 18th, 1913; Educ.: B.Eng. (Civil), McGill Univ., 1935; 1934-35 (summers), with J. P. Porter & Sons Ltd., St. Catharines, Ont., and Geol. Survey of Canada; 1935-36, Canadian Airways Ltd., Montreal. Stereoscopic exam. of air photos, plotting of strip traverses, etc.; 1936 (May-July), Ontario Paper Co. Ltd., Baie Comeau, Que., instr'man.; 1936-37, compiler, Dept. of Mines and Resources, Ottawa; 1937-38, mech. dftsman., aviation divn., Can. Car & Foundry Co. Ltd., Montreal; March 1938 to date, with International Petroleum Co. Ltd., Negritos, Peru. I/c office and dfting. dept. of geol. dept., supervising all dfting., field surveys, location of wells for drilling purposes, and boundary surveys. (St. 1935).

References: E. Brown, R. E. Jamieson, A. E. Simpson, B. H. Segre, G. J. Dodd.

TANNERBAUM—JOSEPH, of 5346 Jeanne Mance St., Montreal, Que. Born at Montreal, Oct. 27th, 1912; Educ.: B.Eng. McGill Univ., 1934; 1931, Temp. 2nd Lieut., R.C.C.S., Camp Borden; 1935, sales engr., Engineering Equipment Co. Ltd., Montreal; 1937-38, gen. shop work, 1938-39, asst. engr. i/c production, and 1939 to date, engr. i/c production, W. R. Cuthbert & Co., Montreal. (St. 1934).

References: N. M. Campbell, B. A. Margo, E. Brown, C. M. McKergow.

LIBRARY NOTES

(Continued from page 444)

NOTIONS COMPLÉMENTAIRES SUR LES TUBES ÉLECTRONIQUES

By M. Chauvierre. Dunod, Paris, 1940. 203 pp., diagrs., charts, tables, 8½ x 5½ in., paper, 77 frs.; bound, 94 frs.

This small, practical work presents the fundamentals of electron-tube construction, operation and application. Certain specific problems with which the technician must cope are considered fully. Graphical methods are used to a considerable extent.

PHENOMENA AT THE TEMPERATURE OF LIQUID HELIUM (American Chemical Society Monograph Series No. 83).

By E. F. Burton, H. G. Smith and J. O. Wilhelm. Reinhold Publishing Corp., New York, 1940. 362 pp., diagrs., charts, tables, 9½ x 6 in., cloth, $6.00.

The beginning chapters briefly describe liquefaction methods, the measurement of temperature, and the physical properties of liquid and solid helium. The following chapters discuss superconductivity, specific heats at low temperatures, paramagnetism, temperatures below 1°K, the nature of the superconducting state, and the transformation in liquid helium. Each chapter has a large bibliography.

PLANNING FOR PRODUCTIVITY

By K. Lönberg-Holm and C. T. Larson. International Industrial Relations Institute, The Hague, Holland, or I.R.I. Research Group, Room 704, 130 East 22nd St., New York, 1940. 43 pp., 10 x 7½ in., paper, $1.00, free to members.

The work of two architects, this pamphlet presents an outline of a "reference frame" to integrate information from the fields of engineering, human activities, etc., for more effective planning in building design. The presentation is general enough in form to be applicable in any branch of production where it is desirable to make sure that no pertinent phase has been overlooked.

PRACTICAL MICROSCOPICAL METALLOGRAPHY

By R. H. Greaves and H. Wrighton. 3 ed. rev. and enl. D. Van Nostrand Co., New York, 1940. 272 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $6.50.

This book is concerned with methods for examining metals and alloys with the aid of the microscope, and with the results of such investigations. A set of typical photomicrographs is presented, suitably annotated and accompanied by a concise account of the results of metallographic researches and other investigations, in so far as they afford an interpretation of the structures observed in commercial materials. The new edition is revised and enlarged.

RECORDS AND RESEARCH IN ENGINEERING AND INDUSTRIAL SCIENCE

A guide to the production, extraction, integrating, storekeeping, circulation, and translation of Technical knowledge.
By J. E. Holmstrom. Chapman & Hall, London, 1940. 302 pp., diagrs., charts, tables, 9 x 5½ in., cloth, 15s.

The author first discusses the nature and methods of technical science and its practical applications. This is followed by descriptions of the character, objects and activities of experimental and technical organizations and societies. The succeeding chapters cover the various ways of searching technical literature, methods of indexing and filing, the expression and transmission of ideas, and the translation of foreign languages, with considerable reference to the author's personal experience. The qualifications and opportunities of the technician are also discussed.

RUBBER AND RAILWAYS

By C. Macbeth. 2nd rev. ed. British Rubber Publicity Association, 1 Albert Mansions, Lansdowne Road, Croydon, Surrey, England, Sept., 1939. 216 pp., illus., diagrs., charts, tables, 8½ x 5 in., paper, free on request.

This publication describes in detail the ways in which railways (chiefly British) have applied the properties of rubber in their designs. A large part of the text consists of descriptions of actual applications, varying from draw-bar springs to pneumatic tires. There is a large number of detailed section drawings.

STATISTICAL MECHANICS

By J. E. Mayer and M. G. Mayer. John Wiley & Sons, New York, 1940. 495 pp., diagrs., charts, tables, 9 x 6 in. cloth, $5.50.

Both classical and quantum mechanics are used as the basis of this elementary treatment of statistical mechanics. Fundamental statistical laws are derived, and the principles of application to various simple energy states are discussed. Certain special operations are combined in an appendix. There are a large glossary of symbols and a small group of illustrative problems.

SURVEYING, Theory and Practice

By R. E. Davis and F. S. Foote. 3 ed. McGraw-Hill Book Co., New York, 1940. 1032 pp., illus., diagrs., charts, maps, tables, 8 x 5 in., flex. lea., $5.00.

While primarily intended as a college textbook, this work is also intended to give, in a single volume, a sufficiently comprehensive treatment to be of value to engineers and surveyors. For this purpose, the more advanced phases of the subject are discussed, and methods used on extensive surveys are described and evaluated. The new edition has been rewritten, and among the new material added is a chapter on photogrammetric surveying.

TABLES OF CIRCULAR AND HYPERBOLIC SINES AND COSINES FOR RADIAN ARGUMENTS

Prepared by the Federal Works Agency, Work Projects Administration for the City of New York, as a Report of Official Project No. 765-97-3-10. Arnold N. Lowan, Technical Director, U.S. Bureau of Standards, Washington, D.C., 1939. 405 pp., 11 x 8 in., cloth, $2.00.

This volume, the third of a series of mathematical tables, contains values of circular and hyperbolic sines and cosines to nine places of decimals for a range of X from 0 to 1.9999 at intervals of 0.0001. Some supplementary and conversion tables are included.

TELEVISION RECEIVING EQUIPMENT

By W. T. Cocking. The Wireless World (Iliffe & Sons, Ltd.), London, 298 pp., illus., diagrs., charts, tables, 8 x 5 in., cloth, 7s. 6d.

This book explains the principles upon which the modern television receiver works, and deals with the design of its essential parts. Amplifiers, frequency-changers, detectors, time-bases and syne separators are treated, and consideration is given to cathode-ray tubes and their deflecting systems. There are also chapters on sound reception and fault finding.

SITUATIONS VACANT

YOUNG MECHANICAL ENGINEERING GRADUATE, who can speak French, required by firm of repute for position of assistant safety engineer. Apply to Box No. 2111-V.

YOUNG MECHANICAL ENGINEER who is a recent graduate of a Canadian university. Preferably a single man who is willing to learn the business of an industrial concern from the ground up. Excellent opportunity for the right man. Apply to Box No. 2133-V.

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SITUATIONS WANTED

MANUFACTURING EXECUTIVE, M.E.I.C. Services of steel plant executive having mechanical and shell manufacturing experience available to company contemplating installing munitions equipment. Capable of assuming complete responsibility for plant layout, tooling and production. Apply to Box No. 67-W.

CONSTRUCTION ENGINEER, 1921 McGill graduate in civil engineering, experienced in heavy industries and municipal work; recently resident engineer on seven million dollar job, available on short notice. Details and references on application to Box No. 121-W.

GRADUATE ELECTRICAL ENGINEER, Canadian, single. Experience includes calculation of power plants, research on and designing of high voltage equipment; radio, transmitting and testing equipment; furthermore, drawing, estimating and designing in the field of electric railways. At present occupied in own business. Would be best suited for research work and the mathematical analysis in the electrical field. Best references to capability and character. Apply to Box No. 2101-W.

SAFETY ENGINEER, Affil. E.I.C., age 24; single; bilingual; presently employed; Canadian; 40 months with large industrial firm. Familiar with all phases of accident prevention and editing of bilingual company organ. Interested in industrial relations, safety, personnel and employment work. Location immaterial. Available with month's notice. Apply to Box No. 2187-W.

INDUSTRIAL EXECUTIVE, Canadian, M.E.I.C., presently associated in an executive capacity with an outstanding firm producing quality communications equipment, actively engaged for past twelve years in directing manufacture, development of new processes, design and provision of production facilities and cost control, will consider responsible position in the production or sales organization of other industrial enterprises. Apply to Box No. 2188-W.

CANADIAN GOOD ROADS ASSOCIATION TO HOLD SPECIAL MEETING

The tentative programme that has been issued for the special war-time convention of the Canadian Good Roads Association, to be held at Quebec, on October 22, 23 and 24, indicates that the motives that influenced the directors to call the meeting at this time—to discuss matters concerning improved highways with a view to military preparedness, relief work, and rehabilitation—will be carried out fully.

A year ago arrangements had been made for the holding of the Silver Jubilee Convention of the Association, but this was postponed owing to the war.

Since then the extreme importance of modern highways as a measure of preparedness for the movement of troops, mechanized units, materials and food supplies, has been brought prominently to the front by happenings in European countries. Realizing this the Ministers of Highways and Public Works of all the provinces, after consultation with their Governments, have considered it advisable that there should, without delay, be a meeting of the best road engineering men in the Dominion to discuss, with experts from the United States, the most effective means of bringing Canadian highways up to the standard where they will be able to withstand the stress that movement of heavy tanks and other motorized and fast moving equipment may put upon them.

To this end the Commissioner of Public Roads for the United States Government, Thomas H. MacDonald, of Washington, has accepted an invitation to address the delegates, to outline what has been done and what is proposed to be done to link the United States highways with that country's scheme of preparedness for eventualities. Superhighways such as exist in some European countries, and also in some sections of the North American Continent are regarded as essentials, and a good deal of the $327,000,000 which the U.S. Congress approved recently has been appropriated for highway improvement in all strategic areas. Captain Arthur W. Brandt, superintendent of public works for the State of New York will deal with the necessity for international co-operation and co-ordination in highway development for military preparedness at another session of the convention. H. E. Sargent, commissioner of highways for the State of Vermont, will also speak on the same subject, as will H. G. Sours, president of the American Road Builders' Association, Columbus, Ohio.

From the standpoint of post-war rehabilitation Hon. T. B. McQuesten, Minister of Highways for Ontario, will give an address pointing out the importance of provincial governments getting together in preparation of a uniform programme of highway construction. The question of Federal aid in this task of providing employment for returning soldiers and those whose work in munitions plants will have ceased, will likely be raised in the discussion on this subject. R. M. Smith, M.E.I.C., deputy minister of highways for Ontario will emphasize the need for long and careful study of such plans, and his address will be entitled "We must plan to-day for the needs of to-morrow."

The third angle from which highway improvement will be discussed will be that of building roads as relief projects. Hon. T. D. Bouchard, Minister of Roads for Quebec—at whose invitation the convention is meeting in the Ancient Capital—will be the speaker on this subject, of which he has already had some experience. Ernest Gohier, M.E.I.C., his chief engineer, will deal with right-of-way problems. Among other subjects listed for discussion are uniform motor vehicle regulations, on which J. P. Bickell, Registrar of Motor Vehicles for Ontario will present the report of a special committee appointed at the last Inter-Provincial Conference; highway road signs by J. O. Martineau, M.E.I.C., assistant chief engineer, Quebec; road stabilization, on which R. W. McColough, M.E.I.C., deputy minister of highways, Nova Scotia will present the report of the National Committee; and the relative merits and suitability of concrete, bituminous coverings and asphalt roads.

Headquarters for the convention will be at the Chateau Frontenac. Any further information or reservations can be secured from Geo. A. McNamee, Secretary-Treasurer, Canadian Good Roads Association, New Birks Bldg., Montreal, Que.

Industrial News

Industrial development — new products — changes in personnel — special events — trade literature

FEED WATER REGULATORS

Copes "Flowmatic" Regulator is described in a 16-page bulletin No. 429 recently issued by Northern Equipment Co., Erie, Pa., represented in Canada by Peacock Brothers Ltd., Montreal, Que. The general description of this regulator is illustrated with installation photographs and is followed by two sections devoted to the direct-operated and relay-operated regulators. Installation diagrams and specifications are given in each case.

BUILT-IN FIRE EXTINGUISHING SYSTEMS

"Lux" Carbon Dioxide Built-in Systems are described in an 8-page bulletin issued by Walter Kidde & Co. of Canada Ltd., Montreal, Que. The booklet is devoted to illustrating and describing the installation of these built-in systems in manufacturing plants and central electric stations. A number of photographs and diagrammatic sketches of typical installations are included.

INDUSTRIAL CUT GEARS

Hamilton Gear & Machine Co., 62 Van Horne St., Toronto 4, Ont., have issued a second edition of catalogue No. 101-B entitled "Industrial Cut Gears." This catalogue contains 16 pages of illustrated descriptive matter covering the company's wide range of products of this type. A description of the company's plant at Toronto is included with comments on the limitations of different kinds of gears both as to production and application.

LIQUID LEVEL METERS

Cochrane Corp. of Philadelphia, Pa., represented in Canada by Canadian Allis-Chalmers Ltd., Toronto, Ont., have described their line of mechanical and electric type liquid level meters in an 8-page illustrated bulletin. In addition to photographic illustrations of these meters, the bulletin contains diagrammatic installation sketches and technical data.

GALVANIZED WIRE

The Steel Co. of Canada Ltd., Hamilton and Montreal, have announced their latest development in electro-galvanizing by describing the new "Zinc Tight" galvanized wire produced by their new process of electro-galvanizing by which zinc in its pure state is applied directly to the wire. The bulletin contains a table of zinc coatings per square foot of surface for various gauges of wire.

ELECTRIC HEATING UNITS AND DEVICES

A 48-page catalogue No. CGED-650A, dealing with a wide variety of heating units and devices, is being distributed by Canadian General Electric Co. Ltd., Toronto, Ont. The book contains illustrations and descriptive matter covering miscellaneous Calrod heating units; immersion heaters, insertion gears, fin heating units, cartridge units, strip heaters, unit heaters, industrial air heaters, electric oven heaters, metal-melting pots, cast-in immersion units, glue pots, soldering irons, control equipment and electric furnaces. Three pages of useful data and graphs are included.

HOT PROCESS WATER SOFTENERS

This is the title of a 32-page bulletin, No. 2341, issued by the Permutit Company of Canada Ltd., Montreal, describing various designs of the company's hot process water softeners to serve different conditions prevailing in steam plants. Elaborately prepared descriptive illustrations of the various types of softeners and all important parts accompany the descriptive matter.

SYNCHRONOUS MOTORS

An interesting 52-page booklet No. CGEA-1191B has been issued by Canadian General Electric Co. Ltd., Toronto, Ont., dealing with synchronous motors. This publication is in the nature of a text book treating first with the economies of the synchronous motor and following this with a general description and specific descriptions of various types. A section entitled "Synchronous Motors and Power Factor" contains a "Direct-reading Power-factor-improvement Chart" and deals with this subject in considerable detail. The final section of the booklet illustrates and describes applications of this type of equipment in various industries.

ARC WELDING

A text book of 144 pages entitled "Lessons in Arc Welding" has been issued by Lincoln Electric Co. of Canada Ltd., Toronto, Ont., and is available for purchase at 75 cents per copy. The book is composed of a series of fifty-two lessons presenting the fundamental facts of welding.

DIESEL ENGINES

Caterpillar diesel engines are described in a 32-page booklet entitled "On the Job," recently issued by Caterpillar Tractor Company, Peoria, Ill. Each page is devoted to illustrating the application of these engines to a particular branch of industry. The booklet provides some idea of the extensive application of this type of engine.

LUBRICANT FOR SURVEYING INSTRUMENTS

Acheson Colloids Corp., Port Huron, Mich., announce a lubricant to which dust does not adhere which has been found useful in eliminating "sticking" of clamps, tangent and levelling screws of transits and levels, for surveying work. The lubricant consists of Acheson colloidal graphite suspended in carbon tetrachloride. When applied, the carbon tetrachloride evaporates, leaving a fine film of graphite serving as a "dry" lubricant.

INSULATING COMPOUND

This new synthetic insulating compound announced by Canadian General Electric Co., Ltd., Toronto, has been given the trade name of "Flamenol," and although it has characteristics which are similar to those of rubber, it

contains none of this material and does not support combustion. It is also highly resistant to moisture, acids, alkalis and oils, has excellent ageing characteristics and is strong mechanically.

Owing to the properties of "Flamenol" it can be made a very soft and flexible compound, or one with celluloid-like rigidity. It can also be put into solution for coating or impregnating, and can be compounded, filled, calendered, and extruded in much the same manner as rubber.

SEWAGE GAS CONTROL

Vapor Recovery Systems Co., of Compton, Cal., have issued a 40-page booklet No. S-3, describing and illustrating sewage gas control and safety devices. "VAREC" equipment finds its application wherever toxic or combustible gas is encountered, such as is common to the petroleum, gas, chemical, industrial and sewage treatment industries. The booklet describes such equipment as pressure relief and flame trap assemblies; flame arresters of the vertical and horizontal types; pressure relief and vacuum breaker valves with and without flame arresters for use on digesters and gas holder pumps; manhole or entrance hatch covers; back pressure regulators; pressure reducing regulators with single and double ports; back pressure check valves; pressure (or explosion) relief valves; waste gas burners; manometers; drip traps; sediment traps and still type pressure relief and vacuum breaker valves. Dimensional drawings, engineering data and flow capacity curves are also included.

MAGNET WIRE

A 4-page bulletin, No. 4253, issued by Canadian General Electric Company, Limited, Toronto, describes a new magnet wire developed by the company under the trade name "Formex." This wire consists of a copper conductor coated with a high quality, tough, insulating film that is comprised of a combination of synthetic resins.

DEAERATING HEATER

The Permutit spray type deaerating heater is described in a 12-page bulletin No. 2357 issued by Permutit Company of Canada, Ltd., Montreal. Illustrations and drawings accompany the detailed description of the various important parts of the heater.

TWIN HORIZONTAL BROACHING MACHINE

The Oilgear Company of Milwaukee, Wis., have issued an 8-page bulletin, No. 21000, describing their fluid power, variable speed, twin horizontal broaching machine. Illustrations, specifications and dimensional drawings are included in the bulletin.

OIL ENGINES

Replacing their VR series, Ruston & Hornsby, Ltd., Lincoln, Eng., have developed a new range of medium speed, cold-starting vertical oil engines, which comes in closely graduated steps, powers from 90 bhp at 750 r.p.m. up to 1,040 bhp at 375 r.p.m. The engines work on the 4-stroke cycle. This range of powers is covered in six cylinder sizes built up in units varying in brake horse power, number of cylinders and revolutions per minute. All powers are in accordance with the B.S.I. 12-hour rating and are based upon conservative lines. The development of this new series of engines has covered a considerable period and a number of units have been in service for some time.

The chief differences between the series and the one which it replaces are an "open" type of combustion chamber with overhead valves, and a new fuel injection equipment including a separate fuel pump for each cylinder mounted alongside the cylinder which it covers and the recently introduced Ruston Mark 37 atomizer. Other differences between the new range and recently delivered engines of the old range are of a comparatively minor nature.

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 23 NOVEMBER 1940 NUMBER 11

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

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PUBLISHED MONTHLY BY
THE ENGINEERING INSTITUTE
OF CANADA
2050 MANSFIELD STREET - MONTREAL

Price 50 cents a copy, $3.00 a year, in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

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AERODROME CONSTRUCTION FOR THE BRITISH COMMONWEALTH AIR TRAINING PLAN

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Paper presented before the Montreal Branch of the Engineering Institute of Canada, October 3rd, 1940

Introduction

Each month of the World War 1914-18 saw a constantly increasing demand for more aircraft—first, for observation, then to fight off the observation planes, and, finally, for bombing military objectives. Young Canada flocked eagerly into the new service and acquitted themselves so well that the Royal Flying Corps established training bases in Canada to enlarge their field of recruitment and supplement their overcrowded home training establishments. Camp Borden, Leaside, Armour Heights, Deseronto, Mohawk and Beamsville were all active flying training schools and Toronto University became the centre of their ground training activities.

History repeats itself—when the crisis came in the end of August, 1939, it was natural that Canada should again play an important part in the war in the air. This time the need was much more urgent. With the expansion of the Royal Air Force, the air space of the United Kingdom was rapidly approaching saturation. Every month saw the creation of new squadrons as the output of aircraft rose. Each new unit required another aerodrome for operations and this, coupled with the expectation of intensive air fighting and the continuous bombing of all aerodromes, made it essential to find other bases where training could proceed without these distractions.

Canada was the only practical outlet. Her accessibility, the satisfactory experience of training in the World War and the known enthusiasm of her youth for the air, made it inevitable that she should become a great flying training centre for the British Empire. Missions from the United Kingdom, Australia and New Zealand reached Ottawa in September and, though a final agreement was not concluded till December, the scale and scope of the plan were determined early in October so that preparatory work could be put in hand.

Training Schools Required for the British Commonwealth Joint Air Training Plan

The original programme provided for sixty-four flying training schools, twenty of which were to be opened in 1940, the first in June, thirty-six in 1941, and the remainder during the first half of 1942. Events subsequent to April, 1940, modified this programme greatly, have increased its tempo and enlarged its scale.

Of the original sixty-four schools, twenty-six were elementary, ten were for air observers, ten for bombing and gunnery, two for air navigation, and sixteen were service flying training schools where intermediate and advanced training is given. At each of the service flying training schools the establishment of aircraft of various types is so large that when the school is in full swing two relief aerodromes are necessary to avoid congestion on the main aerodromes. The programme, therefore, called for aerodromes for ninety-six units. It now includes 124 and further extensions may yet be seen.

The Royal Canadian Air Force, hampered for many years by lack of funds for aerodrome construction, had at the outbreak of war only five aerodromes ready for use and six under construction. Their auxiliary squadrons were all based on civil airports. The service aerodromes were, of course, required for operations immediately the war began and were not available for the training plan.

Due to the energetic support of the Honourable C. D. Howe, M.E.I.C., there had been great activity in the building and improvement of civil airports in all parts of the country since 1936. This was principally along the line of the trans-Canada airway but included many airports to serve feeder lines as well. The use of this chain of airports, built to a common, up-to-date standard, as a foundation for the plan, was the obvious solution of the problem and the Civil Aviation Division was, therefore, called into consultation by the middle of October and the decision reached soon after that the responsibility for finding and building the aerodromes required for the programme should rest on it.

Organization of the Training Plan

While the discussions leading to an inter-governmental agreement were proceeding, organizations were being created to supervise and execute the training plan. A Supervisory Committee was formed consisting of three

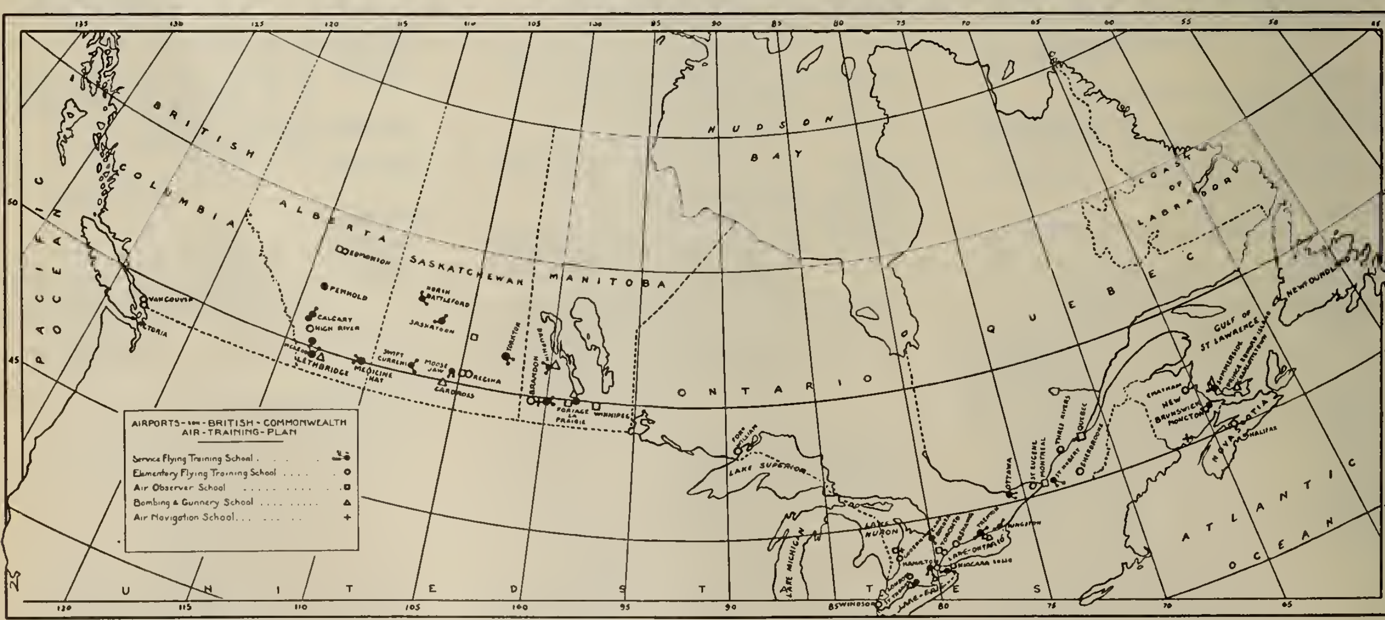

Fig. 1—Map Showing Location of Flying Training Schools for British Commonwealth Air Training Plan.

members of the Canadian Cabinet, the Minister of Defence for Air, the Minister of Munitions and Supply, and the Minister of Finance; the High Commissioners for the United Kingdom, and Australia; the Chief of Air Staff, R.C.A.F.; the Air Member for Training, R.C.A.F.; Senior Officers from the Royal, the Royal Canadian, the Royal Australian and the Royal New Zealand Air Forces, and a representative of the Treasury.

Under this committee, the responsibility for the administration of the training plan was placed in charge of the Air Member for Training of the Canadian Air Council, Air Commodore G. O. Johnston. A committee was formed in his organization to deal with aerodrome construction.

With this committee the officers of the Civil Aviation Division have worked in the closest liaison. The Superintendent, Airways, Department of Transport, and Airway Inspectors and Engineers of the Civil Aviation Division attend its meetings and furnish the committee with full information on all matters under consideration. The committee indicates to the Department of Transport desirable locations for the various types of schools. Following preliminary investigation reports, a field party, consisting of an inspector and an engineer of the Department of Transport and an Air Force officer, decides in the field on the sites upon which detailed surveys should be made. When detailed surveys are received by the Department of Transport engineering plans and estimates for the development

Fig. 2—Ottawa Airport Modified to Service Flying Training School.

of the site are prepared and submitted to the Director of Air Services, Mr. C. P. Edwards, M.E.I.C., and the Deputy Minister of Transport for approval. If approved, these are passed to the Deputy Minister of National Defence for Air in a letter giving these estimates in detail. This estimate is then considered by the Aerodrome Development Committee, the merits of the site compared with others, and a final decision is reached as to whether it should be developed. The committee then recommends to the Minister of Defence for Air that funds be made available from the appropriations for the Air Training Plan for the development of the site. If this is given, a financial encumbrance making available to the Department of Transport the sum necessary for the development is prepared allocating funds for the purpose.

Organization of Departmental Forces

The Superintendent, Airways, of the Civil Aviation Division, is in charge of the detailed execution of all work for the plan undertaken by the Department of Transport. He had wide experience in aviation, having been a pilot in the last war, and made the original aerodrome selections in the prairie provinces in 1929 and 1930 for the trans-Canada system and has since then been responsible for the airport planning and construction on the trans-Canada airway and elsewhere in the Dominion.

Fig. 3—Pendleton Intermediate Field Modified as Relief Aerodrome No. 1 for Service Flying Training School.

In the fall of 1939 every member of the staff, who could be spared, was put on this work so that ground surveys might be started as quickly as possible. Their job was to select the sites; supervise the detailed surveys and see that all pertinent information was placed on the survey plans; assist as necessary the Canadian National Railways' land agents in obtaining options; and consult with the civil engineering staff in regard to the efficient construction of the airport from the airman's point of view.

The formation of a suitable engineering organization to carry out the construction work was simplified because the Department already had an engineering staff which had been busy on the building of the trans-Canada airway for the past eight years and had, therefore, a wide experience in this new phase of engineering which could only be obtained through practical experience. They were familiar with the conditions and problems to be faced in the different districts of the Dominion. This organization, however, was comparatively small and it was necessary to enlarge it greatly. The size of the programme and the speed with which it must necessarily be carried out made it desirable to divide the work between two organizations at headquarters so as to reduce the burden on the key engineers of the organization.

The existing airway engineering staff were fully familiar with the then existing airports as they had built them. It was accordingly decided that they should be made responsible for the improvement of the present aerodromes which might be used for the plan and all work connected with them, and that the new temporary airway engineering organization should be formed to deal with all new aerodromes. This new organization was given the services of certain of the experienced key men from the permanent staff to assist them.

The idea underlying this division of engineering work was that so far as circumstances permitted, the continuity of work on the trans-Canada system should not be interfered with by this large new programme which had suddenly been imposed on the Division and that when the Air Training Plan work was over the temporary staff could be released and our permanent organization would continue their normal duties. In addition, it should be remembered that, though the trans-Canada airway had been in successful operation for two years, much work was still required every year to bring it up and maintain it to the required standard.

This form of organization, though adopted with some misgivings at the time, seemed to be the best way of getting the work done in time, and it has worked admirably. This division of responsibility only applied to headquarters, as in the field the work all comes under the district airway engineers, most of whom had had long experience in such work under the Department. All work in each province was controlled from the district offices and resident engineers were appointed on each project to supervise the work.

Fig. 4—Macdonald, Man., Bombing and Gunnery School Aerodrome looking East.

An electrical engineering section was already in existence in the Civil Aviation Branch to deal with problems arising out of lighting, power and communication services.

Engineers with specialized knowledge and training were added to the headquarters staff to deal with paving specifications and inspection, water supply, and the production of turf surfaces on the aerodromes.

Airports in Canada on October 1st, 1939

The airport situation as of October 1st, 1939, may be summarized as follows: the total number of airports and airport sites yet undeveloped, but about which information was on record, was 153. A rough and ready classification of existing airports and sites showed:

1. Airports of developed dimensions of 3,000 ft. or more.......... 37
2. Airport sites known to be capable of development to 3,000 ft. or more and of which surveys had been made.......... 5
3. Airports then in use under 3,000 ft. 46

Fig. 5—Runway Construction at Medicine Hat, Alta., Wobble Wheeled Rubber Tired Roller Compacting Base Course.

In the first two classes were the airports of the trans-Canada system and those in preparation for its extension. This had been built for civil transportation but when the crisis came its construction was seen to be doubly justified. No project of more importance to national defence had been undertaken since the World War. Good airports at hundred-mile intervals, with emergency landing fields at closer spacing in unsettled and difficult country, hangar accommodation, weather and communication services, and radio aids to air navigation and lighting, were in being from coast to coast, which allowed the free movement of aircraft and gave the R.C.A.F. fine modern airports for the rapid expansion of their service.

The trans-Canada airports had been built as transport airports, that is, they were not all-way turf fields as preferred by the Air Force, but built on landing strip principle by which a system of two or more landing strips 500 ft. wide by 3,000 ft. or more long are laid out on the field in the form of a triangle, "∠" "+" or "T" shape and the rest of the field cleared and rough graded only. This was the most economical development and fully met transport requirements. Since the sites had been carefully selected and planned for future development, to adapt these airports to Air Force use for elementary and air observers schools was comparatively simple, calling for the fine grading and seeding of the other portions of the transport aerodromes not previously finished and by adding taxi strips to give access to R.C.A.F. hangars as necessary. Experience had shown that if an aerodrome is required for use at all seasons of the year hard surface runways were necessary to give sufficient bearing during the spring and fall seasons. Such runways had been built at all major airports on the airway system.

Certain sections of the trans-Canada airway and its connections were not suitable for training purposes because of inaccessibility, climate, proximity to the international boundary, or the nature of the surrounding country. This applies particularly to northern Ontario and the Rocky Mountains. Nova Scotia was considered out of bounds, too, as far as training was concerned, as it was the scene of intensive active service operations. Many fine aerodromes could, therefore, not be considered, but the Department of Transport was able to offer for the use of the training plan, as soon as buildings to accommodate the training schools could be built, twenty-four airports, which required, in most cases, comparatively little work to adapt them for training purposes. (See Figs, 2 and 3.) As some of the larger airports could accommodate both an elementary and an air observers school, these twenty-four airports could accommodate fourteen elementary, one air navigation, six air observers, two bombing and gunnery schools, besides the main aerodromes for twelve service flying training schools and relief aerodromes for two more. The existence of these ready made airports made possible the acceleration of the training plan. Twice as many elementary flying training schools and service flying training schools will be open before the end of 1940 as had originally been contemplated.

Selection of Sites for New Aerodromes

As shown in the preceding paragraph, existing airports could take care of about one-half of the original programme. New sites must, therefore, be found for the remainder. Time pressed. October was already half gone and the advent of snow would increase the difficulty of making reliable surveys. Field parties were, therefore, organized as quickly as possible in the three prairie provinces, southern Ontario and Quebec, and the maritime provinces, to find all the new sites required before the winter set in. These parties consisted of an airway inspector, an airway engineer, both experienced in the location and construction of aerodromes, and an R.C.A.F. officer.

The selection of aerodrome sites even in the prairie provinces and in good agricultural land is not an easy task. Good drainage is the first essential. All approaches to the aerodromes must be clear of obstructions. The ordinary amenities of civilization are very necessary near these schools. They must, therefore, be easy of access by road or rail to some nearby centre of population. Ample water supply, proximity to a reliable power supply and to good road building material are also essentials.

The Air Force organization for the training plan provided for four separate training commands, two in western Canada and two in eastern Canada. It was desirable that the whole programme should be divided between these four commands as equally as circumstances permitted. On other grounds it was desirable that the activities of the training plan should be as widespread as the physical character and climate of the Dominion permitted.

In the prairie provinces the climate and terrain were particularly suitable for a plan of this kind. Western Canada could have accommodated the whole programme, if this had been necessary. The uncertainty of water supply and difficulty of growing good turf were handicaps as well as its distance from the main centres of population and industry. The endeavour has been to secure, to all parts of the country, the benefits arising from the large expenditures involved in building aerodromes for the training plan. Every effort has been made as well, in the location of the new aerodromes, to ensure that they will be of some use in the post war period and will serve the peace time needs of our growing civil air transportation system.

The plan of operation of the survey parties was to study in the office the topographical maps available of each district and mark on them the locations where a level area of approximately one square mile could be obtained. A reconnaissance was then made from the air of such areas, noting particularly the approaches to the site, its accessibility by road and rail, and indications of drainage so as to avoid swampy and low lying areas. After this reconnaissance an examination on foot was made of the apparently suitable sites and preliminary investigation reports of these were prepared. These survey reports were then forwarded to Ottawa by air mail for discussion with the Air Training Command. The most favourable were then approved for detailed ground surveys. A reconnaissance was made of approximately 2,000 sites, survey reports were filed of over 200 and topographical surveys were made of about 150

Fig. 6—Collins' Bay (Kingston)—Main Aerodrome for Service Flying Training School.

sites. It is safe to say we know the location of practically every suitable aerodrome site in the districts covered.

It was essential, if real progress was to be made during the summer construction season of 1940, that detailed engineering surveys of the sites required during 1940 and 1941 should be available in the Ottawa offices by the end of 1939. This would enable construction plans and specifications to be drawn up for the work during the winter months so as to permit of tenders being called for early in the spring and work started just as soon as the frost was out of the ground. If this could be done, the full working season of 1940 would be taken advantage of. All sites required during that year and two-thirds of 1941 must be completed in the fall of 1940 as winter conditions do not permit of aerodrome construction in this country.

Airport Surveys

The problem of putting fifty or sixty survey parties to work at short notice was solved with the assistance of the provincial highway departments who were then laying off their highway survey parties for the winter. The wholehearted co-operation of these services and the open nature

Fig. 7—Gananoque Aerodrome—Relief Aerodrome No. 1 for Collins' Bay.

of the fall season of 1939 made possible the completion of 80 per cent of the surveys before the snow fell. This saved at least six months in the execution of the programme and gave the airway engineering service of the Civil Aviation Division the four winter months to prepare their plans and specifications. The contour plans of the aerodrome sites furnished by the provincial highway engineering departments were certainly a credit to these services.

The work was done with great speed but in spite of this, the most accurate details were given of our requirements. All winter long, as the survey plans were received, work went on in laying out the aerodromes to take the best advantage of the natural features of the site. Plans and specifications for the grading, drainage, hard surfacing and lighting were then put in hand. At the same time, full information was made available to the R.C.A.F. so that their buildings might be planned to fit in with the general development.

The elementary schools call for an all-way turf surface as only light aircraft are used and, with the exception of a week or two in the spring when the frost is coming out of the ground, experience shows that in most districts no expensive hard surfaces are necessary. The air observers, bombing and gunnery, air navigation, and service flying training schools required hard surfaces as their aircraft are all heavier types and the continuous operation required could not be guaranteed at all seasons of the year without pavements. These were usually laid out in a triangular form to provide for 3,000 ft. runways, sea level basis, in six directions of wind.

The interior triangle bounded by the runways is fine graded and seeded to grass, as well as a 250 ft. strip on the outside of the pavements. At the service flying training schools it was necessary to provide for the landing of five aircraft abreast. The landing strips were, therefore, at least 1,000 ft. wide with two hard surfaced and three grass runways. Under the worst conditions, the two hard surfaced runways provide for two simultaneous aircraft movements, or provide for one-way traffic with a return strip for taxiing on the ground.

Zoning

The adequate zoning of the aerodromes presented another problem. Power was taken under the Defence Air Regulations to pass regulations preventing the building of obstructions on property adjacent to an aerodrome used for national defence purposes at a ratio of 50:1, that is, 1 ft. vertical for every 50 ft. horizontal from the end of each landing strip for a flightway width 600 ft. wider than the landing strip of 500 ft.-1,000 ft., and one in twenty at other points on the perimeter. Wherever possible ample land was taken to provide for the extension of the landing strips to 5,000 ft. should this be found necessary.

The zoning of the aerodrome must not only prevent the building of obstructions on its boundaries but must also provide that buildings on the aerodrome do not interfere with the free use of the landing areas by aircraft. Buildings were, as far as possible, concentrated in one area, preferably convenient to the landing strip in the direction of the prevailing wind to reduce the amount of taxiing to the minimum and to good entrance roads. Hangars were set back on a zoned line parallel to this strip with provision for a 150 ft. taxi strip and a 200 ft. apron in front of the hangar entrance so that aircraft could stand out for refuelling and running up, and awaiting their turn use the field without interference with flying operations. Clearing rights

Fig. 8—Airport Drainage—Using Blade Grader for "V" Ditch.

on adjacent properties were obtained where necessary and buildings, trees, power lines and other obstructions were removed to the required ratios.

Acquisition of Land

The acquisition of land for aerodromes up to date has involved the purchase of approximately 40,000 acres in every province of the Dominion. To solve this problem the assistance of the Canadian National Railways was sought. They had, under the Chief Land Surveyor and Property Commissioner, a Dominion wide organization familiar with this work. As soon as an aerodrome was approved for detailed survey, a description of the property required was given to the Railways and the local Land Agent was instructed to obtain options on it wherever possible.

Nearly every aerodrome involved several properties and it was not always possible to obtain options covering the whole area, but every endeavour was made to obtain options of part of it at least, which would govern a fair price for the remainder to some extent. This has involved an immense amount of work. Over 500 separate options have been secured for the purchase of property and, in addition, another 235 covering the clearance of obstructions such as trees, barns, windmills, within the zoned area, and the right to construct ditches for drainage purposes where necessary.

The value of the property purchased or on which options are still outstanding is over two and a quarter million dollars and an additional fifty thousand dollars has been paid for clearances, etc. Leases have been arranged on all the properties required for air firing and bombing ranges by the C.N.R. Lands Department as well.

As soon as final approval had been given by the Department of National Defence for the development of any site, these options were taken up, or failing that, an expropriation plan was filed to cover the area required. In no case has the work been delayed through failure to secure the necessary rights to enter properties in time to permit the contractors to start work.

Power, Lighting and Telephone Services

The Department of Transport also undertook to provide power, lighting and telephone. Here again there was an experienced organization ready to tackle this phase of the work as it was no different from equipping the trans-Canada airway with similar facilities.

The provision of power is a major item. Certain schools have as much as 1,000 hp. Most of this energy is required for lighting, with a smaller part for motor load. This load is the equivalent in size to a town of a thousand to fifteen hundred population.

In the eastern provinces, including Quebec and Ontario, little difficulty is experienced in meeting the power requirements. These provinces are covered with a power network, so that comparatively short lines only are required. However, for the larger loads, it has been necessary in most cases to reconstruct substations.

In the western provinces power is at a premium, particularly where it is generated by steam or Diesel plants. It has necessitated interlinkage of smaller systems to get better diversity and increase quantity. In some instances, stand-by plants are brought into continuous operation. In one case, it has been necessary to add two prime movers; that is, Diesel plants.

It might be of interest to note that the total demands for all schools will probably be as high as 20,000 kw. This is a good sized load, but due to its being distributed across Canada it has been established without major plant construction.

It is the responsibility of this Department to negotiate for such power line and distribution system construction as is required, to see that incoming lines do not obstruct flightway approaches, and to see that existing lines are removed where necessary. The problem of salvage must be considered, if at some future date the projects are abandoned contracts must be prepared to allow for construction, and for energy consumed. Provision of power for water supplies and for heating equipment must also be undertaken.

In lighting the fields for night flying, only the advanced training schools are equipped. In this regard, the Department acts as contractor by preparing plans, ordering materials and organizing field crews to actually install all equipment. In short, the equipment consists of contact lights for each hard-surface runway, a rotating beacon, code beacon, an illuminated wind tee and a ceiling projector for measuring cloud height at night.

These lighting facilities will be provided, with certain variations, at some fifty-five schools.

A telephone system is provided at each site, and at the larger schools a regular switchboard is required. Connections have to be made to bombing ranges, which, in most cases, require ten to twenty miles of interconnecting lines. Trunk lines must be established between the school and the urban centre that is close by.

The establishing of these three services for all schools is well advanced, in spite of periodic advancement of opening dates. It is estimated that these services will amount to more than two and a half million dollars when completed.

In all this work the Department has had the ready co-operation of provincial power commissions, power companies and municipalities all over the Dominion. A great deal is due to them for their wholehearted assistance.

In the communication field the help of the Bell Telephone Company has been invaluable. They have not waited our instructions, but have anticipated them in a wonderful way by preparing connections as soon as the sites were selected so that by the time the orders were placed we found the connecting lines available. They have acted in this way not only for their own systems but for provincial and local telephone services as well.

Runway Construction

Due to the heavy aircraft traffic it was necessary to construct hard surface runways and taxi strips on all service flying training schools' main aerodromes and one relief aerodrome to each main, as well as on all bombing and gunnery schools, air navigation schools and air observers' schools.

As has been seen, the service flying training school's main aerodrome has three double runways, 100 ft. wide and 2,500 ft. long, each at sea level. The reliefs have three single runways, 100 ft. wide and 2,500 ft. long at sea level, but the layout on the relief aerodrome is designed so as to provide room for three additional runways if required.

The bombing and gunnery schools, air observers schools and air navigation schools have three single runways, 150 ft. wide and 2,500 ft. long, at sea level.

The type of construction depended on—

1. Type of aircraft as well as number of aircraft used;
2. Soil condition;
3. Available aggregate;
4. Available construction equipment.

Fig. 9—Stone Filled "V" Ditch.

The bombing and gunnery schools required the best type of runways due to the heavy aircraft used.

The most common runway bases used are—

1. Crushed gravel;
2. Crushed stone waterbound macadam;
3. Suitable soil, gravel and bitumen;

and the most common runway tops used are—

1. Bituminous hot mix;
2. Bituminous road mix;
3. Bituminous penetration.

The thickness of the pavements depended on the bearing quality of the soil and the type of aircraft and varies from 5 in. to 10 in. base and 1 in. to 2 in. top.

On nearly all aerodromes stone backfill runway shoulder drains have been constructed with manholes and catch basins at approximately 400 ft. intervals, with perforated manhole covers.

Water Supply

Competent technical advice has been secured and thorough investigation made to ensure a dependable, clean and adequate water supply for each aerodrome. The gallonage per day varies with the different types of schools, the elementary calling for 8,000, the observers 12,000, the service flying training and air navigation 40,000, and the bombing and gunnery 45,000 gallons.

Sources of supply have been determined by considerations of safety, health and economy. Thus, provision must be made for the protection of buildings and personnel against fire; the Department of Pensions and National Health has co-operated with provincial departments of health in making chemical and bacteriological analyses; and careful study has been given to comparative costs of available sources, equipment and appurtenances.

Sources of water supply fall naturally into two groups. In the larger of these are the airports for which an independent supply has been obtained by the development of ground or surface water by means of wells or from lakes or rivers. In the other group are those aerodromes adjacent to towns or cities in which a municipal waterworks system is now adequate or can be made adequate to take care of the requirements of the aerodrome.

Many of these municipalities have not waited to be approached in this connection, but have themselves taken the initiative. In addition to submitting proposals to supply water, in some instances at rates less than the actual cost to the municipality, municipal corporations and public utilities commissions have placed the facilities of their organizations and the particular knowledge of local problems at the disposal of the government. A willingness to embrace the opportunity to advance such work characterizes the attitude of civic officials and commissioners in every case.

Among the municipalities which have co-operated in this manner are Brantford and Picton in Ontario; Brandon, Dauphin and Portage-la-Prairie in Manitoba; Moose Jaw, North Battleford, Saskatoon and Yorkton in Saskatchewan; and Claresholm, McLeod and Medicine Hat in Alberta.

As may be imagined, many difficult problems have been faced in this phase of the work and it should be remembered that owing to the urgency of the programme it was not always possible to await a final solution of all its many sides before starting construction work. This was specially true in western Canada but in no case has the opening of any school been delayed through the failure to obtain a satisfactory water supply. In one or two cases, however, construction on an otherwise satisfactory site has had to be abandoned for lack of a good supply of water.

Seeding

On many of the airports a grass turf is to be used exclusively, and even where hard-surfaced runways are provided the turf is most important. In all cases a satisfactory turf has to be obtained in a minimum length of time to make the airports available for immediate use.

The magnitude of the work can be realized when one considers that on some seventy airports a total of over 20,000 acres must be seeded this fall or early next spring. Each airport requires individual treatment in the selection of a suitable grass mixture and fertilizer for the various soil types and climatic differences.

The Department of Transport was fortunate in obtaining the services of the Department of Agriculture. With the co-operation of the various agronomists of the Dominion experimental farms and of several agricultural colleges, and soil surveyors in the different provinces, a botanical and soil survey was organized. From the botanical analyses it was possible to select the most suitable grass species for each individual site. The soil survey reports and soil maps furnished valuable information from which the most suitable fertilizer for each site was selected.

On the airports where subsoil was exposed or where the existing topsoil was not of satisfactory quality on which to obtain a good grass turf, it was necessary to add additional topsoil. All topsoil used for this purpose was carefully selected. Much valuable assistance is being given by the experimental farms in assisting the Department in this work.

Construction Contracts

Contract plans and specifications began to trickle through to the Contracts Branch in February, 1940, and increased rapidly to a steady stream during March and April. Public tenders were called for during these months and tenders were awarded to the lowest bidder whose tender complied with Departmental requirements. Herr Hitler's rapid work in Europe then hastened the tempo of the training plan, and, to save the inevitable delay this course entails, restrictions were withdrawn and many contracts have been negotiated direct on an agreed unit price basis with known reliable contractors. The calling of public tenders on the earlier jobs had established a range of fair prices for each class of work in different districts which made a good guide for these negotiations. So many contracts were being let that the services of all reliable contractors experienced in highway work could be used as soon as the plans and specifications were completed and the properties purchased. Later in the summer it was necessary to ask eastern contractors to invade the West as firms there all had their hands full.

To press the work and finish as many projects as possible before cold weather came in the fall, the contractors were put on their mettle; and it is very gratifying to be able to state that practically without exception they rose to the emergency, keeping their units operating twenty-four hours a day and seven days a week, whenever weather permitted.

Fig. 10—Air Photograph Showing Dorval, Que., Site.

The main contracts included clearing, stumping, drainage, grading, paving, seeding and fencing. Aerodrome lighting was done by our own field parties whose foremen had made all installations on the trans-Canada airway and were more familiar with the work than any contractors' gang could be. Power, telephone and water supply were, in all cases, separate contracts.

To September 30th, 94 aerodrome construction contracts had been let as well as a very large number of subsidiary contracts covering miscellaneous necessary works and material not provided for in the main contracts.

To date the sum made available by the Department of National Defence from the Joint Air Training Plan's appropriation to the Department of Transport is $24,313,810. This sum is based on the estimated total cost of the development of each project based on our construction plans and specifications plus the land value. Main contracts have been let for 94 projects involving approximately $11,577,628. In addition, the Department has purchased direct for use on these projects $1,870,915 worth of bituminous materials for paving; grass seed and fertilizer $105,678; lighting equipment $717,271; contracts for power line construction and power services let to date $138,140; water services $186,185. Work done by Departmental forces excepting lighting installations has cost $117,600, and the cost of Departmental engineering inspection and services $289,802. The total sum encumbered to date is $17,793,000. These contracts involve the moving of some 20,000,000 cu. yd. of earth; the laying of some 300 mi. of drains from 6 in. to 36 in. in diameter and the paving of 10,000,000 sq. yd., equivalent to over 800 mi. of standard highway 21 ft. wide.

The average cost of aerodromes for the different classes of schools is as follows:

Elementary School aerodrome, all-way field, with grass surface, acreage from 200 upwards.... $100,000

Air Navigation, Gunnery and Bombing and Air Observers School aerodromes, all-way fields with three hard surfaces 3,000 ft. x 150 ft. and hard surfaced taxiways 500 acres and upwards.. $350,000

Service Flying Training School: one Main field where all living quarters, hangars, shops, etc., are concentrated, with double triangular hard surfaced runways; one Relief field with hard surfaced triangular runways and one all-way turf Relief field.

Total for all three aerodromes............. $800,000

Progress to September 30th, 1940

In spite of exceptionally wet weather in May and June, which made grading in clay soils very difficult and jeopardized the success of the programme in some districts, work has gone well. The contractors and their staffs have been in most cases fired with patriotic zeal and have worked manfully day and night to meet the emergency.

In the case of the earliest opening of schools, construction had to be finished while the school was in operation but part at least of the field was ready for use. The staffs of such schools have carried on cheerfully in spite of the inconvenience of having contractors' machinery working on part of the field.

Grass cannot be grown overnight and some of the fields will be dusty in dry weather and muddy in wet weather till the turf is established. Such trials were inevitable. They have been faced philosophically by the operating staffs as part of the job.

Good drainage is a first consideration. The drainage of approximately a square mile of level land so as to provide a quick run-off is not an easy problem and has called for careful study of each site. Conditions vary greatly. At Ottawa the aerodrome is on pure sand and all that is necessary is to sink manholes below frost level and the water disappears. In some clay soils it is a very different matter and elaborate drainage systems are required. Stone filled ditches to below the frost level line all the hard surfaces on both sides and lead to natural drainage outlets. The precaution has been taken to make the paving on the hard surfaces as dense as possible so as to prevent water percolating through to the clay base and softening it or cause heaving in spring from frost action. Where any considerable cut and fill is involved one cannot guarantee a perfect job during the first year. Settlement takes time and weak spots will show up next spring. Their rectification will not be serious, however, and by next summer when settlement is complete, drainage working and turf established, the training schools will be well found so far as their aerodromes are concerned.

Progress to date justified the statement that in no case will the opening of any school by the revised dates required by the R.C.A.F. be held up by the lack of a usable aerodrome. The dates of completion vary with the amount of work to be done, the priority to be given to the particular site and the weather. Expansion of the programme in July modified greatly the sites originally selected for elementary or air observers schools and on which grading was already well advanced. Some of these were now modified for use as service flying training schools. The necessary hard surfaces and extra drainage were installed and the additional property required for the larger school was acquired. Elsewhere an air navigation school was added on an aerodrome which previously had only been proposed as an elementary school and the necessary modifications were made to the contract specification. In some cases, too, the size of the elementary school was doubled so as to avoid having to construct a new aerodrome. Out of a total of 75 schools, 32 will have their aerodromes completed by September 30th, 1940 with a further 33 scheduled for completion by December 31st, 1940. Compared with the original programme of 64 schools for which aerodromes had to be completed by June 30th, 1942, we shall have completed aerodromes for 65 schools in 1940, leaving only 10 to be carried over into 1941. The following table shows the position:

Dates of Completion
(Except seeding in some cases)

	By Sept. 30/40	By Dec. 31/40	1941	Total
Elementary Flying Training School	13	12	1	26
Air Navigation School	1	1	1	3
Air Observery School	7	1	3	11
Bombing and Gunnery School	2	8	1	11
Service Flying Training School	9	11	4	24
	32	33	10	75

The Effect of the Programme on Civil Aviation

A cataclysm of the magnitude of the present war affects all civil activities. Aviation has been no exception. Every phase of flying has been gravely affected by the change-over from peace to war. While meeting the Air Force requirements in all respects, the aim of the Department of Transport has been to ensure that when the time comes to return to normal peace conditions, as much as possible of the war effort and expenditure may be adapted to increasing the facilities for civil air transport in the Dominion.

The aerodrome situation at any rate will be vastly improved. The size of all the main aerodromes on the trans-Canada airway and its principal feeder lines has been increased. New hard surfaces have been added and many fine hangars and other buildings have been built on the aerodromes. Some of these no doubt will still be required by the R.C.A.F. when the war is over, but much may be surplus to their requirements and can be made available for the expansion of our civil transport services. In addition, aerodromes have been built to serve many new districts.

The situation in Montreal may be taken as an illustration of what is happening in all parts of the country. St. Hubert, the old civil airport, will next summer be turned over to the R.C.A.F. and a new airport designed on modern lines and complete with all facilities will be ready for use by the civil air transport services. The new airport will, at the same time, accommodate an air observers and a wireless school for the duration of the war. The site at Dorval is particularly favourable. It is convenient to the city, as near as is compatible with safety, taking into consideration the obstructions caused by large buildings and Mount Royal. It will be less liable to poor visibility, being on high ground and to the leeward of the city in the prevailing wind. The radio range approaches are much superior to those to St. Hubert where both Mount Royal and Mount Bruno cause obstructions to a blind approach. The lines of flight South, East and West are all clear of Mount Royal and the centre of the city. When it is completed it is safe to say that no city will have superior or more convenient air terminal facilities than will be provided at Dorval for the city of Montreal.

Conclusion

The successful execution of this programme has been due in the first place to the vision and initiative of the Honourable C. D. Howe, M.E.I.C., formerly Minister of Transport and now Minister of Munitions and Supply. In both capacities he has been head of services intimately connected with the war effort. As Minister of Transport he was responsible for the organization of the trans-Canada system, which has been the basis of this programme and without which the rapid progress made would not have been possible. To his energetic support and sympathetic interest civil aviation owes much. Under him the Deputy Minister of Transport, V. I. Smart, and the Director of Air Services, C. P. Edwards, M.E.I.C., have given their daily support and attention to the multitude of questions arising out of its organization and execution.

Mutual confidence between the Air Training Command of the R.C.A.F. and the Civil Aviation Division is complete.

Reference has already been made to the wholehearted co-operation received from other departments and services —Dominion, provincial and commercial. Without their assistance the rapid progress which has been possible during the past year could not have been made. The Department of Transport owes all such services a debt of gratitude.

The results already achieved are proof of the strenuous work of every member of the Civil Aviation Division to ensure the successful completion of their part in one phase of Canada's war effort.

AN UNUSUAL FOUNDATION JOB

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SUMMARY.—The paper describes the procedure followed and the equipment used in shoring a six-storey reinforced flat-slab type concrete building and lowering the foundations three feet.

Extensive alterations to the basement of the Hamilton department store of the T. Eaton Co., Limited, carried out during the early spring of 1940, included the deepening of a portion of the basement three feet and involved the lowering of the column foundations about the same distance.

The building, 151 ft. by 216 ft., is a combination of four different types of construction, being units built at different times and incorporated into one. The first fifty feet from the south end is a three-storey building with wood floors and ceiling carried on steel beams and cast iron columns. The next sixty-six feet is a four-storey section of similar construction except that the columns are steel. The remaining one hundred feet is a six-storey reinforced concrete, flat slab type, building which was put up in 1920. The exterior is finished uniformly with white enamelled hollow tile. When the company first occupied the building in 1928 they built an addition along the rear, or west side, from 20 ft. to 45 ft. wide, of steel and concrete, six storeys high. The basement floor of this new area was set three feet lower than the floor in the existing building, and was made a permanent floor of terrazzo on concrete. The old basement was only 8 ft. 9 in., floor to ceiling, and the clearance was further reduced by the systems of pipes and ducts which served the floors above. The floor of this area consisted of a wood wearing floor on a sub-floor laid on four by four sleepers at two feet centres, the space between being filled with concrete. In course of time this floor had deteriorated, owing to dry-rot, and required renewing, and the work of lowering the floor level to that of the more recent west addition was undertaken at the same time.

Tenders were called for the work, requiring the bidder to submit with his tender a plan of the method he proposed to use in carrying out the work, and in awarding the contract consideration was given to the cost, practicability of the method, and minimum disturbance to business. It is believed that the method adopted and the devices used to accomplish the desired results have made this work unique in engineering construction, in Canada at least.

The main features of the method were as follows:

First, all work was confined to the basement, small areas of which were partitioned off in succession, but not more than twenty-five per cent of the total area at any one time. This was done and stairways were maintained or changed around so as to afford at all times proper entrances and exits and to allow business to be carried on as usual except for the loss of space. Operations were conducted from both ends of the basement, and excavated earth and new materials were handled out and in without having to be passed through the business area, except under certain conditions for work which was conducted at night. Actually, a large percentage of the work was done at night. All noisy operations, such as breaking up old concrete, were only carried on after business hours and before midnight.

Second, the use of special apparatus designed for shoring the columns in the confined space and without going above the ground floor, except in special cases.

And third, the re-setting of the old foundations of the

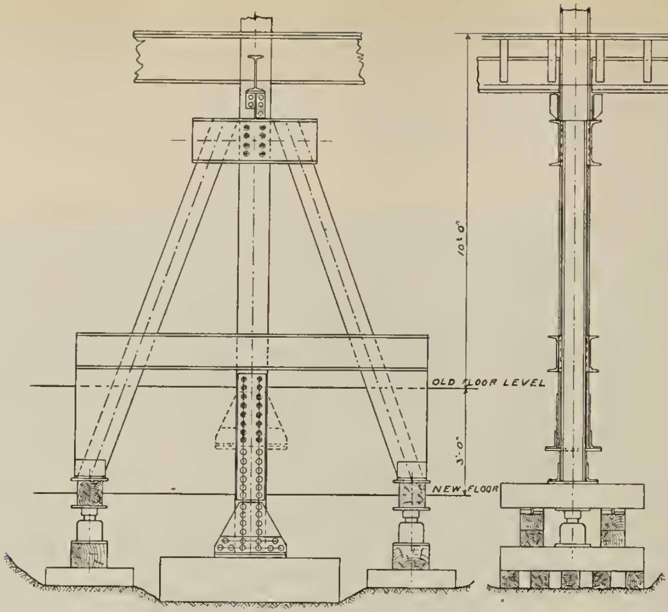

Fig. 1—Steel A-frame for lifting steel columns.

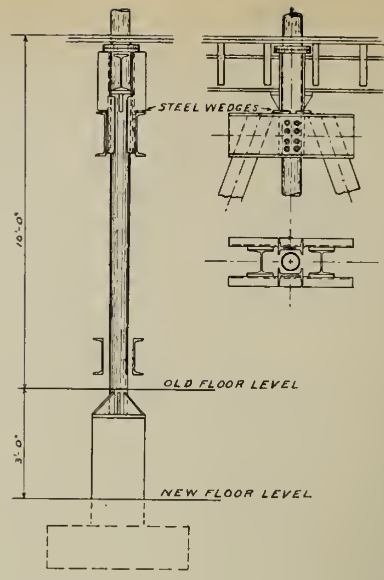

Fig. 2—Sub attachment for lifting cast iron columns.

concrete columns instead of breaking them up and replacing them.

In all, sixty-six columns were shored: twelve 6 in. dia. cast iron; sixteen 8 in. steel H columns; four 10 in. H; twenty-two 22 in. dia. and eleven 24 in. dia. concrete columns. The cast iron and steel columns stood on concrete piers about four feet deep which had to be removed entirely and replaced with a new reinforced concrete pad at a lower level. The foundations of the concrete columns were blocks eight feet square by two feet thick, and nine feet square and two and a half feet thick, and occupied twenty-five to thirty per cent of the area of a floor panel. All bearings for shoring had to be well clear to permit excavation, etc.

The cast iron columns, after they were shored up, were extended by forming up for and pouring a concrete pier under the column base and of the same size. Subsequently the column was furred out, lathed and plastered, to give a uniform shaft above the footing, about three feet from the floor, to ceiling. The steel columns were lengthened by bolting a three-foot length of steel H section, having a new base on it, and the whole was furred, lathed and plastered similarly to the cast iron.

Shoring Steel Columns

The shoring for the steel columns presented no difficulties. The limitations of space resulted in the design of steel A-frames shown in Fig. 1, and holes were drilled in the steel column and the top member of the A-frame was bolted to it. The anchor bolts were burned off and, by means of two small 50-ton jacks under the legs, the column was raised clear of the concrete pier about a tenth of an inch. A pit was dug to one side of the pier and, with block and tackle, it was pulled to one side to be broken up and removed or buried. The old column base was then cut off and the new stub column bolted on with turned bolts and lock washers. The new splice plates were extended up six inches to reinforce the column which was slightly corroded at the top of the side plates. The new reinforced concrete pad was now poured under the base, using quick-setting cement which hardened in twelve hours, and the jacks could be released and the column load put upon it. With two A-frames in operation, an average rate of a column a day was maintained after excavation of the basement and other preliminary work had been done.

Shoring Cast Iron Columns

The six-inch cast iron columns were of such small section that it was considered impracticable to drill them for a shoring connection because, in lifting, eccentric loading might set up stresses dangerous to cast iron. The device used was to bolt two steel stub-columns to the horizontal member of the A-frame and these extended up between the joist of the floor to take a bearing on the under side of the top flange of the column. (See Fig. 2). By applying the lifting force here, the load from the column above was taken directly through the flange. To ensure an even bearing for the stub columns on the flange, before tightening the bolts to the A-frame, steel wedges were driven between the bottom of the stub and the A-frame, the play in the bolt holes being sufficient to allow a slight take-up. The wisdom of this arrangement was demonstrated in at least one instance, where it was noted that, as the column was raised off the foundation, it sprung sideways about a quarter of an inch, indicating that there had been bending in the column due to an eccentric bearing between it and the column above.

One special advantage of the A-frame, as designed, was the small width of space it required to operate in. For one column, alongside a stair stringer, there was not more than seven inches; while in other places there was little clearance for pipes and ducts.

To pour the new pier, under the base of the column, a form was placed around the base and of the same size, and a gate was made on one side at the top of the form to allow the working of the concrete under the base. This projection on the concrete pier was chipped off as soon as the concrete had set enough to permit the removal of the form. The column being raised about a tenth of an inch in the shoring operation, upon releasing the jacks and putting the column on the new pier, this additional height to the pier was sufficient to offset any shrinkage of the concrete or settlement of the new foundation.

Shoring of Concrete Columns

The shoring of columns in a building of flat slab construction is made difficult because of the absence of floor beams or other convenient members under which a lifting force can be applied. The shear value of the floor slab around the column capital is usually little more than sufficient to take one floor load. Besides, the size of the column footing in a high building does not permit the placing of shores near the column in the basement. Under such conditions the shoring by usual methods may be quite an elaborate system of posts and beams extending from the basement to the roof. Such a method could not be considered in this case, due to the time it would take and the interference with business, to say nothing of the cost. Fortunately, it was found for this particular building that the basement column capitals were of such a size that, if they could be supported, the punching shear from the column above would not be excessive. Advantage was taken of this fact, and to provide a clamp for the column capital by means of which it could be lifted, a steel cone to fit around the capital was designed, in four sections bolted together.

Design of the Cones

It was assumed that the weight of the floors above was uniformly distributed over the area of the column capital in contact with the cone. (See Fig. 3). A circle passing through the centre of gravity of this area is 32 in. in diameter and 100 in. in circumference. Dividing the total load on the column by this gave 3,300 lb. per sq. in. of circumference. This force, resolved normal to the surface and divided by the area of a one-inch strip, gave a surface pressure of 344 lb. per sq. in. The horizontal reaction was, for a 45 deg. cone, the same per inch as the vertical. The resulting bursting force was this multiplied by the diameter of the C. of G. circle, or 105,600 lb. This was taken care of by two 2½ in. dia. bolts. The punching shear through the capital was taken to be the load on the column above the first floor, since it was assumed the load of the first floor was taken directly by the cone. The shear amounted to 193 lb. per sq. in. These bearing pressures and shears are well within the limits of conservative design for 2,000 lb. concrete, which the column capital was known to be designed for, not considering any increase due to age.

The design of supports for the 24 in. columns was complicated by the floor beam on one side of the column. While the load on one side could be taken by half a cone, that on the opposite side had to be figured as a shear on the beam. (See Fig. 4). This was considered too great for one beam so for these columns a 10 in. by 10 in. wood shore was placed on the first floor to the underside of the similar concrete beam on the second floor and in this way the load was divided between two beams. This, of course, reversed the existing shear at the ends of these beams, but it was quite safe to do this since the top flange of the beam was heavily reinforced by the floor steel in the inverted drop panel above. For the 24 in. columns with the floor beam, a special cast steel cellular block was designed to bear against the beam and at the same time bear horizontally against the column shaft to take the reaction from the half cone. For other special cases, where there was beam framing with beams too deep to permit the use of the cast block, special blocks were used, made of heavy steel plate with bolt lugs welded on.

The cone was made of four cast steel cellular sections, designed for a load of 400,000 lb. with a wide margin for safety.

Considerable thought was given to the question of the kind of packing to be used between the steel castings and the column capital. This space had to be an inch or more wide, due to irregularities in the concrete, and this did not permit the use of a compressible solid, such as lead or rubber. For the first two columns, plaster of paris was tried, but not only was this found to be a very messy material, but it was necessary to add so much water in order to get it to flow into place that it never dried out or hardened in a reasonable time. However, its use demonstrated that for the pressures exerted, 300 to 400 lb. per sq. in., almost any non-plastic material, in a thin layer and confined space, would answer the purpose. One column was lifted by using damp sand only, but for the rest a lean mixture of sand and quick-setting cement was used. Just enough water was added to give it cohesion so it could be worked in by hand around the top of the cone and then sufficient water was added by hose to flow it into place.

Shoring Trusses

The shoring trusses were constructed of 8 in. by 8 in. H-steel beams and channels bolted together with turned bolts. (See Fig. 5). No diagonal members were put in the trusses nor was any bracing provided between them. There were no calculated stresses that required them, and besides it was considered best not to have the structure too rigid, but to allow for elastic adjustment which might be necessary to equalize stresses caused by eccentric loading or differences in level of the four corners over the jacks. The cone rested on a smooth steel plate which was bolted to the trusses and cross members between them, but with no attachment to the cone. This allowed the cone to be centred on the column without requiring accurate placing of the trusses with relation to the column. The depth of the trusses was as great as possible, allowing clearance between the old column footings and the first floor. The length centre to centre was made exactly a panel width. This brought the bearings of the steel grillage beams, on which the jacks rested, in the centre of panel between the old footings. Thus, upon the completion of one column, the cross members between the trusses were taken out and the trusses were skidded lengthways to the next column and the grillage between was in this way, used twice with one setting. The vertical members of the trusses were designed to take the total load on the column which they would be required to carry during the final stages of the work. In addition, the bottom chord of the trusses was figured to support the weight of a column footing which in the course of the operations, would be suspended from it.

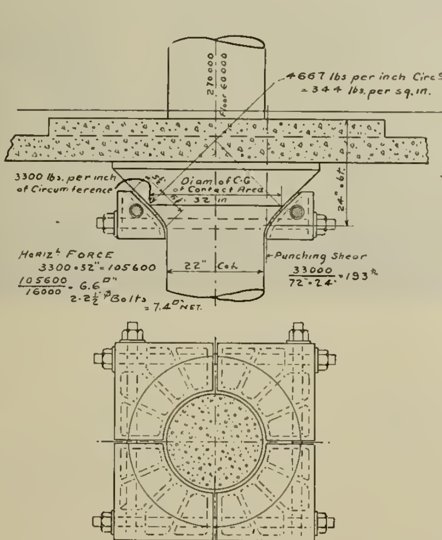

Fig. 3—Design of cast steel cone to clamp around conical column capital.

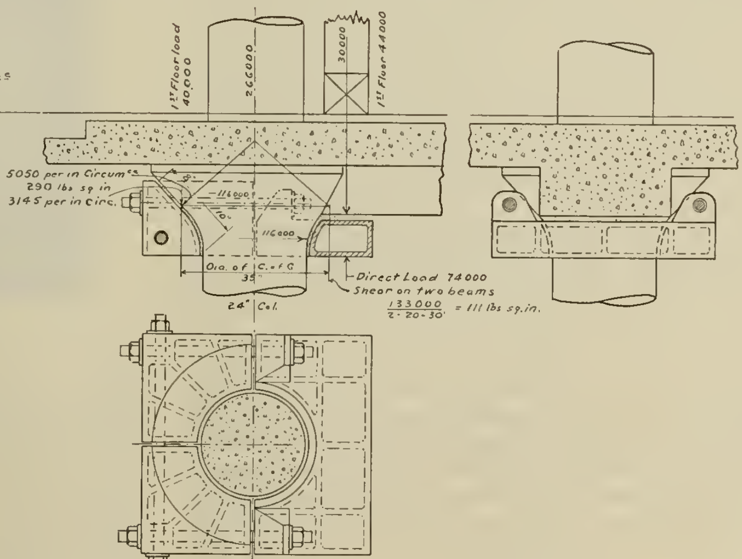

Fig. 4—Design of cast steel clamp for 24-inch column having a floor beam connection.

Calculations

The actual dead weight of the building on a column was calculated as closely as possible from the original drawings and measurements of the existing building. The live loads were found to be very light and it was estimated that 20 lb. per sq. ft. on the upper floors and 100 lb. on the ground floor, and for the restaurant kitchen, would take care of every condition. Of course, snow load did not need to be considered on the roof. Thus, the actual live load worked out about 35 per cent of the design live load, but the total dead and live load amounted to about 80 per cent of the total design load. Since, in re-setting the old footings in the manner which will be described, this load was applied to them, there is little chance that any combination of live load that may be put on them in the future will cause settlement.

Fig. 5—A-frame shores for steel columns, showing old footing drawn sideways and one column with new footing and extension complete.

It was found that with the shoring equipment designed for these calculated loads a free column could easily be lifted. The only exceptions were certain columns around the escalator well and elevator shaft at which points large concrete beams made the construction so rigid that one column could not be raised without tending to lift the adjoining column also. In such cases jack pressure was applied in excess of what was known to be the weight on the column and it was found, when the column was cut free of the footing, there was no settlement whatsoever that might indicate the total load had not been taken on the jacks.

The jacks used were 50-ton, low height, ball-bearing screw jacks, being only ten inches high with a lift of four and a half inches. Hydraulic jacks were not considered; although easily controlled and pressures accurately indicated, it was necessary in this work to carry loads for two or three days without any variation such as might take place from leaks, etc., in a hydraulic jack. In order to have some guide in judging the load on a jack at any time, one was roughly calibrated in a machine used for testing concrete cylinders. A jack was placed in the machine and a pressure of 50 tons was applied. Then, by means of a standard hand lever, the pressure was worked up to the limit which one man could apply, which reached a lift of 60 tons. The pressure was then further increased to 70 tons by the testing machine and it was found that the jack under this load could easily be released by hand. After several experiments of this kind it was possible to judge approximately by the weight applied to the lever, the load on the jack. The overload test gave assurance against jamming under unforeseen overload. As a further check on the load on the trusses, the deflection was measured and this was found to agree with calculated deflection under the assumed load.

Procedure

When all was ready, the lifting pressure was applied slowly by operating the four jacks in unison. The corners of the frame were kept level by reading, with an engineer's level, cardboard scales attached to the corners. By reading another scale on a rod, suspended from the ceiling near the column, the first upward movement of the column was detected. This was taken to indicate that the column load was then on the jacks. The movement was not more than .05 in. and represented the elastic compression in the column and footing. The lifting was not carried further lest tension be put in the column shaft, a condition to be avoided.

The second step was to cut the column free of the footing, which was done by breaking up the 12-in. pedestal between the column and the footing. This pedestal was not replaced when the new stub column was poured, since the stub was made eight in. larger in diameter than the column and served to spread the load over the footing in place of the pedestal. As the steel dowels, which attached the column to the footing, were exposed, they were burned off. It was observed that if this was not done before all the concrete under the column was cut away the column shaft cracked horizontally at one or two planes four ft. and six ft. from the lower end. This occurred only in three 24 in. columns for which the dowels were not first cut away before all the pedestal was removed. Just why this should happen is not clear. Possibly the dowels added some vertical or horizontal stress to the suspended column, which was already under internal stress due to its weight and the reaction between the concrete and reinforcing when the load it had carried for twenty years was removed.

The third step was the placing of the four steel hooks by means of which the footing block was hung from the shoring truss while the earth beneath it was removed for a depth of about 2 ft. 9 in. During excavation, which was done by hand, additional screw jacks were set under each corner as an extra protection for the workmen. The hooks were connected with a link and pin to a threaded eye-bolt provided with a nut, and when the new bed was ready the footing block was lowered into place by a man at each nut turning with a wrench in unison. (See Fig. 6). Ball bearings between the nuts and the support reduced friction and allowed the nuts to turn freely. The arrangement of the hooks gave perfect control of the operation of placing the footings and, in several cases where the footing was found out of line, were easily adjusted. The fourth step was the setting of the footing block.

Fig. 6—Footing block suspended by hooks, excavation complete ready for lowering.

One local condition which greatly facilitated the whole foundation work was the fact that the building rested on a thick uniform strata of damp beach sand which by test was found to contain, on an average, less than three per cent of moisture. The whole process of excavating for and setting the shoring grillage and the footings was influenced by this. While it was known at the time of tendering that at least part of the work would be in sand, the contractor, in his plan submitted, was prepared to adopt special measures for setting footings on hard material in a bed of concrete and to take care of a certain amount of ground water near one corner of the site. As it was, however, it was found very satisfactory to screed off the bearing surface under the suspended footing and when the block was lowered to wash in and consolidate sand under and around it, by means of water from a hose without a nozzle, and secure an even bearing. Any excess of water was soon absorbed by the sand below and when the load was applied later there was little or no settlement. The same method was used in setting the grillage beams for the shoring trusses. In the course of excavating it was found that under one area there was in the sand a stratum of hardpan, two or three inches thick, inclined to the horizontal, so that, while most of the footings were below it, several were just above it. When these footings above the stratum were set it was observed that it required half a day longer for them to settle, which was probably due to the longer time it took the excess water to get away.

The fifth and most important step was the transferring of the column load to the newly placed footing. (See Fig. 7). Four 50-ton jacks were placed symmetrically on the footing block directly under the vertical members of the shoring trusses which, as mentioned above, were designed to take the full column load. As the pressure was applied by the jacks the footing settled slightly at first but by keeping the jacks at a uniform load all movement ceased, in most cases, in twelve hours. When this stage was reached the jacks under the ends of the shoring trusses were released, thus insuring the footing was taking its full column load to which it would be subjected.

Much study was given to the final step in the process to complete the column by filling in the 3 ft. 7 in. space between it and the footing now in its new position. This was somewhat simplified by the fact that these columns were originally designed with only one per cent of vertical reinforcing which carried less than five per cent of the column load. While it would have been quite practicable to have cut back the concrete at the base of the column about two ft. or so and lap the necessary additional length of reinforcing to the existing rods, it was thought more satisfactory to increase the diameter of the new stub eight in. and extend it and its new reinforcing up 18 in. around the old. (See Fig. 8). The removal of the old pedestal left the bottom of the column practically a plane surface, as it was originally a construction joint. To insure a good contact and avoid cavities the steel form for the stub column was made up in two pieces, the lower section being only long enough to come up to the bottom of the old column and the second section was for the required additional 18 in. to lap it. The stub was reinforced with vertical rods the full length but the spiral reinforcing was cut into two pieces the same as the forms. The upper length of spiral was threaded on the column and wired up out of the way while the lower reinforcing and form was placed. Concrete was then poured up to within two or three in. of the old column and vibrated with a small electric vibrator. The 18 in. form section was then placed and the piece of spiral lowered and secured and the pouring continued from *one side of the column only.* Vibration caused the concrete to flow under the column from one side to the other under pressure, so that the formation of cavities was impossible.

The concrete used was proportioned and mixed at a "Ready-Mix" plant, using high early strength cement, designed for a strength of 3,000 lb. per sq. in. in twenty-four hours. Tests were made from each pour until uniformity was assured. The following is the mix used, using ¾ in. coarse aggregate.

	For one batch	Proportions per sack of cement
Cement	600 lb.	1 sack, 87.5 lb.
Sand	1590 lb. 3.5% moisture	2.32 cu. ft. dry
Crushed Limestone	1800 lb. 1% moisture	3.16 cu. ft. dry
Water added, 24 gals.	240 lb.	4.55 Imp. gals.
Calcium Chloride	10 lb.	1.46 lb.

This gave a concrete which tested 3,300 lb. per sq. in. in twenty-four hours and 700 lbs. per sq. in. in twenty-eight days. The time allowed for setting was usually more than twenty-four hours before the load was put on it, and the

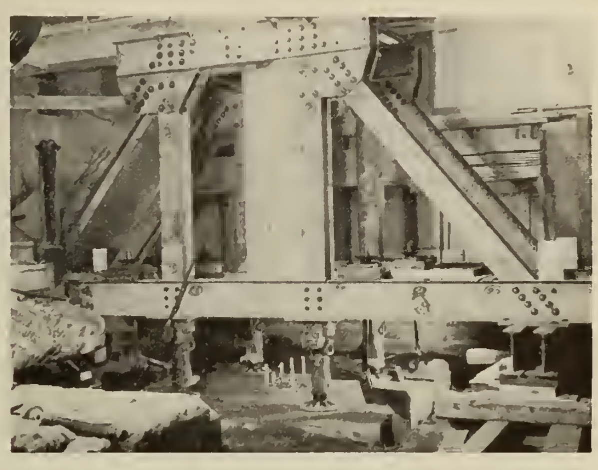

Fig. 7—Footing in new position, column load transferred to it by jacks.

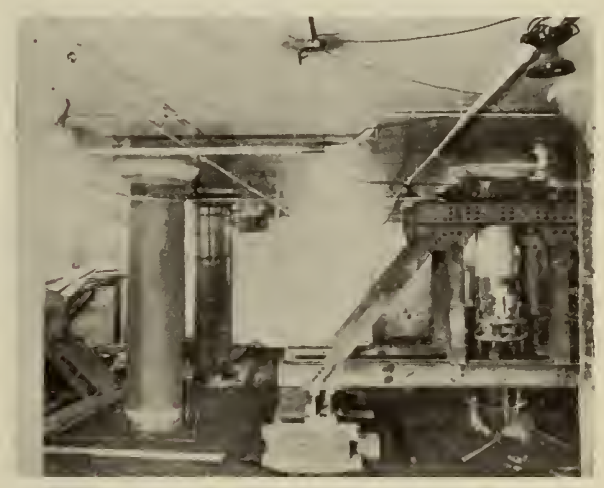

Fig. 8—General view of a working area, showing operation complete and jacks removed, one column furred ready for plastering and a third with first coat. Note "follow-up" blocking under end of shoring truss.

forms were left on until required for the next column. Two sets of shoring trusses and equipment were used, and when the work was fully organized a gang of five men was all that was required to set up the shoring, lower the old footing, and pour the stub column. Additional help did the excavation, back-filling, handling materials, etc. A column was completed, on an average, in four days and thus, on a straight run with two sets of equipment, work was carried on at the rate of one column in two days.

After the shoring and forms were removed, the column above the new stub was furred out to the same diameter and the whole was wrapped with expanded metal lath and plastered to make a uniform column shaft.

Personal

The Frid Construction Company, Limited, Hamilton, Ont., were the general contractors, for whom the writer acted as consulting engineer in planning methods and design of equipment. Mr. R. M. Williams, as superintendent, was in charge of the work and was responsible for the practical technique of all operations. For the owners, the work was under the supervision of Walter Smith, chief engineer, and C. A. Cathers, engineer for the Hamilton branch, with A. H. Harkness, M.E.I.C., and F. M. Byam as consulting engineers.

EXPLORATION FOR HEMATITE AT STEEP ROCK LAKE

DR. A. BRANT

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Steep Rock lake lies about two miles north of Atikokan, Ont., a village 140 miles west of Fort William and 120 miles east of Fort Francis on the Canadian National Railways. The location of the Steep Rock area relative to the other iron ranges may be seen from the map in Fig. 1. Steep Rock lake itself as Fig. 2 illustrates is a narrow body of water about ten miles long and varying in width from half a mile to two miles. It is really an enlargement of the Seine river which flows into it at the power dam and out of it at Tracy rapids and tends to follow the folding of the rock formations, the least resistant of which, the ash rock, lies chiefly in the lake.

The history of the development of the iron deposits of Steep Rock lake is briefly as follows:

The possible presence of hematite beneath the waters of Middle Arm (Fig. 2) was probably first inferred by McInnis and Smith of the Geological Survey of Canada who in their notes on their published map of 1897 state "from the presence of hematite float along the south shores it is apparent that an iron bearing horizon containing hematite of good quality lies beneath the waters of the lake." The location of the observed float is indicated by the crosses on Fig. 2. It increases in density from South-East Arm toward the south shore of Middle Arm where it is found in large quantities. Glaciers moving southward have undoubtedly eroded large streaks of hematite from the deposits now covered by the lake and have taken them varying distances southward where the float has been left on the recession of the glaciers. Since McInnis and Smith failed to find any iron bearing horizon north of the float, and realizing that the float must have come to its present position from a more northerly location, they drew obvious conclusions regarding the presence of hematite under the lake. The same glacial action has, no doubt, also tended to erode the least resistant rock materials and hence has in some measure accounted for the present form of the lake. Subsequent prospecting and drilling, chiefly by American iron companies, was confined almost entirely to land and it was not until the winter of 1930-31 that Mr. J. G. Cross, of Port Arthur, Ontario, the ultimate discoverer of the present hematite, carried out a dip needle survey of the Middle Arm. Two areas of high magnetic attraction (Fig. 2) were indicated which Mr. Cross thought might be due to magnetic iron oxides associated with possible hematite bodies. Bedrock could not be reached by the ineffectual hand drilling so courageously attempted and he was forced to abandon further work.

It was not until 1937 that Mr. J. Errington, convinced of the possibilities, determined to assist Mr. Cross to the extent of several thousand feet of drilling. During the winter of 1937-38 thirteen drill holes were put down; the first four evidencing, however, that the areas of magnetic attraction outlined by Mr. Cross were due to ash rock.* (Fig. 2). As a result Mr. Cross, directing drilling, decided to investigate the areas of low magnetic attraction and selected a location near the high lime ** point in the north-east of Middle Arm. Dense hard hematite beneath approximately 350 ft. of water and clay was withdrawn in the first hole, and before the end of the winter's drilling, hematite had been encountered in holes 6 to 13 along a straight line 700 ft. in length. In the meantime, the Steerola Exploration Company had been formed to continue development and already in the spring of 1938 Mr. W. Neeland, the company geologist, had come to the conclusion that the most probable location of possible hematite was at the ash-lime contact. Accordingly during the summer drilling was continued off shore toward possible hematite bodies inferred by Mr. Neeland and Mr. Bartley of the Ontario Department of Mines, whose party carried out a geological survey of Steep Rock lake during the summer of 1938.

Considerable difficulty was experienced in getting the holes down. Caves were encountered necessitating cementing; cherty fragments scored barrels and bits, resulting in loss of diamonds, jamming of rods, etc. For example, the 1,700 ft. of hole No. 27 started in June were not completed until September at an average cost of over $5.00 per foot.

Other off shore holes had to be abandoned. Aware of the difficulties of drilling off shore (at the time, the summer of 1938, it was uncertain that any of the off shore holes would get down) and aware of the necessity of being able to rapidly outline the hematite bodies, if present, by the more convenient ice drilling, the possibility of a winter geophysical survey was discussed with Messrs. Samuel, Fotheringham, and Neeland of the Steerola Exploration Company. From the summer's work in 1938 with the Ontario Department of Mines it was realized that the ash rock was, in the main, magnetic, the lime non-magnetic. Laboratory measurements showed the lime and the ash, as well as the waters and clays of the lake, to be quite good conductors of electricity. Dense hematite proved to be neither magnetic nor conductive. Hence the possibility existed of delineating the

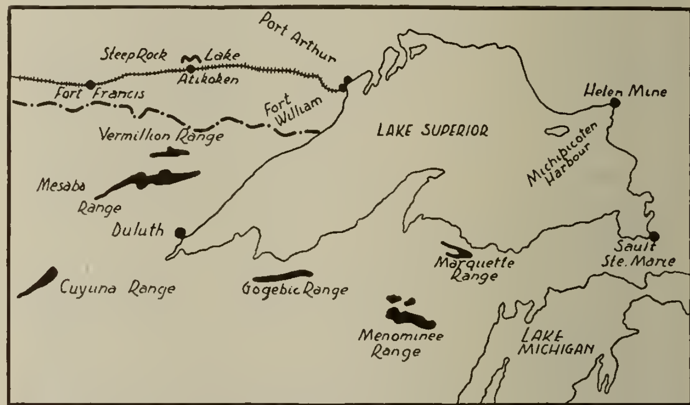

Fig. 1—Location of Steep Rock hematite development.

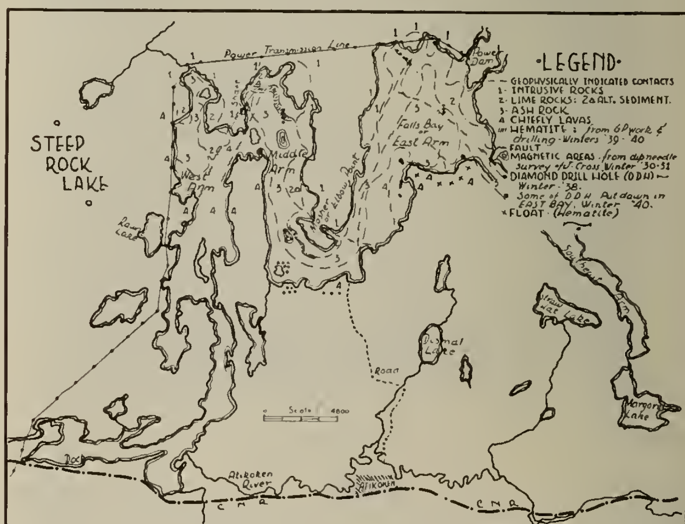

Fig. 2—Steep Rock lake.

* Ash rock is a basic tuffaceous rock.

** Lime is used collectively to include limestone, ferrodolomite and ferruginous breccia.

ash-lime (inclusive of possible hematite) contact by magnetic measurements; and the hematite, which, if present, should be at or near that contact, by electrical measurements.

The first geophysical work was a magnetic and electrical survey of the Middle Arm, carried out during January, 1939, by the Physics Department of the University of Toronto. The purpose of the work was to devise prospecting methods rapidly applicable from the ice, for it was felt this would be of fundamental importance in the development of the roughly 60 per cent of our northern area in winter.

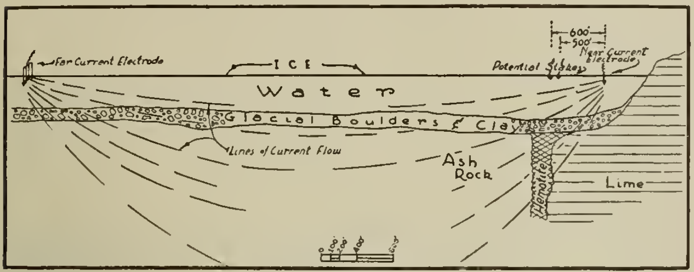

Fig. 3—Diagram of the electrical method of surveying.

Measurements of the vertical magnetic intensity over Middle Arm were made by means of an Askania vertical magnetometer. The setup of the electrical method eventually developed is shown in Fig. 3. The current electrode and the two potential stakes were kept a constant distance apart, and were moved across the magnetically defined ash and lime contact in the direction of the far current electrode. The voltage drop between the two potential stakes will vary with the material contained between the two equipotential surfaces the positions of which the two potential stakes define (See Fig. 3). Since the depth of water in Middle Arm was about 200 ft. and the thickness of clay about 150 ft., the two potential stakes were kept at 500 and 600 ft. The advantage in keeping the two potential stakes at constant distances from the near current electrode is that relatively the same amounts of water, clay and bed rock are considered for each reading and the chance of indicating the electrically resistant hematite is, therefore, much better. Experimental work showed that bedrock topographical features jutting up into the clay and unevidenced by changes in the depth of water resulted in considerable increases in electrical resistance and on one occasion were confused with possible hematite occurrences.

The geophysically obtained results for Middle Arm show, to the north, a hematite body of approximately 3,500 ft. in length running between the known hematite intersected by drill holes 6 to 13, winter, 1938, and the hematite intersected at 1,400 feet vertical depth by drill hole 27, fall, 1939.

At Mosher Point preliminary exploration, without the help of previous drilling results, indicated a fairly certain presence of hematite at the location shown. This was confirmed by four drill holes before the 1939 winter drilling season expired. The results of drilling during winter of 1939 over the northerly geophysically outlined hematite body, subsequent to the geophysical survey, are shown in Fig. 4.The assay results of the core and sludge returns are given on the map. Sulphur and phosphorus contents are quite low and the ore is apparently of bessemer grade. The estimates of tonnage have been made chiefly by company officials and mine newspaper reporters. They arrive at their figure for this north ore body by assuming a length of 4,000 ft., a width of 200 ft. and a depth of 1,000 ft. and 8 cu. ft. of ore to the ton. As a matter of fact the question of the extent of the ore material to depth is still unanswered for the only evidence of its continuation to depth is the intersection of 80 ft. of ore in hole 27 at a vertical depth of 1,400 ft., the hole being discontinued while still in ore. In addition, one electrical geophysical measurement seems to indicate that the ore continues to a depth of at least 1,000 ft. below the surface of the lake. At present a shaft has been sunk (Fig. 4) to a depth of 800 ft. and cross cutting eastward out under the lake has commenced. From a position in this cross cut, drill holes will be fanned out to intersect the ore body at depth. The evidence of these drill holes, it is hoped, will confirm the anticipation of the ore continuing to depth and may also help solve the geological controversy as to whether the ore is the result of leached iron formation or the result of the action of sulphurous waters on the iron carbonates of the lime breccia.

By way of comparison, the ore reserves of the United States Lake Superior ranges, as quoted by Lindgren in his "Mineral Deposits," McGraw Hill, 1933, are given as approximately 1,500,000,000 tons. The average analysis of the undried United States Lake Superior ore for 1925 was moisture 10 per cent, iron 32 per cent, phosphorus 0.1 per cent, SiO_2 8.5 per cent, sulphur from 0.003 to 1.87 per cent (Lindgren). Lindgren states that the Swedish iron ore deposits of Kiruna and Gellivara average 68 per cent iron, with 2 per cent phosphorus and less than 0.05 per cent sulphur. Ore reserves there are also well over 1,000,000,000 tons.

During the latter part of February and the early part of March, 1939, a magnetic and electrical geophysical survey of West Arm was undertaken. Lime and ash rock were found. However, the presence of hematite at the ash-lime contact could not be inferred from the electrical measurements with the exception of about 800 ft. at the easterly end of the contact. Drilling in West Bay was not begun until late in 1939. Then swift currents through the narrows thinning the ice at the location of possible ore above mentioned prevented operations being undertaken at this spot. The drilling done, however, confirmed the absence of hema-

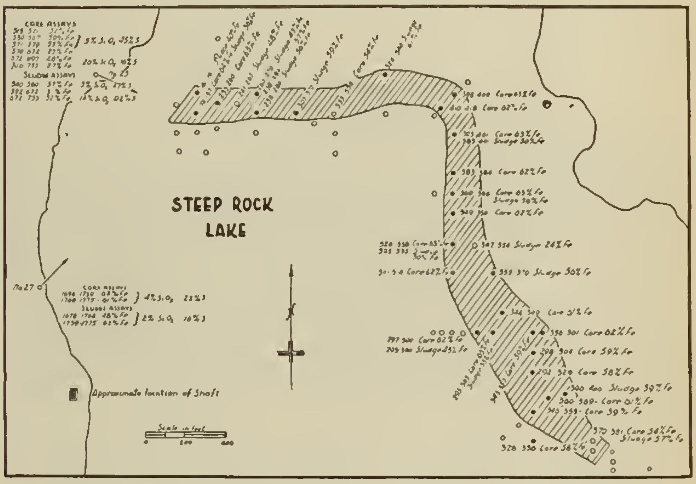

Fig. 4—Map showing results of drilling in middle arm.

tite at the more northerly and westerly portions of the geophysically outlined contact.

For the winter of 1940, magnetic, electrical and gravitational (torsion balance and gravimeter) surveys were contemplated at Mosher Point and in East Bay. Work was not commenced until towards the end of January and already considerable drilling had been done at Mosher Point and in East Bay. Early drilling at Mosher Point in 1940 indicated the extension of the hematite body beyond the conservatively estimated geophysical outlines of 1939. At the completion of the magnetic work at Mosher Point, the electrical results of 1939, reinterpreted, evidenced the possibility of the hematite extending from the north-west to the south-east end. This was proved to be a fact by subsequent drilling. Moreover from the winding of the magnetically outlined ash-lime contact, and from the location of more intensive magnetic sections in the ash, drag-folding at Mosher Point could be inferred; and if the ore were in some manner associated with the looseness of the contact brought about by this folding, it could be deduced that the hematite might possibly extend well to the south-

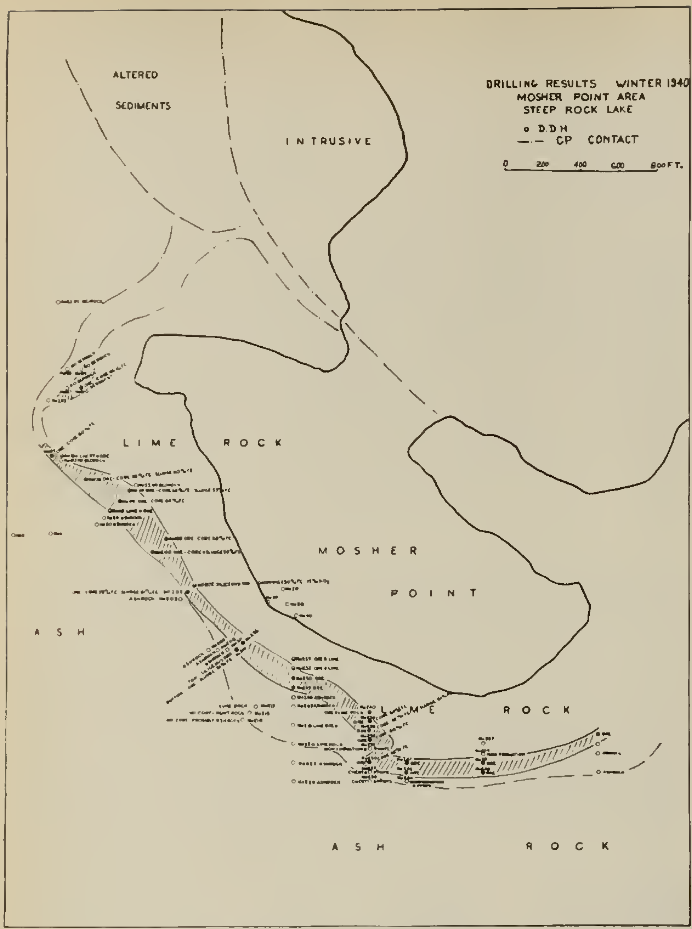

Fig. 5—Map showing results of drilling at Mosher Point.

easterly edge of the ash-lime contact, as was found in the case of the hematite body outlined by drilling at Mosher Point during the winter of 1940 as shown in Fig. 5. The ore body at Mosher Point inferred by the Company officials from the drilling is seen to be 4,000 ft. long and about 100 ft. wide and is still open at both ends which may allow for an additional extension of, at the most, 2,000 ft. (1,000 ft. at the north-west end and 1,000 ft. at the south-east end). Assay results of cores and sludges are given in Fig. 5 and can be compared with the previously outlined information.

Sounding measurements in East Arm in the fall of 1939 indicated the presence of a high underwater peninsula to the south and east. Drilling to ascertain the material of the ridge early in the winter season of 1940 showed it to be lime and, before the geophysical work was under way, drilling had been followed up where evidence of hematite was found. The magnetic work in East Arm outlined the rock contacts as shown in Fig. 2 and enabled the succeeding drill holes to be so accurately placed that the first hole at three successive profiles struck ore. Electrical indications also proved to be hematite. Before the 1940 drilling season was over, hematite had been encountered over a length of slightly greater than 1,000 ft. The presence of thick gravel to the north-west and of great depth to the south prevented the hematite being extended by drilling to the north-east and south respectively. Electrical work was also carried out in the southeast arm, but the electrical results obtained could be accounted for entirely by topographical features of the bedrock floor so that no conclusions as to the presence of hematite could be drawn. However, one hole encountered hematite at a depth of 250 ft. It is very doubtful if this hole was in bedrock; but even if the hematite encountered were float, it could signify the presence of hematite somewhere just to the north, since the movement of float has been in a southerly direction and previous drilling experience has frequently encountered such float near hematite bodies.

In addition to the magnetic and electrical work, gravitational measurements were also carried out in East Bay. Direct gravimetric measurements were attempted with a Boliden gravimeter. This instrument measures the change in gravitational attraction by the change in capacity produced between two small condenser plates, the distance between which varies with the gravitational attraction on a fairly large mass suspended by springs from one of the plates. Since a change in the spacing of the plates of a 1,000,000th of an inch is equivalent to a gravitational anomaly of one milligal, the lapping of the water on the under surface of the ice produced sufficient vibration to preclude the successful operation of this instrument.

In all, 90 torsion balance stations were taken at intervals of 400 ft. in East Bay. The torsion balance was transported in an insulated hut. This instrument indicates the presence of denser bodies, hematite in this case, by measuring the change in gravitational attraction per unit horizontal distance. However, these readings, as may well be imagined, are markedly affected by underwater topography, as the bedrock forms hills and ridges of denser material jutting up into the clay and water. Hence, to make the torsion balance results applicable they must be corrected for underwater topography, that is, the effect of the possible 200 ft. layer of clay and the underwater hills and ridges must be calculated and subtracted from the measured readings so that the corrected readings are accountable for only the presence of hematite.

Fig. 6—Surface plant at Middle Arm.

Water soundings were taken and an attempt was made to find the depth to bedrock by electrical measurements but the underwater topography proved to be so irregular and precipitous that no correct delineation of it could be obtained in this manner. Hence an attempt will be made this summer to indicate the thickness of clay with a supersonic sounding device. Thus knowing correctly the depth of water and clay the torsion balance measurements may be adequately corrected and, it is hoped, the extension of the hematite body and the possibilities of good sized hematite in other sections of East Bay, determined before the winter of 1941.

The results of the surveys may be summarized as follows: Early in 1940, Steep Rock has three orebodies demonstrated, two indicated. One of the new orebodies seems to be larger than the first orebody for which 100,000,000 tons down to the first 1,000 ft. of depth was suggested. The most important, so far, of the newly discovered deposits is at Mosher Point (see Fig. 2). With 4,400 ft. of length already, it is larger than the first found body. Mosher Point body is 300 ft. wide in places.

THE ENGINEER IN WAR TIME

Following is the text of the first three addresses delivered by members of the Institute, as part of the programme of the Radio Broadcasting Committee. These broadcasts were heard over the national network of the Canadian Broadcasting Corporation and in some instances were recorded and rebroadcast by local stations. The text of the addresses is reproduced here for the benefit of those who were unable to listen to the broadcasts.

Broadcast No. 1

ENGINEERS IN THE WAR

DR. THOMAS H. HOGG, M.E.I.C.
President, The Engineering Institute of Canada

Delivered October 16th, 1940

Captain Robert Davies' gallant action in extricating the large high explosive time bomb which momentarily threatened disaster to St. Paul's Cathedral, in the heart of the Empire, was a feat which stirred the hearts and imagination of every loyal British subject.

Captain Davies and his suicide squad knowingly risked their lives to save an historic monument which well symbolizes the democratic freedom for which we are fighting.

It was a job well done. But it was not attempted in any haphazard way. It needed a courage which few of us possess, but more than that it needed knowledge. Unexploded, high-explosive bombs are exceedingly temperamental and only experienced and understanding explosive experts are allowed to handle them.

It was an engineering job, and Davies, who is a captain in the Royal Engineers and has been specializing in this work for some time, undertook the delicate task of rendering harmless this large time bomb. His success was a notable achievement and we in Canada are proud to know that Captain Davies has been awarded the George Cross—the first to receive this signal honour at the hands of His Majesty, The King.

In Canada, following the outbreak of war, the government recalled Major General A. G. L. McNaughton, now Lieutenant-General, from his peace-time work as president of the National Research Council to command the First Division, Canadian Active Service Force.

General McNaughton is an officer of outstanding military qualifications, but he is also a distinguished engineer. He was responsible for the development of an aeronautics laboratory at Ottawa long before war broke out, and this laboratory has been of great service in our war-time effort.

Where can we find greater self-sacrifice, greater devotion to public welfare, than in the several branches of our Canadian Active Service Forces ? In all of these the engineer plays an important part and General McNaughton himself is perhaps the perfect embodiment of this professional engineer's spirit. Under him are hundreds of others trying to emulate his example, using their native talents, their engineering education, and their engineering experience to further and protect our civilization in a world menaced by hordes who would destroy everything we hold dear.

Military and Civil Engineers

In considering the relationship of the engineer to the war, it is interesting to recall that, prior to the 18th century the mechanical and constructional arts were almost entirely the vocation of the military engineer. It was only in the latter part of the 18th century, little more than 150 years ago, that there arose a body of men who confined to beneficial purposes their skill in these arts, and became known as civil engineers in contrast to military engineers.

Today, in a very much widened sphere embracing the main branches of civil, mechanical, electrical, mining and chemical engineering, and their many subdivisions, the majority of engineers are concerned with civil projects of a constructive character. The difference in the aims of the two broad groups of engineers, civil and military, is well expressed in the definition of his profession early adopted by the civil engineer, which was "the art of directing the great sources of power in nature for the use and convenience of man."

In peace-time, the military engineer is concerned with many projects of a constructive character relating to defence measures, but in war-time even his constructive efforts relating to bridge and highway building, the maintenance of transport and communications, etc., are all related to a destructive end—namely, the destruction of the power of the enemy. Nevertheless, much of his training is fundamentally similar to that of the professional civil engineer.

It is not surprising, therefore, that under conditions of modern warfare, mechanized to the limit and exploiting all the scientific and engineering achievements of the past fruitful decades of progress and research, the civil engineer, with his specialized training, is called upon to take a prominent part in the change in the country's economy from a peace-time to a war-time basis.

We find, therefore, that many leaders in our war time activities are men who have been prominent as civil engineers in peace-times.

On the Home Front

On the home front an engineer very prominent in the public eye at the present time is the Honourable C. D. Howe, Minister of Munitions and Supply, who is directing Canada's industrial army. He was formerly a well known civil engineer, and today has the important task of organizing industry to produce the maximum quantity of munitions and supplies in the minimum time.

Associated with Mr. Howe, both directly and indirectly, are a great many Canadian engineers, specialists in various branches of engineering, all applying their specialized knowledge, which may be technical or administrative, for the quick solution of urgent problems. These engineers, co-operating with engineers engaged in industry, are endeavouring to mobilize efficiently and in the shortest possible time the great resources of this Dominion and direct a continuous stream of munitions and supplies through unimpeded channels to their ultimate destinations.

An Engineering Problem—Transportation

We know that war today is a complex economic struggle, but some of the old military dictums still hold good; and one is: to win battles it is necessary to have men and materials in the right place at the right time. This entails a complex engineering problem—transportation. Men must be carried in mechanized units by land, air and sea; artillery must be strategically located; munitions of all types must be continuously distributed; and food, gasoline and supplies of a varied nature must be transported.

The problem and strategy involved in depositing high explosives upon vital military objectives in the enemy's territory is also a major transportation problem, whether this is accomplished by aerial bombers, ships' guns, land guns, or by infantry. And being a transportation problem it requires the best engineering skill available to ensure its success.

Perhaps nothing so typifies the spirit of the British people as the Navy. The fighting ships of today are themselves concentrated marvels of engineering skill, requiring for their operation and maintenance engineering ability of a high order. So, too, with the Air Force. The undoubted superiority of the planes of the Royal Air Force is attributable both to the professional ability of the designing engineer and the long tradition of fine craftsmanship in the engineering factories of Britain.

As you know, airplane production in Canada is fast developing into an important contribution to our war effort, but it may be news to many of you that a woman graduate of Toronto University is a prominent engineer in this newest transportation industry. Later in this series there will be a talk on "Aircraft Engineering" by Miss Elizabeth M. MacGill who is chief aeronautical engineer to the Canadian Car and Foundry Company of Fort William.

Machines or Men

Unquestionably success in this war will largely be dependent upon the wholehearted co-operation of industry, especially the engineering industry. Machines are playing a vastly more important part than ever before. It is mechanized forces that fight this war. The tank and the aeroplane, modern transport of all sorts, new and more costly weapons, these are the realities of today.

Everywhere there are new and expanding needs for mechanization. I think I am right in saying that a battalion of 1,000 men, in the last war, was equipped with only two machine guns. In this war a battalion of 700 men will carry fifty. It is the hope of every one of us, I am sure, that machines may this time take some of the punishment which in the last war was born by flesh and blood.

Canada and Canadian engineers have a very definite part in all this. Canada is not represented only by an expeditionary force. Behind the army in the field there must be mobilized a vastly greater army of technicians and workers; and Canada's greatest contribution will only be achieved after she has organized herself into a vast machine shop, a vast storehouse on which our Empire may call, to meet any need that may arise. Surely it must not be again, as unfortunately it was in the last war, that men were called upon to die because industry at home was inadequate to serve their needs.

During the first World War our own Canadian divisions were largely armed, supplied and trained overseas. Today we are planning to equip them in every detail of their needs. We are also the training ground for the vast air effort of the Empire. Men from every quarter are converging here to learn that art of aerial war. Much more than was the case in the last war, we are being industrially mobilized in this war.

The Engineers' Contribution

Fortunately, due to our great industrial development since 1914, it is a far stronger Canada that stands today by the side of Britain—stronger in both men and materials, experience and stamina. Thousands of Canadian engineers, who have contributed so much to the peace-time economic development of this great Dominion, are now concentrating all their skill and experience upon war-time activities.

Great individual contributions are being made by engineers in almost every branch of engineering, but I would like to pay particular tribute to those engineers who voluntarily are giving their time and talents in a hundred different ways to strengthen Canada's war efforts. These engineering services range from those given by the unpaid specialists at Ottawa to those given by veteran engineer officers of the last war who are spending their nights to train young sappers and engineer officers of the Non-Permanent Army.

The Engineering Institute of Canada, which is a Dominion-wide organization, in co-operation with other professional engineering associations, is trying to find ways and means of doing voluntary work. As far back as 1938, the Canadian engineering organizations, at the request of the Department of National Defence, made a notable contribution by gathering together the academic and professional records of approximately 10,000 Canadian engineers and technically trained men. This voluntary census, completely indexed and filed, is now of considerable help in locating technical men of the type that are so often urgently required for war work.

The Engineering Institute of Canada, with headquarters in Montreal, is not only continuing its peace-time function of disseminating technical knowledge and of consolidating the engineering profession throughout the Dominion, but with its wide knowledge of the profession is able to find the right type of engineer when asked by the various government departments and those firms carrying out special war contracts.

Problems involving the entire technical staff of new industrial units have been brought to the Institute's headquarters, and Canadian engineers with highly specialized experience have been found to fill positions of unusual responsibility.

This talk, I fear, has been somewhat of a eulogy of the engineer—so, if there are Canadian engineers listening to me, I would ask them to remember their grave responsibility in this hour of need.

We cannot all remove time bombs or command armies, but in this war the civilian, and especially the men and women with engineering or technical training and experience, can contribute to the common effort as never before. The engineers and technicians, who form so substantial and important a part of the Canadian Active Service Forces, can be relied upon to do their part. Upon the civilian engineers, who largely direct and control the vast industrial effort that may well be Canada's chief contribution to the Empire's struggle, is laid a still greater burden—greater because its acceptance is an individual responsibility. Let none of us fail in this.

Broadcast No. 2

WAR RESEARCH—AN ENGINEERING PROBLEM

DEAN C. J. MACKENZIE, M.E.I.C.
Acting-President, National Research Council of Canada, Ottawa, Ont.

Delivered October 23rd, 1940

I propose to speak to-night about science and war; of the part science has played in the preparation for and is now playing in the conduct of the present conflict.

Mr. Winston Churchill, reviewing the first year of war in Parliament on August 20th, 1940, drew attention to the fundamental difference between the war of 1914-18 which he described as a "war of men and shells" and the present one which he described as "a conflict of strategy, of organization, of technical apparatus of science, mechanics and morale."

Of the great importance of strategy and morale, there can be no question but I will discuss only the organization and relationship of science to technical apparatus and mechanics of war.

In referring to science, I use the word in its generic sense, not as something apart from its application to operations and industry but as one activity extending from the highly specialized research worker in the laboratory through the stages of engineering development and industrial production to maintenance and military operations in the field.

Of two things I am convinced: (1) That the British Empire to-day is superior to Germany in scientific and technical matters, which was not the case in 1914; (2) That while dictatorships may have some advantages over democracies in the political, financial and economic control of a nation, the same cannot be said of its scientific activities. These two generalizations, if true, are deeply significant, for it can be easily maintained that modern wars are not a matter of "men and shells" but largely of scientific development, mechanics, technical apparatus, and organization—in other words, applied science or engineering. If democracies can mobilize the resources of science as effectively in war as can the dictatorships, there should be no doubt as to the final results of this war, and if the scientific philosophy and techniques can make a nation victorious in war, there should be little difficulty in the peace to follow unless the future leaders of democracies fail to appreciate clearly what are proving to be the fundamental structural elements of a modern industrial nation.

What is the fundamental measure of a nation's status as a scientific and industrial state? At the risk of over-simplification, I suggest it is the degree to which mechanical power has been substituted for human labour. The idea is not new—the evidence is apparent everywhere; the implications of this movement, however, have never, I think, been appreciated in advance. The substitution of mechanical power has been taking place at an ever-accelerated pace since the 18th century; it is still going on. We see around us everywhere changes brought about in the past; we admit in principle but rarely envisage realistically how great will be the future changes. In no field is this more apparent than in war.

When wars descend upon us, the public is inclined to be critical of those in responsible control, but I think it only fair to our military leaders to admit that, for the last 15 years at least, thoughtful staff officers of the forces in Canada and England have been prophesying what Mr. Churchill, on August 20th, stated as a current fact—that the war of to-day would be not one of "men" but of machines, that the front line would run through the factories, and that scientific planning, technical equipment, and industrial production would be prime factors. The scientific and technical officers of the military forces and civil establishments in England, I suggest, are not responsible for the difficulties we are experiencing to-day but they are largely responsible for our greatest blessing that, plane for plane, our Air Force is superior to the much vaunted German machine.

It has been stated that in the old Canadian Corps of 1918, the horsepower of all the mechanical equipment was probably less than 50,000, while to-day a modern Corps of four divisions has about 1,000,000 horsepower incorporated in innumerable vehicles, trucks, tanks and carriages. If, for illustration, we accept the estimate that it takes ten men to perform the work of one horsepower in a machine, we see the modern corps, equipped with an increased effective energy capacity equal to that of nearly 10,000,000 additional men. This comparison, of course, must not be pursued too literally but the implications are obvious: in 1914 all army officers were supposed to know something of horsemanship and be able to ride. To-day such officers must be able to drive a truck, ride a motor-cycle and know something of internal combustion engines.

The tank corps, with their mechanical horses, have made cavalry obsolete, and the pilot of a fighter and the air crew of the bomber control and direct greater forces of power than did many a brigadier-general in 1918. When we realize the extent of army mechanization, the number of high-powered planes, the masses of artillery and tanks with which a modern nation in arms must be equipped, we begin to appreciate that the war of to-day bears about the same relationship to past wars (even that of 25 years ago) as does a modern mass-production industry to a simple cottage industry of the 17th century. This, of course, means more and more scientific, engineering and technical training; relatively fewer men in service units but more highly trained and elaborately equipped.

When Mr. Churchill said, "Never in the field of human conflict was so much owed by so many to so few," he paid a tribute to the most gallant band of heroes of the air and the sea that the world has ever known and we all say, "Aye," but a tribute was also paid at the same time to the relatively few scientists and engineers both of the fighting services and civilian establishments who, through 20 years, while the democracies were bathing listlessly in the enervating philosophy of disarmament and appeasement, were quietly developing machines and equipment as superior in quality as the youths who now operate them.

It is, of course, not permissible to discuss scientific research and developments that have matured or are under way but something can be told of how such work is organized and carried out.

England in 1914 was not organized scientifically; there were, of course, many eminent scientists of world renown and the standards of applied science and engineering were high but there was no co-ordinating agency such as Germany had had for years, no body whose duty it was to organize, support and correlate the activities of the numerous laboratories and workers of the nation. When war broke out in 1914 this handicap was quickly recognized and a government Department of Scientific and Industrial Research was set up for this purpose and increasingly generous support for both civil and military research has been given ever since, with the result that to-day in this respect the advantage is not on the side of Germany.

In addition to the civil Department of Scientific and Industrial Research in England, the Navy, the Army and the Air Force all support research institutions, under the necessary conditions of military secrecy and discipline, and manned by highly qualified scientists, both of civilian and military rank. Unfortunately, scientists and engineers working in such stations cannot, of necessity, publish the results of their work and the public knows, and can know, little of their accomplishments, but events are gradually disclosing the extraordinary value of their activities during the past decade, and I think it will be an eternal credit to the wisdom and far sightedness of responsible officers of the services that during all those depressing days of disarmament and cutting of military budgets they continued to spend larger and larger proportions of their shrinking revenues on scientific research, development, design and planning. The results are now becoming apparent. The Royal Navy is maintaining its ancient level of technical excellence. The youngest of the services, while lacking numbers, is superior, man for man, plane for plane. The magnetic mine was quickly mastered by superior scientific application and the scientific and technical equipment and aids for the three services have proved to be second to none.

To me a fact of the greatest significance is that in the Empire scheme of scientific organization, there is an unusually intimate integration of the efforts of civilian and military scientists, civilian and military engineers and industrial establishments in the production and use of apparatus, equipment and supplies for war. In England, many eminent university scientists have worked as volunteers for years in close co-operation with the services and now are seconded to research stations. Many scientists who, until a few years ago, were interested only in problems of fundamental research of no immediate application, under the stimulus of national peril, have become feverishly interested in direct application and some of the finest engineering design and development is being done by such men. Today, both in Canada and England, the vital stress is on application. The line between pure and applied science has become obliterated. Scientific research is an engineering problem because if developments have no chance of ending up in industrial production and effective tactical use in the field, no scientist engaged in war work is interested. The pure scientist becomes an engineer overnight. It is not a matter of different techniques but a matter of nearness of objective. Long-term fundamental research is for times of peace. In a war for survival we live on our capital and work for today.

In 1916, following England's example, Canada also established a National Research Council for the purpose of organizing and co-ordinating scientific and industrial research in Canada. Through the generous support of successive governments, this institution has grown, at first slowly, but since the laboratories in Ottawa were opened in 1932, expansion has been rapid. Until war broke out, the stress was naturally on problems concerned with peacetime activities but today the reverse is true, and the activities of a staff doubled in number, are devoted almost exclusively to problems having a war bearing.

In Canada there has developed an association between the National Research Council and the services of the Department of National Defence which it is generally conceded is most effective in our war effort. There is an intimate contact between the technical staff of the Council and the scientifically trained officers of the three services (and there are many highly trained scientists in uniform), and the National Research Laboratories are functioning as scientific research stations for all of the services.

The Department of National Defence and the Department of Munitions and Supply use the Research Council much as the large industries use their affiliated research and engineering institutions. The quality of army supplies are today carefully guarded by the departments concerned; changes in specifications, substitutes or new developments are referred to scientific experts and laboratories and scientific tests have now more weight than personal opinion.

There is a growing amount of research and development work going on in the fields of aernonautics, physics, chemistry and electrical engineering and with the active steps being taken for the direct defense of our own shores, the demands for more and more scientific research and development work in Canada will increase. That Canadian institutions can and will meet such demands, is admitted by all; that the integration of the efforts of the pure and applied scientist, the military and civilian technologist, the engineer and the manufacturer is making for the most effective contribution in Canada, there can be no doubt; that scientific research in wartime has become an engineering problem no one can question.

Broadcast No. 3

AIRCRAFT ENGINEERING IN WARTIME CANADA

ELIZABETH M. G. MacGILL, M.E.I.C.,

Chief Aeronautical Engineer, Canadian Car & Foundry Company, Limited, Fort William, Ont.

Delivered October 30th, 1940

To the shame and the glory of the engineering profession the world over, this war is described as an "engineers'" war. To our shame, we engineers devote the years of peace to designing and planning for war. To our glory, we are the group to which our country turns in time of war. Heavily upon us, as individuals and as a professional unit, our national duty rests terrible and dear.

Of this burden of blame and honour, the engineer in the Canadian aircraft industry bears his full share. Sponsored by him, military aeroplanes—Hurricane fighters, Hampden bombers, Blenheim bombers—are built here for the British Government, for use in the defence of Britain and to carry the war into Germany; while training aircraft—Moths, Fleets, Norsemen, Ansons—are manufactured for our Canadian Government to use in training airmen. For the first time in its existence the Canadian aircraft industry is concentrating on war planes.

In war and peace, the world over, the building of aeroplanes is exacting, compared with the manufacture of other vehicles of transportation. All who fly are safeguarded from serious defects and errors in manufacture by a rigid system of inspection and testing of materials, aeroplane parts, installations and finished aircraft. Each part, subassembly, assembly and installation is built exactly to drawing and the complete set of drawings for the aeroplane must be submitted to and approved by the government department licensing aircraft, before the first machine, the prototype is licensed for operation. During manufacturing, each part or subassembly is stamped with an identification number, the number linking it with the approved drawings of the aeroplane. Also, before being assembled onto the aircraft, each part or subassembly passes into the "view room" or detail part inspection department of the manufacturing company where, singly or in batches, the part is checked by an approved inspector against the drawing for correctness of material, dimensions, finish and workmanship. On passing inspection each piece is stamped individually with the number of the inspector and the identification stamp of the manufacturing company. Thus, in any aircraft it is possible to tell from which drawing of the approved set of drawings each part was made, by what firm is was made, and by what inspector it was passed. As there are from 3,000 to over 20,000 parts in an aeroplane, a very comprehensive system is required. Beside the detail inspection, each assembly of components, as, say, the assembly of the tailplane to the fuselage, is inspected and each installation such as the control system, the lighting system, the retractable landing gear system is tested and inspected. Each part and each assembly and installation must be passed before production proceeds.

In all countries, the aircraft manufacturer is interested not only in the material which he receives but in the supplier of the material, his methods of manufacture, his testing procedures, sampling processes and sources of raw material. Each batch of raw or fabricated material to be used in aircraft work must be accompanied by a release note signed by a responsible official, and certifying to the chemical content, mechanical properties, heat treatment, manufacturing processes and test results of the batch. Nor can the aircraft manufacturer buy his supplies anywhere. He must buy from approved firms only, such firms having been thoroughly investigated by a proper authority, as regards processes, system of inspection, competency of personnel, methods of testing, sampling and reporting. In time of peace, the Canadian supplying companies obtain their approval from the Dominion government, while for materials purchased in the United States, the Canadian government recognizes the approval granted there by the United States Army Air Corps, the United States Navy and the Federal Government, and accepts orders made in accordance with them. In the case of aeroplanes built for Great Britain, the British Air Ministry is the licensing authority.

Our wartime job is to produce aeroplanes as quickly as possible. All the warplanes which we are now manufacturing were designed in England. Hundreds of them have been built and tested there, and England is still building them. The aircraft drawings to which we work were prepared and supplied by English firms. This makes the Canadian job of production sound easy, but, to quote from Porgy and Bess, "it aint necessarily so." To understand the root of the difficulty, it is important to grasp the significance of the words "strictly interchangeable" as applied to aircraft. As between aeroplanes of the same type, the principal components—namely, the wing panels, ailerons, flaps, tailplane, undercarriage and so forth—must be interchangeable. It must be possible to exchange rudders, say, between Hurricane fighters whether they were built in Canada or in Great Britain, so that the machines may be repaired and returned quickly to the service after they have suffered damage.

Maintaining strict interchangeability would not present a difficult problem in Canada if sources of supply of the necessary standard parts and of the required fabricated material were available on this continent to the Canadian industry, as they are in England to the English industry. As you know, the standards adopted in manufacturing on this continent differ from those used in England. Thus the threads of English standard parts—screws, bolts, nuts—the sizes of English drills, the thicknesses of English plate and sheet metal differ from those that are standard and available on this continent. Again, in aircraft work, the materials used must be of certain chemical content and have certain mechanical properties, the requirements being laid down in written specifications promulgated by recognized authorities. These specifications vary in the different countries. One set is not necessarily superior to another, but usually is different—in the same way that an apple is not superior to but is different from a pear. Previously, the English aircraft specifications were not used generally by the Canadian industry, as most of the material for Canadian aeroplanes was bought in the United States to United States Army, Navy or Federal specifications. With the building of English aeroplanes here, however, it becomes necessary to establish, on this continent, sources of fabricated material, such as alloy steel, and aluminum alloys, prepared in accordance with the English specifications. Before aeroplanes can be manufactured from native supplies to English drawings and to strict interchangeability with English models of the same type, primary industries must be developed here to produce the specific fabricated materials and the English standard parts required. Aided by the British and Canadian governments, the Canadian aircraft industry has undertaken this task.

In certain cases it is not practicable to develop a source of supply for a specific material. Sometimes the amount required for each aeroplane is very small. Thus, where only four inches, say, of an alloy steel of an English specification is required for each aeroplane, the development costs of the steel would be prohibitively high. Sometimes the component is of so specialized a nature, such as, say, steel tie-rods, that no Canadian company can undertake to supply the industry in time to be of service or at a price to give satisfaction. Sometimes the only possible supplier is an American firm whose shops are so crowded with work for the United States defence programme that, although eager to help in any way possible, he cannot undertake the development of new English specifications at this time. In such cases it is necessary to determine a suitable and readily available substitute for the desired material and to obtain the approval of the British Air Ministry for its use on the aeroplane.

Again, it is necessary to develop on this continent sources of supply for the various proprietary articles required on the English aeroplane—articles, such as valves, pumps, control boxes, gauges, flexible hose. These are special items for which drawings are seldom available, and it is necessary to seek out firms who will undertake to make these parts exactly to samples supplied them. Obviously, strict interchangeability is required here, both as regards operation of the part, and its method of attachment to the aeroplane. Furthermore, arrangements regarding the material used for the part, the testing of the finished article, the inspection and marking of the completed part must be concluded.

Of this whole undertaking, time is of the essence, for the call from Lord Beaverbrook is for aeroplanes and still more aeroplanes. At all costs, the programme must be accelerated. The driving force of the Canadian industry is directed toward increasing production. Methods of fabrication of aeroplane parts are reviewed with an eye to reducing the time of manufacture or of assembly. Mass production techniques are introduced wherever practicable. Since the number of machine tools needed—lathes, milling machines, etc., and their operators—is far beyond that controlled by any one firm, work is sent out to subcontractors. Up and down the country to-day there are machine shops both large and small that six months ago had never made an aeroplane part, but which are now turning out aircraft parts of fine workmanship and finish.

The wartime expansion of the industry provides a measure of the work accomplished. More than 9,000 employees are at work now in the seven Canadian aircraft manufacturing plants, compared with about 2,000 in 1936. Including the allied industries, over 17,000 Canadians are actively engaged to-day in producing aeroplanes. Many of these workers are new to industry. To introduce so great a number of inexperienced people into an industry famous for the exactitude of its requirements, and at the same time to continue to maintain the high standard of workmanship obligatory, is a crazy assignment and no task to be undertaken in cold blood. Fortunately, there is no cold blood in the aircraft industry. Also, a current saying in the aviation world is that "you don't have to be crazy to be in the aircraft business, but it helps." Obviously it does help, but it is a specific craziness that is meant, a craziness that accomplishes prodigous things, a craziness that will win the war.

The challenge of winning the war is thrown directly to the Canadian engineer. It is our job and our duty, yet in it we can take exultant pleasure for our goal extends beyond the war into the peace to follow. We are working, not just for the satisfaction of winning the fight for our side, but for the glory of hastening peace to the world. This peace that is to come must be so compounded of wisdom and justice as to have intrinsic strength. It must last for longer than a generation. It must be a peace which we shall be proud to hail as the Pax Britannica, the British peace.

TECHNICAL EDUCATION

A criticism by Dr. Willis H. Carrier, Chairman of the Board, Carrier Corporation, Syracuse, N.Y., *Mechanical Engineering* (New York), October, 1940.

Abstracted by L. M. Arkley, M.E.I.C.

Dr. Carrier has been called the father of Air Conditioning. As far back as 1911 he had two excellent articles on the subject published in the *Transactions* of the American Society of Mechanical Engineers. One of these dealt with the now well known psychrometric chart and the other written in collaboration with Busey was on air conditioning apparatus. For twenty-five years he has been head of the Carrier Corporation and responsible for the design and construction of many air conditioning plants; he has been president of the American Society of Heating and Ventilating Engineers and takes a prominent part in the affairs of the society as well as those of the American Society of Mechanical Engineers.

With such a background, Dr. Carrier is eminently qualified to discuss Technical Education and he did so at the semi-annual meeting of the A.S.M.E. in June, 1940.

Dr. Carrier contends that there are at least five points on which the average engineering school may be criticised. First, the trend towards specialization in undergraduate courses; second, lack of proper standards for selection of students to be admitted to engineering courses; third, failure to develop in the student the habit of thorough understanding of subject matter and processes; fourth, insufficient emphasis placed on development of student personality; and fifth, examinations and student grading which are not the true test of student ability desired by the employer, and he enlarges on some of these points as follows:

Undergraduate Specialization

First, the objections to specialization in undergraduate courses are as follows:

(a) It takes valuable time of the students which might be used in obtaining a more thorough understanding of and training in the fundamentals of engineering and their broad rather than specialized application.

(b) An overcrowded curriculum leads to superficiality rather than thoroughness—above all things the engineer must be thorough. It should be the aim of the college to teach thoroughness—and then more thoroughness.

(c) With few exceptions current engineering practice in special fields cannot be taught successfully to undergraduates. The newer arts are advancing with exceeding rapidity and text books are out of date almost before they are printed.

(d) Probably more than 90 per cent of the students do not follow the field in which they have specialized when in college and therefore 90 per cent of the time the student puts on this is wasted.

(e) Specialization adds unnecessarily to the cost of running a college. Cost of instruction in and operating laboratories for specialized fields is out of proportion to the cost of more important fundamental instruction.

Inadequate Standards of Admission

Second, lack of proper standards for selection of the students to be admitted to engineering courses. In general, insufficient consideration is given to student aptitude, and the requirements for admission to the course of the type of ability needed in engineering are inadequate.

It may be assumed that most engineering students have an interest in their work, but more than this is required, they must have natural analytical ability and this is the real criterion of whether they should go to a trade school or take an engineering course in a university.

Unfortunately, high-school standings alone cannot be taken as an indication of the students analytical ability. The college entrance examinations should be more of the intelligence test type, to test natural thinking and reasoning ability and should be supplementary to the high-school tests.

The main purpose of an engineering education is a thorough understanding of principles and training in the use of the mental "tools" of the profession. Training in thinking is far more useful than the mere acquisition of factual knowledge. Employers do not want human slide rules or walking encyclopedias of engineering knowledge. They want graduates trained in logical thinking in habits of thoroughness and in the scientific method of approach.

Dr. Carrier now pays his respects to the teaching profession in engineering schools and says that teaching should be by the inductive method rather than by the overdone deductive and classical methods, and it is a question whether the colleges have teachers qualified for this work. Many of them are teachers but not educators.

Development of Student Personalities

There is a tendency in our schools to overemphasize the teaching side of education at expense of the human aspect. The engineer's success depends fully as much on his ability to deal successfully with human problems as it does on his ability to deal with mechanical problems. It has been truly said that few engineers lose thier jobs because of lack of technical ability. Jobs are lost largely through failure in human relations.

It would seem that there is one underlying error common at least in practice if not in theory in most of our institutions to which these various faults may be traced, Dr. Carrier said. This is the failure to appreciate that the chief objective of a technical education should be to train the student in logical thinking and develop his creative imagination; that it should be aimed primarily toward the acquisition of power rather than toward the amassing of factual knowledge. Many educators will not admit that this is a sound accusation, he said, but he insisted that while many agree with this statement in theory they fail to carry it out in practice.

What the employer wants is to be able to select college graduates with greater surety of their success in his particular field because of their proved natural ability and because of their sound grounding in engineering fundamentals, concluded Dr. Carrier.

SUPPLY OF SKILLED LABOUR FOR WAR WORK

Extract from *Trade and Engineering* (London, Eng.), September, 1940

Sheffield University is playing a valuable part in increasing the supply of labour for war work. Its Engineering Department is instructing both men and women in the elementary principles of engineering, and this is followed by further training in works, after which they are absorbed as they become proficient. By the middle of August about 80 men and 50 women who received their initial training at the University had been placed with firms, and employers speak favourably of their desire to learn and make themselves useful. As the war progresses industrial woman power will become more and more important, and in view of this, firms are training women to take men's places. At the same time, semi-skilled men in the works are making themselves familiar with the highly skilled work. As they move forward their places will be taken by women, and the latter will themselves be able after further experience, to undertake more important duties

HIGH ALTITUDE AND ITS EFFECT ON THE HUMAN BODY

Journal of the Aeronautical Sciences (New York)
September and October, 1940

During the last five years, as the growth of aviation has been more and more rapid, physiologic and medical problems have developed, which are definitely dependent on and associated with the fact that man is no longer limited to the land and sea and that the military aviator soars in the air to a height of 7½ miles; he now goes higher and goes longer distances at greater speed than any other living creature. Medical science, therefore, was confronted with innumerable new physiologic and medical problems and, as a result, two and a half years ago the Board of Governors of the Mayo Clinic in conjunction with the Mayo Foundation, University of Minnesota, established the Laboratory for Research in Aviation Medicine as part of the Section on Metabolic Research of the Mayo Clinic.

It is absolutely necessary to maintain a normal supply or partial pressure of oxygen in the lungs because the energy which runs the brain as well as the moving parts of this human machine is activated entirley by the burning or combustion of food by the oxygen carried by the blood stream to every cell of the body; therefore each cell, even those in the more distant parts of the body, must receive its regular supply of oxygen, and, what is more, the oxygen must be delivered to these cells essentially at the normal oxygen pressure.

The length of time an aviator can withstand anoxemia varies somewhat among normal individuals, and in the past the selection of aviators has been largely based on their ability to withstand anoxemia or lack of oxygen. Of course, an aviator in good condition can withstand the anoxemia caused by the low oxygen pressure found at 15,000 ft. much longer (more than an hour) than at 20,000 ft. (less than half an hour). The critical threshold for death of a normal unacclimatized man is between 20,000 and 23,000 ft.

Flying at or above 15,000 ft. for any considerable time causes fatigue—more fatigue, increasing both with an increase in elevation and with an increase in length of time, than results from correspondingly severe mental and physical work at sea level. Even, as shown by Armstrong, an altitude corresponding to 12,000 ft. in a low pressure chamber, where there is no sense of fear or excitement, for several hours daily for several weeks causes subjects to become nervous and irritable. While aviators are well aware of the fact that an altitude of 18,000 ft. and especially 20,000 ft. causes rapid development of fatigue, for this fatigue becomes obvious even after a single comparatively short flight, they are, unfortunately less well aware of the ill effects which develop more slowly and more insidiously at 12,000 and 15,000 ft. However, that is why pilots are permitted to fly only a certain small number of hours each month—many fewer hours than workers in other fields of equal responsibility are accustomed to perform with safety to all concerned. These short hours were established before facilities for administering oxygen efficiently were available, in an attempt to avoid the mental fatigue and exhaustion produced by lack of adequate oxygen pressure in the lungs and therefore in the brain and muscles that have caused some accidents commonly attributed to "pilot error." The failure to use oxygen when flying above 10,000 ft. may well shorten the active flying life of an aviator and may ground him many years earlier than would be necessary provided that (1) he always had an adequate supply of oxygen avaliable, and (2) he always properly used such equipment.

Pilots and crews should not ascend to heights in excess of 15,000 ft. (or in excess of 10,000 ft. for more than short periods) without adequate oxygen equipment to maintain a normal pressure of oxygen in the lungs. It is now possible to ascend to 33,000 ft. with proper equipment and training and to have an absolutely normal oxygen pressure in the lungs, brain and muscles. By the use of appropriate oxygen inhalation apparatus, the rates of oxygen flow required are reasonable from the point of view of aviation economy. However, 30,000 ft. is about the upper practical limit physiologically speaking for commercial aviation because of the danger of rapidly developing unconsciousness if the aviator should remove the oxygen mask. An elevation of 40,000 ft. is the upper practicable limit that can be attempted in military aviation even with the aid of the inhalation of absolutely pure oxygen, perfect equipment, and advanced training, because at altitudes above 33,000 ft. the sum of the partial pressures of oxygen, carbon dioxide, and water vapor becomes the total pressure in the lungs and progressively and rapidly decreases below normal even if no air with its high (80 per cent) nitrogen content is permitted to leak in.

There are three different principles on which methods of compensating for the decrease in partial pressure of oxygen at high altitudes may be based: (1) the supercharged cabin using air under pressure (2) the closed circuit oxygen system, and (3) the open circuit oxygen system.

(1) Supercharged cabins in which the air pressure inside is increased to 1 or more pounds per square inch above the external atmospheric pressure are, of course, ideal from all points of view for long distance land and transoceanic commercial flying. Such planes have been developed and proved commercially practical.

(2) The most economical principle for the administration of oxygen is, of course, the closed circuit system. By such a system is meant a closed, circuitous pipe line approximately 1 inch inside diameter, with an expansible chamber or bag of a capacity of not less than 5 liters for a single individual although this ratio would not have to be maintained for multiple units; a container for soda lime or similar substance for absorbing carbon dioxide; a circulating pump if the system is multiple, or a properly placed inspiratory-expiratory valve when the system is constructed for use by only one individual; and an absolutely airtight face mask. Large reducing valves and automatic controls must be furnished to regulate the supply of oxygen.

The practical objection to the closed circuit system is that air can easily leak into the system around the mask or many other places causing a dangerous accumulation of nitrogen. For this reason the method is not used in commercial aviation and also has proved too dangerous for extensive military use.

(3) The other type of apparatus is known in the physiologic laboratories as an "open circuit apparatus": that is, the air is inspired with the addition of an appropriate amount of oxygen and then expired directly into the surrounding air with only a very small, incidental amount of rebreathing. In the open circuit type of apparatus no attempt is made to remove the carbon dioxide so that no more than a very small amount of the expired air with its enriched oxygen content can be used again.

Until recently, anoxia (lack of oxygen), the prevention of which has just been discussed, was the most serious physiologic condition that aeronautical engineering had to meet. To-day, however, while anoxia is paramount, there are two other conditions that must be met.

Cold—The prevention of exposure to cold is a factor which is within the sphere of the engineers to control and to remedy. If an aviator is not protected from cold then he must try to protect himself by shivering or exercising; muscular movement, of course, requires extra oxygen and therefore the aviator will be obliged to use the large amount indicated on the flowmeters for greater activity.

Flights at 30,000 or 40,000 ft. require protection against cold of tremendous severity (–40 deg. to –55 deg. C. or –40 deg. to –67 deg. F.). In the Finnish campaign, flying was apparently carried out with ground temperatures of –40 deg. C. Clothing alone, as pointed out by Matthews, will not protect the body at very low temperatures at high altitudes without adequate oxygen because the loss of heat from the lungs alone, by conduction and vaporization, will be in excess of what, under the circumstances, the body can furnish.

Aeroembolism—The other great danger to an aviator is that of aeroembolism. This is not a new disease, but a new name, introduced by Armstrong, to indicate conveniently the well-recognized and frequently fatal condition which afflicts divers and caisson workers. By them it is called caisson disease or bends.

If a glass of water is taken into a low pressure chamber, gas bubbles, like those in ginger ale, will start to form at elevations simulating those of about 18,000 ft. and become, in rapid ascent, very numerous at 25,000 ft. Bubble formation will occur within the body, in the tissue fluids and in the blood stream if the ascent is rapid without proper preliminary decompression (or denitrogenation) by the inhalation of pure oxygen while at the same time actively exercising. Danger of aeroembolism begins at approximately ½ atmosphere (18,000 ft.) although symptoms of sufficient intensity to be serious are infrequent below 30,000 ft. at least if too long a stay is not made at the high altitude.

Another important fact which is of great benefit to the aviator is that descent is the best possible treatment and is automatic and spontaneous in his case. If a diver develops symptoms in coming up to the surface, he will have to be recompressed in a chamber and subsequently will have to be very slowly decompressed. A pilot might be paralysed and made unconscious, following rapid ascent, by air bubbles at 35,000 ft. and yet it is barely conceivable that by the time he had fallen to 10,000 ft. he would have regained consciousness and be capable of pulling his plane out of the dive. The chances are, however, that he would crash.

Prevention of aeroembolism—Because of the serious dangers resulting from aeroembolism an attempt has been made to develop a practicable method for its prevention by means of decompression (or denitrogenation) with oxygen just before ascent. Up to the present in the low pressure chamber, a total of 102 simulated ascents to an altitude of 30,000 ft. or more using the B.L.B. apparatus have been made. Of these, eighty ascents were to 35,000 ft. or more, thirty of them being to 40,000 ft. Although the simulated high altitudes as a rule were maintained for only a short time (ten to thirty minutes), in one instance two subjects remained at 35,000 ft. for two hours and fifteen minutes without development of any untoward symptoms.

Parachute descent—There are three types of parachute jumps: (1) jumping very close to the ground such as has been developed for landing troops, (2) intermediate jumps, to save life, from elevations up to 20,000 or even 25,000 ft. and (3) jumps also to save life, from heights as great as 35,000 or 40,000 ft.

The third kind of parachute jump only will be discussed here. Jumps from these heights are made whenever abandonment of the ship is necessary to save life. After the necessity arises for bailing out with probable injury to the oxygen supply, a minute probably would elapse before the preparations to jump can be completed. At an elevation much above 25,000 ft. cerebral anoxia would be present at the end of a minute without oxygen and unconsciousness would begin to develop. Even if the aviator descended as a free falling body until he reached 20,000 ft., he would in the second minute become unconscious, and therefore, be unable to pull his rip cord, although he might come to and be able to do so during the last few thousand feet. On the other hand, if he pulled his rip cord within a few seconds after he left the plane, he would soon become unconscious and it would take five to ten minutes to descend to an altitude at which he would have sufficient oxygen to regain consciousness. He still might not be able to do so because of too long an exposure. Therefore, a parachutist should be provided with special oxygen inhalation equipment for a parachute descent from high altitudes.

Such an apparatus has been devised consisting of a small emergency cylinder of oxygen, special connections and mouthpiece.

As the mask probably would be blown away during the act of jumping out of the plane, it is necessary to supply a mouthpiece with an automatic sponge rubber expirator-inspiratory valve which the aviator places in his mouth before jumping. The mouthpiece can be incorporated as a permanent fixture in the oxygen supply line, about 8 to 12 in. from the place it enters the reservoir bag of the B.L.B. inhalation apparatus. The aviator, after disconnecting his main supply line, pulls off his mask, disconnects it from the mouthpiece, grasps the mouthpiece firmly with his teeth and opens the emergency cylinder valve and jumps. The procedure can be accomplished in a few seconds. Tests have been made with perfect ease insofar as the actual time element is concerned from a simulated altitude of 35,000 ft., in a low pressure chamber, with descent at the calculated rate of a parachutist. As yet tests have not been made in an actual jump from a plane at a high altitude.

THE BATTLE OF CIVILIZATION

From *Aero Digest* (New York), July, 1940

The Battle of France has ended. The Battle of Britain has begun with heavy bombing raids on the coastal areas of England. It is the battle, not only of Britain, but of civilization as we know it. It is the battle of politically-free men against men reduced to political and economic servitude, bound to a civlization of sorts, but not our sort.

We have a vital interest in the outcome of the Battle of Britain. If the British are defeated, totalitarianism will envelop all Europe; the French and British Empires will collapse and disintegrate, with dictator nations grabbing for the spoils—some of which are in this hemisphere.

Our Industrial Part

We already have taken an industrial part in the war. Our airplanes have been used by the French and the English to kill Germans. We are supplying thousands more of them, together with so-called "surplus" equipment from our army and our navy—including torpedo boats—as though there could be a surplus of war materials in a country that suddenly is urged by the Chief of Naval Operations that the navy must be nearly doubled.

We are not yet in the war—although it is a war that will save or destroy the world system under which we live, replacing it with one utterly foreign to our way of life. We are not out of the war, for we are arming those of our political stripe who wage it. Neither in nor out, neither neutral nor belligerent, we stand on the brink, unwilling to take the plunge but tossing our shirt to the one already in. It is a position that only the United States, the Joe Penner among nations, could have jockeyed itself into.

To say that America is at the crossroads is a misstatement. A sane man at a cross-road pauses, then decides which road to take. We, with an indecision bordering upon insanity, decide nothing. We are moving in a traffic circle, dodging frantically this way and that, at the behest of a chorus of shrieks from 130,000,000 nervous back-seat drivers. Before we can sensibly decide which way to travel, we must look at the signboards consider where we want to go, and then get going. Tearing around in circles as we have been doing merely makes us dizzier than we were to begin with.

If the Allies, with one down and the other groggy, face defeat, it is foolish for us to sell them any more war materials that we probably will need desperately ourselves if they are defeated. If they still have a chance to win, if we can help them to hold on until Germany and Italy collapse through hunger—which may be merely wishful thinking—then we are equally foolish to sit here helping them only a little, when we might, by exerting our full strength, turn the tide of battle before it washes on our own shores. Does it take more sanity than a democracy possesses to decide this matter one way or the other?

THE DRIVE FOR EXPORTS
ELECTRICAL MOTORS AND ACCESSORIES

Extract from *Trade and Engineering* (London, Eng.), August, 1940

Continuing the story of British electrical machinery for the export market, electric motors and control gear, those indispensable servants of industry are available in every type for every conceivable application. Here, the British manufacturer has an advantage in the high degree of industrialization at home and the consequently extensive experience available for carrying out oversea contracts.

Perhaps the best examples of large machines are provided by rolling mills for which motors of 20,000 hp. or thereabouts have been supplied to drive a reversing blooming mill and a three-high rail mill in Australia and two blooming and finishing mills in Bengal. A number of smaller motors have also been exported for rolling mill work; among these may be mentioned a tube mill in Spain, where 1700 hp. and 750 hp. motors are to be used on the piercer and the pilger mills respectively, while new reversing drives for push benches are at work in Australia and South Africa. Another typically "heavy" application concerns winding engines for collieries and metallurgical mines. On the South African Rand and in India, Australia, and West Africa British plant has long been giving conspicuous service, and many further equipments are on order. China and Portugal are other countries for which large winder motors are being or have recently been constructed.

Motors from the general industrial range are being exported in large numbers. A copper mine in Turkey required no less than 5,000 hp. of motors in all, while 4,000 hp. of motors were supplied for a paper mill and 7,200 hp. for wood grinders in Australia. Other comprehensive installations concern gold mining and dredging in West Africa, a textile mill (formerly steam-driven), and a bamboo paper mill in India, a colliery in China, a worsted mill (built in 1938 and now extended) in Eire, and jute and other textile mills in South America, Africa, India, China, and Japan. Mention may be made of a.c. variable speed motors, which have been in demand for lift drives in Australia, New Zealand, and South Africa.

FREQUENCY MODULATION

Extracted from *Journal of The Carnegie Technical*, Pittsburgh, Pa., March, 1940

There are three possible ways by which ideas, and, in particular, sound, can be conveyed by means of a radio wave, depending upon whether one varies the amplitude, the frequency, or the phase of the carrier wave. Commercial broadcasting has been based exclusively upon the first of these methods ever since its inauguration nearly twenty years ago. In the last few years another method of great promise has been developed, which, although called frequency modulation (f-m), actually involves the modulation of phase as well as frequency.

Curiously enough, the fundamental principal of f-m was recognized and experimented with early in radio's history. It appears that the early investigators made the mistake of trying to use too small a variation in the frequency, so that not until 1935, when Major E. H. Armstrong used frequency swings of the order of -60 kilocycles, did its advantages become generally known. Its outstanding advantage is the fidelity of its transmission, which reproduces accurately up to 15,000 cycles, as compared with a limit of about 7,000 cycles for amplitude modulation (a-m). It is practically unaffected by static either natural or man-made, for the sound produced in an f-m receiver by nearby electrical disturbances are generally of such high pitch as to be inaudible. Because of the improved "signal-to-noise" ratio less power is required for covering a given area. The transmitting and receiving equipment is no more complicated than for a-m.

Another advantage is the remarkable freedom from interference between stations on the same or neighbouring frequencies. Experiments indicate that whenever the field strength of one signal is twice that of another of the same wave-legnth, the first prevails and the second is not heard; in the case of amplitude modulation a ratio of at least thirty to one is necessary. When two different f-m signals of nearly equal strengths and equal frequencies are received, an interesting phenomenon is observed. Reflection by local obstacles gives rise to a standing wave pattern, with the result that even then only one programme is generally heard at a time. Which signal prevails is determined by the position of the receiver; moving it a few inches may change the programme.

The chief theoretical disadvantage of the f-m system is the comparatively wide channel or frequency band required by each station, which tends to limit the system to the wide open spaces of the ultra-high frequency region. In any case, the use of the lower frequencies for conventional broadcasting has made it necessary to carry out all f-m experiments in the neighbourhood of 40 megacycles. The practical difficulties standing in the way of universal adoption of the f-m system are naturally very great. The broadcasting industry will be reluctant to scrap the several billion dollars worth of equipment now in use. Furthermore, time and advertising will be necessary to start the ball rolling. Advertisers will not sponsor expensive programmes on f-m stations until they have a large audience; sets cannot be manufactured cheaply unless there are many buyers; and listeners will not buy sets in large numbers until the price becomes reasonable, and a good selection of programmes is available. Yet another deterrent is the fact that most existing recordings and telephone connections, designed for the present a-m transmission, are not themselves sufficiently perfect to take advantage of f-m's high fidelity. Nevertheless frequency modulation has passed out of the experimental stage. More than a dozen stations have been set up or are under construction, and receivers have been put on the market.

PLASTICS

By Dr. V. E. Yarsley, F.I.C.

Extract from *Trade and Engineering* (London, Eng.) September, 1940

Although the heavy demand for all types of plastics continues to maintain production at the peak, there is no relaxation in research both to develop new products and to improve those already in use. The latest development is the commercial production of melamine and melamine-formaldehyde resins. Although it is by no means a new compound, having actually been discovered more than 100 years ago, melamine was until recently a chemical curiosity and only rarely seen even in chemical research laboratories. A process is now in operation in this country for the production of melamine in ordinary plant without the use of pressure, and this promises to be the most economical so far evolved. Numerous processes have also been described in the patent literature during the past few years for the production of melamine-formaldehyde resins, and as in the case of urea-formaldehyde the condensation is greatly accelerated by the presence of acids.

Melamine moulding powders are made in a similar manner to urea moulding powders using bleached sulphite pulp as the filler. They have the advantages that they can be moulded in mild steel moulds and are less sensitive to variations in mould temperatures than are urea powders. Finished mouldings are obtainable in light-fast pale colours and are both odourless and tasteless. This and the fact that they are much more resistant than urea mouldings to boiling water and hot beverages makes them excellent for the production of table ware. They also have excellent non-tracking properties and are resistant to dry heat, so that they find particular application in electrical insulation. Melamine mouldings are also unaffected by fruit juices, acetic and citric acids, mustard, fats, oils, etc., so that they may be used for the storage of foodstuffs. In this connection it has already been noted that the more conventional amino-plastics are now being increasingly used in the production of moulded containers.

BRITISH AIRCRAFT INDUSTRY

Extract from *Trade and Engineering* (London, Eng.)
September, 1940

Mr. Churchill gave the best news for a year when, during his recent review in Parliament of the progress of the war, he announced that our production of aircraft and aero-engines now greatly exceeds that of the enemy. This was thanks to the astounding increase in output and repair achieved by Lord Beaverbrook, which has given overflowing reserves of every type and an ever-mounting stream of production, and to American production.

It is believed in the British aircraft industry that our production of airframes, has been higher than Germany's for a number of weeks past and that each week increases the margin of differences. If this can be achieved now, after so short a time, it promises well for the future, for American production is only just getting into its stride, while it is generally recognized that this country has by no means reached the peak of production. On the other hand, many of the experts believe that the German industry will soon have reached its maximum output, in spite of the vast new resources added by the capitulation of France.

He could not have put more plainly the importance of the aircraft industry in the winning of the war. Our Spitfires and Hurricanes in the home field, and our Whitleys, Hampdens, Wellingtons, and Blenheims in the field of offence, have shown very clearly that success or failure is not merely a question of numbers. They have demonstrated how closely success follows superiority in design and production. So far so good, but it is obvious that British superiority is not going to be maintained merely by pressing on indefinitely with existing models, however good they may be judged by present-day standards. While the newest machines are fighting out the battles in the air, a deadly battle of another sort is going on behind the scenes—a battle of future designs.

Fortunately we realize well that we cannot afford to count our present superiority as permanent, and much preparation for the future is going on. All our aircraft of the future are naturally on the secret list and little can be said about them. It is, however, believed that we have at least one splendid new fighter "on the stocks." This aircraft, which has already had extended trials, is expected to be faster than the Spitfire or the Hurricane. Great things are also expected from a heavy bomber, which is said to have a range far in excess of our present longest-range bombers and to be capable of carrying an exceedingly heavy load at an improved speed. With Italy to be reckoned with, and with the long dark nights coming, the very long-range bomber will be a great asset to the R.A.F.

The Germans are not thought, in official quarters, to have any aircraft of a particularly revolutionary design or performance "up their sleeves," but it is known that their designers are busy, not only on improving existing designs, but on evolving new types to replace the Dorniers and Heinkels and the much battered Messerschmitts. Faster fighters and more formidable dive-bombers are believed to be nearing the service stage. The Ju 88 dive-bomber is also in large-scale production. The new Heinkel 113 fighter has not been such a great success as the Germans obviously expected—it has proved no match for either the Spitfires or Hurricanes—but the enemy is reported to be busy with a new "pusher" type of Focke-Wulf single-seat fighter with a reputed top speed of about that of the Spitfire. The Heinkel concern is also reputed to be busily engaged on a two-seater twin-engined fighter with a specially long range.

There are rumours of several other types, but although they may be improvements on existing models they do not, without seeing them in action, promise (or rather threaten) to be a great menace to the R.A.F. One of the new bombers said to be in production is the Do 250, which is meant to replace the unsuccessful Dornier Do 17 (the "Flying Pencil"). It has a rotating gun-turret and will be used for long range bombing.

HEATING BY REVERSED REFRIGERATION

A. J. Lawless, *Heating, Piping and Air Conditioning,* Vol. 12, No. 8

Extract from *Journal of The Franklin Institute,* October, 1940

In order that the all-electric heating and air conditioning installation in the new building of the United Illuminating Co., serving New Haven, Conn., Bridgeport and surrounding communities might be comparable in operating cost with either coal or oil for fuel, the reversed refrigeration cycle for extracting heat from 55 deg. F. well water is employed. In the reversed cycle, the cooled medium is discarded from the system and the heat removed from the medium becomes the useful work of the system. In the simple air conditioning refrigeration cycle, for every 200 B.t.u. removed from the cooled medium, approximately 47 B.t.u. of equivalent electrical energy is consumed; allowing for outside losses, approximately 240 B.t.u. must be removed from the condensers. This indicated that for every B.t.u. of electrical energy used, 5.1 B.t.u. is given up by the condensers. In reversed cycle heating systems this ratio of performance is decreased somewhat because of the increase in compression ratio in order to obtain condensing temperatures sufficiently high for heating purposes. The overall ratio of the system is also further decreased slightly, depending upon the additional electrical energy for the pumps and other equipment performing at a 1 to 1 ratio. Factors influencing the practicality of the reversed refrigeration cycle for building heating include the availability of a source of outside heat, cost of electrical energy, and whether or not summer air conditioning is desired. In some industries where refrigeration is required for processing in winter, it would be possible to use the heat given up by the condensers for heating purposes. There are two natural sources from which heat may be extracted in winter; outside air and water. In cold climates, water becomes the only practical source and in the case under consideration private wells are used. In the winter the well water is cooled by the refrigeration evaporators and discarded; the heat removed is given up by the condensers to a closed system of hot water heating. In summer the well water is pumped through the evaporators, delivered to the various cooling units in the building, and then returned to the condensers and discarded.

LOCOMOTIVES FOR ARGENTINE

From Robert Williamson, London, Eng.

The gauge of twelve locomotives recently delivered by a Lancashire foundry to the Buenos Aires Great Southern Railway was fixed almost by accident during the Crimean War.

The first locomotive to appear in the Argentine was originally built in Leeds for use in India in 1854, but it was sent to the Crimea on military work and sold after the war there to the contractors in the Argentine for the pioneer railing of that country by the Buenos Aires Western.

This locomotive fixed the gauge for the Argentine Railways at 5 ft. 6 in. and it hauled the first train on the opening day, August 29, 1857. It was named "La Portena" and figures on medals struck in honour of the occasion.

Subsequently the Buenos Aires Great Southern Railway placed the biggest single order, for forty locomotives, ever given to any British locomotive manufacturer. It went to the Lancashire foundry which has now delivered the twelve new engines to the same railway. Fitted for oil-burning, these great locomotives weigh 88½ tons apiece.

The foundry, opened by the great Robert Stephenson, father of railway engineering, has made locomotives for almost every railway system in the world, including nearly 400 shipped to India since 1926.

DEVELOPMENTS IN CLYDE INDUSTRIES

Extract from *Trade and Engineering* (London, Eng.)
September, 1940

While outputs from shipyards and engineering works in Scotland are being maintained at very high levels, there are two directions in which developments have been made recently with a view to speeding up production still further. One of these is a reorganization of the supply of skilled labour, and the other an acceleration in the flow of raw materials to the shipyards and the engineering and munition works. Both developments are proceeding simultaneously. So far as the supply of raw materials is concerned the position has undergone a distinct improvement within the past month. The large quantities of steel produced locally have already been augmented by substantial imports from the United States, and further shipments are due to arrive from that quarter shortly.

The principal feature in connection with the reorganization of labour has been the registration ordered by the Ministry of Labour and National Service of engineers and shipyard and other workers in order that such skilled labour may be drafted into industries engaged on work of national importance. Though exemption from registration was made in the case of men wholly engaged on Government work and on marine engineering, shipbuilding, ship-repairing, steel-making, and certain other trades, yet the labour exchanges in Glasgow were crowded with men registering on the five days during which that work was carried on in the latter part of August. This is not surprising to those closely in touch with the heavy industries in the Clyde area, in view of the large numbers of men who were thrown out of employment in these industries during the great depression of 10 years ago. At that time thousands of skilled artisans were obliged to find work in spheres for which they were not originally trained. Following on the registration the men are now awaiting instructions from the Ministry of Labour regarding their employment in Government controlled factories.

The past 12 months of war-time activity in shipbuilding and marine engineering have been marked by several interesting features. One of the most important is the accelerated rate at which new tonnage has been built. Many vessels, large and small, have been completed well ahead of scheduled time, the rapidity of construction being apparent as regards both warship and merchant ship tonnage. This has been made possible not only by effective organization but also by the principle of allocating to individual shipyards contracts for those types of ships which they are best suited to build. The Clyde has thus done much since war broke out to make good the losses of merchant ship tonnage caused by enemy action.

HONORARY MEMBERSHIPS

From the *Journal of The Institute of Civil Engineers,*
June, 1940

The Councils of the Institutions of Civil and Mechanical Engineers entertained the Hon. Joseph P. Kennedy, United States Ambassador in London, to luncheon on Thursday, 23 April, 1940, at which Mr. Kennedy formally presented certificates of honorary membership of the American Society of Civil Engineers to Mr. W. J. E. Binnie, M.A., Past-President Inst. C.E., and of the American Society of Mechanical Engineers to Mr. E. Bruce Ball, Past-President I.Mech.E.

Sir Clement D. M. Hindley, K.C.I.E., M.A., President Inst. C.E., who presided, welcomed Mr. Kennedy, and observed that the occasion was unique and memorable in that it sealed the friendship which had long existed not only between the two Institutions, but also between them and the American Societies which shared their work, the American Society of Civil Engineers and the American Society of Mechanical Engineers. Although the British Institutions were senior in point of time to the American Societies, they were all founded on the same ideals, built up on similar traditions, and worked towards the same end; namely, the advancement of mechanical science. Sir Clement then recapitulated the history of the joint British-American meeting, and said how deeply disappointed they all were that the meeting had had to be cancelled, so that the kind preparations made by their American friends had had to be abandoned. War interrupted, but did not terminate, free intercourse between technical men of different nations, because the bond of common pursuits and ideals, together with the service of a common science, had no relation to national boundaries or forms of government. The brotherhood of engineers would continue despite wars and international complications. In closing, Sir Clement recalled previous visits to the United States of America, and said that they were very gratified that the American Societies had seen fit to mark the occasion of the visit last year by extending to the then presidents of the respective Institutions, Mr. Binnie and Mr. Bruce Ball, the greatest honour in their power, namely election as Honorary Members of those societies. They were most grateful to Mr. Kennedy for having spared the time to be present, and he hoped that the Ambassador would not only convey to the American Societies their deep thanks for the honour they had paid to them, but would also convey the belief that the brotherhood of engineers was a greater power for good and of more lasting value than any of the political faiths which were leading mankind to destruction.

TINS AND CANS

Extract from *Trade and Engineering* (London, Eng.),
August, 1940

The Control of Tins and Cans (No. 1) Order prohibits from July 23, the use of tinplate and sheet in the manufacture of containers for:—

> Bird food, blancmange, butter, cake or cakes, cat food, chicken, chocolate (eating), chocolates, cornflour, crab, custard powder, dog food, dripping, extract of malt, fat or fats other than lard, fruit puddings, honey, lard, liquorice powder and pellets, malt extract and cod-liver oil, margarine, medicinal pills and tablets, prawns, sausages, seidlitz powders, shrimps, strychnine, sugar of milk, bath crystals and bath salts not being medicinal, borax powders, brilliantine, cigarettes, coconut oil, cosmetics and toilet creams, face powder, liquid soap, manicure powder, nail polish, petrol, shampoo powders, shaving sticks, suppositories, toilet soap tablets.

The Order bans the use of tinplate or sheet in the manufacture of advertising novelties and show cards, counter displays, dummies, godets for powder compacts, metal tablets, oil cabinets, shelf strips, waiter trays, and window displays. It specifies approved sizes for tins—some of which will be supplied only to retailers—for pipe tobacco, oils, paints, general chemicals, and many foodstuffs. In future the public will be unable to buy biscuits, toffees, boiled sweets, coffee, cocoa, and drinking chocolate in tins.

Lubricating oil will not be available to motorists in tins holding less than 10 gallons. Luxury packs and small, uneconomic sizes are eliminated, but "regard has been paid to the needs of working-class households, where price is a primary consideration."

Chocolates formerly sold in tins will go into a modified paper wrapping, or in containers made from salvaged paper. Chip board from waste paper will be used for other containers. Some commodities will be available only in cheap paper bags.

The new restrictions and prohibitions will save between 40,000 and 50,000 tons of tinplate and sheet steel annually for the making of shells. Manufacture for export and for special Government purposes will not be affected.

From Month to Month

News of the Institute and other Societies, Comments and Correspondence, Elections and Transfers

ANNUAL MEETING

The 1941 Annual General and Professional Meeting of the Institute will be held in Hamilton on Thursday and Friday, February sixth and seventh. These dates were recommended by the Hamilton committee and were approved at the October meeting of Council.

INTERNATIONAL AFFILIATION

The Engineers' Council for Professional Development has been described as "the first wholly successful co-ordinated co-operative institution in the engineering profession in America." For eight years it has carried on a great work with a single purpose in mind—to enhance the professional status of the engineer.

On October 24th, at Pittsburgh, The Engineering Institute of Canada was admitted to membership in this important body. The chairman, Dr. R. E. Doherty, president of Carnegie Institute of Technology, on this occasion of the annual meeting, announced that as the seven constituent members had unanimously approved the Institute's application for membership, the charter had been altered accordingly, and the Canadian body would henceforth work along with the other societies for the advancement of the profession in America.

This affiliation is one of the most significant developments that has taken place in the Institute. It marks a widening of interests and activities, and an assumption of new responsibilities and obligations to the profession. It affords new opportunities for service.

Perhaps the acceptance of the application is one of the finest compliments that has been paid the Institute. E.C. P.D. membership has been very narrowly limited. This restriction is indicated in the charter which mentions specifically the constituent membership. It is indeed a vote of confidence that the Institute should be admitted to this small group, made up of such important, influential and far-reaching engineering societies.

Almost from its inception, many officers and members of the Institute have watched the work and progress of E.C.P.D. with growing admiration for the boldness of its plans, and the courage of its leaders. That success should be attained is to be expected when such high ambition is served by self-sacrifice and intelligence. It is an inspiration to be associated with such persons and plans. It is expected that the Institute will not only bring to its members the fruits of these deliberations, but will make contributions to the common good through the common medium.

The interests of certain Institute committees over the last several years, and of the present Committee on the Training and Welfare of the Young Engineer, have paralleled many of those of E.C.P.D. Consequently this new affiliation marks an expansion of ideas and activity, rather than an assumption of altogether new interests. It should provide additional inspiration, support and impetus to those Canadian engineers who have been concerned about these matters in the past.

The Institute is fortunate in having such competent men represent it on the committees. To them belongs the privilege of association with great minds thinking along the same lines, and to the membership belongs the privilege of having made available to it the products of these deliberations.

To some engineers this will be the first knowledge of the existence of the Engineers' Council for Professional Development, and to others it will be but an amplification of some previous awareness, but to all members of the Institute it will be the beginning of a great interest of which they will be kept informed by various means, and to which they may make contributions from time to time.

An article on E.C.P.D. will be found on page 482.

ALBERTA BALLOT

The results of the ballot on the proposed co-operative agreement between the Institute and the Association of Professional Engineers of Alberta arrived in Montreal just in time to be announced in the October journal, and by now every member of both organizations should know of the successful outcome.

It has been a matter of great satisfaction to Council and to the Committee on Professional Interests that such a substantial favourable majority should be recorded. The Joint Committee in Alberta worked at great length in this endeavour and to them belongs the credit for the successful outcome. They examined the situation thoroughly, approached the problem intelligently, applied themselves industriously and submitted their proposals openly. Their reward is the almost unanimous support of their recommendations.

It is hoped that the president will be able to attend the signing ceremony in December, and that the agreement will be effective from the first of the year.

PAST-PRESIDENTS' PRIZE

The topic for the 1941 competition which has been recommended by the prize committee was approved by Council at the October meeting. It is "Organizing the Engineer for War Time Efficiency."

The prize of one hundred dollars in cash is awarded for a worthy paper, not previously published, written and submitted by any member of the Institute. The prize year ends on June thirtieth 1941.

Prize committees from time to time have commented on the fact that competitors have not adhered closely to the chosen subject. The chairman of this year's committee has made similar observations as will be noted in the following communication.

"Some papers submitted in the past for this prize have dealt with subjects only remotely related to the set topic. Of course, this is not to say that these papers have not been excellent in themselves, but merely to intimate that contestants are perhaps a little prone to interpret the subject rather too broadly.

"The topic suggested this year—'Organizing the Engineer for War Time Efficiency"—is a general one, and might be treated in a variety of ways. For example, one writer might make a study of the employment of engineers in peace time and in the present emergency, and from this study draw some conclusions as to the engineer's contribution to Canada's war effort as a group compared to the contributions of the public at large or of other professions.

"Another might review industries entirely new to Canada, which have their origins in wartime conditions, and show to what extent development of this kind is due to engineering effort and efficiency. A third might investigate the specific wartime fields in which engineers might well be active, but for which they may require to be organized. Other examples could be given, but these will indicate generally how a subject can be interpreted in several ways but always kept within the proper limitations.

"There is no thought of dictating any special treatment of the chosen topic to the potential competitor. The committee would merely like to feel, when it reads a paper for this prize, that the paper really deals with an important aspect of the set topic, and, at worst, is not merely drawn from the author's file and submitted under a new title, when it really has little or 'nothing to do with the case'."

"RESPECTFULLY SUBMITTED"

The attention of Council has been called to certain matters involving appointments and promotions in government services at Ottawa. After considerable discussion it was decided that communications should be sent to the Prime Minister and to certain departmental ministers respectfully suggesting that engineers be appointed to positions where a knowledge of engineering is required instead of appointing non-technical men to the senior appointments, which necessarily requires the appointment of engineers to junior positions to make up the deficiency.

Council pleads "that engineers should be put in charge of engineering work," and explains that its "interest in such appointments does not spring from a wish to obtain positions for engineers, but from the desire to see the war prosecuted with the maximum of efficiency."

Representations have been made also with regard to certain regulations in the army which seem to be discriminatory from the engineers point of view, particularly the mechanical engineers, urging that the Canadian army follow the practice established by the Imperial army, in matters of promotion and pay. The Imperials grant the engineers equality of rank with officers of other services and equality of pay with members of the other professions.

Council's interest in these matters is based on two considerations. First, a desire to support the profession, and second, a desire to support the war effort. It feels that the two are interdependent and that a thoughtful consideration of the points raised in these communications will result in a greater efficiency and greater satisfaction to all.

FIRE

Members in the province of Alberta have been wondering what has become of their Journals for the month of September. The plain fact is that they were destroyed by fire in the complete loss of a mail car somewhere west of Winnipeg. A series of complaints led to an investigation with the Post Office, and eventually the above information was disclosed.

Copies have been sent since to chairmen and secretaries of branches, and councillors, but the reserve supply is not sufficient to permit a general distribution.

Such an occurence is very regrettable, but as far as can be discovered no similar loss has been experienced by the Institute in fifty-three years of intensive use of the mails. It really serves to call attention to the excellent service rendered by His Majesty's mails in Canada.

ASSOCIATION OF PROFESSIONAL ENGINEERS OF ONTARIO

The regular quarterly meeting of the Council of the Association of Professional Engineers of the Province of Ontario was held in the office of the Association, 350 Bay Street, Toronto, at 2.30 p.m. on Saturday, October 19th, 1940. The president, J. W. Rawlins, occupied the chair. Other members present included Vice-President S. R. Frost and Councillors W. E. P. Duncan, J. Clark Keith, W. C. Miller, R. M. Coleman, R. A. Elliott, H. A. Cooch, C. P. Edwards, W. S. Ewens, C. C. Cariss, L. T. Rutledge, K. R. Rybka, P. D. P. Hamilton, G. A. Howes, D. G. Sinclair, the registrar and the secretary-treasurer. Mr. C. C. Kirby, honorary president of the Dominion Council of Professional Engineers was also present.

At this meeting, it was decided to hold a general meeting of the Association at the Royal York Hotel, Toronto, on the afternoon of January 18th, 1941, to be followed by a dinner meeting for which it is expected to obtain a prominent speaker. W. E. Bonn was appointed chairman of a committee to make the necessary arrangements.

The following ten members of the Association were appointed the Nominating Committee to make nominations for the 1941 Council in accordance with By-Law 1 (a), namely: A. Ross Robertson, A. U. Sanderson, W. E. Patterson, A. E. MacRae, T. R. C. Flint, O. S. Mitchell, A. D. Le Pan, L. M. Arkley, C. G. Williams and V. H. Emery.

It was resolved that the Association advise the committee of the Royal Society of Canada under the direction of Dr. A. G. Huntsman, that as a body of engineers, the Association is in hearty accord with the Royal Society's proposal to inventory the resources of Canada with a view to drafting a national plan for post-war development, and that the Association will be glad to co-operate in the work.

It was resolved that an invitation be extended to the Dominion Council of Professional Engineers to hold their annual meeting in Toronto either immediately before or immediately after the 1941 general meeting of the Association and that the office facilities of the Association be placed at the disposal of that body.

The reference form of the Association was amended to impress upon the member giving the reference the importance of recommending for membership only such applicants as have mastered not only some limited branch of engineering, but also the broad fundamentals of science, and their application to such engineering problems as may confront the applicant in the course of his work.

Reports presented included reports of the Executive Committee, Publicity Committee, Finance Committee and the Committee on the Code of Ethics and By-Laws.

Twenty-seven applicants were granted registration by Council.

TECHNICAL SUPPLEMENTS

The paper of Owen W. Ellis on "Some Developments in Alloys During the Last Twenty Years" which has been published as a technical supplement to the Journal may be secured by members without remitting any money to Headquarters with the order. Just say how many are required and the amount will be charged to your account and will be billed to you along with your regular fees.

Some members have complained of the inconvenience of remitting fifty cents by mail and this proposal is made in order to overcome that difficulty.

The paper should be in the hands of all persons and institutions interested in metals and metallurgy. A good supply is still on hand. If you are interested please let us have your order now.

WINNERS OF PRIZES

The following letters, in addition to the ones that have already been published in the September Journal, have been received from recipients of the Institute prizes awarded each year to outstanding students in the third year of the engineering courses of eleven Canadian universities.

Qu'Appelle Hall, Sept. 26, 1940.

Dear Sir:

May I express my gratitude to you for having awarded me "The Engineering Institute of Canada Prize" for third year engineering students of this University.

I feel proud to have been able to qualify for an award by such an esteemed organization as The Engineering Institute of Canada. My only hope is that, in future years, I may become a permanent member of the Institute.

Thanking you again for your kind consideration,

I am, sincerely yours,

R. H. HALL, *University of Saskatchewan.*

4524 W. 13th Ave., Vancouver, B.C.,
October 20, 1940.

THE GENERAL SECRETARY,
THE ENGINEERING INSTITUTE OF CANADA.

Dear Sir:

Please accept my sincere thanks for the prize which was awarded to me and for your congratulatory letter. I consider it no small privilege as an engineering student to receive the assistance and encouragement of the Institute in this very practical way.

As a prospective engineer, I have made a point of acquainting myself with the aims and functions of the Institute, and I may say that I have every intention of becoming a member as soon as I may qualify.

Yours sincerely,
CHARLES RYDER, *University of British Columbia.*

Fredericton, N.B., Oct. 1, 1940.

L. AUSTIN WRIGHT, *General Secretary,*
THE ENGINEERING INSTITUTE OF CANADA,
MONTREAL, P.Q.

Dear Mr. Wright:

I wish to extend to the Institute my sincerest thanks for the "Engineering Institute of Canada Prize." It was a great honour to receive such a reward, as well as a great stimulus to me in my work.

This year I hope to become a Student member of your organization and am looking forward to many happy relationships with the Institute in the future.

Let me thank you once again for your interest and encouragement.

Yours very truly,
I. F. RONALDS, *University of New Brunswick.*

10622-76 Ave., Edmonton, Alberta,
September 24, 1940.

THE ENGINEERING INSTITUTE OF CANADA,
2050 MANSFIELD STREET, MONTREAL, QUEBEC.

Dear Sir:

May I extend my very sincere thanks to your society for awarding me the "Engineering Institute of Canada Prize." The money is not only a great financial help but also a great encouragement to me in my studies towards an engineering degree.

We have had, in our student society, many examples shown to us of the fine work being performed by your society. I am looking forward to the time when I too can become a full-fledged member and hope that I shall be able to live up to the fine work being carried on by the Institute.

Yours sincerely,
CHARLES A. STOLLERY, *University of Alberta.*

Indian bridge across Kitseguecla Creek, Hazelton, B.C.

Terrace, B.C., October 17th, 1940.

THE EDITOR, "THE ENGINEERING JOURNAL."

Dear Sir:

I am enclosing a photograph of a bridge built by the Indians across the Kitseguecla Creek at Hazelton, B.C., which I thought might interest readers.

As you will notice, it is built in a kind of a frame held together with hay wire, odd bits of old cable and anything they thought fit, but carries quite a load as you can travel across in an automobile.

Yours sincerely,
(*Signed*) R. H. VAUGHAN, M.E.I.C.,
Resident Engineer, Dept. of Public Works of British Columbia.

Duskins, Northwood, Md., October 1st, 1940.

L. AUSTIN WRIGHT, ESQ., M.E.I.C., *General Secretary,*
THE ENGINEERING INSTITUTE OF CANADA,
2050 MANSFIELD STREET, MONTREAL, CANADA.

Dear Mr. Wright:

It was most kind of you to send me, with your letter of the 10th September, the clipping from the Montreal Star making such an amusing reference to my son's recent experience. He is very proud of the honour of being mentioned in your leading newspaper and thinks that alone makes it worth while being torpedoed. Both he and his sister, Bridget, are imploring us to let them sail again but another ship having recently been torpedoed with the loss of many children's lives, we feel that it is better to wait at all events until the spring. If facilities are then available I hope it may still be possible for them to come to you.

I would like to take this opportunity of thanking your Committee for their great kindness in offering to take our children, and it is very greatly appreciated, and if there is anything my wife or I can do on this side at any time to reciprocate, I hope you will let us know.

I enclose an account by my daughter—Bridget—of the torpedoeing and subsequent rescue, which will perhaps interest you.

Yours sincerely,
(*Signed*) C. E. MAGUIRE.

TORPEDOED AT SEA

Three hundred and more of us children had set out happily for Canada and were well out to sea when it happened.

It was dead of night and I had been asleep for some time when I was suddenly awakened by the impact of a torpedo. A few seconds later a warning was sounded on an electric bell so I climbed out of my bunk, slipped on a mackintosh and life jacket and tried to hurry the other child who was sleeping in my cabin. Outside there was a strong smell of burning and the air was full of dust as we hurried to our allotted places at the assembly station. We were then counted and sent to our lifeboat stations, and ordered to get into the boats ready to be lowered into the sea. After about ten minutes it was found that the ship was not in imminent danger of sinking so we were recalled to the emergency station and lay down and tried, with some difficulty, to sleep, only to be ordered half an hour later to take to the boats again.

Our lifeboat was lowered without a hitch and did not even hit the water with much of a smack. It was a motor lifeboat and the engine was used to carry it clear of the ship but soon the engine gave out and the boat's crew had to take to the oars. The sea was dreadfully rough and it was pitch dark.

Some of the children were sick but none cried or screamed and we were fascinated by the lifeboats and ships keeping in touch by messages flashed with electric torches. The waves were so high that often we could not see the other boats at all and every little while waves broke over our boat and drenched us.

We had been in the lifeboat close on an hour when we were brought alongside the ship which rescued us but this was not so easy to achieve as it is to tell of it. The sea was far too rough to tie our boat up and our crew had a terrible time holding on to ropes and to the ship's side trying to prevent our boat from being smashed against the ship and I noticed afterwards that their hands were bleeding from the ordeal they had been through. We were hauled aboard the rescue ship in huge banana baskets lowered over the ship's side into which the children were bundled, two at a time, and hauled up on deck.

It was then about one o'clock in the morning and it was not until about half-past one the following morning that we were landed safely at a Scottish port. Here we were given the warmest of welcomes, treated with every kindness and fitted out with clothing for the train journey back to our homes.

It was not a very frightening experience and I shall always look upon it as a great adventure. As for going to Canada, I am just as eager as ever to go and I do hope it will be possible.

I would like to pay a special tribute to the crews of both ships whose fine behaviour and cool courage must have contributed so greatly to our safe rescue.

Sept. 6, 1940. BRIDGET MAGUIRE.

ELECTIONS AND TRANSFERS

At the meeting of Council held on October 19th, 1940, the following elections and transfers were effected:

Members

Butterfield, Harry Vernon, (Leeds Univ.), 94 Brule Gardens, Toronto, Ont.

Carter, Tullis Ninion, Engr. of Mines (Univ. of Minn.), asst. mgr. and office engr., Carter-Halls-Aldinger Co Ltd., Toronto, Ont.

Dorsey, John Worthington, E.E. (Lehigh Univ.), associate professor of electrical engrg., University of Manitoba, Winnipeg, Man.

Fairhurst, Thurstan William, (Coll. of Technology, Manchester), director, Ruston & Hornsby Ltd., Lincoln, England.

Fulton, Edward Arthur, B.Sc. (C.E.), (Univ. of Man.), M.Sc., (Mass. Inst. Tech.), consltg. engr., 3 South Meramec Ave., St. Louis, Mo., U.S.A.

Gaboury, John Louis Frederic, B.A.Sc., (Univ. of Toronto), consltg. engr., 3712 Park Ave., Montreal, Que.

Kemp, Oliver, B.Sc. (Univ. of New Zealand), designer, Dominion Reinforcing Steel Co. Ltd., Montreal, Que.

Trott, William Alfred, B.Sc. (E.E.), (Univ. of Man.), illuminating engr. and partner in firm, Lighting Materials Company, Winnipeg, Man.

Ward, Harold John, representative, The Holophane Co. Ltd., Montreal, Que.

Wharton, William Henry (Univ. of Sheffield), chief engr., Allied War Supplies Corporation, Montreal, Que.

Juniors

Antenbring, Stanley Victor, B.Sc. (C.E.), (Univ. of Man.), designing engr., Imperial Oil Limited, Sarnia, Ont.

Chard, Albert Elgin, B.Sc. (Mech.), (Univ. of Sask.), B.A.Sc. (Forestry), (Univ. of B.C.), engr. dftsman., Spruce Falls Power & Paper Co. Ltd., Kapuskasing, Ont.

Lane, Robert Campbell, B.Sc. (Met.), (Mich. Coll. of Mining & Tech.), Recruiting Office (Capt.), Sudbury District, Dept. of National Defence, Sudbury, Ont.

Moores, Robert Vernon, B.Eng. (N.S. Tech. Coll.), engrg. inspr., Dept. of Public Works of N.S., Halifax, N.S.

Reeve, David Douglas, B.A.Sc. (Mech.), (Univ. of B.C.), dftsman., Aluminum Co. of Canada, Arvida, Que.

Stanfield, Gordon Dawson, mech. engrg. staff, Dominion Steel & Coal Corpn., Sydney, N.S.

Treggett, Graham Ross, B.Eng. (McGill Univ.), traffic study dept., Montreal Tramways Company, Montreal, Que.

Affiliates

Couillard, Joseph Ovide, field engr., Bell Telephone Company of Canada, Quebec, Que.

Forster, Duncan Hunter, (Armstrong Coll., Durham Univ.), Lieut., Sault Ste. Marie & Sudbury Regt., Sudbury, Ont.

Franklin, Edward, mech. supt., Donnacona Paper Co. Ltd., Donnacona, Que.

Hallamore, John Barnes, sales engr., Powerlite Devices Ltd., Toronto, Ont.

Murray, William John, senior dftsman., transmission section, elec. engrg. dept., H.E.P.C. of Ontario, Toronto, Ont.

Ste-Marie, Gaston P., examiner and technician, Dept. of Labour, Quebec Prov. Govt., Montreal, Que.

Wadsworth, William James Gordon, (Univ. of Toronto), Ontario land surveyor, city planning and surveying dept., City Hall, Toronto, Ont.

Westbeare, Frederick Henry, Capt.-Adj., 2nd Corps Field Survey Co., R.C.E., Fort York Armouries, Toronto, Ont.

Transferred from the class of Junior to that of Member

Dubesky, William J., B.Sc. (Univ. of Man.), supt., Anglo-Canadian Oils Limited, Brandon, Man.

Pitfield, Barclay Wallace, B.Sc. (Univ. of Alta.), asst. engr., Northwestern Utilities Ltd., Edmonton, Alta.

Transferred from the class of Student to that of Member

Barry, Donald John Oswald, B.Eng. (McGill Univ.), signal dftsman., C.P.R., Toronto, Ont.

Blair, James, (Univ. of Alta.), Lieut., 1st Pioneer Battn., R.C.E., C.A.S.F., Toronto, Ont.

Brosseau, Roland Barry, B.Eng. (McGill Univ.), interim supt., Saguenay Electric Co., Chicoutimi, Que.

Gray, James Lorne, B.E., M.E., (Univ. of Sask.), Flying Officer, R.C.A.F., Vancouver, B.C.

Kimpton, Geoffrey Holiday, B.Eng. (Chem.), (McGill Univ.), plant mgr., Oxygen Company of Canada, Montreal, Que.

Lefebvre, Jean A. A., B.A.Sc., C.E., (Ecole Polytechnique, Montreal), asphalt technician, Tropical Oil Company, Bogota, Colombia, S.A.

Lockwood, Clarence Kingsley, B.Eng. (Chem. and Met.), (McGill Univ.), metallurgical engr., Shawinigan Chemicals Limited, Montreal, Que.

Neufeld, Cornelius, B.Eng., M.Sc., (Univ. of Sask.), struct'l. engr., Sault Structural Steel Co. Ltd., Sault Ste. Marie, Ont.

Transferred from the class of Student to that of Junior

Ahearn, William Jefferson, B.Sc. (E.E.), (Queen's Univ.), Allied War Supplies Corpn., Montreal, Que.

Aman, Thomas Freeman Stewart, B.Sc. (E.E.), (Queen's Univ.), inspr. of electricity and gas., Department of Trade and Commerce, Belleville, Ont.

Bélanger, Maurice, B.A.Sc., (C.E.), (Ecole Polytechnique, Montreal), concrete designer, Baulne & Leonard, Montreal, Que.

Benoit, André Persillier, B.Eng. (Civil), (McGill Univ.), sales engr., Dominion Rubber Co. Ltd., Montreal, Que.

Branchaud, Henri, B.A.Sc., (C.E.), (Ecole Polytechnique, Montreal), engrg. dept., and asst. to gen. mgr., Canadian Liquid Air Co. Ltd., Montreal, Que.

Brews, Robert William, B.Sc. (E.E.), (Univ. of Alta.), partner, R. L. Brews & Co., design and installn. of special signal equipment, Calgary, Alta.

Christie, R. Louis, B.Eng. (Mech.), (McGill Univ.), dftsman., Canadian Kodak Company, Toronto, Ont.

Cole, Alfred Herman Purkis, B.Eng. (Elec.), (McGill Univ.), asst. mtce. engr., D. W. Ogilvie Co. Inc., Montreal, Que.

Daignault, Lawrence George, B.Eng. (McGill Univ.), industrial engr., Dufresne McLagan & Associates, Montreal, Que.

Kerr, Robert Allen, B.Eng. (Elec.), (McGill Univ.), 4765 St. Catherine St. East, Montreal, Que.

Laird, David William, (Univ. of Man.), dftsman., works and bldgs., divn., No. 2 Training Command, R.C.A.F., Winnipeg, Man.

Lapointe, Gérard Maurice Alphonse (Audet), B.A.Sc., (C.E.), (Ecole Polytechnique, Montreal), engr., Sewers Commission of Montreal, Montreal, Que.

Laurence, Jacques, B.A.Sc. (C.E.), (Ecole Polytechnique, Montreal), M.Sc. (Elec.), (Mass. Inst. Tech.), instructor, elec. engrg. laboratory, Ecole Polytechnique, Montreal, Que.

L'Homme, Louis Philippe, B.A.Sc (C.E.), (Ecole Polytechnique, Montreal), meters dept., Southern Canada Power Co., St. Hyacinthe, Que.

McLeod, Arthur Malcolm, B.Sc (Elec.), (Univ. of Alta.), 20 Gloucester Street, Ottawa, Ont.

McMillan, Thomas Stewart, B.Sc. (Civil), (Univ. of N.B.), mtce. engr., plastics divn., Canadian Industries Limited, Brownsburg, Que.

Miller, John Jackson, B.Sc. (Elec.), (Univ. of Man.), inspr., air conditioning equipment, C.N.R., Montreal, Que.

Nason, Edward McKinney, B.Sc. (Civil), (Univ. of N.B.), engrg. clerk, air services branch, Dept. of Transport, Moncton, N.B.

Normandeau, Paul D., B.A.Sc. (C.E.), (Ecole Polytechnique, Montreal), plant engr., The Eagle Pencil Co. Ltd., Drummondville, Que.

Parker, Edmund Norval, B.Eng. (Mech.), (McGill Univ.), designer, mech. dept., Dominion Bridge Co. Ltd., Lachine, Que.

Parsons, Ronald Albert, B.Sc. (Civil), (Univ. of Alta.), instr'man., Shawinigan Engineering Company, Three Rivers, Que.

Platt, Peter Leverich Waddington, B.Eng. (Chem.), asst. research engr., Canadian International Paper Co., Temiskaming, Que.

Rose, Paul-Emile, B.A.Sc. (C.E.), (Ecole Polytechnique, Montreal), industrial divn., Can. Gen. Elec. Co. Ltd., Toronto, Ont.

(*Continued on page 485*)

THE ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

A DESCRIPTION OF ITS ORIGIN, AIMS AND OBJECTIVES AND ITS RELATIONSHIP TO THE INSTITUTE

Note—On Thursday, October 24th at Pittsburgh, the Engineering Institute of Canada was admitted to membership in the Engineers' Council for Professional Development. In order that members may have an appreciation of the work of this important body, the following information is submitted. Additional information and comment will be found on page 478.

History

A Conference on Certification made up of representatives of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Chemical Engineers, the Society for the Promotion of Engineering Education and the National Council of State Boards of Engineering Examiners, on April 14, 1932, approved a "Plan for Joint Action," which proposed the establishment of the Engineers' Council for Professional Development. Six of the seven participating bodies having ratified the "Plan for Joint Action," a temporary organization of the Engineers' Council for Professional Development was formed on October 3, 1932. The seventh body ratified on October 21, 1932. The Charter and Rules of Procedure were completed on March 13, 1933, and were referred to and ratified by the governing bodies of the participating societies.

The Engineers' Council for Professional Development was envisioned as the nucleus of a mass movement of the entire engineering profession toward an improved status attained by improving the quality of engineers themselves. As the nucleus, E.C.P.D. collects and, through its participating bodies, disseminates information about the best way to carry on the movement.

Aims and Objectives

The Council consists of 24 members, three from each of the participating bodies, including the Engineering Institute of Canada, from whom a chairman is elected, and a secretary, who need not be one of the representatives. Its purpose is the enhancement of the professional status of the engineer. To this end, it aims to co-ordinate and promote efforts and aspirations directed toward the higher professional standards of education and practise, greater solidarity of the profession, and greater effectiveness in dealing with technical, social, and economic problems. Its immediate objective is the development of a system whereby the progress of the young engineer toward professional standing can be recognized by the public, by the profession, and by the man himself through the development of technical and other qualifications which will enable him to meet minimum professional standards.

E.C.P.D. functions by studying questions within the range of its objectives, and making recommendations from time to time to the governing boards of the participating societies as to procedures that are considered of value in promoting such objectives. It will administer only such procedures as have been approved by the boards of the participating societies and assigned to it.

The work of the Council is done by and through the following four standing committees.

1. Student Selection and Guidance
2. Engineering Schools
3. Professional Training
4. Professional Recognition.

The Engineering Institute was invited to name a representative for each committee, but due to the less complicated situation which exists in Canada, and to certain geographical responsibilities of the members, decided not to name a representative to the Committee on Engineering Schools. The other appointments have been made. The following paragraphs describe briefly the work of each committee.

Student Selection and Guidance

(*E.I.C. representative*—Harry F. Bennett)

The function of this Committee is to report to E.C.P.D. schemes for the educational and vocational orientation of young men with respect to the characteristics of an engineering education and the responsibilities and opportunities of engineers, in order that only those who have the high qualities, aptitude, and capacity required to obtain intellectual satisfaction therefrom may seek entrance to such courses.

The work of this committee is—

(1) To recommend sources of information for promising or interested high-school or preparatory students, their parents, teachers and counselors, describing the qualities and aptitudes which contribute to the successful pursuit of an engineering education and the derivation of intellectual satisfaction therefrom, the quality and quantity of the major subjects pursued in college, the technical positions normally occupied by engineering graduates, the supervisory and executive positions into which they may progress, the value of a technical education as a preparation for industrial and business pursuits, and the activities and responsibilities of the professional engineer.

(2) If satisfactory occupational literature is not available such material should be prepared by revision or compilation after consultation with the National Occupational Conference and other sources of advice.

Committee on Engineering Schools

(*E.I.C. not participating*)

The duties of this Committee are to report to E.C.P.D. means for bringing about co-operation between the engineering profession and the engineering schools. As a first step in its activity the committee has the duty of reporting to the Council criteria for colleges of engineering which will insure to their graduates a sound educational foundation for the practice of engineering.

The first report of this committee under the chairmanship of Dr. Karl T. Compton, president of Massachusetts Institute of Technology recommended—

(1) That the Engineers' Council for Professional Development undertake a programme of accrediting the curricula of the various schools of engineering which are deserving of approval by the Council as representing sound and adequate instruction in various professional fields of engineering, and

(2) That the basis for accrediting colleges which appears in the report be approved by E.C.P.D. as representing the basic principles which should underlie such a programme of accrediting.

In presenting these recommendations the committee pointed out that some method of accrediting engineering schools is required by force of laws governing the licensing of engineers in a majority of the states. In order that accrediting may be done uniformly, consistent with the high ideals of the engineering profession and in such manner as to be a stimulus to the best development of engineering education rather than a deterrent to future progress through codification of certain present standards, the professional engineering societies should be prepared to administer a plan of accrediting engineering schools. The committee suggested the following principles as the basis for such a plan:

(1) Absolute minimum standards of the educational process are to be avoided as likely to fetter future progress.

(2) Information on important aspects of organization, administration, curricula, and standards of each school is to be assembled, the institution is to be investigated personally by a committee, and final action is to be taken by E.C.P.D. after consideration of all aspects of the situation. Because of the variety of types of engineering training and the specialized character of many schools, accrediting is to be on the basis of six major curricula and not on the basis of the school as a whole. Provision is made, however, for consideration of other curricula than these six. It is hoped that the accredited list to be prepared on this basis may be uniformly adopted, thus relieving societies and states of the necessity of duplicating individual action and relieving schools of the necessity of submitting to numerous examinations and questionnaires.

The Council voted to approve the recommendations of this committee and to recommend to the participating bodies that E.C.P.D. be set up as an accrediting agency for schools of engineering.

Already the committee has accomplished most of its main objective. Some idea of the amount of work involved in this may be gathered from the statement that up to the end of October 1940 one hundred and forty-two degree granting engineering institutions in the United States have been visited and acted upon. This leaves only eleven that have not submitted curricula for examination. In all, seven hundred and ninety-one separate curricula were examined, of which four hundred and fifty-seven were accredited unconditionally, eighty-three for limited periods, and two hundred and fifty-one not accredited.

Committee on Professional Training

(*E.I.C. representative*—Professor C. R. Young)

The duties of this committee are to report to E.C.P.D. plans for the further personal and professional development of young engineering graduates and young men who are entering the profession without formal scholastic training.

The committee has for its objective the preparation of a programme which will combine the early experience of the young graduate engineer with a plan of study for further intellectual development until he is qualified for full professional status. This work bridges the gap between graduation or its equivalent, and professional recognition.

Early in the deliberations of the committee, it seemed apparent that the field which must be covered could advantageously be broken down into a number of specific efforts as follows:

(1) Survey of the junior members or equivalent levels of constituent bodies of the Council. The information desired is numbers, names, location, educational, and occupational background of such members, and some indication of their own plans for personal development.

(2) A personal analysis form to assist in constructing an orderly programme of development.

(3) Survey of educational facilities in areas of concentration of junior membership as determined by survey under item 1 above. Preliminary studies by the committee in this field indicate that there are educational facilities available for junior membership, of a postgraduate nature, in the field of engineering.

The work in this field has to do with the analysis of this material and in resolving it into workable form. The types of facilities available include organized late afternoon and evening courses. There is also a rich field available through university extension and correspondence courses. While the committee does not desire to limit these special undertakings on the part of junior engineers to the purely professional field, it believes that the emphasis in these formal undertakings should be scientific and technological in character.

(4) Study of basic objectives for independent reading of junior members. As a contribution to the general development in breadth and vision for junior engineers, an attempt has been made to prepare a list of books in general fields of knowledge. A number of thoughtful people most of them eminent in the engineering profession, were asked to submit lists of books, and the list now approved is a compilation of the results of these recommendations.

(5) It is believed by the committee that a comprehensive presentation of a programme of education and training which will clearly meet the requirements for professional recognition set up by the Committee on Professional Recognition should eventually be prepared. Manifestly, this portion of the work must await the decision of the aforesaid committee.

(6) The committee has conferred and consulted with the secretaries of the several constituent organizations, looking toward the development of procedures which will have for their general objective the enlisting of services of all senior engineers, through lines of Society organization, so that personal opinion may be secured and a feeling of solidarity of interest may be obtained throughout the engineering profession.

This development of procedure should extend to member bodies, their divisions, regions, and local sections. It should include a study of the possibility of decentralized joint action on the part of the subsidiary organizations of member bodies.

Under this subject, study must be given to the best means for publicity and publication of the materials needed by junior engineers in their development programmes.

Committee on Professional Recognition

(*E.I.C. representative*—James A. Vance)

The Committee on Professional Recognition is charged with the duty of reporting to E.C.P.D. methods whereby engineers who have met suitable standards may receive corresponding professional recognition.

The variations in the requirements of different universities, licensing bodies, and technical societies for professional recognition of the engineer indicates the need of some common definition and some common form of recognition, whereby the public, from one end of the country to another, may be able to recognize a qualified engineer, and the man himself may have a definite objective towards which he may strive from the time he starts out towards an engineering career.

The committee has already made an intensive study of this difficult field. The problem is more complex in the United States than in Canada, but there is much that can be learned by Canadians from associations with those who are working on the problem elsewhere.

The E.C.P.D. report for 1939, in the portion devoted to this committee, says—

"The committee does not feel constrained to contribute something new or revolutionary from year to year. At present it contents itself with focusing attention on its past contributions and giving further thought to the problems in its field.

"The committee proposes to gather further data of the processes associated with recognition of engineers and point out the need for correlation. It may consider further the situation in other professions.

"Haste is ill-advised when traditional ideas and practices are to be co-ordinated with what is new and different; when autonomous groups are to co-operate voluntarily, contemplation and understanding must precede procedures and rules.

"The scope of engineering is so comprehensive, its interests so varied, and its recent evolution has been so rapid that realignment is most difficult. There must be freedom for development; regimentation would be deadly. But we may seek the fundamentals which are essential to a unified profession.

"While the committee may appear to concern itself with the details and nomenclature of recognition it is fully cognizant that its major aim is the enhancement of the professional status of the engineer.

"In this continuing evolution we seek not only individual qualifications but adjustments between engineers themselves, minor details in the great whole—which will insure a forward step in the usefulness of the profession, to the end that engineering effort may bring scientific discoveries to full fruition in better ways of living.

"For engineering is not an end; it is a means."

THE ANNUAL MEETING OF THE ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

On Thursday morning, October 24th, at the University Club of Pittsburgh, the representatives of the eight sponsoring bodies that make up the Engineers' Council for Professional Development gathered for the eighth annual meeting. Due to the illness of J. P. H. Perry, the chairman, the chair was occupied by Dr. R. E. Doherty, president of the Carnegie Institute of Technology.

The first business was to welcome the Engineering Institute of Canada into membership. Past-President J. B. Challies, representing the president, spoke for the Institute, and acknowledged the graceful tribute of the chairman. In conclusion he said, "You have conferred a unique honour upon your professional brethren in the Dominion of Canada. May I express their hope that you will, from now on, think of the transcontinental boundary line which joins your country and ours as something which binds us all in the bonds of an indivisible engineering brotherhood.

"In closing, I wish to emphasize the fact that the members of The Engineering Institute of Canada appreciate the opportunity to join with the E.C.P.D. more at this particular time than they would ordinarily, as world events have forced upon us the realization that the English-speaking nations must stand together closer than ever if the world's civilization is to be saved from barbarism."

The chairman of the four standing committees presented their reports and their recommendations for the coming year, all of which were accepted by the Council.

R. L. Sackett, Dean Emeritus of Engineering, Pennsylvania State College, for the Committee on Student Selection and Guidance, made these recommendations.

1. That the work be carried out by local interests in each city with the support of E.C.P.D.
2. That the new booklet "Engineering as a Career" be published. The estimated cost is $4,000.00.
3. That a study be made of tests and examinations which have been used in the selection of students for college training. Such a critical analysis of various lists now in use, and combinations of them, would be of definite value to admission officers, to high-school counsellors, to college personnel officers and to engineering schools.

O. W. Eshbach, Dean of Engineering, Northwestern Technical Institute, in presenting the report of the Committee on Professional Training, said the two principal activities were the exploration of possibilities for closer co-operation between the engineering schools and junior engineering groups, and the possibilities for closer co-operation between local engineering societies, colleges and national engineering organizations, including E.C.P.D.

Dean A. A. Potter, of Purdue University, presented a very comprehensive report on behalf of the committee on engineering schools. This committee has done, and is doing, a monumental piece of work, and the report showed that much still remains for the future. Nothing short of a complete study of the whole report would do justice to the committee's work.

C. F. Scott, Professor Emeritus of Electrical Engineering at Yale, reported for his committee on Professional Recognition. It was directed principally at a definition of "professional recognition," and recommended in part that societies, colleges and senior engineers interest themselves in seeing that students become better acquainted with professional ethics, organization and registration.

These few paragraphs are but a poor commentary on the committee reports, and it is suggested that any one specially interested write to Headquarters, where the complete reports are on file.

Annual Dinner

The largest attendance yet experienced for this function was present on Thursday night with President R. E. Doherty presiding. The speeches were around the theme of "the engineer and preparedness."

The Engineering Journal is indebted to George A. Stetson, editor of *Mechanical Engineering*, for the following brief accounts of the various speeches. The address by Dean A. A. Potter, "Government and the Engineer" will be printed in full in the December *Journal*.

Preparedness and the Engineer

S. D. Kirkpatrick, editor, *Chemical and Metallurgical Engineering*, spoke on "Preparedness and the Engineer." He recalled President Wilson's saying that the sinews of war are men, money, and munitions, and then proceeded to add mobilization of manufacture, machinery, materials, metals, management, and morale to this alliterative combination. Preparedness, he said, had become the nation's No. 1 industry inasmuch as a 10 to 12 billion dollar preparedness programme had been saddled on to the normal peacetime production of the United States.

The fortunes of war, he recalled, were, in Lloyd George's words, decided in the workshops and laboratories of the country. He stated that Germany's preparations had bogged down at one time because of the lack of trained engineers and skilled workmen, but that Germany had succeeded in eliminating these bottlenecks. There was presented in the United States to-day to all engineers more than a duty, an opportunity as well, to serve in the national defence. How he should serve was a question each man would have to answer for himself. One obligation was to help other men, through training and skilled management, to be of greater service to the nation.

He referred at length, with appropriate quotations, to an article in *Harpers* for October, by Carl Dreher, in which it is pointed out that Germany is engaged in "technological politics," and what the implications of this technique were. An important responsibility occasioned by rapidly expanding production was placed on engineers in the successful management of national-defence enterprises. He paid tribute to the people of Canada and to the work of the Canadian Minister of Munitions, C. D. Howe, a civil engineer. He also reminded his audience that compulsory registration of engineers had been resorted to in England, and that a voluntary registration in the form of a National Roster was in progress in this country. A stirring tribute was uttered in recognition of the engineers in the United States engaged in the national-defence programme, and the fact was emphasized that these engineers thought in terms of production and not of politics. Of the great national needs of to-day, he concluded, technically trained manpower comes first.

Preparedness and the Canadian Engineer

Speaking on behalf of the Engineering Institute of Canada on the subject "Preparedness and the Canadian Engineer," Prof. C. R. Young, of the University of Toronto, prefaced his brief address by expressing the satisfaction of the Institute in the honour that had been conferred upon it by its affiliation with E.C.P.D. He paid tribute to C. D. Howe, mentioned by Mr. Kirkpatrick, and other engineers who were defending Canada and the British Empire.

The great problem of E.C.P.D. as he saw it was the welfare of the engineering profession. The central fact that, in his opinion, justified recognition of engineering as one of the learned professions was the trust that was implied in the practice of engineering, whether performed for salary or for fee. It was essential, he said, for the employer or client to trust the engineer, just as he trusts his lawyer or his physician. Because of this element of trust in the relationship between client or employer and the engineer, it should be understood that we can go only so far in improving the welfare of the profession through legislation and organization. Good material with which to construct a body of professional men was essential. The welfare of the engineer was a matter of the individual stature of the engineer.

In this connection he read the following excerpt from a letter of Lindsay Russell, at one time Surveyor-General of Canada, written about 1878:

"The only legitimate means of raising the status of the profession consists in the effort of each individual thereof, by the evidences of conduct, acquirements, and ability, to win for himself the good opinion of those of his fellow-citizens with whom he comes in contact. The more as individuals the members of any profession succeed in this, the higher as a class they will stand. If as a class they are held in slight esteem by the public, it is because they do not merit more. Public opinion is, on the whole, tolerably just, and no doubt rates the services of any class at their true value. I am afraid we will have to rest content with being of no more importance in the eyes of our fellow-creatures than the circumstances of our own merits, and the value of our services to them, have combined to prescribe."

Industry and the Engineer

Announcing that he was not an engineer but that he had many opportunities to deal with many engineers and with young engineers, E. B. Roberts, assistant to the vice-president, Westinghouse Electric and Manufacturing Company, spoke on "Industry and the Engineer."

A majority of the leaders in his company who were engaged in heavy manufacturing were engineers, he said, and the heavy present demand for expansion in the national defence would fall on these men. Although industry had done a good job in training young engineers in the technical phases of their work which had advanced them to executive levels, it had not, in his opinion done so well in training them to manage the mixed functional groups, which include many non-engineering interests. He paid tribute to the engineer as a straight thinker who was able to analyze a problem, find a solution, and put it to work, and to the E.C.P.D. and the S.P.E.E. which were concerned with improving engineering education and training. Let nothing be done, he said, to injure, curtail, or impair engineering training in this country. It should be the policy of the nation, he asserted, to conserve this industrial human material. America, he concluded, was in the hands of engineers, and engineers were in the hands of engineering educators.

Society and the Engineer

The concluding address of the dinner was delivered by John G. Bowman, chancellor of the University of Pittsburgh, who spoke on "Society and the Engineer." Chancellor Bowman said that the engineer was made up of about 75 per cent scientist and 25 per cent humanist and contrasted the methods of the scientist and the humanist. The scientist, he said, avoids logic and bookkeeping. He is motivated by curiosity. He finds something, and says, "Here it is. You've got to take it." His attitude is the attitude of command. On the other hand the attitude of the humanist is one of entreaty. Of his discoveries he says, "Here it is. If you could only get it you would feel as I have that you have lived." In this regard Shakespeare was the greatest humanist; and Chancellor Bowman presented many examples from the playwright to prove his point. There was in the humanist attitude the demonstration of the quotation "There is good in things evil if man observingly would distil them out." Thus Homer inspired the Greeks to courage by reciting their courageous exploits, and David the Hebrews to faith by means of the Psalms. The humanist attitude was coming into engineering, he said, and "to-night's programme could not have happened" some years ago. The engineer, he said, was becoming a combination of the hard-headed scientist and the humanist.

ELECTIONS AND TRANSFERS

(*Continued from page 481*)

Transferred from the class of Student to that of Junior

Smith, Edgar Bernard, B.Eng. (Elec.), (N.S. Tech. Coll.), dftsman. and junior office engr., Canadian Comstock Co., Montreal, Que.

Sylvester, Jack Douglas, B.Sc. (Elec.), (Univ. of Alta.), engrg. dftsman., C.N.R., Montreal, Que.

Wilkinson, William Cameron, B.Sc. (E.E.), (Univ. of N.B.), transmitter development engr., Canadian Marconi Company, Montreal, Que.

Students Admitted

Brosseau, Gérard, salvage dept., aircraft divn., Canadian Car & Foundry Co. Ltd., Montreal, Que.

Cholette, Albert, (McGill Univ.), 53 Third St., Quebec, Que.

Delafield, John, B.Sc. (Mech.), (Univ. of Sask.), 4087 Tupper St., Montreal, Que.

Harvie, Thomas Allan, (McGill Univ.), 633 Cote St. Antoine Road, Westmount, Que.

Hobbs, George Pugh, B.Eng. (Elec.), (McGill Univ.), engrg. office, Defence Industries Limited, Nobel, Ont.

Hubley, John Stuart, B.Sc. and Engrg. Cert. (Mt. Allison Univ.), refinery operator, Trinidad Leaseholds Ltd., Pointe-a-Pierre, Trinidad, B.W.I.

Lowe, Howard Thomas (McGill Univ.), 3506 University St., Montreal, Que.

Paquin, Paul Edward, B.Eng. (McGill Univ.), 2336 Wilson Ave., Montreal, Que.

Richardson, George William, (McGill Univ.), 641 Maple Ave., Point St. Charles, Montreal, Que.

COMING MEETINGS

American Society of Mechanical Engineers—Sixty-first Annual Meeting, Hotel Astor, New York, December 2-5.

Highway Research Board—Twentieth Annual Meeting at National Academy of Sciences, Washington, D.C., December 4 to 6.

Association of Asphalt Paving Technologists—Annual Meeting to be held at Adolphus Hotel, Dallas, Texas, December 9 to 13.

American Institute of Electrical Engineers—Winter Convention at Philadelphia, Pa., January 27-31, 1941.

American Road Builders' Association—Annual Convention, at the Pennsylvania Hotel, New York, January 27-30, 1941. Engineer-director, Charles M. Upham, National Press Building, Washington, D.C.

The Engineering Institute of Canada—Fifty-fifth Annual General and Professional Meeting to be held at Hamilton, Ont., on February 6th and 7th, 1941.

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

Guy A. Lindsay, M.E.I.C., is the chairman of the temporary committee appointed recently to represent Canada in the investigations for the early development of power resources in the international section of the St. Lawrence River. Mr. Lindsay, who is engineer in charge of the general engineering branch of the Department of Transport, has been sitting on behalf of the Dominion Government as engineering advisor in the long negotiations which have been in progress over the St. Lawrence power development.

Dr. T. H. Hogg, M.E.I.C., chairman and chief engineer of the Hydro-Electric Power Commission of Ontario and president of the Institute represents the province of Ontario on this committee.

Dr. O. O. Lefebvre, M.E.I.C., vice-president of the Quebec Streams Commission and a past-president of the Institute is the representative of the Province of Quebec on the committee.

Colonel Frank Chappell, V.D., M.E.I.C.

Colonel Frank Chappell, V.D., M.E.I.C., has been appointed officer commanding the mechanical transport depot at London, Ont. It is understood that the position now filled by Colonel Chappell is entirely new in the Canadian military setup, and is one carrying heavy responsibility with regard to providing mechanical transport equipment for the Canadian Active Service Force. Colonel Chappell has served twenty-five years with General Motors of Canada Limited, at Oshawa, holding the position of superintendent, factory manager and since 1936, director of industrial relations. He was born in England and educated there, and at McGill University, Montreal. He was formerly city engineer for Oshawa, and in the war of 1914-1918 served overseas with the Royal Canadian Engineers, subsequently being placed in command of the 25th Infantry Brigade of the Canadian militia. He was commanding officer of the Ontario Regiment for several years.

Lieutenant-Colonel H. G. Thompson, D.F.C., M.E.I.C., officer commanding No. 2 Army Field Workshop, R.C.O.C., is now in England. He is well known to members of the Institute, having held for over two years the position of Editor of Indices of the Engineering Catalogue at Headquarters. Since his graduation from the University of Toronto in 1922, Colonel Thompson has been engaged in mechanical sales engineering with various firms. In 1934 he joined the staff of Canadian Vickers Limited, and in 1935 he was appointed manager of the Toronto office of the company.

B. E. Norrish, M.E.I.C., formerly managing director of Associated Screen News in Montreal has been made president and managing director of the company at a recent meeting of the Board. A graduate of Queen's University with the degree of Master of Science, he served in the Department of the Interior, Ottawa from 1913-1917. In 1917 he was appointed superintendent in charge of the organization and direction of the work of the Exhibits and Publicity Bureau, in the Department of Trade and Commerce. Joining Associated Screen News in 1920, he organized and estabilshed a Canadian branch of the then United States company. In 1926, he established the Canadian company as it now is, and became managing director.

Lieutenant-Colonel F. J. Simpson, V.D., M.E.I.C., has been appointed district record officer, Military District No. 11, and now resides at Work Point Barracks, Victoria, B.C.

Dr. C. A. Robb, M.E.I.C., has been appointed power consultant in the Munitions Branch of the Department of Munitions and Supply at Ottawa. He was previously engaged with the Gauge Division of the same department. At the outbreak of war Dr. Robb was head of the Department of Mechanical Engineering at the University of Alberta.

Aimé Cousineau, M.E.I.C., was elected chairman for 1940-1941 of the Conference of Municipal Public Health Engineers at the recent Detroit meeting of the American Public Health Association. He is the superintending engineer of the Division of Sanitation, Department of Health, City of Montreal.

J. V. Rogers, M.E.I.C., has been transferred by the Consolidated Mining and Smelting Company from Trail, B.C., to the position of chief draughtsman for the Alberta Nitrogen Company at Calgary. A graduate from the University of British Columbia in 1923, Mr. Rogers was employed for some time with the Churchill River Power Company, and later with Privateer Mines Limited at Zeballos, B.C.

A. W. Finlayson, M.E.I.C., has joined the staff of Defence Industries Limited in Montreal. A graduate of McGill University in civil engineering in the class of 1924, he has been engaged as a designing engineer on several construction projects until 1932 when he became connected with Pressure Pipe Company of Canada Limited, Montreal, as assistant chief Engineer.

J. L. Bieler, M.E.I.C., has been made chief of the Fuze Production Division in the Department of Munitions and Supply at Ottawa. Previous to going to Ottawa he was on the staff of Dominion Oilcloth and Linoleum Company, in Montreal.

Stanley Shupe, M.E.I.C., city engineer of Kitchener, Ont., has been elected president of the Canadian Institute on Sewage and Sanitation, at the annual meeting held last month in Toronto.

J. H. Wilson, M.E.I.C., has been appointed electrical superintendent in the Baie Comeau mill of the Quebec North Shore Paper Company. He graduated in electrical engineering from the University of Manitoba in 1925. After graduation he spent three years in Chicago where he was engaged in draughting and design work on power plants. From 1928-1931 he was designer on the Chute-à-Caron hydroelectric plant of the Alcoa Power Company at Arvida, Que. From 1931 to 1938, he was engaged as an electrical designer on several industrial plants. For the last three years, he worked on the inventory of physical assets of power companies for the Quebec Provincial Electricity Board.

A. T. McCormick, M.E.I.C., has been transferred from Calgary to Winnipeg where he is district manager of Dominion Sound Equipments, Limited.

Aimé Cousineau, M.E.I.C.

Lieutenant-Colonel H. G. Thompson, D.F.C., M.E.I.C.

B. E. Norrish, M.E.I.C.

H. R. M. Acheson, M.E.I.C., has joined the staff of Canadian International Paper Company as supply manager in the Temiskaming mill. A graduate of the University of Alberta in the class of 1929 he had been connected with the Spruce Falls Power & Paper Company, Limited, at Kapuskasing, Ont.

K. R. Chestnut, M.E.I.C., has been transferred from the Department of Munitions and Supply to the Department of National Defence and is now located at the Newfoundland airport.

S. H. Wilson, M.E.I.C., has resigned his position as mechanical superintendent with the Lake St. John Power and Paper Company at Dolbeau, Que., to accept the position of assistant superintendent of works with the Ottawa Car and Aircraft Company at Ottawa, Ont.

A. D. Adlam, Jr.E.I.C., is now located in Hamilton where he is employed with the Hamilton Bridge Company. He was previously with the British American Oil Company, Limited, in Montreal.

J. F. Boux, Jr.E.I.C., is employed with the Inspection Department of McDonald Brothers Aircraft Company in Winnipeg. He was graduated in civil engineering from the University of Manitoba in 1939.

W. E. Taylor, Jr.E.I.C., has joined the staff of Allied War Supplies Corporation, in Montreal. Upon his graduation from Queen's University in 1935 he joined the staff of International Nickel Company at Copper Cliff, Ont. For the last three years he had been in Peru, South America, where he was employed with the International Petroleum Company.

J. S. McMillan, Jr.E.I.C., is now located in Montreal where he is employed with Canadian Car Munitions, Limited. For the past three years he had been on the staff of Lake St. John Power & Paper Company at Dolbeau, Que.

C. R. Timm, Jr.E.I.C., has resigned his position with the Bepco Canada Limited to accept an appointment on the staff of Dominion Rubber Company Limited, in Montreal.

A. M. McLeod, S.E.I.C., is now employed with the Department of National Defence at Ottawa.

E. R. L. Webb, S.E.I.C., who was graduated from McGill University this spring has been granted a scholarship by the Department of Education of the Province of Quebec and is now doing post-graduate study in the Department of Electrical Engineering at the Massachusetts Institute of Technology, Cambridge, Mass.

V. A. Hayward, S.E.I.C., has moved from the Canadian Westinghouse Company at Hamilton and has taken a position as engineering draughtsman in the office of the electrical engineer, Canadian National Railways, Montreal. He was graduated from the University of Alberta in 1938.

E. H. Bartlett, S.E.I.C., has accepted a position with the Calgary Power Company at Seebe, Alberta. He graduated from the Nova Scotia Technical College in 1939 with the degree of bachelor of engineering. He spent a few months with the Bepco Canada Limited, in Montreal, and went with the Canadian General Electric Company in the test course at Peterborough.

S. Barkwell, S.E.I.C., is now working in the Test Department of Canadian General Electric Company at Peterborough, Ontario. He was graduated in electrical engineering from the University of Manitoba this spring.

VISITORS TO HEADQUARTERS

Professor W. E. Cornish, M.E.I.C., Department of Electrical Engineering, University of Alberta, from Arvida, Que., on September 26th.

A. J. Grant, M.E.I.C., from Bathurst, N.B., on September 30th.

G. E. Booker, M.E.I.C., of Bathurst Power & Paper Co. Ltd., from Bathurst, N.B., on October 1st.

S. J. Chapleau, M.E.I.C., from Ottawa, Ont., on October 4th.

M. G. Saunders, M.E.I.C., Mechanical Superintendent, Aluminum Company of Canada, from Arvida, Que., on October 7th.

H. G. Angell, M.E.I.C., from London, England, on October 9th.

Dean C. J. Mackenzie, M.E.I.C., Acting President, National Research Council, from Ottawa, Ont., on October 11th.

H. A. Cooch, M.E.I.C., Vice-President, Canadian Westinghouse Co. Ltd., from Hamilton, Ont., on October 11th.

M. Papineau, S.E.I.C., from Noranda, Que., on October 15th.

Captain C. Ben Bate, M.E.I.C., District Engineer, M.D. No. 5, from Quebec, Que., on October 18th.

C. M. Bang, M.E.I.C., Manager, Hydro-Electric Power Division, International Power & Paper Company of Newfoundland Limited, from Deerlake, Newfoundland, on October 22nd.

W. P. Nesbitt, Jr. E.I.C., Consolidated Paper Corporation Limited, from Grand'Mère, Que., on October 23rd.

S. Hogg, M.E.I.C., Saint John Drydock & Shipbuilding Company Limited, from Saint John, N.B., on October 25th.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

William Harvey Carson, M.E.I.C., died suddenly in his office at Ottawa, on October 9th, 1940. He was born at Stirling, Scotland, on June 27th, 1877, and received his early education in the local High School. Later he was graduated from the Glasgow Royal Technical College with the degree of civil engineer. After a few years of practice in Scotland, he came to Canada in 1907 and entered the service of the City of Ottawa. In 1910 he joined the Department of Marine of the Dominion as assistant to the chief engineer. In 1913, he became district engineer for Ontario in the same department, and occupied this position in the Department of Transport at the time of his death. During the past thirty years he had done much work in the lighthouse service, and supervised the construction of many of the more important lighthouses on the Great Lakes.

Mr. Carson joined the Institute as an Associate Member in 1910, and he was transferred to Member in 1918. He was also a Member of the Institution of Civil Engineers of Great Britain.

John Dennis Garey, M.E.I.C., died at his home in Saint John N.B., on October 4th, 1940, after a long illness. He was born at Saint John, N.B., on September 3rd, 1886, and received his education in the local schools. After serving an apprenticeship with the Phoenix Foundry and Locomotive Works, he joined the staff of Murray and Gregory, Saint John, as an operating engineer. He later became mechanical superintendent. In 1911, he was appointed chief engineer of the New Brunswick Power Company, and remained in this position until four years ago when he was appointed superintendent of the Saint John's plant of the company.

Mr. Garey joined the Institute as an Associate Member in 1934.

Alexandre Georges Sabourin, M.E.I.C., died suddenly at Ottawa on September 24th, 1940. He was born at Beloeil, Que., on June 5th, 1876, and he received his education at the Ecole Polytechnique of Montreal, where he was graduated in 1902. He entered the Department of Public Works of the Dominion in 1905, and was engaged on the Georgian Bay ship canal survey. In 1907, he was transferred to Quebec, and in 1911 he was appointed district engineer at Sherbrooke, Que. He became district engineer at Quebec in 1921. Three years ago he had been promoted to the position of superintending engineer in the Department, at Ottawa.

Mr. Sabourin joined the Institute as an Associate Member in 1913.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

BORDER CITIES BRANCH

H. L. Johnston, M.E.I.C. - *Secretary-Treasurer*
A. H. Pask, Jr.E.I.C. - - - *Branch News Editor*

The first fall meeting of the Border Cities Branch was held at Chatham on Saturday, September 21st, 1940. Such a meeting at Chatham is an annual event of the branch.

The programme began with an inspection of the plant of Libby, McNeil & Libby at 3.50 p.m. It was the height of the tomato season and the plant was engaged in processing and canning tomato juice. The visitors saw the entire process from the loaded trucks of tomatoes to the finished cans going to storage or railway cars. On leaving, the ladies were given a package containing several of the firm's products.

Everyone then went to the William Pitt Hotel where dinner was served at 6.30 p.m. Ladies and members present numbered 33 from Windsor, 8 from Chatham and 6 from Sarnia.

Following a business meeting with Mr. J. F. Bridge as chairman, Mr. T. M. S. Kingston introduced Mr. T. V. Proctor and Mr. C. K. Rolland of Libby, McNeil and Libby. Mr. Proctor gave formal welcome for the firm to all present, and gave an introductory talk on the talking technicolor motion picture film that followed. The film was of the **Salmon Fishing Industry of Alaska.** This showed views of the country and gave some of its history and resources. The life of the salmon was covered and all phases of the fishing and canning industries.

Mr. J. J. Newman then moved a vote of thanks to the firm, Mr. Proctor and Mr. Rolland.

Mr. G. A. McCubbin was then called on to show slides of members of the branch. He told of originating the idea of making up a photo album of all the members of the Border Cities Branch to promote knowledge and friendship among members, and how photographs for copying had been collected with the help of the branch officers. He had presented the completed album in two volumes to the branch and at that moment it was being circulated through the gathering. To test the recognition of members of one another, he showed a number of slides. Members were requested to record the number they recognized. Mr. E. Chorolsky recognized the greatest number and was presented with the set of slides.

Mr. J. W. MacDonald then moved a vote of thanks to the Ladies Committee and the Chatham Committee including Mr. McCubbin and Mr. Kingston, for the work they had done in making arrangements for the day. The meeting then adjourned.

HAMILTON BRANCH

A. R. Hannaford, M.E.I.C. - *Secretary-Treasurer*
W. E. Brown, Jr.E.I.C. - - *Branch News Editor*

Visit To The Shand Dam

By Joseph Clarke, M.E.I.C.

On Friday, September 20th, 1940, the Grand Valley Group of professional engineers of Ontario was the host to a group of about seventy visiting engineers from Montreal, Toronto, Simcoe, Kitchener, Galt, Preston, Brantford and Hamilton.

The party assembled on the east bank of the dam site and were conducted by Mr. Frank Adams of Brantford around the workings. On the west bank there was a veritable beehive of activity—trucks hauling dirt for fill, the packers, levellers and scrapers. This presented a really remarkable tank attack in reverse: instead of destructive, this was constructive. After a thorough inspection, the party drove along the beautiful Grand Valley to the Belwood site where the raising of the bridge was in progress. This bridge, when the dam is completed, will form the centre span crossing the reservoir.

After inspection, the party drove back through Elora to Trail's End Inn where dinner was served. At the head table were Mr. Court Fairchild, chairman of Grand Valley Group, P.E.O., Mr. Harvey Sims, solicitor, Grand Valley Conservation Commission, Mr. Phillips, chairman of Grand

Valley Conservation Commission, and the speaker of the evening, Dr. H. G. Acres, chief engineer, Grand River Valley Conservation Commission.

Mr. Adams introduced Dr. Acres, who spoke briefly on the exploration, development and progress of the dam and of the difficulties encountered in test drills at other sites at first considered.

When completed, the dam will form a lake nearly seven miles in length and one mile wide. Though it has been necessary to remove many dwellings and farm buildings in order to construct this huge reservoir, all the communities from the tributaries to the mouth of the Grand River will eventually benefit from this reserve supply. It will control the flood waters in the spring break up and will eliminate any water shortage during a dry season.

Group of engineers visiting Shand Dam, Fergus, Ont., September 20, 1940.

The photo was taken on the west bank showing the west wall of the dam in the background.

The branch is indebted to Mr. J. Clarke, one of our members, for the photos taken on this occasion, and we also take this opportunity of thanking our fellow engineers, the Brantford Group of the Registered Professional Engineers of Ontario for this instructive and delightful day.

Mr. Stuart Armour, of Ottawa, Assistant to the Deputy Minister for Air, addressed the branch in the Lecture Theatre, McMaster University, on October 8th, 1940. The subject was **The British Commonwealth Air Training Plan.**

Mr. Armour was introduced by Jerry Moes, who was able to point out two items that should make us very proud of the speaker, one was that part of his early schooling was received in Hamilton and the other was that at the outbreak of war he gave up his position in the United States and returned to Canada with his family to find what part he could take to help the British Empire, in the hour of need.

The speaker gave much information on the air training works of Canada and said that this would continue unimpaired during the winter and that much more is being carried on than the ordinary citizen is aware of or is told about. The talk was of a confidential nature to the 45 members and aeronautical engineers present, therefore no details may be given in this report. Alec Love, chairman, moved a vote of thanks to Mr. Armour for his very instructive address.

LAKEHEAD BRANCH

H. M. Olsson, m.e.i.c. - *Secretary-Treasurer*
W. C. Byers, Jr.e.i.c. - - *Branch News Editor*

A meeting of the Lakehead Branch was held on the Canadian Car & Foundry Company's premises in Fort William on September 26th, commencing at 6.00 p.m. by special permission of the management.

A conducted tour was made through the airplane factory, and the various stages of fabrication and assembly of the Hawker Hurricane aircraft was explained quite fully. A keen interest was shown in the production of the vast number of intricate and very exact parts and several comments were made on the amount of organization and engineering genius required to produce the various tools and jigs. The plant has developed most of its own tools and jigs and is continually making improvements to meet the rapid expansion for war-time production.

After the tour of the plant, the thirty-nine members met in the factory dining hall at 8.00 p.m., where they were welcomed to the plant by Mr. E. J. Soulsby, superintendent of the Aircraft Division at the Fort William plant.

Mr. A. W. Wilson, inspector in charge at the plant for the British Air Ministry was also present.

The chairman, Mr. H. G. O'Leary, opened the meeting and then called on Mr. B. A. Culpeper to introduce the speaker of the evening, Mr. David Boyd, works manager of the Aircraft Division at the Montreal plant. He mentioned that Mr. Boyd was known to most of the members, having been previously manager at the Fort William plant.

The address dealt with the manufacture of aircraft to meet the British Air Ministry specifications. Some of the difficulties were cited such as rapid procurement of certain materials, great expansion of plant and personnel, and the development of tools and jigs so that large numbers of relatively unskilled labourers can be utilized to advantage. These jigs and tools have been developed so that no reference to drawings is necessary, thus speeding up the production.

To illustrate the complexity of the fabrication problem, it was stated that there were 3,600 drawings not including the engine and instruments, and there were 50 rigid material specifications of the Air Ministry to be met.

A very extensive system of tagging and filing the various component parts is required by the Air Ministry so that it is possible to trace every part to its origin and it is known which men inspected the part in question. This procedure is necessary so that if a structural failure occurs in any part, then it is possible to ground all aircraft of the same category and to replace the defective part with another of known specification.

A very close tolerance is essential in all parts of the aircraft, so that interchangeability can be maintained and replacements made safely and rapidly.

The plant is continually improving tools and jigs to speed up fabrication. The assembly is relatively simple, compared to fabrication.

Mr. H. G. O'Leary proposed a vote of thanks to the speaker for his very interesting address, and Mr. S. E. Flook seconded the vote of thanks and extended the appreciation of the members.

LONDON BRANCH

D. S. Scrymgeour, m.e.i.c. - *Secretary-Treasurer*
J. R. Rostron, m.e.i.c. - - *Branch News Editor*

The opening meeting of the fall session was held on the 25th September, 1940, in the Board Room of the Public Utilities Commission, the speaker being Mr. Wm. Storrie of Gore & Storrie, consulting engineers of Toronto. His subject was **The Engineer and Public Health.**

Mr. H. F. Bennett took the chair and opened by welcoming the speaker to the session. He explained the absence of the summer meeting by saying that he had been up and down the country on a speaking tour concerning the admission to the Institute of the young engineer.

Mr. Storrie presented a very interesting paper illustrated by a large number of lantern slides which gave a splendid idea of the subject in hand.

The whole subject is covered by an article which appears in the September number of the Engineering Journal by Wm. Storrie and A. E. Berry on "Modern Sanitation of Water Supply Practice" (pp. 380 to 391). This article gives a full description of the whole subject and therefore need not be further described here.

Twenty-six members and visitors were present and several questions were put to the speaker and fully answered.

At the conclusion a resolution of thanks was offered by Mr. R. W. Smith.

MONTREAL BRANCH

LÉON DUCHASTEL, M.E.I.C. - *Secretary-Treasurer*

In response to an appeal made during the summer by the Honourable James G. Gardiner to The Engineering Institute, for volunteer workers to help with the National Registration, the Montreal Branch canvassed its members and received 190 offers of service. This generous response in times when the engineer is overworked, was greatly appreciated by Mr. Brooke Claxton, Member for St. Lawrence-St. George in whose Division most of the members worked. His letter of thanks was published in the October Journal.

On Thursday, October 3rd,the Branch resumed its weekly meetings and was fortunate in having Mr. J. A. Wilson, controller of Civil Aviation for Canada, speak on **Aerodrome Construction in Canada for the British Commonwealth Air Training Plan.** The meeting, under the chairmanship of Mr. H. J. Vennes, was well attended and refreshments were served afterwards in order to give the members an opportunity of meeting old friends and renewing acquaintances. A courtesy dinner was given for Mr. Wilson at the Windsor Hotel, before the meeting.

On October 10th, a paper illustrated by lantern slides and exhibits, was delivered by Dr. I. R. McHaffie of Canadian Industries Limited. The subject was **The Atom—Its Place in Daily Life.** Dr. McHaffie outlined the background and development of modern plastic materials and other new synthetic products.

On October 17th, Mr. P. J. Croft addressed the Branch on **Colour Photography—An interesting and useful tool for Technicians,** and illustrated his paper with some interesting photographic experiments. Members of the Montreal Camera Club were invited to attend the meeting at which there was a record attendance for the season.

OTTAWA BRANCH

R. K. ODELL, M.E.I.C. - - *Secretary-Treasurer*

The fall and winter programme of the Ottawa Branch was initiated with a combined evening meeting on October 17, 1940, held in co-operation with the Ottawa branch of the Canadian Institute of Mining and Metallurgy. This meeting, held at the auditorium of the National Research Council, was presided over jointly by R. A. Strong, vice-chairman of the local branch of the C.I.M.M. and W. H. Munro, chairman of the local branch of the E.I.C. The proceedings included an illustrated address by H. H. Bleakney, B.Sc., metallurgist of the Department of National Defence, on the **Heat Treatment of Nickel Steel**, after which refreshments were served.

The importance of carbon as a constituent and the effects of its extent and distribution upon the properties of steel were first of all emphasized by the speaker. He then related difficulties encountered in handling large nickel steel propeller shaft forgings for the United States Navy while engaged a few years ago as metallurgist for the Pittsburgh Crucible Steel Company at Philadelphia.

Technical data explaining proper methods to be used in tempering these nickel steel shafts to the rigid specifications required, were lacking and what details were given were generally misleading. By devising heating and cooling processes different to those set forth in standard works on the subject, Mr. Bleakney and his colleagues succeeded in producing forgings which fulfilled every requirement and passed strictest tests of naval and military authorities.

Mr. Bleakney was associated in his research on nickel steel with A. W. Grosvenor of the Drexel Institute of Technology in Philadelphia.

By the use of slides and diagrams, the speaker treated the highly technical subject in a manner readily understandable to the layman. With micro-photographs he showed that lowering the temperature of heat treatment had a decided effect on the properties of nickel steel. When the results of this research become more generally known, it is felt that the effect upon the future production of nickel steel may be considerable.

SAINT JOHN BRANCH

V. S. CHESNUT, M.E.I.C. - *Secretary-Treasurer*

The Saint John Branch held its first supper meeting of the season at the Admiral Beatty Hotel on August 29th, with the branch chairman, John P. Mooney, in the chair. Supper was served at 6.30 and, at its conclusion, the speaker of the evening, Mr. Harry F. Bennett, was presented by the chairman. Mr. Bennett is district engineer, Public Works of Canada, at London, Ont., and heads the Institute's Committee on Training and Welfare of the Young Engineer, which was the subject on which he spoke.

The speaker outlined a number of ideas which were to be considered by the committee, with a view to improving the methods of educating and training the young engineer. It was suggested that preliminary training of prospective engineering students should start in the preparatory schools, and that only students of high all-round standing should be selected to enter an engineering course at the University. In this connection it was suggested that the branches of the Institute might form local committees for the assistance and guidance of prospective engineering students. Among other things, the Committee proposes to study the curricula and the required entrance standing of various universities, with a view to making recommendations for improvement. It was thought that engineering courses should be less specialized except during a post-graduate period. The speaker laid particular emphasis on the fact that the ability to speak in public, or to think on his feet, is of considerable value to the engineer.

Following Mr. Bennett's address, a brisk discussion, in which nearly all those present participated, gave evidence of the great interest taken in this subject. A vote of thanks to the speaker was proposed by Mr. G. Stead, and seconded by Mr. C. C. Kirby. Besides Mr. Bennett, other guests of the branch were Dr. John Stephens, professor of mechanical engineering, University of New Brunswick; Col. F. L. West, professor of engineering, Mount Allison University; and Dr. Alexander, principal of the Saint John High School.

Trends and forces behind the outbreak of what he termed "the second phase of the first Great War" were analyzed in detail for members of the Saint John branch of the Institute, by Norman A. M. MacKenzie, LL.M., president of the university of New Brunswick, at the monthly dinner meeting of the branch, held on October 17th, at the Admiral Beatty Hotel.

The present struggle is merely a renewed attempt of German politicians to dictate to European nations in the matter of international policy. Maintenance of arms, conciliation and collective insurance were treated as major methods for the continuance of peace and forestalling further threats of straining capital costs and serious dislocation of social, economic and political systems in the period following the Arm stice.

There were differences between the original and present struggle and chief among these were the further complications of idealogy conflicts of totalitarian and democratic nations and the relation of the present struggle to the international economic revolution.

"There is not sufficient room in the world," Professor MacKenzie declared, "for the simultaneous operation of the democratic philosophy with its emphasis on the individual and the totalitarian ideology and its supremacy of the state."

Gregory Stead moved the vote of thanks to Professor MacKenzie and Lieut-Col. H. F. Morrisey supported the motion. J. P. Mooney, chairman of the branch presided at the meeting and upwards of 30 members and guests were in attendance.

Speakers included Mr. Justice Harrison and Mr. Justice McInerney who were among the invited guests. Other guests were Professor Earl O. Turner and Professor J. Henry Moore of the faculty of civil engineering at the University of New Brunswick and Captain P. C. Ahearn of the Royal Canadian Engineers.

SAULT STE. MARIE BRANCH

O. A. Evans, Jr.E.I.C. - - - *Secretary-Treasurer*
N. C. Cowie, Jr.E.I.C. - - *Branch News Editor*

The Sault Ste. Marie Branch of the Institute began the fall session of its meetings when 27 members and guests sat down to luncheon in the Windsor Hotel at 6.45 p.m., on September 27th. The business portion began at 8.00 p.m. when the minutes were read and adopted on motion of L. R. Brown and R. S. Macleod. C. Stenbol and K. G. Ross moved that the bills be paid.

Chairman E. M. MacQuarrie asked for and obtained the approval of the branch to purchase $200.00 worth of War Bonds. The chairman then expressed regret the loss of some members due to a change of occupation; they were Chairman Hugh Leitch who moved to Montreal, Clive Holman who now resides in Niagara Falls and Ferdinand Masse who is in Newfoundland.

The chairman then introduced the speaker of the evening, Carl Stenbol, chief engineer of the Algoma Steel Corporation, who had for his topic **The Manufacture of High Explosive Shells.** The talk proved to be very popular. K. G. Ross moved a vote of thanks to the speaker. N. C. Cowie moved that the meeting be adjourned.

VANCOUVER BRANCH

T. V. Berry, M.E.I.C. - - - *Secretary-Treasurer*
A. Peebles, M.E.I.C. - - - *Branch News Editor*

The first meeting of the Vancouver Branch's 1940-41 programme was held at the Georgia Hotel on Monday, September 30. About sixty attended, including branch members and guests from other engineering societies. The speaker was W. A. Carrothers, Esq., Ph.D., D.F.C., chairman of the Public Utilities Commission of British Columbia, and also chairman of the Coal and Petroleum Board of British Columbia. His subject was **The Regulation of Public Utilities.**

British Columbia was one of the last areas on this continent to institute direct control over public utilities. An act was passed in 1919, but was not put into effect, and was later repealed. The present act was passed in 1938, and is being gradually applied as rate questions arise, and as the valuation of utility organizations proceeds. Some control of hydro-electric power developments has always been exercised through the medium of water-rights licences, but until the present Commission was created, no other regulation prevailed.

Dr. Carrothers emphasized the necessity of control in natural monopoly industries, where it is uneconomical, if not impossible, to permit competitive duplication of facilities. The chief utilities coming under control to date are those furnishing water supply and electrical energy. There are many borderline industries, such as the marketing of essential foodstuffs, wherein greater economy of distribution might be secured by regulation, but the margin of saving is not great enough to warrant the granting of a controlled monopoly. Economy in these cases is maintained through competition.

The important fact to remember, and the one most often overlooked, is that regulation of public utilities in the public interest, must be associated with a degree of protection and a guarantee of fair return to the utility itself. This is the most difficult point to place before the public, a majority of which do not differentiate natural monopoly service from any other business enterprise. Hence they see no reason for any form of protection for the income or investment of the utility company.

The control of a utility involves a valuation of the physical structure required to render adequate service over a period of time. This is perhaps the most difficult problem to be met. The speaker made it clear that these valuations do not take into account the book value of stocks or bonds which may have been issued, and which technically represent the value of the property. In the past, much harm had been done through the misuse of legitimate instruments of corporation finance, but this has largely disappeared and most utility companies are anxious to render good service for a fair return. The Commission tries to arrive at the value of plant and organization deemed necessary on an engineering basis.

Their ultimate objective is an appraisal of all utility services in the province, and the establishment of fair rates based on this appraisal. Control is exercised over the transfer of assets between companies, the issuance and sale of interest-bearing securities, and the making of contracts with consumers, which may not offer different rates to similarly situated individuals or institutions. The operations of the Commission include the control of transportation, provided for by the Motor Carrier Act, which supplements the general provisions of the Utilities Control Act. Control of motor truck transportation is not limited to organized trucking companies, but covers also the operator who owns only one truck.

In functioning, the Commission holds public hearings wherever necessary, at which the parties to a dispute over rates may present their views. In most cases a private conference is sufficient, and court proceedings are rarely necessary. In this regard, the experience of the Commission has been that all parties are in most cases anxious to meet a fair settlement which will assure good service at a reasonable charge.

The trend in most countries is towards greater control over those services considered necessary to our present mode of life, and Dr. Carrothers, while in agreement with this principle, stated that regulation must not be applied too hurriedly, without careful consideration of the factors involved. Account must be taken of the needs of a growing community, and the fact that such growth may receive temporary setbacks due to business depression, war, or other influences, which may upset a legitimate programme of expansion of utility services. Such services cannot be created overnight, but must be planned years in advance of population and business growth.

Following this address, a number of questions were answered, adding to the value and interest of the evening. Mr. C. E. Webb, branch chairman, presided, and a vote of thanks was tendered by Mr. W. G. Murrin of the British Columbia Electric Railway Company.

FACTS OF INTEREST

Gold production in Canada set up a new high monthly record in July when the output totalled 456,626 ounces compared with 439,925 ounces in the corresponding month of last year.

Central electric stations in Canada produced 20,083,914,000 kilowatt hours in the first eight months of the current year as against 18,243,128,000 kilowatt hours in the corresponding period of 1939.

Coal production in Canada during the first eight months of 1940 amounted to 10,800,000 tons compared with 9,200,000 tons in the corresponding period of 1939.

The output of Canadian newsprint during the first eight months of 1940 totalled 2,300,000 tons as against 1,800,000 tons in the corresponding period of 1939, a gain of nearly 27 per cent.

Canadian Resources Bulletin

Library Notes

Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

Canadian SKF Company Limited:

SKF Engineering data sheets. Montreal, SKF Company Limited, c1939.

Rigid-Frame Bridge:

By Arthur G. Hayden, New York, John Wiley & Sons, 1940. 285 pp., illus., 6 by 9¼ in., $4.50.

Working Stresses:

By Joseph Marin, New Brunswick, Rutgers University Press, 1940. 41 pp., diagrs., 5½ by 8½ in. $1.00.

TRANSACTIONS, PROCEEDINGS

Canadian Electrical Association:

Proceedings, fiftieth annual convention, 1940.

Northwest Coast Institution of Engineers and Shipbuilders:

Transactions, v. LVI, 1939-40.

Punjab Engineering Congress:

Proceedings, v. XXVII, 1939.

REPORTS

American Institute of Steel Construction Inc.:

Annual Report for year ending September 30, 1940.

Canada Department of Mines and Resources—Mines and Geology Branch:

Talc, Steatite, and Soapstone; Pyrophyllite, Ottawa, 1940.

Canada Department of Mines and Resources—Mines and Geology Branch:

Physical and Chemical Survey of Coals from Canadian Collieries. Nova Scotia-Cumberland County Coalfield, Pt. 1—Springhill area—pt. 2—Joggins area.

Canada Department of Mines and Resources—Mines and Geology Branch—Geological Survey Papers:

Preliminary Map, Jumpingpound, Alberta, 40-1; Bragg Creek, Alberta 40-6; Structure and oil prospects of the foothills of Alberta between highwood and Bow Rivers 40-8; Stony rapids and procupine River areas, Saskatchewan 40-10; Lloydminster gas and oil area, Alberta and Saskatchewan 40-11; Zeballos mining district and vicinity British Columbia 40-12; Quyta Lake and parts of Fishing Lake and prosperous Lake areas, Northwest Territories 40-14.

Electrochemical Society—Preprints:

Electrolyte films in acid copper plating baths; electro-galvancing of wire; and electrolytic chromium plate thickness tester; hydrogen and oxygen overvoltages of chromium nickel alloys in a molal potassium hydroxide; phase segregation and its relation to the properties of the system palladium-hydrogen; effect of glycerine on the throwing power of plating baths; electrodeposition of alloys; 1930 to 1940 porosity of lead storage battery plates; electrochemical methods in microchemistry; a study of the kinetics of the reactions in the zinc-hydrogen irreversible cell; the production of ductile titanium; glycerine "foots" as brightening agent in cadmium cyanide baths; electrodeposition of bright copper; the electrodeposition of indium from sulfate baths; addition agents in the electrodeposition of zinc; metallized glass oxygen electrodes; the deposition potentials of metals from fused alkali chloride aluminum chloride baths; the theory of the potential and the technical practice of electrodeposition; production of anhydrous magnesium chloride; electrochemical potential differences at the boundary copper-insulating liquids; amperometric titrations; hydrogen anode; reaction between iron and water in the absence of oxygen; electrolytic polishing of stainless steels; an electrometer tube for laboratory and industrial use; sterilamp its electrical and radiation characteristics. Preprints Nos. 78-1 to 78-27.

Iowa State College Bulletin:

Supporting strengths of cast-iron pipe for water gas service, bulletin 146. Stresses in a curved beam under loads normal to the plane of its axis, bulletin 145.

Northeast Coast Institution of Engineers and Shipbuilders:

List of Members 31st July, 1940.

U.S. Department of the Interior-Geological Survey Water-Supply Papers:

Surface water supply of the United States, 1938, pt. 5—Hudson Bay and Upper Mississippi River Basins, 855; Local overdevelopment of ground-water supplies, 836-E; Surface water supply of the United States 1938, pt. 6—Missouri river basin, 856; Surface water supply of Hawaii, 865.

U.S. Department of the Interior—Geological Survey Bulletin:

Geophysical abstracts 98, July-September 1939, 915-C; geophysical abstracts 97 April-June 1939, 915-B; quicksilver deposits of the Battle Creek district Humboldt county, Nevada 922-A; transit traverse in Missouri, 916-D; manganese deposits in the little Florida mountains Luna County, New Mexico, 922-C; quick silver deposits of the Mount Diablo district Contra Costa County, California, 922-B.

U.S. Department of the Interior-Technical Paper:

Friability, gindability, chemical analyses and high and low-temperature carbonization assays of Alabama coals, 611.

U.S. Department of Commerce—Building Materials and Structures:

Effect of ceiling insulation upon summer comfort, BMS52; Effect of soot on the rating of an oil-fired heating boiler, BMS54.

University of California Press:

Review of the genus aerlurodon by vanderhoof and Gregory; Geology of the Covelo district mendocino county, California by S. G. Clark; Metamorphism in the Southern Sierra Nevada Northeast of Visalia California by C. Durrell.

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

ARTIFICIAL LIGHT AND ITS APPLICATION

Westinghouse Electric & Manufacturing Co., Westinghouse Lamp Division, Bloomfield, New Jersey, 1940. 296 pp., illus., diagrs., charts, tables, 11 x 8½ in., paper, apply.

The history of artificial lighting is briefly surveyed, the units and methods of measuring light are described, and vision and colour are discussed as introduction to drafters which describe modern applications of lighting for all purposes, from ordinary home illumination to photographic work and germicidal radiations. A useful summary of current practice.

CHEMICAL INDUSTRIES

Edited by D. M. Newitt. Chemical Publishing Co., New York, 1940. 364 pp.; bibliography, 79 pp.; illus., diagrs., charts, tables, 11 x 8½ in., cloth, $4.00.

This annual contains a collection of numerical data and information frequently wanted by those in the process industries. The subjects considered are materials of construction, power plant and water treatment, factory equipment and layout, size reduction, separating and grading, handling and transporting, instruments and apparatus, raw materials and fine chemicals. There are also conversion tables, a bibliography, and directories of British manufacturers of supplies and equipment.

COLLECTED RESEARCHES ON CYLINDER WEAR

By C. G. Williams, with foreword by Rt. Hon. Lord Austin. January, 1940, Institution of Automobile Engineers, Automobile Research Committee, London, 1940. 119 pp., illus., diagrs., charts, tables, 9½ x 6½ in., cloth, 10s.

The major part of this work consists of reports on experiments conducted in the laboratory of the Institution of Automobile Engineers. An introductory chapter summarizes published information from other sources, and recent experiences of manufacturers and operators are discussed in a later chapter.

CONSTRUCTION PLANNING AND PLANT

By A. J. Ackerman and C. H. Locher. McGraw-Hill Book Co., New York, 1940. 381 pp., illus., diagrs., charts, maps, tables, 9 x 6 in., cloth, $4.00.

Revised from a series of articles which appeared in "Construction Methods," this book presents practical information on planning, management and procedure for large construction jobs, particularly dams. Many types of construction machinery are fully described, and their efficient operation is explained. There are many diagrams, graphs and tables of useful data.

ELECTRIC CIRCUIT AND MACHINE EXPERIMENTS

By F. W. Hehre and J. A. Balmford. John Wiley & Sons, New York, 1940. 279 pp., diagrs., charts, tables 9 x 6 in., paper, $2.00.

A carefully selected set of experiments designed to cover elementary work in electric machines is presented in this manual. The necessary apparatus, laboratory procedures and safety precautions are described, and an outline of theory precedes each group of experiments. The binding of the manual is such that it will lie flat when open.

ELECTROCAPILLARITY

By J. A. V. Butler. Chemical Publishing Co., New York, 1940. 208 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, $5.00.

This book deals with potential differences at electrified interfaces, the origin and nature of the effects that arise therefrom, and with electrode equilibria and kinetics. The work reviewed is that of the last fifteen years and touches many fields, from the behaviour of proteins to the passivity of metals. Most attention has been given to topics not adequately treated in other works.

ELECTRONIC PROCESSES IN IONIC CRYSTALS

By N. F. Mott and R. W. Gurney. Oxford University Press, New York; Clarendon Press, Oxford, England, 1940. 275 pp., illus., diagrs., charts, tables, 10 x 6 in., cloth, $5.50.

The aim of this book is to develop the theory of the movement of electrons in ionic crystals, and to interpret experimental facts in terms of the theory. The Born theory of cohesion in ionic crystals and the Wagner-Schottky theory of ionic conductions in solids are described as an introduction. The succeeding discussions cover the absorption of light by ionic crystals, with the resulting photo-conductivity and luminescence; the properties of semi-conductors; and the insulating properties of non-conducting materials, including breakdown in high fields. Chemical reactions in solids are briefly considered in the final chapters.

ELEMENTARY FLUID MECHANICS

By J. K. Vennard. John Wiley & Sons, New York, 1940. 351 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $3.50.

In order to present a more comprehensive idea of the basic physical principles of fluid mechanics the mathematical development has been carefully limited. The following topics are discussed: physical properties, fluid statics, frictionless flow, similarity and dimensional analysis, frictional processes, pipe and open-channel flow, measuring apparatus, and flow about immersed objects. Brief bibliographics and groups of problems accompany each chapter.

ENGINES OF DEMOCRACY

By R. Burlingame. Charles Scribner's Sons, New York, 1940. 606 pp., illus., diagrs., maps, 9½ x 6 in., cloth, $3.75.

The history of modern America is viewed in the light of its technological advancement. As the developments in the fields of metallurgy, electrical communication, power, printing, highways, illumination, chemical synthesis, etc., are reviewed, their contribution to our present way of life is stressed. The book closes with a discussion of modern trends and of the social inventions which must follow the technical ones. There are a bibliography, a chronological list of events and inventions, and a very full index.

GREAT BRITAIN. Department of Scientific and Industrial Research. Building Research. Wartime Building Bulletin No. 3. Type Designs for Small Huts

His Majesty's Stationery Office, London, 1940. 22 pp., diagrs., tables, 11 x 8½ in., paper, (obtainable from British Library of Information, 50 Rockefeller Plaza, New York, $0.30).

This pamphlet discusses the wartime construction of one-story buildings to provide living quarters for soldiers, temporary offices and hospitals, etc., using the minimum of timber and steel. Attention is focused upon a hut to provide living accommodation for twenty-four men. A number of type designs are given and discussed critically.

HANDBOOK OF ENGLISH IN ENGINEERING USAGE

By A. C. Howell. 2 ed. John Wiley & Sons, New York, 1940. 433 pp., illus., diagrs., charts, maps, tables, 8 x 5 in., cloth, $2.50.

Rules for proper English covering word selection, sentence construction, style, arrangement, punctuation and grammar are clearly presented. Succeeding chapters discuss the composition of business letters, reports and technical magazine articles. A great many examples from published material are included to demonstrate current practice.

INTRODUCTION TO ELECTRICAL ENGINEERING

By G. V. Mueller. McGraw-Hill Book Co., New York, 1940. 306 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $2.75.

The purpose of this book is to point out the relations, the mathematical expression of the relations, and the graphical interpretations of the expressions in each type of circuit—electric, magnetic and dielectric—under transient as well as steady state conditions. Particular attention is paid to the solution of nonlinear resistance circuits as an approach to the solution of magnetic circuits. Typical oscillograms are used to illustrate important principles. There are many problems, and a group of laboratory experiments is appended.

INVENTORS AND ENGINEERS OF OLD NEW HAVEN

(New Haven Tercentenary Publications). Edited by R. S. Kirby. New Haven Colony Historical Society, New Haven, Conn., 1939. 111 pp., illus., diagrs., 10 x 6 in., cloth, apply to R. S. Kirby, Yale University.

This attractive little volume contains six lectures given under the auspices of the School of Engineering in Yale University. The subjects are: Eli Whitney; Early New Haven inventors; Early Yale inventors; Early Yale engineers; The formative years of New Haven's public utilities; The founding of the Sheffield Scientific School. The book contains a number of excellent portraits and will have permanent interest for students of engineering history.

KINGZETT'S CHEMICAL ENCYCLOPAEDIA

Revised and edited by R. K. Strong, with foreword by Sir G. T. Morgan. 6 ed. D. Van Nostrand Co., New York, 1940. 1088 pp., diagrs., charts, tables, 9 x 6 in., cloth, $14.00.

This book is intended to provide a one-volume reference book upon pure and applied chemistry, which will act as a first aid. Numerous references to more detailed information are included and many trade and proprietary names are present. This edition has undergone considerable revision and new material has been included.

MAKING YOUR PHOTOGRAPHS EFFECTIVE

By J. A. Lucas and B. Dudley. McGraw-Hill Book Co. (Whittlesey House), New York, 1940. 385 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $5.00.

This practical manual discusses all phases of photographic work. Fundamental processes, cameras and other equipment, darkroom construction and print making are described; exposures and lighting problems are considered; and a great variety of methods of work is presented. Many photographs are included to illustrate various parts of the discussion.

MARINE DIESEL ENGINE STANDARDS

Published by Diesel Engine Manufacturers' Association, New York. Edited by M. J. Reed and O. A. Sibley. 1940. 141 pp., diagrs., charts, tables, 9½ x 6 in., cloth, $2.00.

In addition to presenting standard practices for all phases of installation and application in marine work, of Diesel engines and accessories, this book also gives information on standard performances and definitions, classification and marine inspection, and includes some statistical material.

MODERN THEORY OF SOLIDS

By F. Seitz. McGraw-Hill Book Co., New York and London, 1940. 698 pp., diagrs., charts, tables, 9½ x 6 in., cloth, $7.00.

This book surveys the theory of the properties of all types of crystalline solids, treating them from a common viewpoint. Besides dealing with the theory of metals, the book discusses the properties of salts and other insulators as well, showing the factors which account for differences and similarities among these materials.

PRACTICAL MECHANICS AND STRENGTH OF MATERIALS

By C. W. Leigh and J. F. Mangold. 3 ed. McGraw-Hill Book Co., New York, 1940. 498 pp., diagrs., charts, tables, 8 x 5 in., cloth, $3.00.

This volume presents those principles of mechanics and strength of materials that are believed to be essential for the practical man. In order to develop the two subjects as a whole, each chapter on strength of materials is preceded by those principles of mechanics necessary for its presentation. The many illustrative problems are new in this edition, and considerable material has been added.

(The) PYROMETRY OF SOLIDS AND SURFACES

By R. B. Sosman. American Society for Metals, Cleveland, Ohio. 1940. 98 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $2.50.

Three lectures prepared for the American Society for Metals are presented: 1, Scientific foundations of the pyrometry of solids; 2, The pyrometry of metals by means of thermocouples; 3, Radiational pyrometry of solids and surfaces. A brief list of references is included.

REFRIGERATING DATA BOOK, Vol. 2, Refrigeration Applications

American Society of Refrigerating Engineers, New York, 1940. 413 pp.; Catalog Section, 148 pp., illus., diagrs., charts, tables, 9½ x 6½ in., cloth, $4.00.

The "Refrigerating Data Book" published in 1939 covered the principles of refrigeration and the machinery used. The present volume supplements it with a comprehensive account of the industrial applications of refrigeration and air conditioning. Freezing processes, refrigeration in processing, cold storage, food distribution and air conditioning for comfort and in industry are presented practically and thoroughly.

REPORT of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete, submitting Recommended Practice and Standard Specifications for Concrete and Reinforced Concrete; affiliated committees of the American Concrete Institute, American Institute of Architects, American Railway Engineering Association, American Society of Civil Engineers, American Society for Testing Materials, Portland Cement Association

Submitted by American Concrete Institute, Detroit, Mich., 1940. 140 pp., tables, charts, 9 x 6 in., paper, $1.50.

This report consists of three sections: (1) Recommended practice, which covers scope and definitions and details of design and construction; (2) Standard specifications, covering materials, proportioning, mixing, etc., and forms and details of construction; and (3) Appendices containing information on the effect of various substances on concrete, on protective treatments, support moments, and curing, and a list of the specifications cited.

SEWAGE TREATMENT

By K. Imhoff and G. M. Fair, with discussion of industrial wastes by E. W. Moore. John Wiley & Sons, New York, 1940. 370 pp., diagrs., charts, tables, 8½ x 5½ in., cloth, $3.00.

Modern practice in the design of sewage-treatment plants is discussed in a clear, concise manner, including the problem of industrial wastes. Diagrams, graphs and tables of data are freely used; a section of sample calculations is included; and there is a broadly classified reading list. North American requirements and practices are referred to especially.

SILVER IN INDUSTRY

Edited by L. Addicks. Reinhold Publishing Corp., New York, 1940. 636 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $10.00.

A summary of three years' research on silver and its industrial applications is presented in twenty chapters written by the editor and other authorities. Topics discussed include physical and mechanical properties, alloys, commercial production, silver coating methods, electrical and catalytic applications, corrosion properties, and the use of silver in bearings, germicides, photography, coinage, the decorative arts, etc. There is a very large bibliography, a serial list of U.S. patents and a classified list of patents of all countries. This exhaustive review will be indispensable to all workers with the metal.

SIMPLIFIED CARPENTRY ESTIMATING

By J. D. Wilson and C. M. Rogers. Simmons-Boardman Publishing Corp., New York, 1940. 204 pp., illus., diagrs., charts, tables, 7 x 5 in., cloth, $2.50.

In estimating for house construction, it is necessary first to know what materials are needed and how they are properly used. This information together with methods for determining quantities is presented in a logical, simple manner. There are many useful reference tables.

STRUCTURAL PLANNING AND DESIGN

By W. Glendinning. Apply to author, 5123 Bell Boulevard, Bayside, Long Island, N.Y., 1940. 87 pp., diagrs., 11 x 8 in., paper, manifold, $2.10.

This book contains the solutions of problems on structural planning and design given to applicants for the license of Professional Engineer by the New York State Board of Examiners. Over 160 problems are given, being those given in the examinations from January 1933 to January 1940. The problems are indexed by classes. The book will be of value to those preparing for examination.

TELEVISION BROADCASTING

By L. R. Lohr, with a foreword by D. Sarnoff. McGraw-Hill Book Co., New York, 1940. 274 pp., illus., diagrs., maps, charts, tables, 9 x 6 in., cloth, $3.00.

Television broadcasting is discussed in all its aspects, including its effect on society; operating techniques and equipment; program considerations, especially the economic, legal and technical problems; the co-ordination required for presentation; and the advertising potentialities. Two appendices contain a typical television script with production directions, and the Federal Communications Commission rules governing stations.

THEORY OF GROUP CHARACTERS AND MATRIX REPRESENTATIONS OF GROUPS

By D. E. Littlewood. Oxford University Press, New York; Clarendon Press, Oxford, England, 1940. 292 pp., diagrs., tables, 10 x 6½ in., cloth, $5.50.

This book presents a simple, self-contained account of the theory of group characters in its application to finite and continuous matrix groups, and elaborates some of its applications. Preliminary chapters on matrices, algebras and groups precede the development of the theory. Applications to the theory of symmetric functions and to the structure of groups are dealt with in some detail. In the last two chapters the theory is generalized to certain continuous matric groups. There are twenty pages of character tables and a large bibliography.

THORPE'S DICTIONARY OF APPLIED CHEMISTRY, Vol. 4

By J. F. Thorpe and M. A. Whiteley. 4th ed. London, New York and Toronto, Longmans, Green and Co., 1940. 603 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $25.00.

Thorpe's Dictionary is too well known to need an introduction, for it has maintained its position as the leading reference work in its field for many years. In this edition the dictionary style is combined with the use of the monograph where the latter treatment seems suitable. The monographs contain the history of their subject and a concise account of its modern position. Among the subjects which receive extended treatment in the present volume may be mentioned: Disinfectants, Drying and dessication, Industrial dust and dust explosions (68 pages), and Azo-dyestuffs (49 pages). Over one hundred pages are devoted to Explosives.

TROUBLES OF ELECTRICAL EQUIPMENT

By H. E. Stafford. 2 ed. McGraw-Hill Book Co., New York, 1940. 373 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.00.

This book covers the symptoms, causes and remedy of troubles of both alternating-current and direct-current apparatus usually found in the average industrial plant. It also includes many practical hints on efficient operation and maintenance. Diagrams are extensively used, and all formulas are illustrated by practical examples.

VARIABLE BUDGET CONTROL, Through Management by Exception and Dynamic Costs

By F. V. Gardner, with a foreword by C. R. Messinger. McGraw-Hill Book Co., New York and London, 1940. 357 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

This treaties on variable budget control shows what it is, demonstrates its advantages over static budgeting, and describes and illustrates in detail how to develop, install and administer a variable budget system. The object of the book is to explain how to develop controls that show what is happening in a business rather than what has happened.

VECTOR METHODS, Applied to Differential Geometry, Mechanics, and Potential Theory

By D. E. Rutherford. Oliver and Boyd, Edinburgh and London; Interscience Publishers, New York, 1939. 127 pp., diagrs., 7½ x 5 in., cloth, 4s. 6d., $1.50.

The purpose of this little book is to provide on the one hand a clear account of the abstract theory of the vector calculus and, on the other, a brief but broad survey of the applications of the theory to various branches of pure and applied mathematics. It is intended for the use of undergraduates.

WILEY TRIGONOMETRIC TABLES

New York, John Wiley & Sons, 1940. 81 pp., tables, 9 x 5½ in., cloth, $0.75.

This collection aims to present, with accuracy and in clear type, the tables most used by students of trigonometry. The tables are: squares and square roots; constants with their common logarithms; natural logarithms of numbers; five-place logarithms of numbers; logarithms of functions; and four-place values of functions and radians.

Mr. R. McDowall, M.E.I.C., has kindly offered to donate to any member or to any institution, the following publications:

12 volumes of Engineering News of New York from 1886 to 1894.

13 volumes of Engineering Record of New York from 1905 to 1911, all bound in cloth.

These may be secured through the Institute or by writing to R. McDowall Esq., M.E.I.C., Owen Sound, Ont.

PRELIMINARY NOTICE

of Applications for Admission and for Transfer

October 31st, 1940

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

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

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

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

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

The Council will consider the applications herein described in December, 1940.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

A 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 attainment 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

BLOWEY—JOHN FREDERICK GILL, of 2337 Windermere Road, Windsor, Ont. Born at Torquay, Devon, England, Oct. 24th, 1903; Educ.: Bach. Mech. Engrg., Detroit Institute of Technology, 1938; 1928-37, asst. in charge, production welding and welder constrn. and 1937 to date, supervisor of trade school, Ford Motor Company of Canada, Windsor, Ont.

References: J. E. Porter, J. C. Keith, G. W. Lusby, H. S. Clark, J. B. Dowler.

BRAY—COLIN, of 1139 6th Ave. W., Calgary, Alta. Born at Pincher Creek, Alta., April 21st, 1888; Educ.: I.C.S. Civil Engrg. Course; 1907, chainman, Columbia Valley Irrigated Fruit Lands Ltd., Wilmer, B.C.; 1908, rodman, 1909-10, leveller, Canada Land & Irrigation Co., Medicine Hat; 1911-12, leveller, C.P.R., Irrigation Dept., Brooks; 1913-, i/c surveys, Western Engrg. Co., Medicine Hat; 1914, instr'man., engrg. dept., City of Medicine Hat; 1915-19, overseas, C.E.F.; 1919, instr'man., irrigation br., Dept. of the Interior, Calgary; 1920-21, land appraiser, Soldier Settlement, Calgary; 1921-23, dftsman., instr'man. and senior engrg. Clerk, irrigation br., Dept. of the Interior, Calgary; 1924-29, land appraiser and field supervisor, Soldier Settlement; 1930, dftsman., irrigation br., Dept. of the Interior, Calgary; 1931-32, concrete inspr., City of Calgary; 1933, instr'man., Dept. of Public Works, Edmonton; 1934-35, i/c surveys, bldgs., sewers, water mains and roads, Currie Barracks, M.D. No. 13, Calgary; 1935 to date, senior dftsman., Prairie Farm Rehabilitation, Calgary, Alta.

References: B. Russell, J. R. Wood, O. H. Hoover, M. H. Marshall, W. L. Foss;

CAMPBELL—NOEL, of 28 Prado Place, Riverside, Ont. Born at Windsor, Ont., Dec. 28th, 1915; Educ.: B. Eng. (Mech.), McGill Univ., 1938; 1938 to date, engrg. dept., Ford Motor Company of Canada, Windsor, Ont.

References: J. E. Porter, V. N. MacIsaac, W. D. Donnelly, J. B. Candlish, J. E. Daubney.

DUGAL—FERNAND, of 6588 Christophe Colomb St., Montreal, Que. Born at Three Rivers, Que., June 11th, 1914; Educ.: B. Eng. (Mech.), McGill Univ., 1939; 1935-36-37 (summers), Quebec Bureau of Mines, and International Nickel Co.; Summer 1938, and 1939-40, aircraft divn., Canadian Car & Foundry Co. Ltd.; 1940 (Feb.-May), Dept. of National Defence; June 1940 to date, mech. dftsman., Defence Industries Ltd., Montreal.

References: R. DeL. French, C. M. McKergow, E. Brown, G. J. Dodd, G. A. Wallace.

GIBSON—CEDRIC M., of 44 Southwood Drive, Toronto, Ont. Born at Farnham, Que., Feb. 4th, 1895; Educ.: Private study; 1912-13, chainman, rodman, C.P.R., Farnham; 1913-15, struct'l. steel detailing, McKinnon Holmes Steel Co. Ltd., Sherbrooke, Que.; 1915-32, gen. plant engrg., mech'l., struct'l. steel and reinforced concrete design and plant layout, Canada Cement Co. Ltd., Montreal; 1932-33, private practice as struct'l. engr.; 1933-38, sale engr., Jeffrey Mfg. Co. Ltd., Montreal. 1938 to date, engr., Link-Belt Ltd., Toronto,

References: C. Stenbol, F. B. Kilbourn, A. G. Fleming, D. M. Chadwick, C. S. Kane, R. O. Stewart.

GUNG—SIMON FENWICK, of 131 Winnett Ave., Toronto, Ont. Born at Victoria, B.C., Sept. 25th, 1914; Educ.: Diploma, Central Technical School, Toronto, 1936; 1933 to date, military engrg.; 1936-37, Canadian Jefferson Electric Co. Ltd.; 1937-38, aircraft dfting., 1938-39, asst. in charge of progress and production, and 1939 to date, chief dftsman. (engrg. dept.), DeHaviland Aircraft Co. of Canada Ltd., Toronto, Ont. (Applying for admission as Affiliate).

References: W. B. Redman, T. R. Loudon, G. R. Conrod, F. H. C. Sefton, D. Shepherd.

KELLY—JOSEPH JOHN, of Hamilton, Ont. Born at Toronto, Oct. 2nd, 1909; Educ.: B.A.Sc. (Elec.), Univ. of Toronto, 1932; 1933 to date, with the Lincoln Electric Company of Canada Ltd., in the development of arc welding and its application to industrial processes, and at present, manager, Hamilton District Office.

References: E. G. Wyckoff, A. Love, W. J. W. Reid, A. C. Macnab, W. A. T. Gilmour.

LAUGHTON—JAMES ALEXANDER, of Hamilton, Ont. Born at Brandon, Man., July 29th, 1909; Educ.: B.Sc. (C.E.), Univ. of Man., 1935; 1929-30, chainman, C.P.R. constrn.; 1933, Manitoba Govt. land survey; 1930-31, chief clerk to asst. engr., C.P.R. constrn.; 1935-38, engr., Canadian Brown Steel Tank Co.; 1938, engr., McKinnon Industries; 1938-40, engr., Lincoln Electric Co. of Canada Ltd.; At present, welding engr., shop supt., Hamilton Bridge Co. Ltd., Hamilton, Ont.

References: T. C. Macnabb, A. Love, H. J. A. Chambers, A. W. Sinnamon, G. A. Colhoun, R. E. Smythe, J. N. Finlayson.

McGORMAN, DONALD, of Wallaceburg, Ont. Born at Walkerville, Ont., June 2nd, 1912; Educ.: B.A.Sc. (Mech.), Univ. of Toronto, 1935; 1937 to date, supt., Schultz Die Casting Co., Wallaceburg, Ont.

References: F. H. Kester, J. C. Keith, J. E. Porter, P. E. Adams, C. M. Goodrich.

ROBINSON—RICHARD HENRY, of Winnipeg, Man. Born at Winnipeg, April 30th, 1908; Educ.: B.Sc. (C.E.), Univ. of Man., 1928; 1928-29, demonstrator, (plus M.Sc. work), Univ. of Man.; 1925-28 (summers), instr'man., tech. dftsman., C.P.R., on constrn., Carter-Halls-Aldinger, dftsman., Dom. Bridge Co.; 1936-38, asst. sales mgr., J. J. H. McLean & Co., Electric Appliances; with the Vulcan Iron Works Ltd., as follows: 1929-33, dftsman., 1935-36, design, power and heating boilers, struct'l. and mining equipment, 1938 to date, sale engr., respons. for power and heating installns., mining sales and engrg.

References: H. L. Briggs, E. S. Braddell, T. E. Storey, G. H. Herriot, W. F. Riddell, J. N. Finlayson.

SAUNDERS—MELVILLE SYDNEY, of 151 Erskine Ave., Toronto, Ont. Born at Toronto, Feb. 24th, 1910; Educ.: B.A.Sc. (Civil), Univ. of Toronto, 1933; 1929-30-31-33 (summers), timber cruising, Ont. Forestry Br., house constrn., township surveys, H. W. Sutcliffe Co., instr'man., Toronto and York Roads Commn.; 1934-35, junior engr. and dftsman., Minefinders Ltd., Toronto; 1935, engr. i/c diamond drill operation, McDonald Gold Mines Ltd.; 1936, dftsman., Mining Corporation of Canada, technical supervisor, Aerofilms Ltd., London, England; 1936-37, engr., Big Master Consolidated Gold Mines; 1937, dftsman., Mich. Central Railroad; 1938, engr., Denison Nickel Mines; Aug. 1938 to date, topographic engr., plane table surveys, precise boundary surveys, levelling, etc., Tropical Oil Co., Colombia, S.A.

References: J. H. Addison, W. L. Sagar, W. J. Shaw, R. E. Smythe, C. R. Young.

SIMARD—JOSEPH W., of Montreal, Que. Born at Montreal, June 14th, 1885; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1908; 1908-10, gen. engrg.; 1910-18, contracting engr.; 1918-27, finance engr.; 1928-40, well drilling engrg. in Europe and Africa, International Water Supply Limited.

References: deG. Beaubien, A. Frigon, T. J. Lafreniere, O. O. Lefebvre, A. Surveyer.

FOR TRANSFER FROM JUNIOR

AKERLEY—WILLIAM BURPEE, of 8 Barker St., Saint John, N.B. Born at Saint John, Jan. 6th, 1907; Educ.: B.Sc. (C.E.), Univ. of N.B., 1932; 1934-35, asst. engr., Miramichi Lumber Co., Minto, N.B.; 1935-36, junior instr'man., 1936-37, instr'man., 1937-39, asst. engr., Dept. of Highways of N.B.; 1939 to date, Works Officer, Lieut., R.C.E., Dept. of National Defence, Saint John, N.B. (St. 1932, Jr. 1936).

References: W. H. Blake, D. R. Smith, J. T. Turnbull, E. O. Turner, J. P. Mooney, A. A. Turnbull.

CLIMO—PERCY LLOYD, of Chandler, Que. Born at Cobourg, Ont., Oct. 17th, 1906; Educ.: B.Sc., Queen's Univ., 1932; 1928-29 (summers), mach. shop ap'tice. John Bertram & Sons, Dundas, Ont.; 1930, inst'man., R.C.A.F. Training Station, Trenton; 1932 (Apr.-Oct.), field engr., Gardner Construction Co., Welland; 1932-34, municipal engr., sewer constrn., Town of Cobourg, Ont.; 1934-40, with Hollinger Consolidated Gold Mines Ltd., Timmins, Ont., as follows: 6 mos. mill office record clerk, 9 mos. milling mach. mtce., 13 mos. mine survey helper, 3½ years, mech. dftsman.; at present, mech. engr., Gaspesia Sulphite Co. Ltd., Chandler, Que. (St. 1928, Jr. 1934).

References: L. M. Arkley, L. T. Rutledge, D. S. Ellis, H. G. Bertram, W. B. Wilson.

LOCHHEAD—KENNETH YOUNG, of Vancouver, B.C. Born at Lachine, Que., Sept. 26th, 1907; Educ.: B. Eng., McGill Univ., 1932; with the Hudson's Bay Company as follows: 1933-34, asst. to plant engr. (Winnipeg store), 1934-37, asst. to supt. of bldgs., and 1937 to date, supt. of bldgs., i/c of bldg. mtce., and struct'l. alterations; mech. plant operation, mtce. and alteration; delivery fleet mtce. and operation, Vancouver, B.C. (St. 1931, Jr. 1935).

Reference: D. Boyd, G. J. Dodd, R. DeL. French, R. C. Pybus.

MINARD—GUY McRAE, of Montreal, Que. Born at Ottawa, Dec. 19th, 1906; Educ.: B.Sc., Queen's Univ., 1928; Summers: 1923-24, asst. lab. for testing materials, Dept. of Public Works, Ottawa; 1925-26, chemist, 1928, chemist and works foreman, Jas. Weir Co. Ltd., New Toronto; 1927, transitman, rly. constrn., T. & N.O. Rly.; with the Spruce Falls Power & Paper Co. Ltd., Kapuskasing, Ont., as follows: 1928-29, chem. engr., 1929-30, asst. to supt., supervision of chem. lab., water filtration plant; 1930-40, supt., tech. dept., complete control of paper mill tech. work, process control, research, etc. (now on leave of absence); at present, Pilot Officer, R.C.A.F., Aero-Engineering School, Montreal, Que. (Jr. 1929).

References: T. R. Loudon, J. W. Roland, L. F. Goodwin, E. Viens, C. W. Boast, A. M. Wilson.

PATRIQUEN—FRANK ANDREW, of Manawagonish Road, Fairville, N.B. Born at Apohaqui, N.B., Aug. 2nd, 1906; Educ.: B.Sc. (Elec.), 1930, B.Sc. (Civil), 1931, Univ. of N.B.; R.P.E. of N.B.; 1931-37, junior engr., National Harbours Board; 1937-38, instr'man., Dept. of Highways of N.B.; 1938-40, dftsman., and at present, junior engr., Dept. of Public Works of Canada, Saint John, N.B. (St. 1930, Jr. 1934).

References: A. Gray, V. S. Chesnut, A. R. Crookshank, J. P. Mooney, D. R. Smith.

PICHE—JOSEPH ALPHONSE ARTHUR, of 28 Murray Ave., Quebec, Que. Born at Montreal, Jan. 14th, 1907; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1930; R.P.E. of Que.; 1928-29 (summers), engr. helper, Welland Ship Canal; 1931-32, sales engr. and combustion engr., Anthracite Coal Service Regd., Montreal and Quebec; 1935-37, drainage engr., Dept. of Agriculture, Prov. of Quebec; 1937 to date, asst. engr., Dept. of Public Works of Canada, Quebec, Que. (Jr. 1931).

References: A. Frigon, E. P. Murphy, A. R. Decary, A. Circe, L. G. Trudeau.

STRATTON—WILLIAM DONALD GEORGE, of 28 Exmouth St., Saint John, N.B. Born at Saint John, Dec. 20th, 1906; Educ.: B.Sc. (C.E.), Univ. of N.B., 1929; 1926-27-28 (summers), Dom. Topog. Survey, and instr'man., N.B. Highway Divn.; 1929-33, toll line engrg. office, Bell Telephone Company of Canada, Ottawa and Montreal; 1934-35 (intermittent), inspr. of drilling and dredging, Dept. Public Works of Canada, Saint John; 1935, instr'man., 1936-40, res. engr., N.B. Highway Divn.; at present, res. engr., civil aviation branch, Dept. of Transport, Saint John, N.B. (St. 1929, Jr. 1936).

References: G. Stead, J. T. Turnbull, J. Stephens, A. R. Crookshank, D. R. Smith.

WHEATLEY—ERIC EDMUND, of Grand'Mere, Que. Born at Montreal, Sept. 2nd, 1907; Educ.: B.Sc., McGill Univ., 1930; R.P.E. of Que.; 1930-32, mech. dfting. and design, Dominion Bridge Co. Ltd.; 1932-35, instructor, mech. engrg. dept., McGill Univ., Montreal; 1935-36, sales engr., Jenkins Bros. Ltd.; 1936-39, chief dftsman. i/c drawing office and estimating dept., Canada Iron Foundries Ltd., Three Rivers; at present, asst. to divn. engr., Consolidated Paper Corporation Ltd., Laurentide Divn., gen. paper mill engrg., design and estimating. (St. 1930, Jr. 1935).

References: W. B. Scott, H. G. Timmis, F. W. Bradshaw, K. S. LeBaron, C. M. McKergow.

FOR TRANSFER FROM THE CLASS OF STUDENT

BELLAMY—KEITH LACY, of 2548 Taylor St., Niagara Falls, Ont. Born at Niagara Falls, Dec. 20th, 1911; Educ.: B.Sc. (Elec.), Queen's Univ., 1935; 1936 to date, in business as electrical contractor, Niagara Falls, Ont. (St. 1934).

References: D. M. Jemmett, L. M. Arkley, W. D. Bracken, R. A. Low.

BRANNEN—EDWIN RALPH, of Asbestos, Que. Born at North Devon, N.B., Jan. 28th, 1912; Educ.: B.Sc. (Elec.), Univ. of N.B., 1935; 1937 to date, chief inspr. i/c mill laboratory, Canadian Johns-Manville Co. Ltd., Asbestos, Que. (St. 1935).

References: A. F. Baird, J. Stephens, B. H. Hagerman, E. O. Turner, L. A. Wright, L. Trudel, J. R. Carter.

BUTLER—JOHN ARTHUR TWEED, of 637 Grosvenor Ave., Westmount, Que. Born at Calgary, Alta., Jan. 3rd, 1912; Educ.: B. Eng. (Mech.), McGill Univ., 1934; 1929-30 (5 mos.), junior dftsman., Dominion Bridge Co. Ltd., Lachine; 1932-33 (summers), chem. lab. tests, and 1934-37, St. Lawrence Sugar Refineries Ltd., Montreal, 6 mos. factory routine, dfting. and mtce., and 2 years, foreman in production dept.; 1937-38, shop fitter, aircraft dftsman., and aircraft stress analyst, Westland Aircraft Ltd., Yeovil, England; Jan. 1939 to date, chief stress analyst, Fairchild Aircraft Ltd., Longueuil, Que. (St. 1931).

References: E. Brown, A. Peden, O. R. Brumell, C. M. McKergow, A. R. Roberts.

CARTIER—LEONARD, of Montreal, Que. Born at Sorel, Que., Feb. 12th, 1913; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal. R.P.E. of Que., Summers; 1937, dftsman. and asst. engr., 1939, transitman and engr., Quebec Roads Dept., 1938, student engr., Southern Canada Power Co.; Oct. 1938 to date, lab. asst., hydraulic lab., Ecole Polytechnique, Montreal, Que. (St. 1936).

References: A. Frigon, A. Circe, A. Gratton, L. Trudel, L. Perrault, P. P. Vinet.

CHAMBERS—ROBERT, of 4 Summit Ave., Shawinigan Falls, Que. Born at Edmonton, Alta., Nov. 4th, 1910; Educ.: B.Sc. (Elec.), Univ. of Alta., 1937; 1937 to date, field engr., Shawinigan Water & Power Co., Montreal, Que. (St. 1937).

References: R. E. Heartz, W. E. Cornish, J. A. McCrory, C. R. Lindsey.

DAVIDSON—GEORGE ROSS, of Prince Rupert, B.C. Born at Pincher Creek, Alta., Mar. 2nd, 1913; Educ.: Grad., R.M.C., 1935; 1930-31, chainman and rodman, C.P.R.; 1935 to date, with the Royal Candn. Army Service Corps., as officer i/c transport, supplies, etc., at London, Calgary, Victoria and Prince Rupert, B.C. (St. 1934).

References: L. F. Grant, H. H. Lawson.

DEMCOE—JOHN WILLIAM, of 1233 Yonge St., Toronto, Ont. Born at Kenora, Ont., April 18th, 1912; Educ.: B.Sc. (C.E.), Univ. of Man., 1929; 1934 (summer), chainman, rodman, 1934-35, dftsman. on location and constrn., Ont. Dept. of Northern Development; 1935-36, instr'man., on constrn., 1937 (summer), dftsman. on constrn., Ont. Dept. of Highways; 1938 (summer), asst. engr., 1939 (summer), miner, Bankfield Cons. Mines Ltd.; 1939-40, struct'l. dftsman., and at present, asst. divnl. engr., C.N.R., Toronto, Ont. (St. 1938).

References: E. G. Hewson, J. R. Paget, R. O. Paulsen, A. E. Macdonald, G. H. Herriot.

DESJARDINS—ROGER, of 1621 St. Hubert St., Montreal, Que. Born at Quebec, Que., Mar. 12th, 1913; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal; 1935-37-39 (summers), with the Prov. of Quebec Dept. of Roads, Dept. of Mines and Dept. of Health; May 1939 to date, engr., Public Service Board of the Province of Quebec. (St. 1937).

References: J. A. Beauchemin, A. B. Normandin, T. J. Lafreniere, G. V. Douglas, A. Circe.

DUFOUR—GASTON, of Arvida, Que. Born at Montreal, April 11th, 1911; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1937; 1937-38, asst. engr., Brown Corporation, La Tuque, Que.; 1938-40, asst. to district engr., Public Works of Canada, Quebec; at present engr., Aluminum Company of Canada, Arvida, Que. (St. 1936).

References: M. G. Saunders, L. G. Trudeau, A. C. Johnston, A. R. Decary.

FORD—JOHN FRANKLIN, of 17 Avenue Road, Toronto, Ont. Born at Milton, Ont., May 13th, 1913; Educ.: B.A.Sc., Univ. of Toronto, 1939; 1937 (summer), constrn. mechanic, Rayner Constrn. Co.; 1938 (summer), timkpr. and cost acct., Standard Paving Co.; 1939 (summer), asst. job engr., Foundation Co. of Canada; Sept. 1939 to date, job engr., Russell Construction Co., Toronto, Ont. (St. 1939).

References: J. J. Spence, R. F. Legget, J. H. Russell, A. E. Berry, M. B. Watson.

FOSTER—IAN McLEOD, of La Tuque, Que. Born at Washford, Somerset, England, Mar. 22nd, 1910; Educ.: B. Eng., McGill Univ., 1937; 1933-36, summer work at McGill Univ.; 1937 to date, mech. engr., Brown Corporation, La Tuque, Que. (St. 1937).

References: C. Luscombe, H. J. Racey, G. R. Rinfret, C. M. McKergow, E. Brown.

FRENCH—PHILIP BEMIS, of Montreal, Que. Born at Louisville, Ky., Dec. 2nd, 1910; Educ.: B. Eng., McGill Univ., 1934; 1931-33-34 (summers), rodman, survey party, Seigniory Club, dfting. and mtce., Canadian Celanese Ltd., cast iron, steel and bronze analysis and physical tests, Dom. Bridge Co. Ltd.; Oct. 1934 to date, sales engr., Canadian SKF Co. Ltd., Montreal, Que. (St. 1934).

References: P. E. Poitras, L. A. Wright, D. Giles, G. J. Dodd, E. Brown.

GERSHFIELD—MAX, of 371 College Ave., Winnipeg, Man. Born at Winnipeg, Sept. 18th, 1913; Educ.: B.Sc. (E.E.), Univ. of Man., 1937; 1936-37 (summers), plant inspr., sub-grade inspr., Manitoba Good Roads Board; 1938 to date, asst. supt., Radio Oil Refineries, Winnipeg, Man. (St. 1937).

References: A. E. Macdonald, G. H. Herriot, W. F. Riddell, N. M. Hall, J. W Dorsey, W. J. Dubesky, E. P. Fetherstonhaugh.

GERVAIS—AIME, of 3462 Laval, Montreal, Que. Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1938; 1937 (summer), Quebec Dept. of Roads; 1938 to July 1940, technical secretary, engrg. dept., Provincial Electricity Board, and Aug. 1940 to date, same position with the Public Service Board, Montreal, Que. (St. 1936).

References: A. Frigon, O. O. Lefebvre, J. A. Beauchemin, A. Circe, L. A. Duchastel.

GREEN—JOHN SCOTT, of Toronto, Ont. Born at Simcoe, Ont., April 29th 1911; Educ.: B.A.Sc., Univ. of Toronto, 1934; 1930 (summer), American Can Co., Simcoe; 1931-32-33 (summers), and 1933-34, asst. to county engr., County of Haldimand; 1935-40, sale engr., handling metallurgical and other technical problems, William Jessop & Sons Ltd., Toronto; at present aircraft examiner, British Air Commission. Toronto, Ont. (St. 1931).

References: W. S. Wilson, R. E. Smythe, J. J. Spence, R. W. Angus, E. A. Allcut.

HAMILTON—CECIL ROY, of Calgary, Alta. Born at Weymouth, N.S., April 23rd, 1912; Educ.: B.Sc., N.S. Tech. Coll., 1934; 1932-33 (summers), surveying and mach. shop work; 1934-35, gen. mech. work; 1936-37, service stn. attendant and mgr.; 1937-39, stock room clerk, and at present, accounts receivable clerk, accting. dept., Ford Motor Co. of Canada Ltd., Calgary, Alta. (St. 1930).

References: S. G. Coultis, P. F. Peele, J. McMillan, D. G. Tapley, F. H. Sexton.

HERTEL—ALFRED FREDERICK, of 8 Dundas St. W., London, Ont. Born at London, Ont., April 24th, 1913; Educ.: B.Sc. (Civil), Queen's Univ., 1936; 1936-37, engr's dept., City of London; 1937 (3 mos.), instr'man., Lake Erie Shore survey; 1938 (3 mos.), divn. engr's. office, C.N.R.; 1938 (3 mos.), asst. to Elgin County Engr.; July 1938 to date, junior engr., Dept. of Public Works of Canada, London, Ont. (St. 1937).

References: H. F. Bennett, W. M. Veitch, R. W. Garrett, J. Ferguson, F. A. Bell, D. S. Scrymgeour.

HEWITT—HERBERT EUGENE, of 176 McNaughton St., Sudbury, Ont. Born at McLeod, Alta., July 5th, 1912; Educ.: B.Sc. (Civil), Univ. of Alta., 1936; 1934 (summer), rodman, Geodetic Survey of Canada; 1935-38, engr., Mohawk Bituminous Mines; 1938 (summer), dftsman. and instr'man., F. C. Lane, O.L.S., Sudbury; at present, engr., Sudbury Hydro-Electric Commission and City of Sudbury waterworks dept. (St. 1936).

References: R. S. L. Wilson, H. R. Webb, F. A. Brownie, N. G. McDonald.

HURTUBISE—JACQUES EDOUARD, of Montreal, Que. Born at Montreal, Oct. 3rd, 1911; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1934; 1937-38, designing, reinforced concrete, Baulne and Leonard, Montreal; 1934-37, instructor, testing materials lab., and at present, i/c of laboratory, Ecole Polytechnique, Montreal, Que. (St. 1934).

References: A. Frigon, A. Circe, J. A. Lalonde, A. Duperron, T. J. Lafreniere, A. Cousineau.

LeBEL—RAYMOND, of 4387 Christophe Colomb St., Montreal, Que. Born at Montreal, Dec. 18th, 1912; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1939; summer work with Quebec Streams Commission; 1939 (2 mos.), Quebec Roads Dept., 1939-40, asst. engr., Montreal, Divn., Dept. of Public Works of Canada; March 1940 to date, engr., J. M. Eugene Guay Inc., consltg. engrs., Montreal, Que. (St. 1938).

References: A. Circe, L. Trudel, J. A. Lalonde, A. Frigon, W. J. Manning, P. P. Vinet.

MacKAY, NORMAN ALLISON, 43 Rigby Road, Sydney, N.S. Born at Sydney, April 17th, 1913; Educ.: B. Eng. (Mech.), McGill Univ., 1939; 1937 (summer), boiler erecting, Babcock-Wilcox, 1938-39, shop production engrg., Canada Metal Co. Ltd., 1934 (summer) and 1935-36, mech. dept., and 1939 to date, lubricant engr., Dominion Steel & Coal Corporation, Sydney, N.S. (St. 1937).

References: A. Sutherland, C. M. McKergow, W. S. Wilson, J. A. MacLeod, M. W. Booth.

PETERS—JAMES HORSFIELD, of Brownsburg, Que. Born at Annapolis Royal, N.S., June 19th, 1912; B.Sc. (Chem.), Univ. of N.B., 1933. 1933-35, two years, chem. engrg., McGill Univ.; 1933 (summer), field work, Geol. Survey of Canada; 1935 (summer), gen. plant work, Warren Bituminous Paving Co.; 1935-36, research and development, at Beloeil, and 1936-39, metal and chemical analysis, etc., Canadian Industries Ltd., Brownsburg, Que.; at present, shift supervisor, Defence Industries Ltd., Brownsburg, Que. (St. 1935).

References: C. H. Jackson, H. B. Hanna, H. C. Karn, A. B. McEwen, E. B. Jubien.

PLAMONDON—SARTO, of Amos, Que. Born at Montreal, June 7th, 1913; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1936; 1936 to date, asst. sanitary engr., Ministry of Health, Province of Quebec. (St. 1936).

References: T. J. Lefreniere, A. Frigon, O. O. Lefebvre, A. Lariviere, A. Duperron, A. Circe.

(*Continued on page 497*)

Employment Service Bureau

The Service is operated for the benefit of members of The Engineering Institute of Canada, and for industrial and other organizations employing technically trained men—without charge to either party. Notices appearing in the Situations Wanted column will be discontinued after three insertions, and will be re-inserted upon request after a lapse of one month. All correspondence should be addressed to THE EMPLOYMENT SERVICE BUREAU, THE ENGINEERING INSTITUTE OF CANADA, 2050 Mansfield Street, Montreal.

SITUATIONS VACANT

RECENT GRADUATE in electrical or mechanical engineering for plant manufacturing electrical wires and cables and telephone equipment. Apply to Box No. 2176-V.

GRADUATES in civil, mechanical, electrical, metallurgical and chemical engineering, and ELECTRICAL DRAUGHTSMEN for work with large Canadian company. Applications should be accompanied with photo, list of references and synopsis of experience. Apply to Box No. 2177-V.

EXPERIENCED PAPER MILL DRAUGHTSMAN for modern paper mill. Good living conditions. Permanency and good salary for suitable man. Apply Box No. 2190-V.

METALLURGICAL OR MECHANICAL GRADUATE with some knowledge of and preferably experience in non-ferrous metallurgy for production and laboratory tests, etc., location in Toronto. Apply Box No. 2210-V.

JUNIOR EXECUTIVE ENGINEER.—Chemical or Mechanical engineer with considerable pulp and paper mill experience and ability to handle administrative problems, required to act as assistant to Paper Division manager. Extremely attractive position. The salary to be paid will depend upon the applicant's experience. Apply giving complete information to Box No. 2221-V.

MECHANICAL ENGINEER with plant engineering experience. Required to act as assistant to the chief engineer of Paper Division. The work will include draughting, engineering studies and development. The salary to be paid will be between $250 and $300 a month. Apply giving complete information to Box No. 2222-V.

GRADUATE CHEMIST of two or more years experience to do inorganic and analytical work for essential war industry. Apply with full particulars, references and photograph to Box No. 2225-V.

CALLING ALL ENGINEERS!

Any engineers who are so situated that they can get leave of absence in order to participate in some phase of war industry are requested to communicate with Headquarters.

SITUATION WANTED

MANUFACTURING EXECUTIVE, M.E.I.C. Services of steel plant executive having mechanical and shell manufacturing experience available to company contemplating installing munitions equipment. Capable of assuming complete responsibility for plant layout, tooling and production. Apply to Box No. 67-W.

SPECIAL ENLISTMENT—R.C.A.F. WIRELESS AND ELECTRICAL MECHANICS (R)

1. Men with experience on modern radio are urgently required for service in the R.C.A.F. Overseas.

Graduate engineers of this type are specially qualified for commissions.

2. These men are required for the maintenance of various types of radio equipment used by the R.C.A.F. Knowledge of the Morse Code is not necessary, but applicants should have a good practical knowledge of modern superheterodyne receivers and of servicing and fault-finding. They should preferably have some experience on short-wave receivers and should have mastered at least the elementary basic principles of radio transmission and reception. Men who have had knowledge in the servicing of the better types of radio receivers for some time are particularly suitable, as are radio amateurs who have operated their own radio transmitting sets.

3. The applicants must have the following qualifications:

(a) Be between the ages of 18 and 45.

(b) Have education equivalent to High School Entrance.

(c) Medical category "A" or "AV", colour vision safe.

(d) Must pass a special trade test.

4. Applicants who can pass the trade test are to be enlisted as Wireless and Electrical Mechanics (R) and classified as LAC's, group "B," but they are to be warned that they will be given a further trade test at the Manning Depot. If they should fail to pass the second trade test, they will be given the option of:

(a) Re-mustering as Wireless and Electrical Mechanics AC.2, Standard group, or other group, as qualified.

(b) Re-mustering as Standard General duties.

(c) Taking their discharge.

5. No special quota will be assigned, but all enlistments must be shown in the Recruiting Centre's Daily Report as "WIREMECS". When a sufficient number of men are enlisted to cover immediate requirements, special quotas will be assigned to cover the enlistments.

6. Applicants need not be British Subjects. American Citizens may be accepted.

7. Applicants in this category should be advised that they will be given approximately one month's training at No. 1 Manning Depot before proceeding Overseas.

Apply to nearest R.C.A.F. Recruiting Centre.

LIST AND ADDRESSES OF R.C.A.F. RECRUITING CENTRES

VANCOUVER, B.C.—Commanding Officer, R.C.A.F. Recruiting Centre, 332 Federal Building, Vancouver, B.C.

CALGARY, ALTA.—Commanding Officer, R.C.A.F. Recruiting Centre, 1206 1st Street, East, Calgary, Alta.

EDMONTON, ALTA.—Commanding Officer, R.C.A.F. Recruiting Centre, Ramsay Building, Edmonton, Alta.

SASKATOON, SASK.—Commanding Officer, R.C.A.F. Recruiting Centre, Hotel Bessborough, Saskatoon, Sask.

REGINA, SASK.—Commanding Officer, R.C.A.F. Recruiting Centre, New Regina Trading Co. Bldg., Regina, Sask.

WINNIPEG, MAN.—Commanding Officer, R.C.A.F. Recruting Centre, Lindsay Bldg., 228 Notre Dame Ave., Winnipeg, Man.

FORT WILLIAM, ONT.—Commanding Officer, R.C.A.F. Recruiting Centre, Customs Building, Fort William, Ont.

NORTH BAY, ONT.—Commanding Officer, R.C.A.F. Recruiting Centre, 99 Main St. W., North Bay, Ont.

WINDSOR, ONT.—Commanding Officer, R.C.A.F. Recruiting Centre, Liddy Bldg., 461 Ouellette Ave., Windsor, Ont.

LONDON, ONT.—Commanding Officer, R.C.A.F. Recruiting Centre, Old Post Office Building, London, Ont.

HAMILTON, ONT.—Commanding Officer, R.C.A.F. Recruiting Centre, 275 James Street, South, Hamilton, Ont.

NIAGARA FALLS, ONT.—Commanding Officer, R.C.A.F. Recruiting Centre, 827 Jepson Street, Niagara Falls, Ont.

TORONTO, ONT.—Commanding Officer, R.C.A.F. Recruiting Centre, 297 Bay Street, Toronto, Ont.

KINGSTON, ONT.—Commanding Officer, R.C.A.F. Recruiting Centre, Bibby Bldg., 86 Princess Street, Kingston, Ont.

OTTAWA, ONT.—Commanding Officer, R.C.A.F. Recruiting Centre, 90 O'Connor Street, Ottawa, Ont.

MONTREAL, QUE.—Commanding Officer, R.C.A.F. Recruiting Centre, Post Office Bldg., 1254 Bishop St., Montreal, Que.

QUEBEC, QUE.—Commanding Officer, R.C.A.F. Recruiting Centre, Morgan Bldg., 12 Ste. Anne St., Quebec, Que.

MONCTON, N.B.—Commanding Officer, R.C.A.F. Recruiting Centre, Dominion Public Building, Moncton, N.B.

HALIFAX, N.S.—Commanding Officer, R.C.A.F. Recruiting Centre, Navy League Bldg., 17 South St., Halifax, N.S.

CHARLOTTETOWN, P.E.I.—Commanding Officer, R.C.A.F. Recruiting Centre, 25 Kent St., Charlottetown, P.E.I.

PRELIMINARY NOTICE (*Continued from page 496*)

POPE—FRANCIS ROBERT, of Peterborough, Ont. Born at Montreal, July 6th, 1913; Educ.: B. Eng. (Mech.), McGill Univ., 1935; 1932-34 (summers), Can. Gen. Elec. Co. Ltd., Peterborough; 1935-36, student course, and 1936-39, field engr., Bell Telephone Company of Canada; 1939-40, training course, and April 1940 to date, asst. supt., Western Clock Co. Ltd., Peterborough, Ont. (St. 1933).

References: R. L. Dobbin, I. F. McRae, J. A. Loy, J. B. Challies, W. H. Munro, C. M. McKergow, A. L. Killaly.

SANDERS—GEORGE OSTROM, of 444 Augustus St., Cornwall, Ont. Born at Vancouver, B.C., Feb. 15th, 1913; Educ.: B.Sc., Queen's Univ., 1937; 1937 to date, mtce. engrg., Howard Smith Paper Mills, Ltd., Cornwall, Ont. (St. 1937).

References: H. E. Meadd, A. L. Farnsworth, D. deC. Ross-Ross, A. Jackson, L. M. Arkley, W. H. Magwood.

SAWLE—ROSS TREGERTHEN, of St. Catharines, Ont. Born at Welland, Ont., March 13th, 1913; B.Sc., Queen's Univ., 1934, M.A.Sc., Univ. of Toronto, 1935; R.P.E. of Ont.; summer work, Page Hersey Tubes, Welland Ship Canal, Welland Electric Steel Castings; 1935 to date, design engr., rotating machy., English Electric Co. of Canada, St. Catharines, Ont. (St. 1934).

References: S. Hairsine, C. G. Moon, A. W. F. McQueen, E. C. Little, A. C. Blue.

SHATFORD—RALPH GRANT, of 310 North St., Halifax, N.S. Born at Maccan, N.S., Dec. 16th, 1911; Educ.: B. Eng., N.S. Tech. Coll., 1935; 1936-40, junior engr., process control and meter dept., and July 1940 to date, cracking coil inspr., Imperial Oil Limited, Dartmouth, N.S. (St. 1932)..

References: A. D. Nickerson, W. P. Copp, R. L. Dunsmore, C. Scrymgeour.

TASSÉ—YVON ROMA, of Quebec, Que. Born at St. Gabriel de Brandon, Que., Oct. 1st, 1910; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1935; 1934 (summer), surveying party; with the Can. Gen. Elec. Co. Ltd., as follows: 1935-36, students' test course, 1936-37, departmental plan, 1937-38, Montreal office, and 1938 to date, apparatus sales engr. for Quebec office territory. (St. 1934).

References: R. Dupuis, A. Frigon, I. S. Patterson, A. B. Normandin, O. O. Lefebvre, R. B. McDunnough.

THIBAULT—JOSEPH GEORGE, of North Hatley, Que. Born at Tway, Sask., Dec. 11th, 1911; Educ.: B.Sc. (E.E.), Univ. of Man., 1937; 1935 (summer), student asst., Geol. Survey of Canada; 1939 (summer), elect'l. dftsman., Canadian Industries Ltd., Montreal; Oct. 1939 to date, engrg. ap'tice., Southern Canada Power Company. (St. 1937).

References: H. C. Karn, P. Varley, E. P. Fetherstonhaugh.

WHITEHOUSE—RALPH JOHN, of Trail, B.C. Born at Nelson, B.C., May 3rd, 1911; Educ.: B. Eng., McGill Univ., 1933; 1935 to date, constrn. dept., and at present machine shop progress clerk, Cons. Mining & Smelting Co. Ltd., Trail, B.C. (St. 1933).

References: S. C. Montgomery, G. H. Bancroft, A. C. Ridgers, H. Vickers, H. A. Moore.

BOILER FEED WATER CONDITIONING

The Permutit Co. of Canada Ltd., Montreal, Que., have issued an eight-page bulletin, No. 2377, entitled "Permutit 'Mag-de-Sil' (Magnesia Silica Removal) Process" which gives a detailed description of the process and shows how the silica content of any water can be reduced to any value, using moderate amounts of low-cost reagents which do not add soluble by-products.

DIESEL CRAWLER TRACTOR

The new HD 7 Diesel crawler 54-h.p. tractor recently announced by Allis-Chalmers Mfg. Co. (Tractor Division), Milwaukee, Wis., is described in the 24-page catalogue, form MS 290. The features of this tractor are: two-cycle Diesel power; balanced power and speed; bi-metallic clutches and brakes; new track release mechanism and "positive-seal" truck wheels. The catalogue is written in a novel conversational style and is well illustrated.

EMULSIFIED ASPHALT

Construction Series No. 53, issued by The Asphalt Institute, New York, N.Y., is a four-page booklet containing the specifications for emulsified asphalts as adopted by The Asphalt Institute on September 11, 1940. These specifications are new and are the first issued by the Institute.

EXTENDED INNER RING BEARINGS

Style "A" extended inner ring bearings for machine applications on straight shafts with timers ranging from 5/8 in. to 2.15/16 ins. is announced by Stephens-Adamson Mfg. Co. of Canada Ltd., Belleville, Ont., in their bulletin No. 740. This one-page bulletin gives dimensional drawing with table of specifications for bearings for various shaft dimensions.

INDOOR POTENTIAL TRANSFORMERS

Canadian General Electric Co. Ltd., Toronto, Ont., describe and illustrate in their four-page bulletin CGEA-3184, types JE-1 and JE-2, 60 cycle indoor potential transformers with specifications and dimensional drawings of each.

SPOT WELDER

Commonwealth Electric Corp. Ltd., Welland, Ont., describe the new "Hi-Wave" welder in bulletin 1404. Just recently announced, this spot-welder is designed especially for the welding of aluminum alloys.

SWITCH GEAR

A new eight-page bulletin entitled "Switchgear for Industrial Plants" recently issued by Canadian General Electric Co. Ltd., Toronto, Ont., is devoted to illustrating a wide variety of jobs featuring modern designs.

TIME RECORDERS

The Stromberg job time recorders are illustrated and described in an eight-page bulletin No. 221-F issued by Stromberg Time Recorder Co. of Canada Ltd., Toronto, Ont. This booklet includes interesting sample daily cost tickets reproduced to illustrate the application of the recording system and to show the complete distribution of an employee's time.

TIME STAMPS

Stromberg Time Recorder Co. of Canada Ltd., Toronto, Ont., have issued an eight-page bulletin No. 224-E which gives illustrated descriptions of the Company's various types of automatic time stamps. These time stamps are designed to give an accurate check and an indelible record of the time of arrival or departure of letters, telegrams, documents or any other similar material. General construction and various purposes for which they can be used are outlined.

THE ENGINEERING CATALOGUE

The eighth annual edition of The Engineering Catalogue has recently been issued and, as in the past, copies are available to all members of The Institute whose duties entail the recommending, specifying or purchasing of equipment, materials and supplies.

Since its inception in 1932, The Catalogue has shown a steady growth and in each successive volume the number and variety of products described and illustrated has been increased.

In the present volume over 200 pages are devoted to the description of the products of various manufacturers, while 135 pages are utilized to include the comprehensive Products Index and Directory of Manufacturers in which the products of 4,157 individual firms require over 22,000 entries to ensure their proper listing under approximately 3,000 products classifications.

MONORAIL SYSTEMS

A four-page bulletin has been issued by Beatty Bros. Ltd., Fergus, Ont., which describes Beatty monorail systems for light, medium and heavy loads and illustrates its application to improve various industrial requirements.

MOTORIZED HELICAL GEAR SPEED REDUCERS

Link-Belt Ltd., Toronto, Ont., have illustrated and described the features of the Link-Belt motorized helical gear reducer in an 18-page book No. 1515. This gear reducer is a compact, self-contained combination of speed reducer and integral motor requiring no base plate or flexible coupling.

REMOTE PNEUMATIC TRANSMISSION

Bulletin 98156 made available by Taylor Instrument Cos. of Canada Ltd., Toronto, Ont., describes the many advantages of the Taylor remote pneumatic transmission systems in the measurement and control of pressure, rate of flow and liquid level.

SEWAGE TREATMENT

Bio-Filtration Sewage Treatment with Link-Belt "straightline" and "circuline" sludge collectors is the subject of a new four-page folder No. 1881, announced by Link-Belt Ltd., Toronto, Ont. A description of how the system works and illustrations of the single-stage and the two-stage complete treatment are included.

AGENTS WANTED

Feedwater Specialists Co., St. Pauls Square, Liverpool, 3, England, wish to appoint agents for the sale of their Algor Products in Canada. These products are for the conditioning of industrial water supplies, particularly in connection with water supplies to boilers for steam generation purposes. Applicants should have established contact and a knowledge of local conditions as they affect the operation of steam boilers.

TRANSFORMERS

Hammond Control Circuit Transformers of the air-cooled type are described in the four-page catalogue C-54 recently issued by Hammond Manufacturing Co., Guelph, Ont. They cover a complete range of sizes available from 25 va. to 2,000 va. in 60-cycle type and 25 va. to 1,500 va. in 25-cycle type. Included in the catalogue are specifications and dimensional drawings.

VACUUM CLEANING SYSTEMS

An interesting 16-page catalogue No. A-182 has been issued by Canadian Hoffman Machinery Co. Ltd., Toronto, Ont., dealing with the Hoffman heavy duty industrial vacuum cleaning systems. Its application to special jobs in industrial plants is described with photographs and principal elements are illustrated with sectional drawings. A typical piping diagram showing how sweepers may be operated simultaneously in different locations is included.

WORM GEAR SPEED REDUCERS

Link-Belt Ltd., Toronto, Ont., describe and illustrate their line of worm gear reducers for use where large ratios, flexibility of arrangement and enclosed drives of the right angle type or a variety of other shaft set-ups are required, in an attractive 38-page book No. 1524.

INSULATING MATERIAL

A new 1,500-deg. insulating material called "L-W Superex" furnished in both block and pipe covering form has been announced by Canadian Johns-Manville Co. Ltd., Toronto, Ont., and, according to the announcement, represents a marked improvement in conductivity and strength for an insulation in the service temperature range above 600-deg. F.

RECHARGEABLE FLASHLIGHT BATTERY

An interesting announcement has been issued by Canadian Industries Ltd., Montreal, Que., regarding a rechargeable battery that has been designed for use in flashlights. "Lucite," a transparent plastic of remarkable characteristics, has played a leading part in bringing about this development.

The battery, like the "wet" or storage cell of an automobile, is charged with sulphuric acid. Practically unbreakable, the plastic spill-proof cylinder stands up admirably to rough treatment, and is proof against the corrosive action of the acid inside.

When the battery is getting low, it is easily renewed by means of a special small charger sold with the outfit, and which may be plugged into any 110-volt electric light socket; or it may be recharged from a 6-volt automobile battery or D. C. charger.

CABLE SPLICER

Mine Safety Appliances Co. of Canada Ltd., Montreal, Que., have announced a new modern tool named "M.S.A. Velocity-Power Cable Splicer" which has been designed for making repairs on all types of mining machine cables and, according to the manufacturer, the splice is made effectively and safely with the expenditure of a minimum of time and effort.

The cable splicer weighs 6 lbs. fully assembled and is operated by a cartridge discharge compressing a copper sleeve tightly about the two butted ends of a broken cable.

THE ENGINEERING JOURNAL

THE JOURNAL OF THE ENGINEERING INSTITUTE OF CANADA

VOLUME 23 DECEMBER 1940 NUMBER 12

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

PUBLISHED MONTHLY BY
THE ENGINEERING INSTITUTE
OF CANADA
2050 MANSFIELD STREET - MONTREAL

Price 50 cents a copy, $3.00 a year, in Canada, British Possessions, United States and Mexico. $4.50 a year in Foreign Countries. To members and Affiliates, 25 cents a copy, $2.00 a year. —Entered at the Post Office, Montreal, as Second Class Matter.

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(*Photo Courtesy of Department of Mines and Resources*)

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MOMENT DISTRIBUTION AND THE ANALYSIS OF A CONTINUOUS TRUSS OF VARYING DEPTH

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Paper to be presented before the General Professional Meeting of The Engineering Institute of Canada, at Hamilton, Ont., on February 7th, 1941

SUMMARY—An application of moment distribution to varying depth continuous trusses; their stress analysis without reference to member areas; two further pieces of technique to facilitate such an analysis.

I. Outline

This paper discusses the analysis of a five span continuous highway truss of varying depth (Fig. 1) under the following divisions:

1. The paper suggests a method of adapting moment distribution to a truss of the type illustrated. In the conventional solution, redundant reactions are found by equating deflections, and moments over the supports are found therefrom. The suggested method involves less work, eliminates machine calculations, arrives at the moments directly, and removes the uncertainties of a solution resulting from small differences between large terms of simultaneous equations.

2. The paper illustrates a method whereby a close stress analysis of such a truss may be made without reference to the areas of the members.

3. It outlines a way of making one set of moment distributions cover all the very numerous cases of partial loadings involved in such a problem.

4. It sets up a table which, by a sum in proportion, will give the stress in any member due to any set of applied loads and their resulting moments.

II. Design Procedure

This paper is the result of experience growing out of an actual design. A first approximation of the member areas was found on the assumption of a uniform moment of inertia. Moments over the supports were found by three moment equations and used, without correction, in calculating stresses and resulting areas. After encountering the difficulty and uncertainty of conventional methods of proceeding to an accurate solution, the writer evolved a method of adapting moment distribution to the case of the truss in question. The approximate areas were used in finding fixed-end moments, carry-over factors, and stiffness factors in a way to be described in the next section and illustrated later. Using moment distribution and correcting stresses for changes in moments over the supports, new areas were found. The direction and magnitude of moment changes were observed. A further arbitrary correction to the moments was made as the result of these observations, and the stresses and areas were again corrected. Using the latest areas, the moments were again calculated and found to be sufficiently close to the assumed moments so that only minor adjustments were necessary to bring the two into coincidence.

III. Moment Distribution Applied to Trusses

A knowledge of Professor Cross's method of moment distribution and his terminology will be taken for granted[1]. The technique for finding fixed-end moments, carry-over factors, and stiffness factors for a varying depth truss follows.

FIXED END MOMENT

Fixed end moment is defined by Professor Cross as that moment which would exist at the end of a member if the ends were fixed against rotation[2]. The method of finding this moment for a truss depends upon an extension of the conventional *PUL* over *AE* principle of Maxwell-Mohr. Instead of finding the deflection of a point by applying a unit load at that point, the rotation between two points, measured in terms of arc, is found by applying a couple in the form of opposite unit loads at the two points[3]. In this way, the rotations of the two end posts, due to applied loads, are found. The rotations at each end caused by couples of unit loads applied first at one end and then at the other end are then found. Since, by definition, the end rotations are zero, two equations can be set up in which the two fixed-end moments are the two unknowns.

In Fig. 2, let P represent the stresses due to the actual loads applied at the loading points; let U_a represent stresses due to a couple of unit loads along the lines XX at end a; and let U_b represent stresses due to a couple of unit loads applied along YY at end b. Let the depth at a be D_a and at b be D_b. Let the required fixed-end moments be XD_a and YD_b due to forces X and Y applied along the lines XX and YY respectively. Let δ_{ap} represent the arc measuring rotation at end a due to applied loads P. Let δ_{axy} and δ_{bxy} represent rotations at a and b respectively due to final couples of X and Y at a and b respectively. Thus we may write:

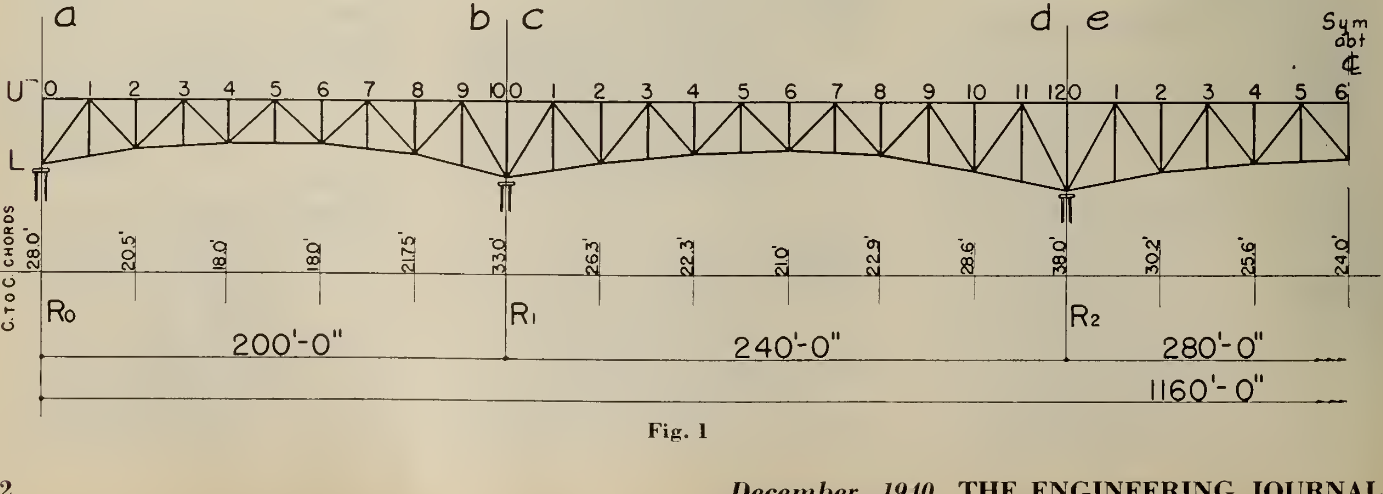


Fig. 1

$$E\,\delta_{ap} = \sum \frac{PU_aL}{A} \qquad (1)$$

$$E\,\delta_{bp} = \sum \frac{PU_bL}{A} \qquad (2)$$

$$E\,\delta_{axy} = X\sum\frac{U_a^2L}{A} + Y\sum\frac{U_aU_bL}{A} \qquad (3)$$

$$E\,\delta_{bxy} = X\sum\frac{U_aU_bL}{A} + Y\sum\frac{U_b^2L}{A} \qquad (4)$$

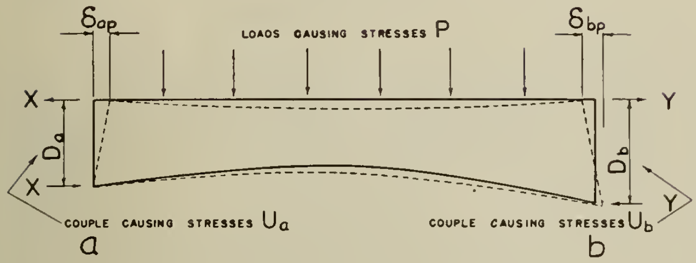


Fig. 2

From the definition of a fixed-end moment, the end rotations must be zero. That is, the rotations caused by applied loads P must be equal and opposite to those caused by the fixing forces X and Y. Thus—
$\delta_{ap} = -\,\delta_{axy}$ and $\delta_{bp} = -\,\delta_{bxy}$. Thus we may write:—

$$-\sum\frac{PU_aL}{A} = X\sum\frac{U_a^2L}{A} + Y\sum\frac{U_aU_bL}{A} \qquad (5)$$

$$-\sum\frac{PU_bL}{A} = X\sum\frac{U_aU_bL}{A} + Y\sum\frac{U_b^2L}{A} \qquad (6)$$

Solve for X and Y.

Then the fixed-end moments due to applied loads P will be:—

XD_a at a
YD_b at b

CARRY-OVER FACTOR "f"

Professor Cross states that "if one end of a member which is on unyielding supports at both ends is rotated while the other end is held fixed, the ratio of the moment at the fixed end to the moment producing rotation at the rotating end is called the carry-over factor."

In Fig. 3, let XD_a be the applied moment at rotating end a, and let YD_b be the induced moment at the fixed end b. Then, by definition, the carry-over factor from a to b, say $f_{ab} = \frac{YD_b}{XD_a}$

Since there is no rotation at b, we may write $\delta_{bxy} = 0$. Whence:

$$X\sum\frac{U_aU_bL}{A} - Y\sum\frac{U_b^2L}{A} = 0 \qquad (7)$$

$$\therefore \frac{Y}{X}\frac{D_b}{D_a} = \frac{\sum\frac{U_aU_bL}{A}}{\sum\frac{U_b^2L}{A}} \times \frac{D_b}{D_a} = f_{ab} \qquad (8)$$

similarly, for the other end:—

$$\frac{X}{Y}\frac{D_a}{D_b} = \frac{\sum\frac{U_aU_bL}{A}}{\sum\frac{U_a^2L}{A}} \times \frac{D_a}{D_b} = f_{ba} \qquad (9)$$

The minus sign in equation (7) results from the fact that a moment applied at the free end of a member fixed at the other end produces a moment of the opposite sign at the fixed end.

It should be noted that these calculations are simple slide-rule calculations as all the necessary summations were found in the fixed end moment equations.

STIFFNESS FACTOR

Professor Cross defines the stiffness of a member (on unyielding supports) as the moment at one end necessary to produce unit rotation at that end when the other end is fixed. In other words, the relative stiffnesses of several members are inversely proportional to the rotations produced by unit moments at their free ends. It will be seen that the stiffness of a member about one end is not necessarily the same as its stiffness about the other end.

Thus, in our example, we will consider in turn each pair of adjacent ends and apply unit loads in the form of a couple as before. By definition, the relative stiffnesses will be inversely proportional to the rotations produced, i.e., to the arc between top and bottom points of the end posts. This arc, which is the relative displacement of top and bottom points, is affected by the unit couple applied at this end and also by the induced moment at the fixed end. (Or, in other words, by the moment at the far end necessary to prevent rotation.)

To find the relative stiffness of adjacent members at the centre support in Fig. 4, separate spans at b and fix ends a and c, apply couples of unit loads to each at b and b_1. The relative stiffnesses will be as the inverse of the rotations thus produced. The induced moment at a is $f_{ba} \times 1 \times D_b$. Therefore, the forces induced at top and bottom points are $f_{ba}\,\frac{D_b}{D_a}$. Similarly, the forces at c are $f_{b_1c}\,\frac{D_{b_1}}{D_c}$. In Figure 4, b and b_1 are actually the same point.

Thus we may write:

$$\delta_b = \sum\frac{U_b^2L}{A} - f_{ba}\frac{D_b}{D_a}\sum\frac{U_aU_bL}{A} \qquad (10)$$

$$\delta_{b_1} = \sum\frac{U_{b_1}^2L}{A} - f_{b_1c}\frac{D_{b^1}}{D_c}\sum\frac{U_cU_{b_1}L}{A} \qquad (11)$$

$$\text{and } \frac{\text{stiffness ba}}{\text{stiffness b}_1\text{c}} = \frac{\delta_{b_1}}{\delta_b} \qquad (12)$$

As noted before, all the necessary summations have been found and the stiffness calculation is thus just a slide-rule operation.

These operations are illustrated in Table I.

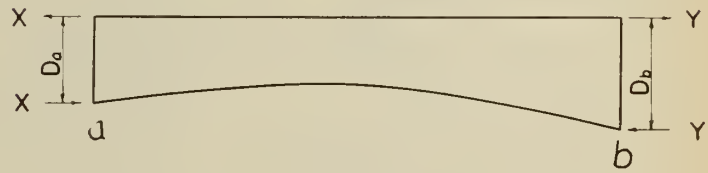


Fig. 3

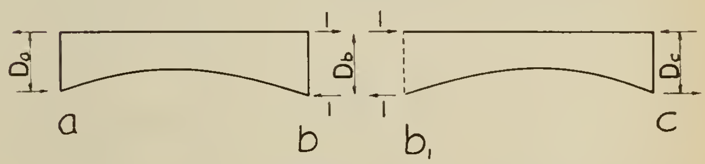


Fig. 4

IV. Analysis Without Reference to Areas

The "area which cannot be found without knowing it first" is the common dilemma of all indeterminate analyses. In the present case, the convergence between assumed and figured moments was so slow that the designers again wondered whether the dilemma might not be sidestepped. In 1936, Professor Albert Haertlein of Harvard made a series of investigations on several well known existing structures. He calculated the redundant reactions accurately using real areas. He then omitted the L/A terms from his calculations and discovered that the redundant reaction

TABLE I

CALCULATION FOR D.L. MOMENTS BY MOMENT DISTRIBUTION

SPAN	MEMBER	AREA "A" UNIF. I	AREA "A" FINAL	LENGTH L-FEET	$\frac{L}{A}$	P KIPS	U_a KIPS	U_b KIPS	$\frac{PU_aL}{A}$	$\frac{PU_bL}{A}$	$\frac{U_aU_bL}{A}$	$\frac{U_a^2L}{A}$	$\frac{U_b^2L}{A}$
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	TC U_0U_1		27.73	20.0									
	U_1U_3		34.44	40.0	1.161	+ 475	-	- 32.2	-	- 17,780	-	-	+ 1,200
200'-0"	U_3U_5		50.48	40.0	.794	+ 810	-	- 72.2		-46,400	-	-	+ 4,140
	etc.												
	Σ									-539 284			95460
							U_c	U_d	$\frac{PU_cL}{A}$	$\frac{PU_dL}{A}$	$\frac{U_cU_dL}{A}$	$\frac{U_c^2L}{A}$	$\frac{U_d^2L}{A}$
	U_0U_1	41.44	50.48	20.0	.396	- 0	-100.0	0	0	0	0	+ 3960	0
	U_1U_3	29.23	27.73	40.0	1.442	+ 465	-104.5	- 23.9	- 70 100	- 16 100	+ 3 610	+ 15 750	+ 825
	U_3U_5	31.35	29.23	40.0	1.369	+ 876	- 98.0	- 57.0	-117 500	-68 400	+ 7 650	+ 13 150	+ 4 440
	U_5U_7	41.44	34.44	40.0	1.160	+1048	- 78.0	- 89.7	- 94 800	-109 000	+ 8120	+ 7 060	+ 9 350
	U_7U_9	29.23	29.23	40.0	1.369	+ 856	- 47.2	-111.0	- 55 300	-130 100	+ 7 170	+ 3 050	+ 16 850
	U_9U_{11}	29.23	29.23	40.0	1.369	+ 428	- 19.2	-111.0	- 11 200	- 65 200	+ 2910	+ 505	+ 16 850
	$U_{11}U_{12}$	48.87	55.94	20.0	.357	0	0	-100.0	0	0	0	0	+ 3 570
	BC L_0L_2	27.19	34.52	40.5	1.175	- 230	+103.5	+ 10.6	- 28 000	- 2 870	+ 1 290	+ 12 600	+ 132
	L_2L_4	20.23	20.23	40.2	1.982	- 681	+102.0	+ 39.6	- 138 000	- 53 500	+ 8025	+ 20 650	+ 3 110
	L_4L_6	36.97	29.00	40.0	1.380	- 985	+ 88.5	+ 73.4	- 120 500	- 99 700	+ 8960	+ 10 800	+ 7 440
	L_6L_8	36.97	29.00	40.1	1.385	- 977	+ 62.1	+ 101.5	- 84 000	-137 300	+ 8 720	+ 5 340	+ 14 250
	L_8L_{10}	20.23	23.10	40.2	1.744	- 650	+ 31.7	+ 112.0	- 35 900	-127 100	+ 6 210	+ 1 750	+ 21 850
240'-0"	$L_{10}L_{12}$	37.50	45.26	41.0	.907	- 207	+ 8.6	+ 107.5	- 1 620	- 20 200	+ 840	+ 67	+ 10 480
	Web L_0U_1	35.44	33.60	38.4	1.142	+ 437	- 3.6	- 20.5	- 1 800	- 10 300	+ 85	+ 15	+ 480
	U_1L_2	27.50	26.12	33.0	1.263	- 395	+ 4.0	+ 22.0	- 2 000	- 11 000	+ 111	+ 20	+ 613
	L_2U_3	28.30	26.74	33.0	1.235	+ 352	+ 4.6	- 24.3	+ 2 000	- 10 500	- 138	+ 26	+ 730
	U_3L_4	21.60	20.78	30.0	1.442	- 297	- 5.0	+ 26.2	+ 2 145	- 11 250	- 190	+ 36	+ 990
	L_4U_5	19.61	19.61	30.0	1.530	+ 170	+ 14.9	- 24.3	+ 3 880	- 6 270	- 554	+ 340	+ 902
	U_5L_6	14.64	14.64	29.0	1.980	- 84	- 15.2	+ 25.1	+ 2 530	- 4 150	- 755	+ 457	+ 1 250
	L_6U_7	14.64	14.64	29.0	1.980	- 103	+ 23.1	- 15.2	- 4 710	+ 3 100	- 700	+ 1 060	+ 457
	U_7L_8	20.85	20.85	30.5	1.463	+ 180	- 22.1	+ 14.8	- 5 820	+ 3 950	- 480	+ 710	+ 320
	L_8U_9	23.06	20.94	30.5	1.458	- 322	+ 24.1	- .4	- 11 300	+ 188	- 14	+ 850	+ -
	U_9L_{10}	30.60	30.60	35.0	1.142	+ 375	- 22.4	+ .4	- 9 620	+ 172	- 10	+ 575	+ -
	$L_{10}U_{11}$	26.26	25.30	35.0	1.383	- 395	+ 19.1	+ 11.4	- 10 400	- 6 230	+ 301	+ 505	+ 180
	$U_{11}L_{12}$	33.60	33.60	43.0	1.280	+ 435	- 17.8	- 10.6	- 9 910	- 5 890	+ 242	+ 405	+ 144
	Σ								-801925	-887650	+ 61403	+99681	+115213
							U_e	$U_{e'}$	$\frac{PU_eL}{A}$	$\frac{PU_{e'}L}{A}$	$\frac{U_eU_{e'}L}{A}$	$\frac{U_e^2L}{A}$	$\frac{U_{e'}^2L}{A}$
	TC U_0U_1		55.94	20.0	.357	0	- 100.0	0	0	-	0	+ 3 570	-
280'-0"	U_1U_3		27.73	40.0	1.441	+ 505	- 108.3	- 18.3	- 79 000	-	+ 2860	+ 16 900	-
	U_3U_5		31.48	40.0	1.270	+ 986	- 106.4	- 42.6	-135 500	-	+ 5 760	+ 14 400	-
	etc.												
	Σ								-971930		+54 520	+105 815	

200'-0 SPAN

FIXED-END MOMENTS:-

$$Y\sum\frac{U_b^2L}{A} = -\sum\frac{PU_bL}{A}$$

$$95{,}460Y = 539{,}284$$

$\therefore 100Y = 565 \quad F.E.M._b = 33 \times 100Y = 18{,}640$ ft. Kips

CARRY-OVER FACTORS:-

0

STIFFNESS FACTORS "S":-

$$\frac{\delta_b}{\delta_c} = \frac{\sum\frac{U_b^2L}{A} - 0}{\sum\frac{U_c^2L}{A} - f_{cd}\frac{D_c}{D_d}\sum\frac{U_cU_dL}{A}} = \frac{95{,}460 - 0}{99{,}681 - .614 \cdot \frac{33}{38} \cdot 61{,}403} = \frac{95{,}460}{66{,}960}$$

$\therefore S_b = .41 \quad S_c = .59$[1]

240'-0 SPAN

FIXED-END MOMENTS:

$$X\sum\frac{U_c^2L}{A} + Y\sum\frac{U_cU_dL}{A} = -\sum\frac{PU_cL}{A}$$

$$X\sum\frac{U_cU_dL}{A} + Y\sum\frac{U_d^2L}{A} = -\sum\frac{PU_dL}{A}$$

$$99{,}681X + 61{,}403Y = 801{,}925$$

$$61{,}403X + 115{,}213Y = 887{,}650$$

$\therefore 100Y = 508.7 \quad F.E.M._d = 38 \times 100Y = 19{,}331$ ft. Kips.

$100X = 491.2 \quad F.E.M._c = 33 \times 100X = 16{,}207$ ft. Kips.

CARRY-OVER FACTORS:

$$f_{cd} = \frac{\sum\frac{U_cU_dL}{A}}{\sum\frac{U_d^2L}{A}} \times \frac{D_d}{D_c} = \frac{61{,}403 \cdot 38}{115{,}213 \cdot 33} = .614$$

$$f_{dc} = \frac{\sum\frac{U_cU_dL}{A}}{\sum\frac{U_c^2L}{A}} \times \frac{D_c}{D_d} = \frac{61{,}403 \times 33}{99{,}681 \times 38} = .535$$

STIFFNESS FACTORS:

$$\frac{\delta_d}{\delta_e} = \frac{\sum\frac{U_d^2L}{A} - f_{dc}\frac{D_d}{D_c}\sum\frac{U_cU_dL}{A}}{\sum\frac{U_e^2L}{A} - f_{ee'}\frac{D_e}{D_{e'}}\sum\frac{U_eU_{e'}L}{A}} = \frac{115{,}213 - .535 \cdot \frac{38}{33} \cdot 61{,}402}{105{,}815 - .516 \cdot 1 \cdot 54{,}520} = \frac{77{,}413}{77{,}600}$$

$\therefore S_d = .50 \quad S_e = .50$

280'-0 SPAN

FIXED-END MOMENTS:

$$X\left(\sum\frac{U_e^2L}{A} + \sum\frac{U_eU_{e'}L}{A}\right) = -\sum\frac{PU_eL}{A}$$

$$(105{,}815 + 54{,}520)X = 971{,}930$$

$100X = 606.2 \quad F.E.M._{e} = 38 \times 100X = 23035$ ft. kips

CARRY-OVER FACTORS:

$$f_{ee'} = f_{e'e} = \frac{\sum\frac{U_eU_{e'}L}{A}}{\sum\frac{U_e^2L}{A}} = \frac{54{,}520}{105{,}815} = .516$$

Summary

	200'-0 Span	240'-0 Span		280'-0 Span
STIFFNESS FACTOR:-	.41	.59	.50	.50
CARRY-OVER:-	0	.614	.535	.516
F.E.M. (ft. Kips):-	-18,640	+ 16,207	-19,331	+23,035
FINAL DISTRIBUTION:[2] D.L. MOMENTS	- 16,863 ft. Kips		- 21,315 ft. Kips	

1 STIFFNESS CONVERTED FROM A RATIO TO COMPLEMENTARY PARTS OF ONE. NOTE THE INVERSION NECESSARY TO GET RELATIVE STIFFNESSES.

2 DISTRIBUTION FIGURES NOT SHOWN.

Table II

Calculation of D.L. Moments by Moment Distribution Neglecting Length Over Area Term.

1	2	3	4	5	6	7	8	9
	P	Ua	Ub	PUa	PUb	UaUb	Ua²	Ub²
T.C. U₀U₁								
U₁U₃	+ 475	-	- 32.2	-	- 15,300	-	-	+ 1,038
U₃U₅	+ 810	-	- 72.2	-	- 58,400	-	-	+ 5,220
etc.								
Σ					- 500,521			+ 85,437
		Uc	Ud	PUc	PUd	UcUd	Uc²	Ud²
T.C. U₀U₁	0	- 100.0	0	0	0	0	+ 10,000	0
U₁U₃	+ 465	- 104.5	- 23.9	- 48,600	- 11,100	+ 2,500	+ 10,930	+ 571
U₃U₅	+ 876	- 98.0	- 57.0	- 85,800	- 50,000	+ 5,580	+ 9,600	+ 3,250
U₅U₇	+ 1,048	- 78.0	- 89.7	- 81,800	- 94,200	+ 7,000	+ 6,080	+ 8,060
U₇U₉	+ 856	- 47.2	- 111.0	- 40,400	- 95,100	+ 5,240	+ 2,215	+ 12,310
U₉U₁₁	+ 428	- 19.2	- 111.0	- 8,200	- 47,600	+ 2,130	+ 370	+ 12,310
U₁₁U₁₂	0	0	- 100.0	0	0	0	0	+ 10,000
B.L. L₀L₂	- 230	+ 103.5	+ 10.6	- 23,800	- 2,300	+ 1,100	+ 10,700	+ 112
L₂L₄	- 681	+ 102.0	+ 39.6	- 69,500	- 27,000	+ 4,040	+ 10,400	+ 1,570
L₄L₆	- 985	+ 88.5	+ 73.4	- 87,200	- 72,200	+ 6,490	+ 7,820	+ 5,390
L₆L₈	- 977	+ 62.1	+ 101.5	- 60,600	- 99,200	+ 6,300	+ 3,860	+ 10,300
L₈L₁₀	- 650	+ 31.7	+ 112.0	- 20,600	- 72,900	+ 3,560	+ 1,005	+ 12,550
L₁₀L₁₂	- 207	+ 8.6	+ 107.5	- 1,800	- 22,300	+ 925	+ 74	+ 11,550
Web L₀U₁	+ 437	- 3.6	- 20.5	- 1,600	- 9,000	+ 74	+ 13	+ 420
U₁L₂	- 395	+ 4.0	+ 22.0	- 1,600	- 8,700	+ 88	+ 16	+ 485
L₂U₃	+ 352	+ 4.6	- 24.3	+ 1,600	- 8,500	- 112	+ 21	+ 590
U₃L₄	- 297	- 5.0	+ 26.2	+ 1,500	- 7,800	- 131	+ 25	+ 686
L₄U₅	+ 170	+ 14.9	- 24.3	+ 2,500	- 4,100	- 362	+ 222	+ 590
U₅L₆	- 84	- 15.2	+ 25.1	+ 1,300	- 2,100	- 381	+ 231	+ 630
L₆U₇	- 103	+ 23.1	- 15.2	- 2,200	+ 1,600	- 352	+ 535	+ 231
U₇L₈	+ 180	- 22.1	+ 14.8	- 4,000	+ 2,700	- 327	+ 487	+ 219
L₈U₉	- 322	+ 24.1	- .4	- 7,800	+ 130	- 10	+ 581	-
U₉L₁₀	+ 375	- 22.4	+ .4	- 8400	+ 150	- 9	+ 501	-
L₁₀U₁₁	- 395	+ 19.1	+ 11.4	- 7,500	- 4,500	+ 218	+ 365	+ 130
U₁₁L₁₂	+ 435	- 17.8	- 10.6	- 7,700	- 4,600	+ 189	+ 317	+ 112
Σ				-562,200	-638,780	+43,750	+ 76,368	+ 92,066
				PUe		UeUe₁	Ue²	
TC U₀U₁	0	- 100.0	0	0		0	+ 10,000	
U₁U₃	+ 505	- 108.3	- 18.3	- 54,600		+ 1,980	+ 11,720	
U₃U₅	+ 986	- 106.4	- 42.6	-105,100		+ 4,540	+ 11,350	
etc.								
Σ				-865,400		+49,369	+94,123	
Note:-	All Formulae are the same as for Table I except that L and A values have been omitted. Only numerical values are shown below							

200'-0 Span	240'-0 Span	280'-0 Span
Fixed-End Moments:- 85,437 Y = 500,521 ∴ 100Y = 586 F.E.M$_b$ = 33 × 100Y = 19,338 ft Kips	76,368X + 43,750Y = 562,200 43,750X + 92,066Y = 638,780 ∴ 100Y = 472.6 F.E.M$_d$ = 38 × 100Y = 17,961 ft. Kips 100X = 465.4 F.E.M$_c$ = 33 × 100X = 15,358 ft. Kips	(94,123 + 49,369)X = 865,400 ∴ 100X = 603.1 F.E.M$_e$ = 38 × 100X = 22,917 ft. Kips
Carry-Over Factors:- 0	$f_{cd} = \frac{43,750 \times 38}{92,066 \times 33} = .547$ $f_{dc} = \frac{43,750 \times 33}{76,368 \times 38} = .500$	$f_{ee'} = \frac{49,369}{94,123} = .522$
Stiffness Factors "S" $\frac{S_b}{S_c} = \frac{85,437}{76,368 - .547 \times \frac{33}{38} \times 43,750} = \frac{85,437}{55,568}$ ∴ $S_b = .394$; $S_c = .606$	$\frac{S_d}{S_e} = \frac{92,066 - .500 \times \frac{38}{33} \times 43,750}{94,123 - .522 \times 1 \times 49,369} = \frac{66,870}{68,353}$	$S_d = .505$ $S_e = .495$

Stiffness Factor	.394	.606	.505	.495
Carry-Over	0	.547	.500	.522
Fixed-End Moment ft. Kips	- 19,338	+ 15,358	- 17,961	+ 22,917
Final Distribution DL. Moments:-	- 16,822 ft. Kips		- 20,665 ft. Kips	
(Intermediate figures not shown)				

so found agreed very closely. If X be a redundant reaction, the general form of solution may be written $X = \frac{\sum \frac{PUL}{AE}}{\sum \frac{U^2L}{AE}}$ where symbols have their conventional meanings.

Professor Haertlein held that if we put $X = \frac{\Sigma PU}{\Sigma U^2}$ the result would be accurate enough for a semi-final design. His paper, published by the Boston Society of Civil Engineers[4], explains this somewhat surprising result on the basis of the characteristics of a series in the form of a fraction $\left(\text{i.e.} \frac{P_1U_1 + P_2U_2 \ldots}{U_1^2 + U_2^2 \ldots\ldots}\right)$ with both the numerator and denominator multiplied by another series $\left(\text{i.e.} \frac{L_1}{A_1E} + \frac{L_2}{A_2E} \cdots\right)$ To test the claims made by Professor Haertlein, the calculations for fixed-end moments, etc., were made, neglecting the L/AE terms. The results are shown in Table II. The moments found in this simple and direct way differed from the correct moments by three per cent, while those found on the basis of uniform moment of inertia were out by more than 20 per cent. The author has found that, in some structures, both the L and the A terms may be dropped for a close solution while others require that the L terms be retained. This introduces an uncertainty which can be cleared up only by experience and experiment. But the method is potentially too valuable to be allowed to go by default and its application to this problem has been included in this paper for that reason. It is here suggested that in structures where the members are of approximately the same length (as in this example) the L term may be omitted, but in others, such as a longlegged rigid frame truss, the L term should be included.

V. One Set of Moment Distributions

A considerable number of different partial loadings will contribute to the maximum stresses of the members of this continuous truss. The conventional procedure would find the fixed-end moments for each partial load and distribute them. Table IV suggests a procedure whereby 100 units are distributed at each joint in turn. The results then show, as a percentage, the effect of a fixed-end moment at any joint on the structure. Note that a fixed-end moment moved from one side of a support to the other merely changes signs throughout, and exchanges the values at the support in question for its complement of the original F.E.M. of 100. The example will illustrate the principle clearly.

VI. Basic Stress Table

Table V shows a table drawn up for the stresses in every member of a truss for a unit load at each loading point and a unit moment at each end. From this table, the stress in any member, due to any loading, with any resultant condition of end fixities, is at once ascertainable by a simple sum in proportion. Further, this table is a great aid in deciding what partial loads will govern certain members. This procedure may, at first glance, seem a bit heavy, but the simplification and elimination of chances of error in a problem such as the one herein illustrated is very considerable. In setting up this table, only two stress diagrams are required for each span—the effect throughout each span of a unit reaction first at one end and then at the other. The rest follows as a matter of proportion.

Tables

Table I shows the necessary summations and calculations for fixed-end moments, carry-over and stiffness factors for the dead loads. For uniform live loads, the fixed-end moments are found by direct proportion, and the factors, of course, are the same for all conditions of loading as only U summations are involved. All chord members are governed by some combination of fully loaded spans. Only the webs are governed by any discontinuity of uniform load within any given span. In these cases it was found quite accurate enough (within one or two percent) to use the actual fixed-end moment for the span fully loaded, less the fixed-end moment due to the removed panel loads figured on the basis of uniform moment of inertia. Shears are affected only by the relative difference of moments at each end of a span; they are affected in proportion to the span rather than the depth as in the case of chords; and this type of discontinuity in uniform live load is highly theoretical. Of course, the method lends itself to the treatment of point loads, but, in the case under review, the extra work is not justified. Therefore, in Table I, we have all the essential figures for proceeding to a final analysis.

Columns 6, 7 and 8 in Table I are, respectively, the stresses in the members due to applied loads, and due to two 100 kip forces applied horizontally as a couple at the top and bottom of the end post of first one end and then the other end of each span. In all three cases, the span in question is regarded as simply supported. These stresses may all be found by proportion from Table V. For instance, the D.L. concentration for the 240 ft. span is 61 kips, the unit concentration for Table V is 100 kips; therefore the factor is .61. Likewise the moment factors are 100 ÷ 303 = .33 for the left end and 100 ÷ 263 = .38 for the right end. Since, in the PUL summations, U has been taken for convenience as 100 kips instead of unity, the answer should be multiplied by 100 to get the correct fixed-end moments.

Column 3, in Table I, gives the member areas found on the basis of a uniform moment of inertia. The large variations in the chords and the small variations in the webs will be noted. In analysing a continuous plate girder, the flange material may be corrected in direct proportion to the change from the preliminary to the final moment. It is to be noted that this is not so in a frame structure whose members receive their stress increments only at panel points. Table I is based upon the final areas given in column four. The bodies of the tables for the 200 and 280ft. spans have been omitted and only the first three lines and the summations given.

Table II shows the same calculations with the L/A term omitted throughout.

Table III summarizes the dead load moments found by the various methods and shows the variation from the actual moments found by using the final areas.

Table III

Dead Load Moments Found by Several Methods, Compared by Percentage With The Actual Moments

Method	1st pier ft. kips	%	2nd pier ft. kips	%
$\sum \frac{PUL}{A} \div \sum \frac{U^2L}{A}$	16,863	100	21,315	110
$\Sigma PU \div \Sigma U^2$	16,822	100	20,665	97
Uniform M.I.	13,600	80	18,100	85

As explained in Section V, Table IV shows 100 units, applied as a fixed-end moment at eight fixed points on the structure, one on each side of the four piers. The abutments are free. It will be seen that only two distributions are necessary. The rest follow from these and give all the information necessary to handle any type of partial loading. The figure shows a calculation for the maximum live load moment over the first pier. The uniform live load concentration is 25.6 kips while the dead load concentrations are 61 kips for a 200 ft. span, 61 kips for a 240 ft. span and 63 kips for the 280 ft. span. The live load fixed-end moments will be seen to be in direct proportion to those from the dead load. Spans one, two and four are loaded and the resultant fixed-end moments are multiplied by their appropriate percentages and the result is the maximum live load moment.

Table IV
Distribution of Fixed End Moments in Percentages.

Spans: a–b 200'-0"; c–d 240'-0"; e–e' 280'-0"; e'–d' 240'-0"; 200'-0"

	b (200'-0")	c (240'-0")	d (240'-0")	e (280'-0")	e' (280'-0")	d' (240'-0")	(240'-0")	(200'-0")
Stiffness	.41	.59	.50	.50	.50	.50	.59	.41
Carry Over	0	.614	.535	.516	.516	.535	.614	0
F.E.M.	-100.00							
	+41.00	+59.0	+36.20					
		-9.70	-18.10	-18.10	-9.36			
	+3.97	+5.73	+3.52	+2.50	+4.68	+4.68	+2.50	
		-1.61	-3.01	-3.01	-1.56	-.90	-1.47	-1.03
	+.66	+.95	+.58	+.64	+1.23	+1.23	+.66	
		-.33	-.61	-.61	-.32	-.24	-.39	-.27
	+.14	+.19	+.11	+.15	+.28	+.28	+.15	
		-.07	-.13	-.13	-.065	-.055	-.09	-.06
	+.03	+.04			+.06	+.06		
	-54.20		+18.56		-5.05		+1.36	
			-100.00					
		+26.80	+50.00	+50.00	+25.80			
	-11.00	-15.80	-9.70	-6.66	-12.90	-12.90	-6.90	
		+4.40	+8.18	+8.18	+4.30	+2.50	+4.07	+2.83
	-1.80	-2.60	-1.61	-1.75	-3.40	-3.40	-1.82	
		+.90	+1.68	+1.68	+.87	+.65	+1.07	+.75
	-.35	-.55	-.34	-.39	-.76	-.76	-.40	
		+.19	+.36	+.36	+.19	+.15	+.24	+.16
	-.08	-.11	-.07	-.09	-.17	-.17	-.09	
		+.04	+.08	+.08	+.04	+.03	+.05	+.03
	-.02	-.02			-.04	-.03		
	-13.25		-51.42		+13.94		-3.78	

Whence we may write:

F.E.M. at	R_1	R_2	R_{2_1}	R_{1_1}
R_1 Left	-54.20	+18.56	-5.05	+1.36
R_1 Right	-45.80	-18.56	+5.05	-1.36
R_2 L.	-13.25	-51.42	+13.94	-3.78
R_2 R.	+13.25	-49.58	-13.94	+3.78
R_{2_1} L.	+3.78	-13.94	-49.58	+13.25
R_{2_1} R.	-3.78	+13.94	-51.42	-13.25
R_{1_1} L.	-1.36	+5.05	-18.56	-45.80
R_{1_1} R.	+1.36	-5.05	+18.56	+54.20

Supports: R_o, R_1, R_2, R_{2_1}, R_{1_1}, R_{o_1}

D.L. Panel Concentrations
200' Span - 61.0 Kips
240' Span - 61.0 Kips
280' Span - 63.0 Kips

D.L.F.E.M. (See Table I)
b - 18,640 ft. Kips
c - 16,207 "
d - 19,331 "
e - 23,035 "

Therefore F.E.M., Uniform L.L.

200' Span = 18,640 × 25.6 ÷ 61 = 7,840 ft. Kips at "b"
240' " = 16,207 " " = 6,820 "c"
= 19,331 " " = 8,110 "d"
280' " = 23,035 × 25.6 ÷ 63 = 9,370 "e"

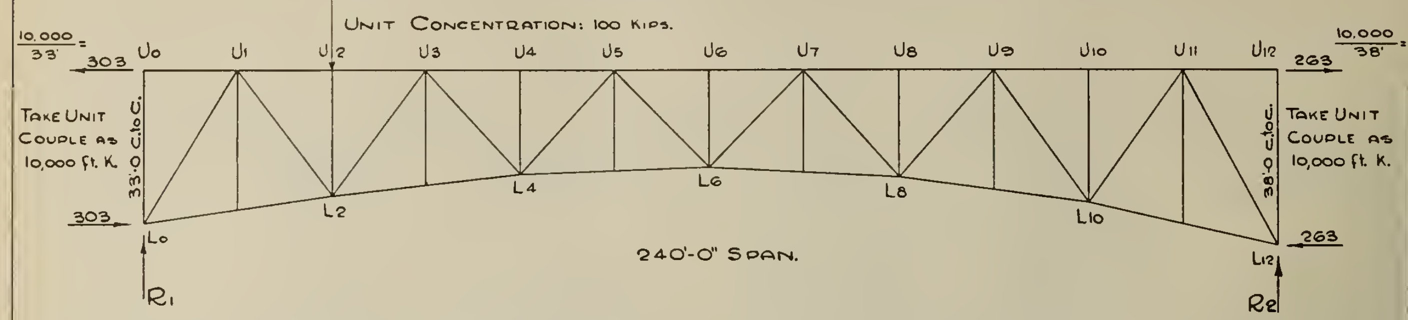
Find Max. L.L. Mom. at R_1 (Span 1, 2, and 4 Fully Loaded)

M.R_1 7,840 × - 54.20 % = - 4,250
6,820 × - (45.80 + 1.36) = - 3,220
8,110 × - (13.25 + 3.78) = - 1,380
- 8,850 ft. Kips. Max. L.L. Mom.

M.R_2 7,840 × + 18.56 % = + 1,450
6,820 × - (18.56 - 5.05) = - 920
8,110 × - (51.42 - 13.94) = - 3,040
- 2,510 ft. Kips for above Loading

Table V

Table Showing Stresses Produced By Unit Loads and Unit End Moments.



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Unit Load at	R_0	L_0U_1	L_0L_2	U_1L_2	U_1U_3	L_2U_3	L_2L_4	U_3L_4	U_3U_5	L_4U_5	L_4L_6 All	U_5L_6 Stresses	U_5U_7 Shown	L_6U_7 in	L_6L_8 Kips.	U_7L_8	U_7U_9	L_8U_9	L_8L_{10}	U_9L_{10}	U_9U_{11}	$L_{10}U_{11}$	$L_{10}L_{12}$	$U_{11}L_{12}$	R_{12}
U_1	11/12	+120	- 63	- 4	+ 63	- 3	- 62	+ 3	+ 59	- 9	- 54	+ 10	+ 48	- 14	- 38	+ 13	+ 29	- 15	- 20	+ 14	+ 12	- 12	- 5	+ 11	1/12
U_2	10/12	+109	- 57	-117	+127	- 6	-124	+ 6	+119	- 17	-107	+ 19	+ 95	- 28	- 76	+ 27	+ 58	- 29	- 40	+ 27	+ 23	- 23	- 10	+ 22	2/12
U_3	9/12	+ 98	- 51	-105	+114	+118	-186	+ 9	+178	- 25	-161	+ 29	+143	- 42	-115	+ 40	+ 88	- 44	- 59	+ 41	+ 35	- 35	- 15	+ 32	3/12
U_4	8/12	+ 87	- 46	- 93	+102	+104	-166	-112	+239	- 34	-215	+ 39	+191	- 55	-153	+ 54	+117	- 59	- 79	+ 55	+ 47	- 47	- 21	+ 43	4/12
U_5	7/12	+ 76	- 40	- 82	+ 89	+ 91	-145	- 98	+210	+ 90	-269	+ 48	+238	- 69	-191	+ 67	+146	- 73	- 99	+ 68	+ 59	- 58	- 26	+ 54	5/12
U_6	6/12	+ 65	- 34	- 70	+ 76	+ 78	-124	- 84	+180	+ 78	-231	- 81	+286	- 83	-229	+ 81	+175	- 88	-118	+ 82	+ 70	- 70	- 31	+ 6.5	6/12
U_7	5/12	+ 54	- 29	- 58	+ 64	+ 65	-103	- 70	+150	+ 65	-192	- 67	+238	+ 41	-267	+ 94	+204	-103	-138	+ 95	+ 82	- 82	- 36	+ 76	7/12
U_8	4/12	+ 43	- 23	- 47	+ 51	+ 52	- 83	- 56	+120	+ 52	-154	- 54	+191	+ 33	-213	- 32	+233	-117	-158	+109	+ 94	- 93	- 41	+ 86	8/12
U_9	3/12	+ 33	- 17	- 35	+ 38	+ 39	- 62	- 42	+ 90	+ 39	-115	- 40	+143	+ 25	-160	- 24	+175	0	-177	+123	+105	-105	- 46	+ 97	9/12
U_{10}	2/12	+ 22	- 11	- 23	+ 25	+ 26	- 41	- 28	+ 60	+ 26	- 77	- 27	+ 95	+ 16	-107	- 16	+117	0	-118	0	+117	-117	- 52	+ 108	10/12
U_{11}	1/12	+ 11	- 6	- 12	+ 13	+ 13	- 21	- 14	+ 30	+ 13	- 38	- 13	+ 48	+ 8	- 53	- 8	+ 59	0	- 59	0	+ 59	- 6	- 57	+ 119	11/12
Σ Plus						+586		+ 18		+363		+145		+123		+376									
Σ Minus						- 9		-504		- 85		-282		-291		- 80									
Σ Total		+718	-377	-646	+762	+577	-1117	-486	+1435	+278	-1613	-137	+1716	-168	-1602	+296	+1401	-528	-1065	+614	+ 703	-648	-340	+713	Kips
Unit M U_0L_0		- 11	+313	+ 12	-316	+ 14	+309	- 15	-297	+ 45	+268	- 46	-236	+ 70	+188	- 67	-143	+ 73	+ 96	- 68	- 68	+ 58	+ 26	- 54	Kips
Unit M $U_{12}L_{12}$		- 54	+ 28	+ 58	- 63	- 64	+104	+ 69	-150	- 64	+193	+ 66	-236	- 40	+267	+ 39	-292	- 1	+295	+ 1	- 283	+ 30	+ 283	- 28	Kips

Example:-

L.L. Panel Concentration = 25.6 Kips; Unit Concentration = 100 Kips.

M R_1 = - 8,840*; Unit Couple = - 10,000 ft. kips

M R_2 = - 2,510*; Unit Couple = - 10,000 ft. kips

* See Table IV

L.L. Stress L_0L_2 (Col. 4) -377 × .256 = - 97

+313 × .884 = + 277

+ 28 × .251 = + 7

+187 Kips.

Table V shows the stresses for every member due to a unit load at each panel point and a unit moment at each end. The example in the table calculates the maximum live load stress in L_0L_2 of the 240 ft. span. The panel load is 25.6 kips, and the loading condition is that shown in Table IV whence also come the appropriate end moments, viz. 8,850 ft. kips and 2,510 ft. kips.

In the examples given in Tables IV and V, isolated cases are worked out. These examples may give an erroneous idea of the total work involved. Actually, simple tables may be set up for live load and dead load stresses and all the values filled in by inspection and proportion from the basic tables.

Acknowledgments

The author wishes to acknowledge the help and advice of his co-workers, and especially of Mr. P. G. A. Brault, M.E.I.C., who suggested Table V, and Mr. D. J. Shone who discovered the paper of Professor Haertlein which led the author to Section IV of this paper.

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ANNUAL MEETING, HAMILTON, ONT., FEBRUARY 6th and 7th, 1941

CANADA'S HIGHWAY—BANFF TO JASPER

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NEGOTIATIONS ARE UNDERWAY WITH THE OBJECT OF SECURING LANTERN SLIDES THAT MAY BE SHOWN AT THE ANNUAL PROFESSIONAL MEETING, AND WHICH WILL ILLUSTRATE SOME ENGINEERING FEATURES NOT DEALT WITH IN THIS GENERAL PAPER

With the completion of the Banff to Jasper highway late in 1939, a project, first discussed over twenty-five years ago, became an engineering fact. This highway affords direct connection between Banff and Jasper National Parks and was constructed by the Department of Mines and Resources through the Engineering and Construction Service, Surveys and Engineering Branch.

For many years the overland trip between Banff and Jasper, Alberta, was classed as one of the most difficult pack-train routes in the Rocky Mountains, requiring some eleven days over a route where trails only existed in part. Gradually a practical route for a highway took form which received great encouragement when the main highway westerly from Banff to Lake Louise was completed. Lake Louise, thirty-eight miles west of Banff, then became the logical starting point of the southerly end of the proposed new highway.

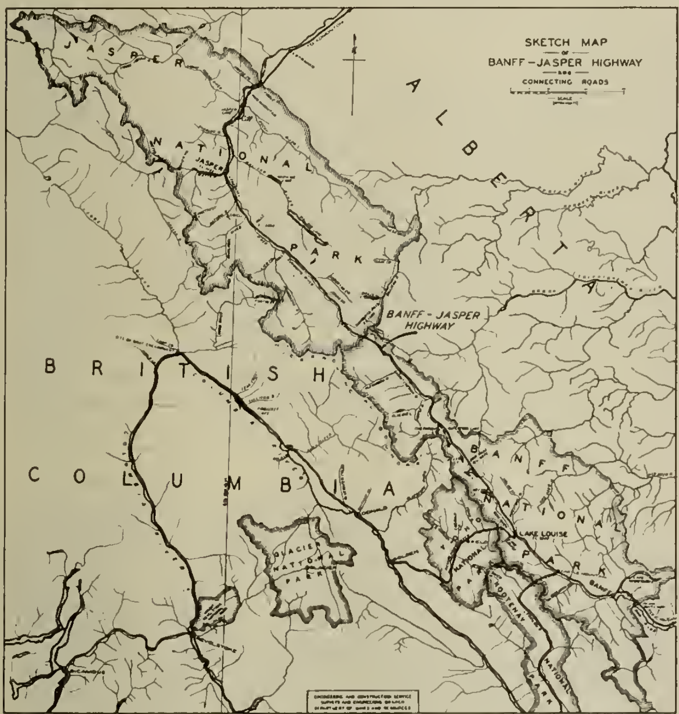

Fig. 1—Map showing route of Banff-Jasper Highway.

From the beginning, the Lake Louise-Jasper route was recognized as offering unequalled scenic possibilities. Greater expenditure would naturally result in better highways from an engineering standpoint but none would traverse a more interesting or spectacular area.

Following immediately east of the continental divide, formed by the Rocky Mountains, the route finally selected traverses a mountain area that possesses all the best features of Alpine country. On its course it passes over mountain summits, crosses innumerable mountain streams, and passes in sight of eight glaciers, one of which is within a stone's throw of the highway itself. Canada's greatest ice area south of the Arctic circle, namely, the Columbia Icefields, is made easily accessible by the new highway.

Naturally a highway through country of this nature offered most interesting problems in location and construction. These problems were emphasized by the fact that the recently completed section of the highway between Lake Louise and the vicinity of Jasper, involving some one hundred and forty miles of entirely new construction, traversed virgin country where there were no settlements or communications of any kind. Of the entire distance between Lake Louise and Jasper some sixty miles of the road is more than a mile above sea level. Along many sections of the road timber line is only some fifteen hundred or two thousand feet above the highway. This condition results in a quick run-off and presents new problems in drainage.

At the point where the highway takes off from the Trans-Canada highway east of Lake Louise station the elevation of the road is 5,040 feet. On good alignment and by gradually ascending grades following northerly the upper reaches of the Bow river for twenty-six miles, the first summit and the highest point on the entire highway is reached at Bow pass, elevation 6,878 ft. From Bow pass the road descends through the Mistaya river valley to the North Saskatchewan river which is crossed at Mile 50, elevation 4,565 ft. From this point following the easterly side of this river the highway ascends to the headwaters at the upper crossing of the North Saskatchewan river, Mile 73, elevation 5,248 ft. The next seven miles brings the highway to the second summit at Sunwapta pass, the boundary between Banff and Jasper National Parks, Mile 80, elevation 6,680. Heavy grading was encountered on this section which is known as the Big Hill. The latter embraced the most difficult section of the highway both from the standpoint of alignment and grades. Northbound an ascent of 1,362 ft. in a limited distance of approximately five miles was necessary from the Athabaska valley to the Sunwapta. From Sunwapta summit the road descends rapidly for about ten miles following down the Sunwapta river, thence on easier gradients to the crossing of the Athabaska river near Athabaska falls at Mile 128, elevation 3,864. From the latter point the highway

Fig. 2—Typical concrete girder bridge, Athabaska River.

Fig. 3—Bow string treated truss, North Saskatchewan River.

follows the westerly side of the Athabaska river and after crossing the Whirlpool river continues to the junction with the Edith Cavell highway at the Astoria river bridge, Mile 140, and thence descends for nine miles to Jasper, elevation 3,483 ft.

When one considers the topography of the country through which this highway was located consisting of mountain passes and valleys amidst towering mountain ranges and also that in places the roadway had to be carved out of steep rocky sidehill, the alignment secured is exceptionally good. Of the one hundred and forty miles, a winding mountain type of location had to be adopted for

Fig. 4—Completed section of gravel highway.

scattered sections totalling under twenty-three miles. Generally, curves have a radius ranging from five hundred to one thousand feet and there are few curves which have a radius under the above minimum. Naturally it is not feasible on a project of this nature over mountainous terrain to set for original construction a minimum curve radius or sight distance when the initial construction cost must be kept within certain limits. However, except for a few sections where there is necessarily winding alignment and such sections being suitably marked by caution road signs calling for special attention by drivers, the minimum vertical and horizontal sight distances are sufficient to ensure safety.

Construction operations were commenced from each terminus of the highway in September, 1931. All work from its inception to its completion in November, 1939, was carried out by day labour. While the standard adopted for this highway called for a minimum width of travelled roadway of 18 ft., exclusive of side ditches, several sections were constructed to a greater width. The entire highway has been completed as a first class all weather gravelled road with sections treated with a dust layer where necessary. In order to obtain as permanent construction as possible, many miles of the highway received a total of 2,000 cu. yd. of gravel and over during the period of building. While this was in excess of standard surfacing requirements for a highway of this type, it was necessary to bring up to grade settlement in newly constructed fills and to maintain the road as sections were opened to public traffic the same year as constructed.

In September, 1931, location surveys were run for the first sections from each end of the highway. Construction camps were established and clearing and grading operations commenced, the former being continued into the winter season. Work was carried out simultaneously from the northerly and southerly ends each subsequent season until in the fall of 1939, a junction was made and the road connected up near Mile 67 from Lake Louise or Mile 82 from Jasper.

In 1931, operations were undertaken as an unemployment relief measure at authorized relief allowances and continued on this basis until 1934. In order to make available the maximum amount for relief allowances, the purchase of highway equipment was restricted and work carried on mostly with hand tools with a minimum of heavy grading and motorized equipment. During this period the working forces were established in 50-men camps. These were spaced approximately three miles apart. This reduced to a minimum the time required for men going to and from work daily. Each camp consisted primarily of three main buildings, viz:—a combined dining room and kitchen, a building for sleeping quarters and an office with storehouse attached. The buildings were of log type with lumber floor and roof covered with rubberoid.

During 1934 a change was made in executing the work from relief allowances to wages based upon established prevailing rates of pay in the district for the various classes of labour employed. The latter system was continued for the balance of the construction period. With the transition during 1934 of this project to more standard construction conditions the power equipment in use was increased. Major equipment included Diesel and gasoline tractors fitted as required with angledozers, power shovels, graders, fresnos, scrapers, air compressors, jackhammers, trucks and teams and wagons. Canvas camps were established for advance crews and later some of these, as required, were converted to more permanent quarters by constructing log buildings. Much of the lumber used was produced by a portable sawmill from logs cut off the right-of-way. Supplies were hauled by trucks over completed sections of the grade and by wagon and tractor over tote roads to the advanced work. Tote roads were located in so far as possible on the right-of-way so that later they could be incorporated in

Fig. 5—Traversing along Waterfowl Lake.

the highway as finally constructed. The two railhead points, Lake Louise on the Canadian Pacific and Jasper on the Canadian National railways, are approximately one hundred and fifty miles apart and as the work progressed supplies had to be hauled increasing distances. Towards the close of operations, supplies were being transported to advanced camps more than eighty miles from Jasper on the northerly and sixty-five miles from Lake Louise on the southerly ends. Working crews averaged about four hundred and fifty men for some six months each year.

Crews working in Jasper Park encountered most difficult construction in the Sunwapta area about sixty-five miles southerly from Jasper. A series of switchbacks were developed and an elevation reached from which a panoramic view of unsurpassed mountain scenery is revealed. In Banff Park over the first twenty-five miles wet sidehill work was encountered involving the construction of numerous drainage structures. In order to facilitate construction, large drainage ditches were constructed the year before grading operations commenced affecting a thirty foot right-of-way. As a result, the following year, wet ground was thoroughly drained and dried and offered no difficulty to grading equipment. The next fifty miles passing over Bow summit, down the Mistaya valley to the main crossing of the Saskatchewan river and thence on ascending grade to the forks of the Saskatchewan headwaters was typical mountain highway construction. From this point to the junction with the work carried out from the Jasper base, considerable exploratory operations over an extended area were undertaken and numerous reconnaissance and location lines were run before the final route was selected for the Big Hill.

Clearing and grubbing were important items of construction as this highway was located through virgin timbered territory. Clearing was carried out to widths varying from 40 to 60 ft. and grubbing from 30 to 60 ft. Culverts, mostly of the box type, were built of native logs secured from clearing operations. While these have only a limited life, they are cheaply and easily constructed from material available on the ground and consequently can be built to ample proportions. Thus an increased safety factor is provided against excessive runoffs at a considerable saving in cost over the more permanent types to provide equivalent water carrying capacity. In a highway of this type traversing previously undeveloped mountain areas it is difficult to forecast accurately the peak flow of water-courses. Some of these might carry a large amount of water at certain seasons of the year and little or none during the remainder of the year. As part of the maintenance of the highway subsequent to the completion of construction operations, these water-courses are kept under observation so, when the native wood structures require replacement, the best size and type of culvert for permanent installation can be installed.

Courtesy Canadian National Railways.

Fig. 6—On upper reaches of Sunwapta River, Banff to Jasper highway.

Thirty-nine bridges were constructed of various materials such as timber, concrete and steel and included such types as timber stringer, pony and Howe truss as well as reinforced concrete slab and steel girder. The longest span is a 140 ft. 3 in. preframed and treated bow string through Howe truss timber bridge over the North Saskatchewan river approximately 50 miles north of Lake Louise.

Fig. 7—Typical road section on sidehill.

Where short span bridges not exceeding 25 ft. were required, native timber obtained locally was utilized. Lumber for decking and superstructure was cut from timber on the ground by a portable sawmill. The latter was also utilized for sawing lumber required for the camps, including roofing, flooring, tables, bunks and other furniture.

On the Jasper end of the highway some medium span bridges were constructed using reinforced concrete beam and slab type and also steel girder with concrete face and parapet wall. The former were used for spans not exceeding 30 ft.

Courtesy Canadian Pacific Railway.

Fig. 8—Peyto glacier, Banff to Jasper highway.

and the latter for spans up to 50 ft. A laminated flooring was used on the latter built up of 2 x 4 in. treated timber laid on edge. Reinforced concrete abutments were used with the above types of bridges. These bridges combine permanent qualities with neat and pleasing appearance.

The larger bridges are of the Howe truss type, with curved upper chord. Truss members are of preframed British Columbia fir, pressure treated with zinc chloride. Substructure timbers were given the pressure creosote treatment before delivery on the job. In the pressure treatment, standard specifications of the American Wood Preservers Association were followed and generally the treatment consisted of one pound of dry zinc chloride salt and a minimum of eight pounds of No. 1 grade creosote oil per cubic foot of timber respectively. Other lumber used for decking and handrail was cut locally by the portable mill. Decking used was the laminated type of 2 by 4 in. material laid on edge and brush treated with creosote on the work.

The Banff to Jasper highway affords a circle drive through Calgary, Edmonton, and the mountains. It provides also the mountain route from Northern Alberta and Saskatchewan to the Trans-Canada highway and over the latter to the Pacific coast by the newly completed Golden-Revelstoke highway.

The Banff to Jasper highway was opened to the travelling public on June 15th, 1940, as a new link in Canada's chain of scenic motor highways.

SOME FUNDAMENTAL ENGINEERING PRINCIPLES AS APPLIED TO MECHANIZATION

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Paper presented before the Kingston Branch of the Engineering Institute of Canada, on October 31st, 1940

(ABRIDGED)

It is a criticism—not altogether unjustified—that the soldier is slow to avail himself of the discoveries that science puts at his disposal. There are many reasons for this, and the instinctive caution and conservatism of military thought in all countries is not by any means the only reason. Military evolution has always tended to be a process of accretion—tacking new devices on to the old system. Any sort of remodelling involves the haunting dread of difficulties that will be caused to mobilization—of reservists with no knowledge of the changes—of the ever present fear of being caught in mid-stream while changing horses. This applies with special force to the mechanization of our armed forces.

Success in modern warfare depends on the results of scientific research and achievement. For seven or eight years the entire support of the Nazi regime has been behind such a programme. Our own scientists are as good or better than the German. Of vital importance at the moment is the ability to make practical use of scientific equipment.

No one who has taught engineering for a number of years can have failed to notice how much more mechanically-minded and more receptive of mechanical ideas the rising generation is than was the case with those who were brought up in the "steam age." There is more independence of judgment as well, which makes the handling of this generation more difficult and at the same time more interesting. It is perhaps for this reason above all others that it is so important that the higher command in the Army should be in the hands of relatively young officers who are accessible to new ideas and untrammelled by tradition. In fact, it is essential that if the Army is to perform its duties in a satisfactory way it must be up-to-date in thought as well as in equipment.

It has been said that engineering is fundamentally concerned with four M's:—

Men—Administration and Management.

Money—To do with one dollar what might be done by the layman with two dollars.

Materials—Choice, Discrimination, etc.

Method—Knowledge of Science, Acquired Art.

Engineering is the scientific handling of these factors, and in a modern army they must be applied to a fifth M, namely, *Mechanization.*

Simplicity and robustness is the keynote of anything that is to stand up to use by the soldier in the field. The time factor is also a matter of far more importance to the soldier than to the civilian, and scientific adaptation and improvement is a matter where time in abundance is required.

It is therefore important that soldiers in general—not merely those belonging to technical formations—should have a sufficient knowledge of the recent trend of scientific thought, and especially in those directions that are most likely to affect the fighting arms.

Mechanization and Standardization

The purpose of an army is to deliver a maximum blow in a minimum time and with the least possible loss; its organization and equipment should be carried out with this end in view. The object of mechanization is to render the army more efficient in the performance of this purpose without excessive increase in cost.

Army mechanization is by no means the mere provision of armoured fighting-vehicles—it involves the whole matter of the use of the machine in place of muscles of man and horse. Such matters as the provision of power-driven tools in place of manual articles are of the very essence of mechanization.

Time, money and energy will be wasted however, unless due regard is paid to the question of standardization.

It would be unfortunate if some item of ordnance supply should be of a special type, while thousands of commercial stores of a slightly different pattern were available which would suffice equally well for the purpose. On the other hand, it would be undesirable to increase the number of different patterns if this involved the provision of spare parts for maintenance purposes. In finding a solution to such problems, the armed forces can and must play a very definite part; they must permit ordnance stores to be designed as far as possible along the lines of similar goods used in peace. In cases where this is not possible, as in material for armament, (as opposed to articles of equipment) the armed forces must permit reasonable modifications in design to be made if quantity production is to be undertaken.

Thus the subjects of mechanization and standardization are closely connected, and in fact the former is impossible without the latter.

Certain salient points may now be noted regarding production methods in wartime.

Perhaps the most important of these (and one not generally appreciated by the layman), is the difficulty of providing for effective inspection and of securing proper gauges for controlling and maintaining the accuracy and the interchangeability of parts between plants manufacturing the same items. Accurate gauges are necessary to insure conformity to drawings and specifications and also for government acceptance of guns, ammunition, and manufactured parts, and where such gauges are not provided in sufficient quantities, delays inevitably will occur. In order to control the accuracy of tools, gauges and measuring instruments, it is necessary to provide for the calibration of the gauges themselves by a specially equipped standards department under control of the Ordnance Service.

Close liaison moreover must be maintained between the various departments of the Army, Navy and Air Force concerned in developing a definite policy to avoid overlapping of facilities.

In addition to the problem of gauge supply and control many other problems must be solved in the production "en masse" of manufactured articles. In the first place a commodity must be specially designed to avoid loss of time in the manufacturing processes. Three million automobiles were produced in the United States in 1939—it is estimated that the maximum number of planes which could be built in the same year amounted to 28,000 in the case of the United States, Great Britain, France, and 28,000 in the case of Germany and Italy*. Thus for every aeroplane built for the world powers engaged in the present war, more than sixty motor vehicles were produced in the United States alone. This startling comparison at once invites serious consideration of the principles employed in mass production.

For example, if we compare the design of the modern car with that of its predecessors, we find that whereas the earlier car bodies were assembled from many different frames, angles and brackets, a modern car body is made from four steel pressings. Moreover the number of separate parts of a modern car has been reduced to around 500-2,000 as against 3,000-20,000 in the case of a modern monoplane.

In order to overcome the difficulty of "bottle-necks" in the assembly line and speed up production generally, work must be kept flowing through the factory at a regular rate. Normally it should progress from small components to the finished article in easy stages, each step consisting of a simple short-time routine individual operation, which should be limited to minutes, not hours or days.

A very serious difficulty in carrying out the mechanization of industry and the armed forces at one and the same time arises from their competitive demand for skilled labour. It is true that mass production methods lend themselves to the use of unskilled labour to a certain extent, but trained technical personnel on an ever increasing scale must be available both for industry and the defence services, if they are to perform their tasks properly.

The total number of men in uniform forms but a small proportion of the total population engaged directly in war work. In considering the relative needs for skilled personnel two important distinctions should be noted. (1) Whereas industrial labour can be diluted to some extent by women, children and others who would normally be considered unfit, the standards required for a modern mechanized army cannot be lowered; and (2) In certain fields peculiar to the needs of war-time industry such as the manufacturing of armament (where margins of allowable error are sometimes as low as half a ten thousandth of an inch), certain specialist trades are at a premium. It is evident that there are hundreds of thousands of skilled workers in industry who must, on no account, be taken into the armed forces. Yet, the requirements for maintaining the mechanical efficiency of the armed forces demand a large number of tradesmen with qualifications as good or better than those in civil life.

*See, *Mechanical Engineering*, p. 523, July 1939; also *The Engineering Journal*, p. 306, July, 1940.

It has been erroneously assumed in many quarters that a lower standard of mechanical skill can be relied upon to maintain mechanically propelled vehicles in the Army, than would be the case in servicing similar vehicles in civil life. Nothing could be further from the truth.

In regard to man power, it has been estimated that forty-six men in uniform on lines of communication duties are required to keep a tank (manned by two men) in action, while each aeroplane requires close upon sixty men for its ground staff. These approximate figures do not take into account the number of men (or women) who may be required to manufacture the tank or the aeroplane, or the munitions which it expends, or who are needed to provide and supply hundreds of incidental requirements such as clothing, equipment and rations.

The need for qualified engineers to direct the activities of mechanization both in war-time industry and the defence forces is also apparent. Some of the more important engineering fields in so far as they affect the Ordnance Service may be briefly summarized.

METALLURGICAL

In addition to the many metallurgical engineers who will be absorbed in industry, a number of engineers of outstanding ability in this field must be available to assist in the development of special steels for guns, armour plate and other vital metallurgical necessities.

AUTOMOTIVE

In order to assist in formulating a consistent policy of design in this field a group of highly qualified automotive engineers should be appointed in a consulting capacity. The group might include military and civil members and to them would be entrusted the task of achieving constructive development. Only in this way will improvement in design be adapted to military needs with the minimum expenditure of time and money.

RUBBER, ETC.

Attention must be given to every material vitally necessary for armament, and the rubber industry may be taken as an example. The many uses of rubber for linings and insulations in tanks, new types of bullet-proof tires, and other purposes in Ordnance material, are instances of this.

OPTICAL

The larger companies engaged in optical work conduct independent research in connection with all types of fire-control instruments. This would indicate the necessity for having a highly qualified department of Ordnance to direct such work in the interests of military requirements. The provision of height and range finders and anti-aircraft optical equipment generally is a field of the first importance.

Where the facilities of the Ordnance Department are inadequate for dealing with problems such as those mentioned, the National Research Council is available to give the necessary assistance.

MECHANICAL

Numerous examples of the requirements demanded by a modern army in the realm of mechanical engineering might be given. The design of a new front-wheel drive for trucks, the adaptation of gun carriages to pneumatic tires, the development of armament and guns for tanks are a few pertinent examples.

The layman has no idea how mechanization may be hindered by insistence on what may be indeed a genuine improvement. Even in peacetime this is a matter of much importance and in war-time overwhelmingly so. An example may be taken from a modification intended to reduce weight with no loss of efficiency in the turret of a medium tank. "It was found that the proposed changes affected some 500 drawings most of which would have to be re-drawn, and this did not take account of alterations which would have to be made in the manufacturing processes to jigs, fixture, tools, etc."

Mechanization is not merely a matter of the acquisition of a number of machines; it involves the cultivation of mental qualities necessary to take advantage of mechanical and scientific development in such a manner as will secure the highest possible degree of efficiency in war. This involves a revolution in outlook not unlike the change in the Royal Navy when steam replaced sail, and the army does not take kindly to revolutions.

The recent trend whereby the production of any essential war material comes under the direction of one man is specially to be noted. Overlapping and consequent delay in production in that particular field should thereby be reduced to a minimum.

Air-Mindedness

In turning to the most recent innovation of mechanized warfare, namely, the aeroplane, it can be said that the whole military picture has been altered in the last few years.

The assembly of large armies has become less important than diminishing vulnerability.

Every means must be studied to reduce and disperse targets of importance.

The self-reliant and level-headed person is now very much in demand.

Let us regard the aeroplane as a long range mechanized vehicle, one which will supply increased mobility, yet one that is shorn of many of the drawbacks of land vehicles.

The aeroplane is no longer a mere army co-operation agency—we must use it as a weapon in itself and one that is refreshingly independent of terrain. It is not that the day of armies is past—it is the soldier and the soldier alone who can occupy territory and make good the ground won. But it is the air force that supplies much help in relieving the stalemate, and for a country like our own, where man is costly and the machine cheap, we must exploit to the full advantages that we thereby gain.

The infantry soldier is still taught that it is he alone who wins wars, and that such aids as aeroplanes and tanks are just to help him in this. The air force, on the other hand, can undertake the bombing of hostile capitals, factories and rear organizations, and this alone may win a war. But it is the two together that are so essential—the mechanized army and air force are like the two fists of a boxer and they should be directed by a combined general staff. The essence of war is that the two parties try to impose their will on each other by giving as many blows and receiving as few as possible, and this is the essence of boxing. The modern idea of war is to demoralize rather than to destroy—the boxer tries temporarily to paralyse the brain, not to break the jaw—and here again the parallel is close. The stalemate 1914-18 was due to the time honoured belief that the power of an army was proportional to its numbers.

There is little difference between defensive and offensive aerial warfare. In both cases the squadrons of bombing planes attack political and industrial centres, railroad terminals, bridges, etc., in the territory of the adversary, while pursuit and interceptor planes as well as anti-aircraft artillery attempt to destroy the invading bombers or chase them away from the most important objects of attack. Besides this, aircraft must fulfil various missions in connection with the activities of their respective armies and navies.

The vast majority of military aeroplanes in Europe are short range planes that could not bomb objectives situated at a greater distance than 750 or 1,000 miles from their operating base. At the present time, therefore, geographic position provides the only sure defence against air attack. This factor, however, will be modified to some extent in the future as the efficiency of the aeroplane is increased.

It may be assumed that every possible means will be taken to increase the effectiveness of the aeroplane and rapid developments in the field of aeronautical engineering may be expected to take place at any time.

GOVERNMENT AND THE ENGINEER

A. A. POTTER
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An address delivered at the 1940 Annual Meeting of the Engineers' Council for Professional Development, at Pittsburgh, Pa., on October 24th, 1940

The welfare of the engineering profession is now more closely tied up with government than ever before. Municipalities, states, and the federal government are constantly carrying on a variety of engineering operations and are becoming concerned to a very large extent with the regulations of engineering enterprises and in many cases with the operation of technical industries as well. However, the influence of engineers on government has not been in the past as great as it should have been, when one considers that the problems of government are largely technological in character. We have in our country a large number of engineering societies to serve our specialized interests. Our profession has also set up several functional organizations which are intended to serve our mutual technical objectives. One of these, the Engineers' Council for Professional Development, has been endeavoring to insure to the public better prepared and more competent engineers. Another, the Engineering Foundation, has been successful in fostering high-grade engineering research. Still a third functional agency, the National Council of State Boards of Engineering Examiners, has been a most important factor in giving national scope to licensing laws for engineers. We have, however, failed to support our only public-affairs mouthpiece, the American Engineering Council, which was created by our profession to relate the engineer to government. It is feared that the engineer's influence in government and in public affairs will remain insignificant, unless our various engineering societies are willing to support one functional agency of our profession which is able to present a united front in matters pertaining to government. Washington needs during the present emergency one spokesman for the engineering profession and not separate competitive mouthpieces for different specialized engineering societies. Are we willing to admit that we lack ability to organize in the interest of public welfare during this emergency?

Government's Need For Engineers

Engineers in the past have been largely associated with private enterprise and there has been a considerable tendency on the part of some members of our profession to depreciate government service for engineers. We engineers must change our mental attitude about employment in government service, particularly in view of the present most friendly attitude of the U. S. Civil Service Commission toward engineers for major posts in government. We must also take a much more active interest in public affairs. It must be realized that the national-defence programme, which we are now organizing, will require for its effectiveness large numbers of engineers skilled in a wide range of technical and administrative services. In fact, the success of this undertaking will depend very largely upon the extent to which our government can command expert engineering talent to serve during the emergency. There is an acute shortage of technical and supervisory engineering personnel not only in the industries concerned with national defence but also in the Army, Navy, and other defence agencies of government. By an Act of Congress, approved on October 9, 1940, $9,000,000 was turned over to the U. S. Office of Education, the regular defence agency of government which has cooperated with higher education for many years, for the purpose of increasing the supply of engineering specialists. It is impractical and undesirable to speed up the regular engineering collegiate programmes of study, but the appropriation referred to will make it possible for engineering schools to utilize their special facilities in the following ways:

1. Institutions which are located in large industrial centres, such as Pittsburgh, will be encouraged to offer in-service training courses of special value in up-grading the supervisory and technical personnel of defence industries in its locality.

2. Institutions which are removed from industrial centres, but which have outstanding engineering staffs, will be encouraged to develop certain types of in-service training on the engineering college level through extension classes.

3. Intensive resident programmes of study, varying in duration from one to several months, will be set up in a number of engineering schools which have outstanding facilities in staff and equipment, to retrain engineers for certain specialized fields of special value to the defence programme.

A regional organization is now being developed so that the needs of industry and of government for engineering talent may be coordinated with the facilities available in engineering schools for training of a specialized type. It is hoped that the engineering in-service and intensive training programmes which are now being organized will prove helpful in supplying the urgent needs for engineers in the rapidly expanding defence industries as well as for the defence agencies of government, but without disrupting the regular curricula which lead to degrees in engineering.

Stability of Government Essential

As engineers-citizens we must realize that government is an essential part of our existence and that our usefulness as engineers depends very largely upon the stability of our government. No one can predict what the future will hold for us. I am, however, one of those who has faith in the American form of government and who is fully convinced that the United States is a land worthy of our best endeavors and of the most loyal patriotism in peace or in war. Any one of you who feels unhappy because of the present conditions in our country will do well to compare, without political bias, our government with the totalitarian, or gangster rules, of other lands. Place in one (left-hand) column the ideals for which the government of the United States stands, such as, truth, right, liberty, law, equality of opportunity, humanity, and government by consent. Set down in the other column what one finds in totalitarian lands. You will have to write down in the right-hand column not truth but lies, not liberty but slavery and obedience to mediocrity and tyranny, not law but arbitrary authority by gangsters, not equality of opportunity but privilege limited to members of the gang, not humanity but cruelty, and not government by consent but government by cruel and dishonest dictatorship. Our American system has been able to provide comforts and even luxuries for our people to a scale unheard of in other lands, not through banditry or through the confiscation of the property of individuals or peoples, but by encouraging on the part of the citizens of our country freedom from revolutionary worries, industry, and the maximum development of their creative talents.

How Engineers Can Protect America's Future

During these difficult times we as engineers-citizens can protect the future of our country in the following ways:

1. We must do everything in our power to aid in speeding up the defence programme of our government, by giving our best talents to problems which will insure adequate and speedy production of the very best implements of war. This country is responsible for more than two thirds of the epoch-making inventions of our times. Let us use our creative abilities as engineers to build up our defence equipment so that we are fully insured against war. Remember the German war machine represents expenditures which in terms of our system of fairness and not banditry would cost more than 100 billion dollars. However, our expenditures for defence should be an insurance against war and not for the purpose of waging war, except in the gravest and proved national emergency.

2. We must give our support to the selective draft. It should be realized that the best mechanized equipment is useless unless we have men who have military as well as technical knowledge, and who possess qualities of physical endurance as well as of technical skill. Even the selective draft will give us an Army of about 33 divisions as compared with 250 divisions in Germany.

In discussing the selective draft with our friends of draft age let us impress upon them that no autocratic group in Washington but their own neighbors are members of the draft boards who have the responsibility of deciding which men are to be called, or deferred because of civilian activities or dependents. These boards have been advised in volume 3 of Selective Service Regulations that "it is in the national interest and of paramount importance to our national defence that civilian activities which are contributing to the national health, safety, and interest should be disrupted as little as possible, consistent with the fundamental purpose of the Selective Training and Service Act." Also a registrant is to be considered for deferment if he is "a necessary man" in industry, business, employment, agricultural pursuit, governmental service, or in any other service or endeavor, including training or preparation therefor, *only when all of these conditions exist:*

(*a*) He is, or but for a seasonal or temporary interruption would be, engaged in such activity.

(*b*) He cannot be replaced satisfactorily because of a shortage of persons with his qualifications or skill in such activity.

(*c*) His removal would cause a material loss of effectiveness in such activity.

Dependency deferments are particularly liberal. While peacetime draft is distasteful to many of us we must realize that in the present national emergency the Selective Service Act was approved by a large majority of our representatives in Congress, and as patriotic American citizens it is our duty and responsibility to uphold this Act of Congress which is now the law of our land.

3. We must realize that Great Britain is fighting our common enemy and should be given every possible assistance, short of actual warfare, in exterminating the worst gangster bands of all times. This can only be done if we are wise and courageous enough to stay out of war. For our country to be drawn into a war at this time will prove most detrimental to the future of all democracy.

4. We must bring about greater unity among our people. Foreign propaganda constantly at work even in our own land, supplemented by partisan political intrigue, have been responsible for developing extreme class, race, color, and creed consciousness. Let us do everything in our power to discourage such un-American efforts and let us retain the qualities of tolerance, humanity, and equality which have characterized our people at all times. Let us, as engineer-citizens, not forget that we are fortunate to live in a land where nonconformity with the views of government does not threaten us with death or concentration prison, where individual liberty is still considered sacred, where there is true equality of opportunity, where one is free to accept or change employment, where there is still considerable respect for the integrity of contract, and where the individual, more than in any other land, has full right to life, liberty, and the pursuit of happiness.

THE EXPLOITATION AND CONSERVATION OF MINERAL RESOURCES IN A BALANCED DEVELOPMENT OF CANADA

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Presidential Address to the Royal Society of Canada, May 19th, 1940

(ABRIDGED)

The purpose of this address is to consider how the mineral resources of Canada may be made to play their proper role in the development and consolidation of our national economy.

The term "conservation" in the title is used with its proper meaning—not a restriction of use, but a wise exploitation with a minimum of waste, and a maximum of utility for all purposes. The term "balanced development" means a development so planned and carried out that each section of the country will be exploited to its maximum usefulness according to its peculiar resources.

Within the last ten years the frontiers of mining in Canada have been pushed farther and farther north. We can now point to the long line of mining towns extending from Alberta to eastern Quebec—towns that support a large and growing population where only wilderness reigned a short time previously. Transportation systems by water, rail, roads, and air have been provided and great hydro-electric systems have been developed to serve the mines and the communities; heavy expenditures have been made in providing houses, water-works, sewerage, and all the services demanded by modern communities. Business houses and manufactories have arisen or expanded in the southern part of the country to furnish supplies to the mining industry.

Now what of the future? The mines must become exhausted in a few years, and there is nothing developed in the district to offer primary employment; to supply traffic for the transportation systems; to use the services that have been provided; or to buy supplies from the scattered local farms, or from our consolidated districts in the south. The result of this is that unless action is taken now the district will revert to wilderness. Are we to leave this whole country to deteriorate, and push on to do the same thing again farther north, leaving waste after waste behind us until we reach the Arctic Ocean? We need only consider what has been the fate of the once thriving towns of the Boundary district of British Columbia: the great Slocan camps where 140 mines were operating at one time; Barkerville in the Cariboo of central British Columbia; the towns of the Omineca district; Anyox, on the west coast; and numerous others northward to Dawson City which was booming at the beginning of this century. Nova Scotia has a similar tale to tell in its gold districts. The old communities of the Lake of the Woods district; the north of Lake Superior and the numerous developments along the southern edge of the shield in Ontario; the Tetreault mine of Quebec; the bog iron deposits; most of the copper and placer deposits of the Eastern Townships—all these, important in their day, are almost forgotten. Cobalt in Ontario also illustrates the point.

Are we to sit idle and have these things happen to such a large part of our Dominion? Or are we to use every effort to assure that our endowment of mineral wealth will not be squandered, but will serve as a support and a maintenance while we make sure that industries will be developed to take their place and consolidate our expansion? It must be done *now*, while the mines are in existence, or it may never be possible to do it at all.

Some of the factors that should influence the formulation of a reasoned policy for the exploitation and conservation of our mineral resources are as follows:—

(1) The search for and exploitation of metal deposits have been the incentive, in large measure, for the opening up and colonization of great tracts of our country formerly thought to be of little economic value except as a source of furs, game, and wood products.

(2) Similar development and colonization occurred in other countries—our closest example is that of our neighbour to the south.

(3) A great difference exists between the type of country opened in this way in Canada, and that in the United States, for example:

- (*a*) Only a small fraction of *our* new country is suitable for agricultural development.
- (*b*) The climatic conditions become more and more rigorous as our development is pushed northward.
- (*c*) So far as we know we have no great deposits of iron and of coal in our new country so related as to form the basis of great industrial development.
- (*d*) Coal deposits are far from the expansion area, and the coal is relatively costly in those mining districts.

(4) The search for gold, especially, has been the principal primary incentive to open up previously unoccupied lands, culminating in their political and economic expansion. In those countries opened in this way, i.e., Africa and the Americas, the production of gold, although still large, is only a fraction of the wealth now obtained from their pastoral and agricultural products.

The countries concerned have so consolidated their new territories by other developments that the disappearance of gold mining will have relatively little effect on permanent national development.

In Canada we must plan to attain this same state of affairs. Long before our mines wane by depletion, the large and growing population of our new mining districts, and all the services which are now absolutely dependent on the mines and their communities, should be assured a permanent, if somewhat different, place in our national development.

How is all this to be accomplished? That is the question about which our statesmen should be concerned at the present time, not ten, fifteen, or fifty years from now. We have great disadvantages as compared to other countries where much of the consolidation followed as a natural development; here it must be the result of foresight, intensive research work, and careful planning.

On the other hand, we have some wonderful assets which may well overbalance any disadvantages noted above:

(*a*) Our new mining developments are in the region of forestry developments on which are based our pulp and paper industries; careful fostering of our forests can perpetuate those industries.

(*b*) Within the region of present mining development is a stretch of fertile land running east to west through Quebec and Ontario for a distance of about 700 miles with an average breadth of about 60 miles; this district is traversed by the Canadian National Railway.

Most of this agricultural land is presently covered by small timber. Local sections along the railway have already been cleared and farmed, and a market for the products is in the mining communities, but so far they supply but a small fraction of local requirements. The scientific development of this area could be accomplished within the life of the mines in the neighbourhood, and result in a large, permanent farming community. Part of the timber from clearing could be sold to the mines for rough lumber, props, lagging, etc.; part to the paper companies as pulp wood; and part as cord-wood or stove wood for fuel.

This would involve a proper study of the local conditions of farming—of soils, growing season, climatic conditions, present and future markets, proper size of farms, and perhaps of the most suitable temperament of peoples to settle this region.

(*c*) In the persistent drive for, and exploitation of its metals, the country has been opened up by leaps and bounds, leaving large tracts of country, between and south of developed districts, untouched. A thorough stocktaking of the possible resources of those districts should be taken with a view to developing activities which will take up the slack as the metal mining wanes, and which will maintain the population, the transport systems, power and other services when the mining camps disappear.

Besides the possible resources of farm, forest, surface waters, game, furs, and recreational facilities, the whole field of minor metallic minerals and of the non-metallics, should be investigated. It is well known that in recent years many mineral materials have passed from the worthless class to that of highly profitable raw materials, for example, rocks high in nepheline as a basis for special ceramics and glass; graphic granites for abrasives and in the porcelain and glass industries where feldspar alone was formerly sought. Industries based on such resources can support large communities. Besides these, there are materials of probable use in the manufacture of refractories and of insulating materials. In the utilization of such materials, the supplies are likely to be large and any industry based on them will probably enjoy a long life.

The present time in Canadian development may be compared to that period, during the years 1870-1900, when the United States had its great period of rapid development.

It is largely due to the great deposits of coal and of iron and to the industries founded on them that the eastern United States has attained industrial supremacy. At the same time, local industries were established all through the country, which, with the development of agriculture, were able to absorb much of the population and of the services when, as has happened in many areas, mining gradually began to decrease instead of expand.

In the United States, the country has become more and more conscious of the extravagance, the wastefulness, and often the ruthlessness, which accompanied this rapid development, and it has been perfecting organizations, federal and state, to attempt to correct past mistakes and to bring about a balanced development or consolidation of the country.

A glance over our own country shows that we have been heading for more serious difficulties even than those encountered in the United States. Actually we are still exploiting our natural resources with a view to immediate profit, with practically no effort to perpetuate them or to replace them by other means by which future generations may exist. Is our collective intelligence less than that of a dictator or a bureaucracy, that we cannot look ahead and try to direct our destiny along the lines indicated by what we see ? Why not take out some insurance for the continued prosperity and development of the country as a whole ?

The question is raised at once—where is the money to come from for such a comprehensive undertaking ? Let us look at the situation first before we get scared in this way. A very large part, the really expensive part, of the whole foundation has already been built. Our technical departments of governments have accumulated, through the years, vast stores of accurate knowledge regarding our natural resources, actual, anticipated, and potential, so that a picture may be had of any one of these resources. *The crux of the whole matter is that we need a composite picture, not a series of detached pictures.* Using that composite picture we must plan so to exploit and get the maximum service out of those resources.

Regional and local planning are necessary; the federal government must cover the general field, and the provincial governments their respective more restricted fields, and both must work in close co-ordination and co-operation.

Let us look at some of our natural resources, their extent and general distribution in relation to the new country to be consolidated.

We have a total area of 3,729,665 sq. mi. in Canada, of which only 12½ per cent is considered to be physically suitable for agriculture or grazing (as against over 50 per cent of the United States). Most of our total potential farming land is in the prairie provinces or in the St. Lawrence river drainage basin.

It is obvious that we cannot depend greatly on farming to replace mining in our northward development. It is estimated that approximately one-quarter of Canada is covered by forest growth, and that about one-quarter of this (or 150,000,000 acres) bears saw-timber of merchantable size; the balance carries young stands, or timber suitable for pulpwood, fuel, etc. Two-thirds of the saw-timber is in part of British Columbia, so that the rest of forested Canada contains an average of only 1,600 ft. board-measure of saw-timber per acre—one rather small tree. Again a large part of this is concentrated in the St. Lawrence basin and in the Maritimes, and lumbering cannot be depended on to contribute largely to industry in the mining districts.

By a similar analysis the total estimated pulpwood 800,000,000 cords spread over 600,000,000 acres or an average of 1⅓ cords per acre, is not impressive when we consider that much of this is tributary to the St. Lawrence and in the Maritimes. The pulp and paper industry is already developed to take care of any probable demand for many years to come, but as there are large stands north of the Hudson Bay-St. Lawrence watershed, it might be more profitable to build industries in the region of origin, than to bring the wood to the southern mills.

Canada has 186,000 sq. mi. of fresh water lakes (other than the boundary lakes) in its interior, which produce fish of the finest quality. Climatic conditions also facilitate the work of distribution and marketing the catch. Here then is an important resource worthy of attention.

Our fur trade has been developed for a long time and its output could be greatly expanded in selected sections by fur farming in the natural environment of the animals.

We have nearly 1,000,000 hp. of water-power origin on the rivers draining into James bay; 2,500,000 hp. on the Nelson river draining into Hudson bay; and 400,000 hp. on the Hamilton river in Labrador—nearly all undeveloped.

Many industries are vitally dependent on cheap power, for example, the aluminium industry at Arvida where the raw material is brought all the way from British Guinana to the source of power. Electro-chemical and electro-metallurgical industries of many types are possibilities for our northern regions. Electricity is presently of prime importance in the manufacture of phosphorus, carbide, carborundum, electrolytic zinc and copper, cyanamide, caustic soda, chlorine, artificial graphite, nitrates, etc.

By exercising a little foresight, and at relatively small actual outlay, we can assure that Canada, for generations to come, shall have ample and diversified industries each based on sections of country selected as most suited for its particular activity.

Forests fostered, protected, and scientifically cropped, on lands particularly valuable for that purpose.

Farms on lands suitable for farming, and not on land which should never have been released for that purpose. Farm regions protected as to water-supply and cropped with vegetation suitable to regional and soil environment.

Water-powers developed where required and safe-guarded in the sources of supply.

Mining of metals exploited according to planned developments and not so far in advance of development of services that only the highest grade ores can be taken—and that at a much reduced profit—leaving the lower grade perhaps permanently unprofitable.

Expansion of production of non-metallics, with their accompanying industries established at strategic points.

Towns and cities located for permanence—founded on lasting industries.

Utilization of all raw materials in our own country wherever practicable, to furnish employment, increase the gross exports, and furnish a market for other home materials in the processing.

The Mining Industry

Now where does the mining industry fit into a composite picture of planned national development?

Two primary points of view must be taken into account, and some plan must be developed whereby these become mutually beneficial instead of antagonistic, as they appear at first glance:—

(1) It is an axiom in mining that the maximum profit accrues to the company with the most rapid exhaustion of available ore commensurate with good mining practice.

(2) From a national point of view (with certain exceptions due to periods of national stress) the life of the mines should be extended as long as possible, commensurate with a reasonable return on the capital invested. This may be accomplished in a variety of ways:

(*a*) By determining the rate of mining with due regard to the life of the community directly dependent on it, and to the rate at which new industries may be developed in the district.

(*b*) By the government doing everything possible: (i) to assist the mines in locating all the ore in the district, so that nothing will be overlooked; (ii) to assist in providing lowest possible costs of mining so that the lower limit of profitable grade will include the maximum quantity of material; (iii) by a policy of assisting only those developments which take place in the region planned to be consolidated, before opening up more remote, new territory.

This is not a plea for governmental regulation of our mines—a wide freedom of action is desirable. It suggests that the government has a right to ask in specific cases for a policy by which mining activity will be assured for a maximum time, in return for assistance as in 2(*b*) (ii) above; and also that it has the right to withhold assistance for development in districts which should be opened only at a later date. Planning cannot proceed far without popular and governmental support, for *all* must appreciate the need for such planning.

Although a national planning unit is essential as a co-ordinator and stimulator of regional, provincial, and local planning, actual planning should be by local units, provincial units, or regional units, who are thoroughly familiar with the resources of that district.

There should be direct contact between all these units so that the views and attitudes of the national board are directly interchanged with the views and attitudes of provincial or local boards, with a consequent adjustment of ideas and concerted action.

Other countries have discovered that national planning is vital in their economy and most of them have realized it long after unplanned development has raised so many perplexing and distressing problems of national importance that they were forced to take action. Our own country, young in development as it is, has plenty of warnings to offer, and there are numerous indications that thinking members of the community are alive to the serious consequences that will follow if these trends in development are not checked and redirected. In this connection it is only necessary to mention the work of the Canadian Forestry Association and the Society for the Protection of Fish and Game, on a national scale, and of the local Boards of Trade on a local scale, to illustrate the point.

In Canada, governmental commissions have been set up at various times:

(*a*) For the solution of the great "dust-bowl" problem of our prairie provinces;

(*b*) to learn what to do with our great wheat surpluses;

(*c*) to learn what could be done about markets for our great coal mines of the West and of the East;

(*d*) to learn what to do with our fishing communities in the Maritimes, when their source of livelihood became depleted, or failed for other reasons;

(*e*) to learn the cause of the serious fall in water in the St. Lawrence system which threatens inland navigation;

(*f*) to study the effect of the deep-waterways power proposal on Canadian development;

(*g*) to study the problem of over-expansion of railways;

(*h*) to study the cause of the disastrous fall in the price of newsprint;

(*i*) to study the reasons for the serious depletion of former widespread important game and fur animals and to plant for their protection and conservation.

Most of these, and many other problems of national importance, as well as numerous problems of a provincial nature, have arisen as a result of haphazard development without any well considered planning for permanent security of our industries and of our populations depending on them.

All such situations could be avoided if serious study is given to each of our major resources in relation to their permanency and if some competent body has the responsibility of co-ordinating all the information available to develop plans for their exploitation and development as permanent national assets. The government must be prepared to act on such general plans as are developed and accepted to insure an orderly execution.

Plans of this nature can be formulated only if most of the facts are known. Many of our former mistakes were due to lack of specific information and to ignorance of all the factors vital to the continuance of an industry.

The case of the mining industry is somewhat different in that mining is a wasting asset, but we hope that many new mines will yet be discovered, but we have no absolute assurance of this. It will be fatal if we neglect to secure all possible geological information as to every part of the country.

This is a concern of vital interest to the Dominion as a whole. Many who do not see any national connection maintain that it is the duty of the provinces to provide all the geological surveys required, since the mineral resources belong to the provinces. But geology knows no political boundaries, and is a national concern. We as yet know very little of the geology of Canada even in the southern quarter of the Dominion, and practically nothing of those newer districts opened by mining, except in the immediate vicinity of the mines. Dr. J. F. Walker said recently that although 75 per cent of British Columbia is considered to be favourable for prospecting for minerals, and "at present there seems little likelihood of its being useful for anything else," more than 83 per cent of the province has not yet been geologically mapped. The situation is similar as regards our whole Laurentian Shield area, and it must be borne in mind that, although reconnaissance maps help and guide the prospector, they must be followed by detailed maps to help and guide the actual mining, in the public interest.

Far from curtailing the work of our Federal Geological Survey it should be expanded and given every incentive to speed up its work and supply the country with the information it needs so vitally, and which the provinces require as a basis for more detailed work.

In 1936, the Hon. Mr. Crerar made the following statement:—"Is it too much to expect that a production of gold in Canada of from $200,000,000 to $250,000,000 a year would give the following results?:

(1) Decisively and permanently settle the problem of unemployment.

(2) Bridge the gap between the East and the West with mining camps and communities established at numerous points.

(3) Bring a constructive and probably a permanent solution to our railroad problem.

(4) Create an even greater market than at present for foodstuffs, clothing, structural materials, mine machinery and equipment, electrical supplies, electric power, fuel, explosives, and innumerable other commodities, including household furnishings and automobiles.

(5) Revitalize the whole national economic life of the Dominion.

(6) Open up careers for coming generations of university graduates.

(7) Ease the financial problems of the Dominion, provinces, and municipalities.

(8) Alleviate the burden of our international indebtedness.

(9) Assure the stability of the Canadian dollar; and finally,

(10) Stimulate the opening up and development of our resources in those north lands about which we have little present knowledge.

We must not fail to grasp the opportunity that lies before us."

I maintain that the ten items listed above are all of national importance and each is a major national problem. I further maintain that mining of gold or of all our minerals cannot achieve those results *permanently* unless we grasp the opportunity as suggested in number 10.

The essential point is that our governments must grasp the opportunity *now* while mining is an active industry. In my opinion the situation outlined above and the recommendations suggested to meet that situation, should be brought to the attention of the country and of the government. The government should be requested to set up, without undue delay, a competent organization for national planning for a balanced development of the country.

THE ENGINEER IN WAR TIME

Following is the text of the last three addresses delivered by members of the Institute, as part of the programme of the Radio Broadcasting Committee. These broadcasts were heard over the national network of the Canadian Broadcasting Corporation and in some instances were recorded and rebroadcast by local stations. The texts of the addresses are reproduced here for the benefit of those who did not hear the broadcasts.

Broadcast No. 4

RADIO IN CANADA

DR. AUGUSTIN FRIGON, M.E.I.C.

Assistant General Manager, Canadian Broadcasting Corporation, Montreal, Que.

Delivered November 6th, 1940

Those who have assigned to me the subject "Radio in Canada" had undoubtedly radio "broadcasting" in mind but it is interesting to remember that radio broadcasting is a form of radio telephony and that as such it only concerns, technically speaking, a very small portion of what may be called "Radio in Canada." Listeners very seldom realize that other stations operate on frequencies other than those shown on the dial of their receiver. As a matter of fact, broadcasting occupies only a small section of the total spectrum of the electro-magentic frequencies used by radio telephony and telegraphy. To the radio engineer, the use of radio communication for such services as marine, aviation, army and navy, point to point commercial telegraphy, meteorology, beacons for ships and aircraft are even more important than broadcasting, although this last occupant of the ether is becoming more and more a necessity of modern life. This aspect of radio explains why allocation of frequencies to different services and to different countries requires long and frequent international meetings. The ether is so crowded with radio services that unless international order is maintained, there will soon be so much confusion that no one will be able to hear anything. So that international order in radio broadcasting may exist on the North American continent in the future, a complete reallocation of frequencies will take place at the end of March, 1941. You may as well be prepared to change your listening habits, because there is a good chance that your favourite stations will change frequencies at that time. The Canadian Broadcasting Corporation will tell you more about this in a couple of months. But let me speak of "Radio Broadcasting" in Canada as it is today.

Some years ago, difficulties arose in the administration and control of broadcasting and the Government of Canada requested a Royal Commission on Radio Broadcasting composed of three Canadians, quite independent of any broadcasting enterprise, to make suggestions as to the most suitable system for Canada. Since then (1928), many Committees of the House and as many Parliaments have further studied the question; the Commission, all those Committees and all Parliaments including the Opposition, have always been unanimous in opinion that, on account of its tremendous size, of its scattered population, of the characteristics of its people and for many other excellent reasons, Canada needed a public service system of radio broadcasting. This unanimous decision was supported by the fact that almost all important countries in the world had adopted similar systems. The United States having started on a large scale in another direction is the outstanding exception to the rule. The Canadian Broadcasting Corporation (C.B.C.) was therefore instituted in 1936 to succeed a previous attempt at "state control" through the Canadian Radio Broadcasting Commission.

To-day the Board of Governors of the Canadian Broadcasting Corporation, composed of nine well chosen Canadians, fully controls the policy of the Corporation and regulates freely all broadcasting throughout the Dominion—the state only intervenes in the indispensable control of long term finance of the Corporation, in the collection of a $2.50 per year contribution from the listeners and in the allocation of broadcasting frequencies.

Privately owned stations have, however, been maintained in operation; their main purpose is to serve the locality in which they operate. The significance of this combination of privately owned stations with a "public service" system operated for the exclusive benefit of the public can best be understood by studying the operation of the coast to coast network of the Canadian Broadcasting Corporation. May I explain first that included in its coast to coast so called national network, the Canadian Broadcasting Corporation operates a regional network of stations in the province of Quebec, devoted mostly to French language programmes.

In order to present a full view of the picture, I propose to describe the C.B.C'S complete network as it operates when carrying broadcasts of national interest.

In November 1926, immediately upon taking over the control of radio broadcasting in Canada, the C.B.C. made a thorough study of the situation from an engineering viewpoint and laid down, in an imposing set of working documents, a nation wide project which when completed would bring public service radio to almost every home in our vast country. This project is still in the process of realization, but the bulk of it has already been achieved as evidenced by the fact that to-day well over 92 per cent of our population can be reached by radio through the C.B.C. network.

The first accomplishment of the Corporation was to extend the network which already existed on a modest scale and establish across Canada a network that would operate sixteen hours per day, seven days per week. By this means, news can reach almost everybody, as soon as it is available, the best talent in Canada can be heard by everyone no matter whether the listener lives in Toronto or in some remote shack in the wilderness, learned people can give to the Canadian public the benefit of their wisdom and, last but not least, Government leaders from here and abroad can readily inform every Canadian of their actions and explain problems of important national and international significance.

To-day, the C.B.C. network includes 35 permanently connected stations spread across the continent, 35 more may be added to these as supplementary stations if and when the occasion justifies. Sixteen others, not included either in the basic or in the supplementary network, can also, on rather short notice, be made available to co-operate with the rest of Canadian stations.

In order to make this possible, over 7,000 miles of special telephone lines were contracted for with the Canadian Pacific Railway Company and Canadian National Railways, who, in turn, utilize various telephone facilities across Canada. This vast network of telephone lines, one of the largest in the world, is monitored continuously by the C.B.C. staff in co-operation with the wire line companies.

This indispensable medium absorbs quite a fair proportion of the $2.50 fee listeners contribute to their national radio service, but it may be considered as the most essential component of the C.B.C's important contribution towards national unity.

I said a minute ago that the national network operated by the C.B.C. included 35 stations; of these, 25 are owned by private citizens and are operated commercially for their own benefit. All that these private station owners have to do to enjoy the privilege of being admitted into your homes is to obtain from the Government the monopoly of the use of a radio broadcasting frequency if one is available and pay an annual registration fee which is quite incommensurate with the revenue they can derive therefrom. This is enough to prove that, from the point of view of "radio in Canada" generally speaking, radio is not state owned in Canada. As a matter of fact, only ten of the 86 stations operating in the Dominion are owned by the C.B.C. and some of these are used principally to provide regional coverage in areas where it is too expensive for private enterprise. This is particularly true of CBK covering the prairie provinces and CBA serving the maritimes. Four of the high power C.B.C's owned stations, rated at 50,000 watt, are CBA, Sackville; CBF, Verchères; CBL, Toronto and CBK, Watrous. Other C.B.C. stations are CBR, Vancouver; CBY, Toronto; CBO, Ottawa; CBM, Montreal; CBV, Quebec and CBJ, Chicoutimi.

Although the C.B.C. network may be considered a commercial venture from a certain viewpoint, the C.B.C. itself is strictly a non-profit-making enterprise; its entire revenue is used in the production of programmes and in the maintenance of national coverage.

After having been a pioneer nation in radio communications, Canada has been slow to take its place beside the United States in radio broadcasting. Whilst its geographical position in respect to Europe and the importance of the proper organization of its seashore for the guidance of ships made Canada conscious from the very beginning of wireless telegraphy, the way radio broadcasting was commercialized at the very start made Canada more or less dependent on the American industry for the development of that newcomer. To-day, our own industry, our research men and engineers are catching up with lost time and have reached the point where Canadians can talk on equal terms with their colleague engineers south of the border.

Being a national enterprise with a sizeable although altogether insufficient budget, the C.B.C. is also trying to lead the way in radio engineering. Its transmitting stations are the last word in technical perfection and so are its well equipped studios located at Vancouver, Toronto, Ottawa, Montreal, Quebec, Chicoutimi, Halifax and Winnipeg. The Winnipeg studios however are the property of the Manitoba Telephone Commission.

An engineering division has been kept extremely active during the last three years. Amongst its 150 engineers and technicians, it includes the best radio men in the country. It is divided into six departments:

Design and Construction Department,
Architectural and Drafting Department,
Operation and Maintenance Department,
Development and Research Department,
Coverage Statistics Department,
Purchasing and Stores.

You are probably familiar with a good many of the programmes offered by the C.B.C. and its affiliated stations. If full credit is to go to the programme producers and artists for the excellence of their material, the engineering staff is also deserving credit for the fact that programmes reach you as nearly technically perfect as possible.

The C.B.C. staff is of course justly proud of the alltime broadcasting record of the royal visit network broadcasts. These were a nightmare for some of our men, but also a grand feeling of satisfaction for a job well done. Many months of difficult preparatory work and then 32 days of nerve racking activity. This was a sort of a prelude to what was to take place a few months later when the war was to affect the whole broadcasting industry particularly the C.B.C. where national responsibilities required re-arranging the control of network and providing for quick changes in network operation.

The importance of radio communications in war time need hardly be emphasized here. The Army, the Navy, the Air Force, the leaders of the people, all depend on this medium either to co-ordinate their efforts, to guide them over vast territories or to keep continuous contact with all peoples of the globe. An important message has frequently been delivered to all Canadians within a few hours, even a few minutes after it had become necessary to do so. Events are described to the whole nation as they occur, the C.B.C's overseas staff is keeping Canadians in close touch with happenings in Great Britain, news is distributed by all stations in Canada, moreover commentators endeavour to interpret the news of the day for you.

Unfortunately, what should be a powerful instrument of social welfare has been used by the dictators to contaminate the mind of their people and to impose their barbaric will upon the other peoples of the world. In Canada, the unlimited possibilities of radio broadcasting are placed at the service of the nation: through radio, our war effort is activated and our national unity is fortified.

INDUSTRIAL DEVELOPMENT IN CANADA TO MEET THE WAR EMERGENCY

WILLIAM D. BLACK, M.E.I.C.
President, Otis-Fensom Elevator Company, Limited, Hamilton, Ont.

Delivered November 13th, 1940

In this war there are no exemptions. We can be very sure that before it ends each one of us will feel the impact of it in our own particular sphere and in our own particular time. That being so, it would be most unfair—in fact it would be foolish—to claim for any one section of the community, a precedence or preeminence over the others. Total war does not create distinctions. It destroys them.

If I were not very sure that everyone, in due course of time, will be called upon to serve, I would hesitate to assert that this war has, so far, been an industrial war and, consequently, an engineer's war. It could not possibly have been otherwise. It is merely an unavoidable circumstance of modern war that its first demands are made upon industry and particularly upon those heavy industries which are almost entirely of an engineering character.

How has industrial Canada responded to these demands? I will anticipate a little by saying at once that the response has been wholehearted and effective. Obviously, the picture of wartime industrial development as a whole is something beyond the scope of individual experience. The mere statement of figures hardly suffices to convey an adequate impression for they lose their significance for us as they expand to astronomical proportions. But if we could relate our figures to some previous and comparable experience, we might expect to obtain an adequate conception of what is going on.

The evident background against which we might usefully contrast our present performances is that of the last Great War. Let us see how the Canada of to-day compares with the Canada of 1914 from an industrial point of view.

In 1914, the working population of Canada (that is, the total of all those gainfully employed) was 2,700,000. To-day it is in the neighbourhood of 4,000,000, an increase of almost 50 per cent in the past 26 years. We are bigger—numerically speaking half as big again as we were in 1914. Can we claim to be correspondingly stronger—economically and industrially?

In 1914 the total value of our exports was $432,000,000. According to the latest available figures, these have now increased to over $1,100,000,000 or a gain of more than 150 per cent. During the same period we advanced from eighth place to fourth place in total volume of world trade. In 1914 our manufactured exports had a value of $44,000,000. To-day they are valued at almost $700,000,000, no less than 15 times more than they were when we entered the last war.

The advances in production of raw materials during the past quarter-century have been phenomenal. Take the non-ferrous metals for example. Nature has endowed us liberally with most of these valuable and versatile metals, while she has treated our enemies with a scant courtesy which, we may well be excused for thinking, was no more than they deserved.

Since 1914 our annual non-ferrous metal exports have increased from $52,000,000 to $273,000,000 or by more than 500 per cent. Nickel production has risen from 47,000,000 lb. to 227,000,000 lb., again a fivefold increase; lead production from 36,000,000 lb. to 390,000,000 lb. up ten times; copper production from 76,000,000 lb. to 607,000,000 lb. increased eight times; zinc production from 7,000,000 lb. to 395,000,000 lb. multiplied almost 60 times.

The frequency with which favourable production figures appear in this country tends to dull their edge, but no amount of repetition can obscure the significance of such increases. They are probably without parallel in the world to-day. In other respects the list might be prolonged indefinitely. Thus the production of minerals of all kinds has quadrupled in the past 25 years. So has the production of electric power. The current production of crude oil is at thirty times the rate of 1914 and so on.

In wartime there are no more significant figures than those concerning the manufacturing industries in general. Prime Minister Churchill, with his unerring sense of the illuminating phrase, highlighted this fact for all of us when he said:—"The front line runs through the factories." It would be difficult to describe the situation more graphically or accurately. In 1914 the total capital value of the industrial plant of Canada was about 1½ billion dollars. At the outbreak of the present war, it was approaching 4½ billion dollars. But we have not only trebled our manufacturing facilities since the last war. We have also improved their productive efficiency immensely. In the six years from 1923 to 1929, the physical volume of manufacturing production increased by 50 per cent while our population increased by only 11 per cent during the same period. Since 1914, the cost of materials employed, the net value of production, and the salaries and wages paid, in the manufacturing industries of Canada have all increased anywhere from 200 to 300 per cent while the number of persons employed has increased by no more than 20 per cent. Quite clearly, the increases in our total or working population convey no adequate impression of our industrial growth and expanded war potential, since we were last embattled with the Hun.

This is all very gratifying, of course, but from a war-making point of view it gives no grounds for self-satisfaction or complacency. All this rapidly developed productive capacity has been devoted exclusively to the purposes of peace. So when war came, our great potentialities served merely to emphasize the immensity of the task which faced us in diverting our material and mechanical resources into the channels of war production. To the extent that we are called upon in Canada to produce the actual instruments of combat (aircraft, tanks, guns, shells, bombs, small arms and ammunition, explosives, and chemicals) we must secure new equipment and erect new plants.

I place new equipment first advisedly, for it is this rather than the required building that is determining the rate of expansion of our manufacturing programme. Our all-too-elastic building industry is not likely to be over-strained by immediate demands, but the production of machine tools is a very different matter. These tools, and more particularly, their ancillary gauges and fixtures, are, in fact, instruments of precision. The making of such equipment can be neither inordinately rushed nor hastily expanded. This point will bear emphasis for it explains to a considerable degree the sense of frustration and impatience which was widespread in the early months of this year. The Canadian public, having embarked upon war, clamoured for weapons and equipment as visible evidence of our warlike intentions. At the same time, our machine tool industry, the very fount and source of all manufactures, was staggering under a colossal and unprecedented load. It is still severely strained but the initial lag or inertia has been overcome. The largest machine tool makers in this country have tripled their rate of output since the war began, have orders on hand to maintain the rate for two years, and are working to the limit of capacity. But even this kind of effort is not sufficient to provide us with the tools we need, in the time we want them. We have had to call upon the great machine tool industry of the United States and we make no mistake if we regard the accessability and familiarity of this source of supply as a major wartime asset, not only for Canada, but for the Empire at large.

During the first year of the last war, the value of all construction of every kind undertaken in Canada was roughly $80,000,000. During the first ten months of this year, the recorded value of contracts awarded for industrial building alone was well in excess of this sum, even though many millions of dollars' worth of Government owned plant construction had not at that time appeared in the ordinary trade returns. The Director of Public Information announced on October 30th last that over $250,000,000 of purely Government owned plant construction was under way, a figure that may be contrasted with the $80,000,000 of industrial building erected in the so-called normal year 1926. The industrial building contracts awarded in September actually exceeded those of the entire year 1939 by several million dollars.

Some idea of the headlong speed of the present industrial building programme can be gathered from the fact that contracts were awarded during last September at five times the average rate of the preceding eight months.

All this huge volume of plant and equipment is, of course, but the shadow of a dream without men to operate it. Already, the situation with regard to trained men is severe and, as to highly skilled men, actually acute. Yet the present demand for labour is, broadly speaking, of a provisional or preliminary nature and the flood tide of war employment will not arrive until the great explosive and armament plants reach full production in six to twelve months' time. How is this looming problem of industrial man-power to be dealt with? We will find no one easy "royal road" to a solution, but rather a number of complementary approaches. The training of youth in technical and vocational schools, the assistance of employers in the recovery and development of skill by men who have abandoned an industrial pursuit, the recruitment of Canadian women, the provision of Government-sponsored refresher courses, will all play, and in most cases are already playing, an important part. The Dominion Government is alive to the situation and the return of suitable men from the military to the industrial front is under careful consideration. But I venture to suggest that the solution will lie, more than anywhere else, in the ability of industrial management to organize and rationalize their working forces so as to effectively employ a maximum of unskilled or part-skilled labour under a minimum of fully-skilled supervision. It is a common misapprehension to regard this labour problem as one calling for a vast number of fully and equally competent workers. This is a distorted picture of even normal industrial employment. The fact is that, given a reasonable degree of informed and intelligent direction, great numbers of workers who might otherwise be largely ineffective, will become valuable and productive industrial recruits.

As I trust I have already made clear, it is no purpose of this talk to foster the idea that what has so far been achieved, or contemplated, in an industrial way is sufficient or complete. There can be no end to the story until it ends in victory. But no harm and some good may result from a sober realization that an immense and well-considered effort is on foot throughout the country. We are only 11½ million people, but I am convinced that with our resources and an inflexible determination, we can build ourselves up to the equal of 25 millions of the best of Hitler's strained and regimental people. This is no idle boast or empty phrase. It is a legitimate and attainable war objective.

A popular question of the day is: "What are we going to do with all this industrial plant and all these workers when the war is over?" I do not profess to know. But I believe the question is, at the present time, pointless and wasteful of speculative energy which might be otherwise more usefully employed. It would be much more excusable, though quite as useless, to cogitate upon the economic advantages which we might hope to gain from a victory. Not that I believe this currently frequent question to be unanswerable or pregnant with disaster. There are a number of mitigating indications. We absorbed a great amount of the industrial development of the last war into our peacetime economy and scrapped much more without any catastrophic results. The great depression of the thirties amply demonstrated the ability of the modern world economy to withstand great shocks and strains. The social and economic trappings of civilization are, in fact, amazingly tough and resilient. Let us go steadfastly and unflinchingly on to win this war—let us at least arm ourselves to fight it—before we begin timidly to deplore its cost. Let us march breast-forward in the certain knowledge that our grandchildren will inhabit a Canada, politically, socially, and economically better than the Canada we know to-day and find good enough to fight for.

Broadcast No. 6

THE TRAINING OF ENGINEERS AT THE ECOLE POLYTECHNIQUE

ARMAND CIRCÉ, M.E.I.C

Dean, Ecole Polytechnique de Montréal, Montreal, Que.

Delivered November 20th, 1940

To-night brings to a close the series of broadcasts during the course of which the previous speakers have outlined before you the part enacted by the engineering profession in the tremendous task imposed upon all liberty loving nations by the fanatical mania of a 20th century Hun. It has been indicated that to a large extent the physical might of a modern Attila is the result of a perverted use of the scientific discoveries given to the world by scientists and of their applications and developments made possible by the engineering mind and method. To be sure, if the engineer can justly lift his head in pride at his technical achievements, he wonders at times should it not be bowed in shame before the destruction and ruin that the misuse of them can bring out. Let him take comfort in the thought that there is good and evil in every deed human, that the mind and the spirit are the sole criteria of the value of our strivings, and that the mind always conquers matter in the end, as to-day the people of the British Isles are so magnificently *en passe* of proving to the world.

It is now my lot to present to you a picture of the atmosphere in which is created, matured and brought to fruition the engineering philosophy that makes possible such transformation in our physical environment as we are daily witnessing; and I will take as a background the institution with which I am most familiar, the Ecole Polytechnique, which, as many of you undoubtedly know, is the Faculty of Engineering of the Université de Montréal.

At the time of Confederation, there was no well organized school or college of engineering in Canada. It must be said that the need of large numbers of engineering specialists had not yet been felt to be very imperative. Industry was in its infancy, public works were few, and the military engineers had been able to cope satisfactorily with the problems arising from the gradual development of the country. But the Act of Confederation marked the opening of an era of great industrial activity, and it soon became evident that means had to be provided for the training of the scientifically minded men which would be needed to insure a logical and efficient development and utilization of our natural resources. There were of course some engineers in civil occupations at that time, but their knowledge was also largely the result of empirical if valuable experience, sufficient to the solution of problems met before in the course of their practice, but in many cases inadequate to enable them to envisage properly the new problems created by the rapidly developing country.

And so was soon realized the necessity of educational establishments where the engineers of the future could receive the preliminary theoretical courses required to make them something better than mere skilled artisans.

The province of Quebec was not inactive in that regard. McGill University for its part was organizing a School of Applied Science which was to become later its Faculty of Engineering, and Laval University then also initiated a course in applied science which however was abandoned after a trial of two years. Immediately afterwards, in the year 1873, was founded in Montreal the Ecole Polytechnique; it was known first as the "Ecole de Sciences Appliquées aux Arts; but it received shortly after its foundation (in 1876), the official name of Ecole Polytechnique, which it has retained to this day.

The first class of the new school graduated in 1877. Of its five graduates, only one is now living, but it may be illuminative, before proceeding further, to briefly pencil sketch the career of each of those men, which will serve as a background against which can be projected the whole structure of French Canadian engineering practice and accomplishments.

Ernest Marceau associated himself with the Railways and Canals Division of theMarine Department of the Dominion, as it was then called, and gradually climbed to the responsible charge of chief superintending engineer of canals for the province of Quebec, which post he was occupying at the time of his death in 1919. In 1905, he had been elected president of the Canadian Society of Civil Engineers, to-day the Engineering Institute of Canada.

Mr. Stanislas Parizeau, still living, started his career with the Dominion Public Works Department, but soon transferred to the Department of Railways and Canals, where he had much to do with canal construction and hydrographic surveys, succeeding Mr. Marceau as chief engineer in 1919, in which capacity he acted till the time of his retirement in 1930.

Gustave Papineau turned equally to civil service employment with the Federal Government as a resident engineer at Chambly Canal, and was eventually promoted to the position of superintendent engineer at the Sorel Ship Yards. When he died in 1931, he had retired from the position of supervising engineer for the Department of Public Works of the Dominion.

William Haynes died shortly (1878) after graduation and we have therefore no way of knowing what his chosen call would have been.

Emile Vanier went into consulting work as a young engineer and built up a considerable practice. All his life he was engaged in municipal engineering and surveying work, and at the time of his death, in 1934, he was still consultant to a large number of municipalities.

So it is seen that all four of the 1877 graduates who lived to build their professional life specialized in public works or civil engineering. That was to be the largely predominating field of engineering for the graduates of the Ecole Polytechnique for many years to come, and it is not more than about fifteen years since they seriously began to seek a career in industry. They are strongly encouraged to do so, for it is realized that here is a door open into the industrial house of this Dominion, the door of technical proficiency upon the threshold of which our engineers can now step without fear and contribute their share to the prosperity of the community.

A more comprehensive picture of the field of activities of the early French graduates was presented some time ago, when it was decided by the Graduates' Society to celebrate the fiftieth anniversary of engineering practice of the living graduates of that early period. Exactly fifty engineers were graduated by the Ecole Polytechnique before 1889, of whom ten are now living, occupying the following positions at the time of their retirement:

L. S. Pariseau, as mentioned before, became chief superintending engineer of the Department of Railways and Canals in Montreal.

G. J. Desbarats, C.M.G., Deputy Minister of National Defence.

L. Gauthier, Chief geographer in the section of International Surveys in Ottawa.

E. R. Faribault, D.Sc., Senior geologist of the Federal Department of Mines.

Sir Georges Garneau, President of Garneau Limitée and on the board of directors of many large companies.

V. H. Dupont, Consulting engineer in municipal projects.

L. E. Demers, Municipal engineer.

E. Loignon, D.Sc., Chief engineer of Dufresne Construction Company.

J. A. Vincent, Consulting engineer to this day.

Here again is seen the predominating part occupied by the civil engineering branch of the profession in the activities of those men.

This propensity of our first diplomates might be particularly accounted for by the nature of the course which was offered them at first, and which had marked tendencies towards public works and construction. But I think that a more plausible reason might be that industries had not yet sufficiently developed in Quebec to offer strong inducements and numerous opportunities, and that almost all engineer graduates of that period had to rely on government services for employment, or take their chance in private practice at a time when the public was far from engineer-conscious, to use a much abused word in modern phraseology and speech.

At a later period in the development of the Ecole Polytechnique, the course was revised to offer preparation in five different branches of engineering, but despite fifteen years of a system affording specialization during the junior and the senior years, most of the students chose civil engineering, for by that time the graduates of the first period had attained prominent positions in the Government public services, and our young engineers found in them sympathetic friends occupying key positions and willing to give them work, whereas they were still little known by the captains of industry, making it the more difficult to secure employment with industrial concerns.

And so it was that our engineers came to have a large control of municipal, provincial and federal public works in the province of Quebec.

It can be said, I believe, that the part played by them in the development of public works in Canada is very important. They have occupied such prominent positions as that of chief engineer of the Department of Public Works of Canada (three of them), chief engineer of the old Ministry of Marine, chief engineer of the Department of Railways and Canals, chief engineer of the Quebec Streams Commission, chief engineer of various provincial departments, chief engineer and manager of most cities of the province. Forest protection in the province, hydraulic resources and their development, sanitary engineering are under their control. Large bridges have been built under their direction and by contracting firms managed by our graduates. They also have taken their share of professional activities in societies and professional organizations. The Canadian Society of Civil Engineers and later the Engineering Institute of Canada have had six presidents coming from our diplomates.

The Corporation of Professional Engineers of the Province of Quebec was organized largely owing to their initiative.

A rough classification of the interests of our engineering graduates, numbering about 850, would be the following:

Highway engineering.......	14	per cent
Railroad engineering........	2½	" "

Surveying engineering	5	per cent
Mechanical engineering	1½	" "
Mining engineering	6	" "
Construction engineering	18	" "
Chemistry engineering	3½	" "
Electricity	5	" "
Hydraulics	18	" "
Teaching	3½	" "
Industrial Engineering	6	" "
Not classified	17	" "

In the light of our previous experience in specialists courses, it was later on decided to offer a general engineering course of five years duration, with 300 semester hours of work as against 225 for the ordinary four year course, embracing a general training in all principal branches of engineering and enabling our students to specialize at will in any branch, when they are in engineering practice. More and more, the heads of firms whose business necessitates the services of engineers require that they possess a broad fundamental training making them adaptable to their particular needs; initial training courses have been instituted by most of those firms for their technical employees, courses which must be taken by all new graduates, whether or not they are specialists in some particular branch. Another consideration is that a general engineering course allows the student more time to make his choice of the particular branch he wishes to embrace, which choice is in good measure determined by conditions of employment and opportunities offered at the time of graduation. At present they receive a degree in "Génie Civil," which is not to be translated as "Civil Engineering" as now understood, but as engineering applied to all types of engineering work outside of military engineering.

This system has given fair results; the majority of the graduates are satisfied with it and, with it as a basis, they have tackled successfully positions in various fields. Firms which have employed our students come back to us for new men, and we believe our formula is the best adapted to the conditions as the French Canadian engineer finds them when he ventures out into the world with his new diploma. We are now trying to improve on it by a plan whereby we could retain the general engineering feature of the course, which would be common to all students during four years, and provide options in the fifth and final year. This would have the advantage of a more thorough preparation in the optional subjects, while not detracting from a general training which gives the student a reasonable assurance of success in any branch of engineering, should he decide later on, for some reason or other, to build his career outside of the field of the option chosen at school.

Although, as I have shown, they have played a prominent part in public engineering services, as much cannot be said of our engineers in industry. Few occupy commanding positions in that field. Doubtless, there are factors hampering their progress in that direction: factors within and without their control. While not wishing to elaborate on them, I may say that our constant endeavour is aimed at removing the first by enlarging the scope of our studies, by encouraging the new graduates to consider the opportunities offered in the industrial field, by impressing them with the necessity of participating more fully in the activities of professional groups, with a resultant benefit to themselves. In this I have reason to hope that we will succeed. And at a time when organizations with engineering staffs are considering in such a fair-minded manner the qualifications of our graduates, I am confident that they will eventually share with their fellow engineers of English stock in a greater use of their technical ability towards the exploitation of the resources of this Dominion, and that they will contribute in larger measure than heretofore to the industrial development and progress of our cherished country.

Thus have I tried to give you an outline of the part played by the French Canadian engineers during the last 60 years. I believe that, within their own sphere, they did reasonably well. At first, their means of instruction were limited, their laboratories were ill-equipped, their opportunities were not varied, but they went ahead with a stout heart and they succeeded where others less tenacious would have failed. Let me express the fervent hope that the example of those pioneers may inspire to greater deeds the young engineers of the present day, who sometimes do not quite fully realize what advantages they have over their predecessors in the facilities put at their disposal for their instruction and in the opportunities offered them when they leave their Alma Mater.

In these days of national peril, they find another inspiration in the conduct of many of our young graduates who have rallied to their King's standard. The terrible conflict which now ravages the face of the world may require of them greater sacrifice, but they will not hesitate, when the hour is at hand, to give of their toil, their sweat and their tears, if I may be permitted to thus make reference to a now famous pronouncement.

And later, when the evil nightmare of the present darkness has dissolved in the dawn of tranquillity and peace, when the sanguinary flood which now engulfs the world has subsided, when the monstrous and dreaded horsemen of war, fire, famine and pestilence have ridden away, a trail of destruction and ruin will have been left such of which may never have been seen. The work of healing its wounds, the task of rebuilding its shattered homes and cities will face the world; and it will be stupendous. Let me express the fervent hope that then again our young engineers, who can do such fine work in the armed services, especially in the artillery, engineering and signal corps, will prove themselves to be equal to the responsibilities devolving upon them and by their exertion and devotion hasten their fellow-men on the road to comfort and contentment.

ANNUAL MEETING, HAMILTON, ONT., FEBRUARY 6th and 7th, 1941

GLASS REINFORCEMENT FOR CONCRETE

Reproduced from *Engineering* (London), October 4, 1940.

In our issue of September 20 last, on page 225 (reprinted in the *Engineering Journal*, October 1940, pp. 424-426) we referred to a method of using glass instead of steel for reinforcing concrete and gave the results of bending tests on beams 4 ft. 6 in. in length and impact tests on beams 2 ft. 3 in. long. The system has been developed by Mr. A. W. Soden, A.R.I.B.A. and Mr. John A. Lincoln, and the tests referred to were carried out by Dr. W. S. Marshall, A.M.Inst.C.E., in the Structural Laboratory of the City and Guilds College, South Kensington. We mentioned, in the conclusion of the article, that there were limitations in the length of the glass strips available for reinforcement, and that further investigations were proceeding with the object of overcoming this and certain other difficulties encountered in developing the system. Some of these investigations have now been completed and further tests have been carried out by Dr. Marshall, from whose report we have extracted the information given below.

The tests were made for Messrs. Pilkington Brothers, Limited, 63-65 Piccadilly, London, W.1, and Messrs. Honeywill and Stein, Limited 21, St. James' Square, London, S.W.1. The objects of the tests were to determine the resistance moment of beams of 12 in. by 7 in. and 9½ in. by 4½ in. sections; to determine the grip length or "lap" required for glass reinforcement; and to design a beam of long span using short lengths of glass with the lap previously determined and to test such a beam. The concrete used throughout the tests was a 1:2:3 mix of rapid-hardening Portland cement, well graded clean river sand, and Thames ballast.

For the concrete between the glass strips a ⅜-in. aggregate was used, and for the portion of the beam above the glass ¾-in. aggregate was employed. A wetter mix was used for the lower part of the beams to facilitate consolidation. The glass reinforcement was supplied by Messrs. Pilkington Brothers and consisted of strips ¼ in. in thickness. In each specimen the glass strips were placed vertically, the fire-finished edge being given ½ in. cover of concrete on its under side. Details of the specimens are given in Table I. For specimens 1 to 10 the test was carried out on a 6-ft. span and for specimens 11 and 12 on a 9-ft. span, the loads being applied at the third points in each case. Specimen 13 was tested on a 16-ft. span, the loads being applied at 5 ft. 6 in. from each support. During the test the deflection at the centre of the span was measured by a Mercer dial and from these readings the modulus of elasticity of the material was calculated.

Table I—Details of Specimens

Specimen number	Cross Section of concrete	Length	Reinforcement
1	12 in. x 7 in.	6 ft. 4 in.	7 strips, 5⅞ in. deep, 6 ft. long.
2	12 in. x 7 in.	6 ft. 4 in.	" "
3	12 in. x 7 in.	6 ft. 4 in.	" "
4	12 in. x 7 in.	6 ft. 4 in.	4 strips, 5⅞ in. deep, 6 ft. long.
5	12 in. x 7 in.	6 ft. 4 in.	" "
6	12 in. x 7 in.	6 ft. 4 in.	8 strips, 5⅞ in. deep, 4 ft. long, with central lap of 2 ft.
7	12 in. x 7 in.	6 ft. 4 in.	" "
8	12 in. x 7 in.	6 ft. 4 in.	8 strips, 5⅞ in. deep, 3 ft. 10½ in. long, with central lap of 1 ft. 9 in.
9	12 in. x 7 in.	6 ft. 4 in.	" "
10	12 in. x 7 in.	6 ft. 4 in.	8 strips, 5⅞ in. deep, 3 ft. 9 in. long, with central lap of 1 ft. 6 in.
11	9½ in. x 4½ in.	9 ft. 4 in.	4 strips, 4½ in. deep, 9 ft. long.
12	9½ in. x 4½ in.	9 ft. 4 in.	
13	12 in. x 8 in.	16 ft. 6 in.	

Dealing first with the specimens without lap, where the object of the tests was to determine the resistance moments, the results are summarised in Table II. The failure occurred in all cases by tension and was of the type associated with brittle materials. In most cases a preliminary crack occurred at about 90 per cent. of the failing load. The deflection readings taken gave an average value for the modulus of elasticity of 3.5 x 10^6 lb. per square inch, which is approximately the same as that for plain concrete.

The following simple method was used to determine the grip length required for a glass strip 5⅞ in. deep: The beams 6-10 were made with short strips of glass of the lengths stated in Table I, thus giving laps varying from 1 ft. 6 in. to 2 ft. Specimens four and five gave the strength of a beam using continuous reinforcement and by comparing the strength of the beams with lapped reinforcement with these beams it was possible to determine the amount of lap required to give the same strength. It is realised that this is a very inadequate method of tackling the problem, but it is suggested that it provides some useful information as a prelude to further work. The results of the tests are given in Table III. These tests thus showed that 2 ft. was sufficient lap for the glass used in these beams. The failure was similar to the other beams tested, i.e., a tension failure, the fracture section occurring in each case at the end of the lap. The deflection readings gave the same value for the modulus of elasticity as for the unlapped reinforcement.

Table II—Results of Tests of Unlapped Specimens

Specimen No.	Failing Load	B.M. at Failure	Design Moment Soden	Factor of Safety
1	25,290 lb.	—	—	—
2	19,060 lb.*	—	—	—
3	23,900 lb.	—	—	—
Av.	24,600 lb.	288,000 in. lb.	91,500 in. lb.	3.15
4	15,360 lb.	—	—	—
5	17,960 lb.	—	—	—
Av.	16,660 lb.	199,000 in. lb.	52,300 in. lb.	3.81
11	5,560 lb.	—	—	—
12	5,330 lb.	—	—	—
Av.	5,450 lb.	98,200 in. lb.	33,000 in. lb.	2.98

*Reject result.

The final problem in this series of tests was to use lapped reinforcement in the design of a beam of long span using only glass strips less than 10 ft. in length. By stopping off the reinforcement to match the bending-moment diagram and using a lap of 2 ft., it was found possible to keep the maximum length of reinforcement at 9 ft. 6 in. in a beam of 16-ft span. The beam failed at a load of 8,130 lb. by a tension crack 18 in. from the centre of the span. This corresponds to a bending moment of 269,000 in.-lb.; the moment taken by a similarly reinforced section (specimens 1 and 3) without laps was 288,000 in.-lb. thus giving a ratio of 0.93 between the two strengths. This test was very satisfactory, as it showed that the value of 2 ft. taken for the lap in the design of the beam was satisfactory.

Dr. Marshall's conclusions were as follows:—It has already been stated in the previous tests carried out for the Kensington Borough Council (see page 225, ante), that glass should not be used as reinforcement when impact loads are likely, but these tests confirm the fact previously stated that for static loading glass makes a suitable reinforcement for concrete. The feature of the tests has been the consistency of the behaviour of the material, only one reject result having been obtained in the whole series. Apart from inability to resist impact the main criticism to make against

Table III—Results of Tests on Lapped Specimens

Specimen No.	Lap.	Failing Load	B.M. at Failure	*Ratio Strength* Strength of unlapped
6	—	16,870 lb.	—	—
7	—	15,810 lb.	—	—
Av.	2 ft. 0 in.	16,340 lb.	196,000 in. lb.	0.985
8	—	13,970 lb.	—	—
9	—	15,470 lb.	—	—
Av.	1 ft. 9 in.	14,720 lb.	176,500 in. lb.	0.886
10	1 ft. 6 in.	11,070 lb.	132,800 in. lb.	0.666

the reinforcement is the value of the sale resistance moment calculated by Mr. Soden. The factor of safety based on this moment varied in the Kensington tests from 2.3 to 2.8; in the present series it varied from 2.98 to 3.81. The increase in the present tests was probably due to the ½ in. cover of concrete on the under side of the glass; as this will be used in practice the values obtained in the present series may be taken as representing the true case. The generally accepted value for the factor of safety for ductile materials is 3.5; for brittle materials it is much higher, generally of the order of 10. Glass reinforced concrete is definitely brittle material and to use the low factor of safety which Mr. Soden's figures give is definitely bad practice.

The tests show that the ultimate resistance moment of a glass-reinforced beam can be expressed empirically by the formula $M = 1,250\ t\ d^2$, where t is the total thickness of glass plates used and d is the depth of the beam measured to the edge of the glass reinforcement. Taking this value as the ultimate resistance moment of the section, it rests with the firms using the material to adopt what, in their opinion, is a satisfactory value for the factor of safety for the conditions under which the material is being used. This report must not be taken as conclusive evidence on the value of glass as reinforcement. Much more exhaustive tests would have to be carried out before it could be universally adopted. In these tests certain problems which were of interest to the parties concerned have only been investigated,and I do not wish this Report to be taken as a thorough investigation of the subject.

Abstracts of Current Literature

Abstracts of articles appearing in the current technical periodicals

THE TRANS-CONTINENTAL ROAD IN NORTH AFRICA

By T. Gubler
From *Strassenbau*, 1939

Abstracted from *The Institution of Municipal and County Engineers*, May, 1940

This route traverses Morocco, Algeria, Tunis, Libya and Egypt. Almost the whole of the western portion constructed by France, has a bituminous surfacing. In Morocco the opposing traffic lanes are often distinctly coloured; curves are superelevated and provided with guardrails, which consist of wire mesh painted in constrasting colours and attached to concrete posts. Road signs consist of rectangular plaques bearing informative notices, and surmounted by a triangular portion with a red margin, within which warning or informative symbols are displayed in red. The hilly Algerian section contains numerous sharp curves on which the superelevation is unusually great. Most of this section has a bituminous surfacing. The signs are mainly metal plaques of the type used in France, but on minor roads use is made of wooden boards painted in white on black. A special sign is used on roads that are slippery in wet weather. The design and construction of the Italian section through Libya are considered admirable. The author considers the Egyptian section greatly inferior, with the exception of one or two stretches, to the sections constructed under French or Italian control. He states that a considerable length consists of sandy track in which motor vehicles are liable to sink. On the Sidi el Barrani-Mersa Matruh and Alexandria-Cairo sections a "mix-in-place" surfacing has been provided. The sand is levelled and shaped to a 2-in. crown on a width of about 20 ft. A mixture of sand and cut-back bitumen (method of mixing not stated) is spread between wooden side forms at the rate of 1 cu. yd. to approximately 9.4 sq. yd. The material is then levelled and consolidated by a light roller. It is stated that after two years' service the surfacing was already in poor condition and that accidents had been caused both by the sinking of the surfacing under the weight of light passenger vehicles and by serious breaking at the margin, under which the cohesionless sand tends to become hollowed out. The system of road signs is considered good. Direction signs consist of plaques 6½ ft. wide and 3.3 ft. high lettered in black and white and mounted at eye level, while warning is given of curves, gradients, etc., by plaques bearing inscriptions in English and Arabic. Distances are indicated by plaques at 1-km. intervals. It is thought that the entire length of the transcontinental route may be completed during 1940.

THE GAS TURBINE

By E. Butikofer, Zurich
From *Swiss Technics*, May, 1940

When reading the words "gas turbine" one thinks almost always of the gas engine principle. It seems that this principle could have been applied to a rotary machine in a way similar to that in the case of the piston engine and the steam turbine. Now, in fact, the gas turbine has nothing whatever to do with the principle of the gas engine. In the case of the gas turbine, gas is not the source of power (which may be gas, oil or coal dust) but a power generating medium through a combustion process. A rotary compressor delivers air at a pressure of about four atmospheres. This brings the temperature of the compressed air to some 932 degrees Fahrenheit. At this temperature it passes on to the combustion chamber where gas, oil or coal dust is burned. Air temperature thus reaches 2,500-2,800 degrees Fahrenheit. Air volume is then twice that before combustion. In this volume increase is to be found the source of the power, the air at four atmospheres pressure being now capable of action on a far greater surface than air at 932 degress. When the air leaves the combustion chamber to pass through the turbine, it develops energy in the latter by expansion in the same way as steam developing power in a piston engine or turbine. Practically, compressor, turbine and electric generator form a single unit, being all coupled together. The combustion chamber is fitted above those machines, forming a large longitudinal cylinder. A certain likeness with a motor car engine is therefore apparent. Power production is not possible before an independent source of energy has effected the first compression. The gas turbine thus needs a starting device fed by battery or mains. The gas turbine is a very high speed machine like the steam turbine. The machine shown at Zurich was running at 3,000 r.p.m.

It must not be forgotten that air can be considered as a gas. Just enough air as would be necessary for combustion could be fed in the combustion chamber. Combustion exhaust gases would then have a temperature of 8,132 degrees Fahrenheit and the turbine's thermal efficiency would reach its peak. In practice, such a solution is not possible, at least at present. No material of sufficient resistance to heat is yet available for the turbine blades at such high temperatures. With present day materials, a slow but permanent stretching is unavoidable. After a certain time, blades would come into contact with the casing, causing damage, as is well known. In order to avoid such trouble and ensure safe running, existing turbines operate with a great excess of air. The quantity of air fed into the combustion chamber is about four times that needed for combustion. A cooling effect is achieved and the maximum temperature does not exceed 2,800 degrees Fahrenheit. Materials capable of standing this temperature are available. Sooner or later, metal-

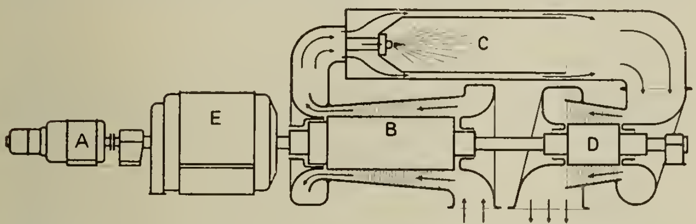

Diagram of a gas turbine: A=Electric motor for starting, B=Compressor, C=Combustion chamber, D=Gas turbine, E=Electric generator.

lurgical laboratories will surely find materials resisting still higher temperatures. But time will only show how closely the ideal temperature of 8,132 degrees Fahrenheit can be approached.

With the simplest gas turbine design and a temperature of 2,800 degrees Fahrenheit, a 18% thermal efficiency is attained. Pre-heating of the combustion air by turbine exhaust gases permits a rise in efficiency to 22-27%. When air pre-heating is supplemented by intermediate heating of power gases, efficiency rises to 25-30%. According to turbine use the annual number of running hours, preference will be given to cheap, simple design with a comparatively low thermal efficiency, or to a more complicated or expensive design with higher efficiency.

In the United States, 18% efficiency gas turbines can already compete with Diesel engines, as the chief point is not efficiency percentage, but oil cost per hour-kilowatt generated. Gas turbines permit using oil costing half that required for Diesel engines. One must not lose sight of the fact that gas turbines are still in the initial stage and that efficiency will increase with every temperature progress effected.

This new type of thermal prime-mover takes up little space. Moreover, the gas turbine requires not a single drop of water. It is therefore very suitable for hot or dry countries. It is always ready for use and can be started without any preliminary operation (e.g. boiler heating). Gas turbines share this advantage with Diesel engines. The gas turbine is a most suitable reserve machine for power distributing systems. It can take charge of electric power production in the case of air raid destruction of a power plant or substation, to quote a topical example. The 4,000 kilowatt turbine exhibited at Zurich is designed for such cases. It has been ordered by the city of Neuchatel (Switzerland) electricity supply service and has been installed in a cave of this town, and is thus protected from bombs. In fact, the turbine power amounts to 16,000 kw, but 12,000 are absorbed by the compressor and only 4,000 go to the electric generator.

If nothing unexpected happens, the first gas turbine locomotive will appear in Switzerland in the spring of 1940. The Swiss Federal Railways have ordered such a locomotive and will run it on non-electrified lines. A gas turbine coupled to a direct-current generator is fitted inside the locomotive. Current is then supplied to the driving motors. There is complete analogy with Diesel-electric locomotives. Such locomotives may prove in future to be a good solution for hot countries where water is scarce.

The gas turbine also finds a particularly interesting application in industrial blowing-plant (e.g. blast furnaces or mine ventilation). In this case, the power generated is not absorbed by an electric generator but by the blower. And as the turbine compressor may also be considered as a blower, it may often become possible to combine the two blowers, that is to say to provide only one blower for both turbine and industrial needs. A compact and simple unit, easily serviced, will thus be obtained.

Hence a new prime-mover is available for technical purposes. With time, it will certainly be improved from both the technical and economic standpoints. How far it will spread and what will be its scope are secrets of the future. Its present stage of development has nevertheless permitted us to point out some of its possible uses.

ROAD CONSTRUCTION IN WAR

From *Strassenbau*

Abridgement from *The Journal of the Institution of Municipal and County Engineers*, May 21st, 1940

A writer contributed two articles to Strassenbau last year for the purpose of showing what military requirements demand of road construction. First, Herr Hummelsberger deals with what was done during the World War, 1914-18. Then he gives an account of the road work done by the Italians during their Abyssinian campaign and a much briefer account of which was done in the Spanish. His final section is headed "Experience gained and its application to road construction in future warfare." Through the courtesy of the Ministry of Transport, we are able to give this in full. It is as follows:

The nature and scope of road construction in warfare depend on tactical necessity, on the purposes for which existing roads can be used, the time at our disposal, the strength of the available construction units, the supply of suitable materials and the climatic conditions.

War conditions, demanding rapid construction in spite of shortage of materials and enemy action, demand divergencies from the rules of peace-time construction. The art of the road engineer in war-time consists in correctly and at the proper time striking a balance between military necessity and the feasibility and technical rightness of a method. Further, in war-time the road engineer is often obliged to use materials which he would certainly not use under normal conditions without forfeiting his right to be called an engineer. In war the end justifies the means. We must not lose sight of our object, which is the construction of a firm road. In grading little importance is attached to the transport of soil. Any soil which is needed is taken from beside the road, and superfluous material is dumped wherever there is room; incidentally the gradients and curves are considerable.

After the completion of the survey the design of the road is settled, together with the date of starting work, the time to be taken and the type of construction to be adopted. In addition to the usual materials, such as sand, gravel, stone and chippings, it has already been pointed out that use may be made of any materials which are available locally; these include soft stone, blast furnace slag, clinkers, bricks, material from ruined walls or houses, tree trunks, logs, planks, faggots, brushwood, etc. The supply of water to the construction units is also very important. The amount required for the different methods of construction varies from 5 to 120 litres (1.1 to 25 gallons) per running metre of road three metres wide, the additional supply for the use of the troops for all purposes amounting to 4.4 gallons per man per day. The selection of the type of construction may thus depend on the water supply. Geologists should be employed on surveys on which estimates of water supply are to be based.

The tools and machinery required depend on the locality in which they are to be used. In the battle zone only small machines and tools can be used (spades, shovels, picks, axes, barrows, etc.). On the lines of communication, use can be made of tar-sprayers, rollers up to six tons net weight (capable of being transported by road), watercarts, rails and skips; trailer attachments may include travelling concrete mixers, but mixers may alternatively be of a type which can easily be loaded on to a lorry. Machinery of this type recently put on the market can be towed at 37½ to 45 m.p.h. and they are likely to be of great service to the German building trade in the future. In addition, the so-called truck mixers are of great use in war; they are loaded behind the line, out of range of artillery fire, with aggregate, cement and water, and the mixing process is completed in transit. Somewhat larger plant may be used for transporting soil on communicating routes, e.g., trailer-type band conveyors, scrapers, and tractor-operated and transported units. Tractor-type excavators can be operated across country and, if intelligently used, can greatly accelerate the work. Construction machinery may be used freely in the rear, where work is carried out by contractors.

In the repair and maintenance of roads, use is made not only of the usual tools but also of units which are especially mobile and portable. Road construction in devastated areas is facilitated by the use of excavators for filling up shell-holes, the fill being then consolidated by Diesel-operated tamping units. The whole plant should be kept together in a central position in the engineer's machine park and should be kept under central control.

The oldest type of road—waterbound gravel or macadam, with or without a foundation of stone pitching—can be carried out in almost any climate provided that sufficient material is available (40 to 150 tons of stone per 100 running decimetres of road three metres wide). The maximum output of a construction party of 90 men may be taken as 750 sq. metres (9,000 sq. yds.) in ten hours. The surfacing rapidly becomes worn under the enormously heavy military traffic; it becomes dusty or muddy, and quickly disintegrates. Hence, if it is not protected by surface treatment as soon as possible its useful life is very short. We must, however, take this method of construction into consideration in future wars, as it is this type of road which is most easily made by unskilled labour.

Penetration surfacing and "Einstreudecke" (dry penetration surfacing) may be described as much superior types. Although the amount of material required is as great as in the case of the gravel or macadam road, and construction cannot be carried out in wet weather, the durability of these surfacings, and the ease with which they can be constructed by unskilled labour, render them decidedly suitable for use in military construction.

Concrete roads, which are being increasingly used under peace conditions, are in many respects even more suited to wartime construction than are penetration surfacings or "Einstreudecken" as a smaller weight of material is used and construction is rather more rapid. Gravel is usually more easily obtained than the high-quality stone used in bituminous surfacings, and under war conditions cement is often more readily obtainable than bitumen. It must, however, be taken into consideration that concreting must be stopped during frosty weather. The inconveniently long setting period may be minimized by admixtures of calcium chloride.

Various high-grade types of close-structured bituminous surfacing (rolled asphalt, tarmacadam, mastic asphalt, etc.) can scarcely be considered suitable for war-time construction, as the rate of construction hardly justifies the somewhat extensive plant and the necessary trained personnel. For similar reasons sett paving must be used for small areas only.

In advance and attack we must take into consideration not only the destruction of roads by shell-fire and bombs behind our front, but also the need for crossing the devastated areas and for making good as rapidly as possible any damage done by the retreating enemy. If he has succeeded in causing extensive damage by mines at points of special difficulty (e.g., on gradients) it will often be necessary to use bridging plant which has been kept in readiness, or other emergency plant. A practical instance was afforded by the advance of the National Army of Spain in Catalonia. The damage in the devastated areas may be so extensive that the original road is no longer distinguishable and re-alignment is necessary.

Even the best methods of construction are useless in war unless provision is made for proper maintenance at the right time. It should not be deferred until serious defects have appeared, as this is generally too late.

We will now briefly survey the so-called "emergency roads" and the methods of rapid construction in the battle zone on which the mobility of the modern army depends. Although during the last 20 years the speed of road construction has greatly increased, the methods already described are not rapid enough for the high speed construction required by an advancing army. Efficient and fairly mobile machinery is now readily obtainable from most construction firms.

For this purpose high-speed methods must be found and tested. The use of soil stabilization methods, which include the use of incorporated moisture, bitumen, Portland cement, calcium chloride, salt, lignin, etc., is still in the experimental stage in all countries, and such claims as "10 kilometres of road built in 10 hours" are extravagant and will not bear serious investigation. In Egypt and India the British have used wire mesh in stabilizing the soil, but this material has the disadvantage that it can only be used for light one-way traffic by rubber-tyred vehicles. The log, plank, sleeper and fascine roads which were formerly used were certainly good emergency roads, but their rate of construction was too slow for modern high-speed work. Lieut.-Col. Steiner (Engineers) described in the "Rivista di Artigleria e Genio" the use of single stretches of road by connecting metal sections, as bridge construction, in crossing broken or marshy ground. He recommends the use not of steel but of light alloys, and refers to a light-alloy bridge of British construction. He emphasizes that in high-speed road construction trained technical personnel must be available, and that successful construction depends on their efficiency.

UNEXPECTED EXHIBITS AT LEIPZIG FAIR

From *Trade & Engineering* (London), October, 1940

We are indebted to the Christian Science Monitor of Boston for an account of a British visit to the autumn Fair at Leipzig. It was from the R.A.F. who delivered leaflets a few days in advance announcing that they would provide a foreign feature at the Fair, although they had not been invited to participate. Their arrival was greeted by a heavy anti-aircraft barrage and their departure cheered by thousands of visitors and residents who had been forced under cover. In spite of this exhibition the Germans declared that the Fair differed in no way from its predecessors. But the truth of this statement was challenged by an occurrence a day or two afterwards when the outstanding entertainment was to have been an international football match just outside Leipzig. The major attraction, however, turned out to be a large fire which it had not been possible to get under control since the R.A.F. had made their contribution to the fun of the Fair. It is not reported whether the fire was at the gas-works end or from the direction of the Leuna synthetic oil plant. European neutrals, on their return from Leipzig, are quoted as saying that few of the exhibitors could offer goods either at attractive prices or at acceptable delivery dates.

"FLAK" BARRAGES

From *Trade & Engineering* (London), October, 1940

Toughness of British Aircraft

Probably the most frequently used word in the reports of R.A.F. Bomber Command pilots who take part in the raids on Germany and other enemy occupied territory is "Flak." The word means what used to be called in the last war "Archie" "Ack-Ack" or anti-aircraft fire, and it derives its name from the German initials Fl.A.K.—"Flieger Abwehr Kanone," or the gun which drives off raiders.

It is very rare for a pilot to return from a raid without mentioning the word in his report. He may record that "Flak" was either heavy or light, accurate or inaccurate, intense or moderate, or, if his luck is in, that there was no "Flak." In these days of highflying aircraft anti-aircraft gunnery is a much more complicated and varied business than it was in the 1914-18 war, and the "Flak" intelligence experts at the Air Ministry have issued recently a "Strangers Guide to Flak." This guide shows, in convenient and readily comprehensible form, the range, calibre, weight, and type of shell, and rate of fire.

Light and Heavy

There are two principal kinds of "Flak," light and heavy. Light "Flak" means guns of calibres between -¾ in. and 2 in. The weight of the shell increases from less than half a pound, in the case of the smallest of the guns, to 3⅓rd lb. in the case of a 47 mm. gun. The rate of fire, as would be expected, decreases as the range, weight, and calibre of the shell increase. The German 20 mm. for example, fires about 160 rounds a minute up to 7,000 ft., while the 47 mm. gun fires 25 rounds a minute to a height of more than three miles.

Light "Flak" fire tracer shells burst on impact and have self-destroying detonators. That is to say, they explode in the air even if they miss the target, and, therefore, cannot fall back and explode on the ground. Heavy "Flak" do not fire tracers. They fire timefuse shells, and range from 15 rounds a minute, 75 mm. guns, throwing shells to 20,000 ft., to the 105 mm. guns, firing 10 32-pounder shells a minute to 30,000 ft.

The method of fire-control differs between light and heavy "Flak." Light "Flak" is directed by a speed and course sight. Heavy "Flak" is controlled by a predictor, the complicated instrument with which 11 men obtain for the gunner all the data necessary in theory for the shell to meet its target if, in the interval between the firing of the gun and the arrival of the shell at the point of prediction, the aircraft has not changed direction, height, or speed. Normally, an aircraft encountering anti-aircraft fire continues to change at least one of these factors.

At night or in cloud, "Flak" fire can be directed with reasonable accuracy by sound locators, but this method is naturally much less accurate than visual shooting. Our own anti-aircraft batteries possess guns equivalent to, and even better than, the German "Flak." It is encouraging to note that while our "Ack-Ack" batteries have scored many successes at the expense of the enemy bombers and fighters—particularly in recent raids—our own aircraft frequently fly home after having passed through intense, heavy, or light "Flak" barrages. Occasionally shells have actually passed through their wings or fuselages.

Sound Workmanship

In the last few months many of our aircraft, both bombers and fighters, have returned home and made perfectly good landings after receiving damage which would have sent the majority of German machines crashing to the ground. In fact, R.A.F. aircraft have shown a strength and "toughness" in the air which is a striking tribute to the good material and sound workmanship of our home industry. Recently, returning over the seas from a raid on Germany, the pilot of a Blenheim bomber was forced down through bad weather conditions until, before the position could be retrieved, the nose of the Blenheim plunged into the waves. For a few moments the airscrew churned the water and the air intake scooped up gallons. Then the aircraft bounced upwards and both engines picked up again. The pilot was able to fly the bomber safely home, although the airscrews were bent, the tail wheel missing, the bomb-hatch cover stove in, and the shield, cowlings and air intake wrecked.

Another Blenheim, which had been flying over Rotterdam, meeting the full fire of ground defences, came back to its station although the port oil tank was punctured in three places, the lead from the starboard petrol supply fractured, and the fuselage considerably damaged. Yet both engines functioned almost normally, and the aircraft was back in service two days later.

Over Bremen a Whitley bomber was hit by A.A. fire. One engine was put out of action and the other affected. But on that one damaged engine, which had, of course, to be nursed most carefully the whole way, the pilot was able to return to a British aerodrome. The greater part of the journey was covered at a height of only 400 ft. above the sea. Similar successful homings under comparable conditions of damage which might be expected to bring any aircraft to ground, have been made by Wellingtons and Hampdens.

A Hurricane Exploit

The Hurricane has also stood up well to heavy battering. Recently a Fighter Command pilot "pancaked" a landing in a field after gliding his plane for nearly 20 miles from a height of 5,000 ft. He had encountered over the Channel off Deal a large formation of Messerschmitts. In the ensuing dogfight the pilot followed down a 109 to 10,000 ft. and shot it into the sea. While he was searching the sky he came on a strong formation of enemy bombers at 12,000 ft., and while he was following one of the bombers—a Heinkel 111—a Messerschmitt 109 came at him out of the sun. The first enemy cannon-burst stopped his engine and incendiary bullets wounded the pilot in the shoulder and closed his right eye.

Other cannon shells ripped great holes in the wings, one shot away most of the covering from the tail plane, another ripped three holes in the rudder, two passed right through the fuselage, and another took away part of the engine cowling. When he tried to bale out the pilot found that the hood of his parachute had jammed. By extraordinary manoeuvring of his riddled aircraft, which by this time looked something like a drunken Mayfly, he managed to "pancake" in a field near Folkestone. His undercarriage and both flaps were up. Technical experts who examined the battered plane described it as "not flying, but a miracle."

CONCRETE SHIPS

Abstracted from *Concrete* (Chicago), May and August, 1940

Reports received from abroad indicate that interest is again being revived in the possibility of building sea-going ships of reinforced concrete, in order to conserve steel for more direct war uses. In view of the probability that technical committees of engineering societies are even now engaged in investigating the possibilities of reinforced concrete merchant vessels, it may be well to hold up a "caution signal" in order that such committees may proceed with their investigations with a fuller knowledge of what is ahead.

Several Outstanding Facts

Several outstanding facts may be stated on the basis of the experience gained by the Emergency Fleet Corporation during the World War, and the performance of the concrete ships built by the Corporation.

In the first place, it is a fact that seaworthy ships may be built of reinforced concrete, and that such vessels may be expected to give good service.

The second fact is based primarily on the actual record of what happened in the early 1920's. After the emergency was ended, most of the concrete ships, tankers, and barges, were taken out of service because their greater weight and their consequent slower speed and greater power requirements made their operation uneconomical, as compared with vessels of the more usual types of construction. As a result of this situation, very few of the concrete ships built by the Emergency Fleet Corporation were in service more than three years.

In consequence, the length of service of concrete ships is likely to depend upon the length of the emergency. That, of course, is something which no one can estimate in advance.

It is an important fact that little trouble was encountered because of rusting and swelling of the concrete reinforcement bars in the Emergency Fleet Corporation vessels, even though the protective coating of concrete was scarcely more than one-fourth of an inch.

Due to the rich mixtures of concrete used, and its careful placement, which was aided by external hammering or vibration, the quarter-inch protection seemed to be ample. In some of the hulls still available for inspection, much of the steel continues to remain unaffected after 20 years, even where the protection is as little as a quarter inch.

The service record of a reinforced concrete derrick barge built at Chicago in 1919 and continued nearly twenty years in service, proves that this form of construction is entirely practicable for vessels of certain types where the greater weight of the concrete is an advantage and speed is of little consequence.

In dealing with vessels of the barge type, the heavier weight and slower motion is of little concern, since these vessels are slow moving in any event, and they do not cover great distances. Furthermore, in the case of vessels of the derrick barge type, their greater weight is an actual advantage, as counterbalance to the loads being handled.

These points were well established in a recent letter written to a personal friend by Oscar E. Strehlow, recently president of Walsh & Masterson, Inc., a Chicago firm of engineers and contractors. His letter discusses the derrick barge mentioned above, and which was designed by him in 1918, and built under his direction in February, 1919.

This barge, Mr. Strehlow's letter explains, was operated and maintained in perfect condition until the time of its accidental sinking in December, 1938, in a storm.

Mr. Strehlow's letter describes the barge as having had a length of 113 ft., a 33 ft. beam and a depth of 12 ft. The draft was 4 ft., light. There were 15 water-tight compartments formed by gunwales and rakes 3 in. thick, two longitudinal bulkheads 4 in. thick, and four transverse bulkheads 4 in. thick, and by the deck and bottom, each 2½ in. thick. Ribs 5 in. wide and 8 in. deep (including the slab thickness) were built on 4-ft. centers running transversely inside of the barge around the bottom, the gunwales and the deck, and similarly up and down both rakes. This required 213 cu. yd. of concrete, and reinforcing bars from ½ to 1¼ in. sizes, totaling 24 tons. The crown and shear were 4 in. Timberheads were of extra heavy 12-in. pipe filled with concrete and reinforcing bars extending deep into the gunwales and transverse bulkheads located at the foot of each rake.

Six raising lugs (by means of which the barge could have been raised) projected 12 in. above the deck, with ½ in. steel side plates provided with holes 2½ in. in diameter to accommodate the shackle pins of the raising cables.

The mixture of concrete employed in the construction consisted of one part of cement, 2⅔ parts of torpedo sand graded up to ⅝ in. pebbles. One brand of slow-setting portland cement was reground in order to speed up its setting time to that of the other brand of cement, thus bringing about "team work." Then one part of the reground cement was mixed with 2⅔ parts of portland cement having an average setting time. This cement mixture resulted in a very dense and waterproof concrete. Concreting operations were carried on continuously for three days and two nights. Each batch was mixed for three minutes.

The barge was built on the bottom of Section 1 of the Calumet-Sag canal while that canal was under construction. The boat was floated when the water was admitted into the channel. The cost of the derrick barge, in round figures, was $25,000. It will be seen from the location of its construction that no expense was involved for ways and launching.

AERIAL PHOTOGRAPHY

Extract from *Trade and Engineering* (London, Eng.)
September, 1940

The exploits of the R.A.F. in taking photographs over Germany and Norway have received much attention, but little has been said of the cameras and methods used. The more technical side of photography in the R.A.F. deserves to be described. Great advances have been made in all branches of photography since the 1914 war, and the Service has taken what is useful to it from all of them. The laboratories, for example have contributed photographic emulsions for films of increasing speed and finer grain; panchromatic coatings for films intended to be used in the air that make for greater sensitiveness to the red end of the spectrum; infra-red films; and a bromide emulsion for paper that makes it unnecessary now to have several grades of bromide paper in the printing room since the emulsion provides for either contrasting or soft effects in printing.

The camera itself has undergone similar improvements. Cameras used in aircraft in the last war were not nearly so effective as modern ones. Clumsy and slow to handle, they were worst of all, not to be depended upon. The modern aerial camera is first of all a "precision instrument" dependable and simple to handle, and will stand the hard wear and tear that men and machines must endure on active service. The camera used for taking vertical photographs is electrically operated and starts at the turn of a timing switch. The control unit continues to make exposures at set intervals, either until it is switched off or until the film runs out. If a few exposures are enough, the photographs are taken merely by pressing a control button at the time intervals required. After the release of the shutter the mechanism automatically drops into mesh, rewinds the shutter, winds over the exposed portion of the film, and changes the number on a veeder counter. In a second or so the camera is set for another exposure. Like some older types of camera the modern aerial camera is built on the unit system so that any part can be quickly replaced. No special tools are needed to dismantle the camera; a coin is all that is necessary to remove a faulty unit.

Lenses, too, have been much improved. The peculiar conditions of aerial photography require lenses free from the many imperfections that may occur in such a delicate instrument, and the lenses used in the R.A.F. are as nearly perfect as possible. Among the types in use are one with a 3¼ in. focal length working at a large aperture with a covering power of over 90 deg., and practically free from distortion, and others up to 40 in. focal length. The latter are used for photographs taken from great heights.

A special application of the aerial camera to work other than intelligence is also notable. Prospective air gunners, are taught to fire by camera, and the ciné camera guns now used are a great improvement on the single-shot camera gun. Bomb aimers get practice in sighting and aiming at actual military objectives such as docks, railheads, and the like by the "simulation of bombing photography;" and the photographs taken show the amount of error and may explain the reason for it. As in actual bombing, the practice is carried out with the approach, turning off, computing and setting of bomb sights, and the release of the "bomb."

Bombing practice at night is also possible, by means of a suitably lighted target and the use of infra-red sensitive film in the camera. Experiments in aerial photography at night are well advanced, and there is a camera that exposes automatically to the "peak" illumination of a flare.

Fifty-fifth

ANNUAL GENERAL MEETING

AND

GENERAL PROFESSIONAL MEETING

THE ENGINEERING INSTITUTE OF CANADA

HAMILTON - Thursday and Friday
February 6th and 7th, 1941

The Hamilton Branch has set up a special committee under the chairmanship of H. A. Cooch, M.E.I.C., to handle all arrangements.

All sessions will be held at the Royal Connaught Hotel.

Preliminary Programme

THURSDAY, FEBRUARY 6TH

9.00 A.M. - -	REGISTRATION
10.00 A.M. - -	ANNUAL MEETING
12.30 P.M. - -	LUNCHEON—CHAIRMAN, W. A. T. GILMORE
2.30 P.M. - -	TECHNICAL SESSIONS
7.00 P.M. - -	JOINT DINNER WITH NIAGARA DISTRICT ELECTRIC CLUB, FOLLOWED BY LECTURE AND DEMONSTRATION

FRIDAY, FEBRUARY 7TH

9.30 A.M. - -	TECHNICAL SESSIONS
12.30 P.M. - -	LUNCHEON—CHAIRMAN, E. P. MUNTZ
2.30 P.M. - -	TECHNICAL SESSIONS
7.30 P.M. - -	INSTITUTE BANQUET
10.30 P.M. - -	DANCE

Full details will be found in the January Journal

THE FIFTY-FIFTH ANNUAL GENERAL MEETING

Notice is hereby given in accordance with the by-laws, that the Annual General Meeting of The Engineering Institute of Canada for 1941 will be convened at Headquarters at eight o'clock p.m., on Thursday, January 23rd, 1941, for the transaction of the necessary formal business, including the appointment of scrutineers for the officers' ballot, and will then be adjourned to reconvene at the Royal Connaught Hotel, Hamilton, Ontario, at ten o'clock a.m. on Thursday, February 6th, 1941.

L. AUSTIN WRIGHT, *General Secretary.*

ENGINEERS FOR THE AIR FORCE

Attention is called to an important notice on the Employment Page (553) which has been printed at the request of the Chief of Air Staff. This notice describes two separate groups of engineers for which special needs exist at the present time. There are not many places in the forces where an engineer can be of more vital service to his country than in the technical sections of the Royal Canadian Air Force.

As in other services, several persons with special technical training have enlisted in the air force in non-technical capacities. Already a shortage exists in all arms of the service and in industry for technical men. Therefore it becomes depressingly apparent that much valuable skill is being wasted, and that the time has arrived when such persons should not be permitted to become fliers just because they are anxious to have to go at Jerry, or because ground work does not appeal to them.

This whole war is a great national emergency and now is no time to sacrifice the principle of "the greatest good to the greatest number." Ours is still a voluntary army, but that does not seem sufficient reason for permitting men with special skills to enlist in services where these skills can have no application. Actually, there is a regulation forbidding such enlistments, but every day it becomes more and more evident that in the desire to make up complements some units are getting around the regulation. The Institute has had and is having certain correspondence with Ottawa officials on this very point—referring to all branches of the service, but unfortunately without much satisfaction.

The latest appeal from the R.C.A.F. is a definite call for technical men for technical work, and should receive a splendid response from engineers all over Canada and perhaps from other countries. If members remote from recruiting centres would like further information, Headquarters will be very pleased to send it, or to assist in any other manner that may be required.

AIDS TO TECHNICAL EDUCATION

So much is heard these days of the need of scholarships in technical education that it is a matter of interest and gratification to know that substantial progress is being made along this line, particularly in the United States. Perhaps the most outstanding contribution is that made by the Westinghouse Electric and Manufacturing Company, which has established a comprehensive and unique agreement with the Carnegie Institute of Technology at Pittsburgh. In the belief that many members will be interested in knowing the details, and in the hope that other companies may be inspired to similar endeavours, the following description is given—

"The George Westinghouse Scholarships in Carnegie Institute of Technology are in engineering and are undergraduate in character. Normally, there are fifty of the scholarships, of which ten become vacant at the regular commencement of the Institute in June of each year. Each scholarship has a total value of $3,000, payable monthly at the rate of $50 for the five year period of the Course. ($30,000.00 per year.)

"The plan affords an unusual opportunity for combining theoretical training with practical experience. At the age of twenty-two to twenty-four, the participants will have completed a four-year formal engineering course and, at the same time, will have acquired a substantial background based upon two years' industrial experience. The plan provides the partial financing of a balanced programme of academic and practical education for young men whose previous performance justifies a high degree of confidence that they will become leaders in their chosen fields of engineering.

"The Course covers a five-year period with arrangement of schedule in broad outline as follows:

	Summer	*First Semester*	*Second Semester*
First Year	Westinghouse	Carnegie	Carnegie
Second Year	Westinghouse	Carnegie	Carnegie
Third Year	Westinghouse	Carnegie	Westinghouse
Fourth Year	Westinghouse	Westinghouse	Carnegie
Fifth Year	Westinghouse	Carnegie	Carnegie

"Any branch of engineering for which regular instruction is given at Carnegie may be chosen. However, the branches contemplated are electrical, mechanical, metallurgical, chemical, and management. A full description of these courses is presented in the bulletin of the College of Engineering of the Carnegie Institute of Technology. At the Westinghouse Electric & Manufacturing Company, the scholars will be trained in manufacturing departments, testing departments, laboratories, drafting rooms, and engineering offices.

"The co-operative programme constitutes an integrated whole in the theory and practice of engineering.

"The programme, on account of the unusual nature of its provisions, is probably attractive to a considerable number of high school boys who have in view engineering careers. Before a young man presents himself seriously as a candidate for these opportunities, he should feel sure that his own best field will be technical engineering or the related commercial or management fields. He should have back of him a performance record in high school subjects, particularly in the physical sciences and in mathematics, within the top 15% of the graduating class of an acceptable high or preparatory school. He should be free of any inherent personality or physical limitations. Above all he should feel within himself that urge to express his own best effort through the medium of engineering or industrial work."

An account of the results so far obtained was given by Douglas F. Miner, George Westinghouse Professor of Engineering at Carnegie, as part of the programme of a regional meeting of the Society for the Promotion of Engineering Education (S.P.E.E.). This meeting was held in conjunction with the annual meeting of the Engineers' Council for Professional Development in October at Pittsburgh. Professor Miner's topic was "Co-operative Engineering Education." Arrangements have been made with the S.P.E.E. for printing this address in a later number of the Journal. According to discussions at the Pittsburgh meeting co-operative education is making substantial progress in the United States, and it is expected that many persons in Canada will be interested in knowing more about it. The arrangement between The Carnegie Tech and Westinghouse is a recent example. Other cases go back for over twenty years.

THE JAMES WATT INTERNATIONAL MEDAL

This year The Council of the Institution of Mechanical Engineers unanimously awarded the James Watt International Medal to Professor Dr. Aurel Stodola of Zurich, Switzerland, the choice having been recommended by several national engineering societies, of which the Engineering Institute of Canada was one.

The James Watt Medal was founded in 1936, to mark the bicentenary of the birth of Watt; it is awarded biennially with the co-operation of the appropriate engineering society of each of seventeen major industrial countries of the world. It is provided that to be eligible for this distinction, commemorating one who was eminent as a scientist, and inventor and a mechanical engineer, a recipient should have achieved international recognition of the ability with which he has applied science to the progress of mechanical engineering. The first medal was given in 1937 to Sir John Aspinall, and the second in 1939 to Henry Ford. The third medal of the series will be presented in 1941 to Dr. Stodola. Unfortunately, it is probable that he will be unable to come to England to accept the medal personally, and accordingly His Excellency the Swiss Minister in London is being asked to receive it for him. The ceremony is planned for a day as near as possible to the date of Watt's birthday (19th January). The High Commissioner for Canada and the Envoy of Czechoslovakia in England will also be invited to participate in the meeting.

Dr. Stodola is a native of Slovakia, and after a long and distinguished career as Professor of Mechanical Engineering at the Swiss Federal Polytechnikum in Zurich, retired from active work five years ago. Many of his former pupils at this famous college now occupy important engineering positions in Europe and America, and he is also widely known for his pioneer work in the development of the steam turbine. Beginning some forty years ago he carried out a series of researches on the discharge of steam through nozzles and vanes which were an important contribution to the store of experimental data on which modern theories of turbine design have been built. His treatise on the steam turbine is a classical work of reference. His achievements have already been recognized by awards from many technical and scientific societies, and the James Watt Medal is a well-earned addition to his long list of distinctions.

THE MANUFACTURE OF MUNITIONS IN CANADA 1914-1918

Twenty-two years ago the close of hostilities ended a period of remarkable industrial development in Canada. During four years of intense effort, plants and organizations for producing war munitions and equipment had been established and put in operation on a scale which did much towards giving the country an industrial rather than an agricultural outlook. At their peak during the summer of 1917, these activities required an expendutire of some $50 millions a month; they produced and sent to England the many types of shells, ammunition, explosives, aeroplanes and ships which were called for by the British Government as the great war ran its course. Since 1918 the industrialization of Canada has continued, though at a slower pace, with the result that we are now very much better equipped than in 1914 to embark upon the industrial expansion made necessary by the development of mechanized warfare.

It is apparent that for the present at any rate, the kinds of supplies we are asked to furnish will be more varied and elaborate than those required in 1914-1918. For example, in addition to ships, ammunitions and explosives, there is need now of machine guns, anti-tank guns, rifles, transport vehicles, tanks and aeroplanes, in quantities which greatly exceed the requirements of World War I. But the same problems still arise in the conversion of an existing plant from ordinary commercial work to the production of warlike equipment, or in the construction of a new factory for some special purpose. Consideration must be given to such matters as the subdivision of the work, the allocation of contracts to the most suitable firms, the financial arrangements needed to provide for the huge expenditure involved, the provision of materials which will meet service specifications, the supply of machine tools, jigs and gauges, the inspection of the finished product, and measures for obtaining the earliest possible delivery.

The Presidential Address at the Annual Meeting of the Institute in Ottawa in February, 1919, was devoted to an account of the way in which these questions were handled successfully in 1914-1918. It was entitled "The Manufacture of Munitions in Canada." Past-President H. H. Vaughan had himself taken a leading part in the recent industrial war effort, and his address, which was reprinted later as a 90-page booklet, contains much material which will repay study at this time by members who are concerned in the development of Canada's power to produce munitions and war equipment. Copies of this pamphlet are available, and will be sent on application to the Headquarters.

THE MANUFACTURE OF MUNITIONS IN CANADA

By H. H. Vaughan, M.E.I.C., Presidential Address, Ottawa, 1919. Published by the Engineering Institute of Canada, 91 pages, 103 illustrations, diagrams, production charts. $9\frac{1}{4}$ x 6 in. Obtainable from The Engineering Institute of Canada, 2050 Mansfield St., Montreal. Price $1.00, including sales tax and postage. Special prices in lots of ten or more.

CORRESPONDENCE

THE PROFESSIONS AND THE SIROIS REPORT

University of Toronto, November 13th, 1940.

The Editor, The Engineering Journal,
2050 MANSFIELD STREET, MONTREAL, P.Q.

Dear Sir:

The possibility of obtaining a clarification of the legal position regarding the regulation in Canada of the professions, and the engineering profession in particular, by submission of the problem to the Royal Commission on Dominion-Province Relations was discussed at a recent meeting of the Institute.

The Report of the Commission is a document of monumental proportions; its importance has been widely acclaimed. It appears to include only two references to professional qualifications. It may be of service, therefore, to abstract these references for the benefit of those members of the Institute who have not yet been able to read the complete Report.

On page 35 of volume two, public health services in Canada are under discussion, and in listing matters which "the provinces should accept responsibility for" the Commission include as the last item "Professional qualifications for the practice of medicine and quasi-medical vocations."

On page 67 of the same volume the Commission conclude their review of certain economic activities with this statement:—"There should, we think, be complete freedom of trade and commerce throughout Canada; complete freedom of investment; complete freedom of movement and freedom from arbitrary restrictions (as distinct from a bona fide test of vocational qualifications) in the practice of a trade or profession; and complete freedom from discriminatory taxation. If there are to be exceptions to these general principles they should be authoritatively and unambiguously declared."

Since no useful purpose can now be served by commenting upon this conclusion and the extremely important professional possibilities which it suggests, the quotations may well be left for the individual interpretation of interested members.

Yours faithfully,

(*Signed*) ROBERT F. LEGGET,
Assistant Professor of Civil Engineering.

THE INSTITUTION OF MECHANICAL ENGINEERS
STOREY'S GATE, ST. JAMES'S PARK, LONDON, S.W.1

1st November, 1940.
W S T .

L. AUSTIN WRIGHT, ESQ., CENTRAL COMMITTEE,
THE ENGINEERING INSTITUTE OF CANADA,
2050 MANSFIELD STREET, MONTREAL, QUEBEC.

Dear Mr. Wright:

You may be interested to see the enclosed copy of a letter I have received from the Childrens Overseas Reception Board giving a summary of how matters stand at the moment regarding the evacuation of children to Canada.

Naturally we feel sorry that the great interest and immense amount of trouble taken on your side has not borne fruit, but that does not alter our deep feelings of gratitude towards our brother engineers which will never be forgotten.

It is, of course, impossible to foresee what the turn of the war may bring about in the spring. What we all earnestly hope is that by that time further evacuation from this country will not prove necessary, but if the scheme is again put into operation, it is a great satisfaction to us at the Institution to feel that your generous offer remains open.

With kind regards,

Yours sincerely,

(*Signed*) J. E. MONTGOMREY, *Secretary.*

The following letter comes from the father of some English children in Canada in whom the Institute has been interested. The Institution of Mechanical Engineers has been the medium through which these contacts have been established. The letter is published because of the sketch it gives of conditions in England as they appear to an officer of the Navy. For obvious reasons the identity and address of the writer is not disclosed. The letter is dated late in October.—(Editor).

Dear Mr. Wright:

Very many thanks indeed for your letter of 10/9/40. I think it had been delayed somewhat in the Censor's office, and it arrived while I was on leave. Once again may I thank you most heartily for all that you have done. I was, of course, somewhat inaccessible at the time the children went, in fact it was quite a number of days before I heard they had gone. It was more than a relief, I can assure you, to hear how extremely kindly they had been treated and are being treated.

I have just come back from a few days leave. I found things in general very little altered. The black-out of course remains, and the sign posts and milestones have gone, which makes motoring a rather more adventurous pastime. Rationing seems to have made practically no difference, except for the restricted number of courses in the restaurants, certainly no hardships on that score. I had not time to get to London, but it may put the picture somewhat in form when I say that, although my whole leave was spent in dangerous and military areas, I did not in a whole week hear one air-raid alert. Evidence of bombing was very slight too. I only remember seeing two bomb craters from a main road, both in the same place although I had to cover some hundreds of miles by car. Petrol rationing is of course, very strict. People in general I found certainly in good heart—in fact I think they err, if anything, on the side of complacency. I feel that it may interest you to hear how things strike one who comes to them practically from another world at very long intervals.

The naval side of the picture is one of cold dreary monotony. I must freely admit I for one don't look forward to the winter at all. We just go slogging on. However everyone is full of confidence and determination and all that I have seen are fit and full of fight, and very envious indeed of the bombers, who seem to be almost the only people who are really getting a chance to have a go at Jerry. We have been attacked quite a few times by both bomb and torpedo but so far without result, (touch wood) despite Goebbels, who has "sunk" us five times.

I hope you will excuse this long and discursive screed, but I feel that it may be of interest to you to get news of things from an unusual slant.

Once again, my most heartfelt thanks to you, and to all those who have shown and are showing such almost incredible kindness.

Sincerely yours,

Ottawa, 12 November, 1940.

EDITOR, ENGINEERING JOURNAL,

Dear Sir:

In the Engineering Journal for October there appeared a reprint of an article on glass as a reinforcing medium for concrete. I believe it might be a good idea to follow this up either with an abstract or a quotation in full of an article on glass reinforcement for concrete appearing in "Engineering" dated October 4. This article describes a further series of tests made by Dr. Marshall at the City and Guilds College and in the test report Dr. Marshall emphasizes that glass reinforced concrete is essentially a brittle material. He states, "The generally accepted value for the factor of safety for ductile materials is 3.5; for brittle materials it is much higher, generally of the order of 10. Glass reinforced concrete is definitely a brittle material and to use the low factor of safety which Mr. Sodden's figures give is definitely bad practice." I am taking the liberty of mentioning this matter because I feel that the design moments given in Table 2 on page 425 of the Journal may possibly be accepted without question.

Yours very truly,

(*Signed*) S. D. LASH, M.E.I.C.

Editor's Note: The article referred to by Dr. Lash is reproduced in full on page 525 of this issue.

THE PRESIDENT GOES WEST

The president, Dr. T. H. Hogg, visited some of the western branches this month. On the 11th he was in Winnipeg, on his way to Calgary for the signing of the co-operative agreement between the Institute and the Association of Professional Engineers of Alberta. This ceremony, which took place on the 14th, was marked by a joint banquet of the Institute and the Association at the Renfrew Club in Calgary. A regional meeting of the Council of the Institute was also held in Calgary on the occasion.

The president then proceeded to Vancouver where he visited the branch on the 16th. The next day he visited the Victoria branch. Past President Dr. O. O. Lefebvre, Councillors J. A. Vance and C. K. McLeod, and the General Secretary accompanied the president.

Full details of the tour will be found in the January issue.

MEETING OF COUNCIL

A meeting of Council was held at Headquarters on Saturday, October 19th, 1940, at ten thirty a.m., with President T. H. Hogg in the chair, and ten other members of Council present.

In view of the forthcoming annual meeting of the Engineers' Council for Professional Development (E.C.P.D.), of which the Institute is becoming a member, nominations were made for the Institute's representatives on various committees of the E.C.P.D.

Confirming newspaper announcements, the secretary reported that advice from officials of the Immigration Department indicated that all government supported proposals for evacuating children from the Old Country have been abandoned, at least temporarily. This means that the engineers' scheme will be suspended until such time as the government resumes its activities.

The favourable results of the ballot on the co-operative agreement between the Institute and the Association of Professional Engineers of Alberta were noted with satisfaction.

Discussion took place on the representations which are being made to the federal government in regard to passport applications, and the appointment of engineers by federal departments.

A tentative programme for the annual meeting, which had been drawn up in consultation with the annual meeting committee of the Hamilton Branch, was discussed. The programme and the dates of Thursday and Friday, February 6th and 7th, 1941, were approved.

The report of the Finance Committee was presented, and it was noted with appreciation that the finances of the Institute were in a very satisfactory condition.

Two resignations were accepted, one Life Membership was granted, and the names of six members were removed from the membership list.

On the recommendation of the executive of the Peterborough Branch, it was unanimously resolved that H. R. Sills, M.E.I.C., be appointed as councillor to represent that branch for the balance of this year, and that his name be placed on the officers' ballot for the year 1941 in order to complete the balance of the full term of the late councillor.

On the recommendation of the Past-Presidents' Prize Committee it was unanimously resolved that the subject for the Past-Presidents' Prize for the year 1940-1941 should be "Organizing the Engineer for Wartime Efficiency".

The secretary presented a letter from Dr. Robert C. Wallace, president of the Royal Society of Canada, advising that that Society, through a committee of which Dr. A. G. Huntsman, of the University of Toronto, is chairman, "has undertaken to make a survey of the resources of our country with the object in view of assisting, by research and otherwise, in the most effective integration of the development of these resources in the best interests of the future as well as the present needs of our population."

After discussion the secretary was directed to advise Dr. Wallace that the Institute was interested in the proposal and would be glad to co-operate.

A number of applications were considered, and the following elections and transfers were effected:

Elections	
Members	10
Juniors	7
Affiliates	8
Students admitted	9
Transfers	
Junior to Member	2
Student to Member	8
Students to Junior	26

The Council rose at one-thirty p.m.

ELECTIONS AND TRANSFERS

Juniors

At the meeting of Council held on November 16th, 1940, the following elections and transfers were effected:

Bloom, David, B.Eng. (Elec.), (McGill Univ.), 352 St. Joseph Blvd. West, Montreal, Que.

Booth, Frank Martin, B.Eng. (Mech.), (McGill Univ.), engr., Trans-Canada Air Lines, Winnipeg, Man.

Affiliates

Armstrong, Thomas Chapman, (Queen's Univ.), Department of Highways of Ontario, Port Arthur, Ont.

Bonenfant, Edmond (Quebec Tech. School), asst. metallurgist and refinery operator, Beattie Gold Mines Ltd., Duparquet, Que.

Holt, William Allison (Welland Tech. School), asst. engr., Atlas Steels Ltd., Welland, Ont.

Transferred from the class of Junior to that of Member

Fotheringham, William Webster, B.Sc. (Civil), (Univ. of Man.), estimator, Manitoba Bridge & Iron Works Ltd., Winnipeg, Man.

MacDonald, Murray Vickers, B.Sc. (Civil), (Univ. of Sask.), M.Sc. (Geol.), (McGill Univ.), constrn. engr., Beloeil Works, Canadian Industries Limited, Beloeil, Que.

MacKay, Leslie, B.Sc. (Civil), (Univ. of Man.), asst. to mgr., Manitoba Power Commission, Winnipeg, Man.

Transferred from the class of Student to that of Member

Lemieux, Roland A., B.A.Sc., C.E. (Ecole Polytechnique, Montreal), asst. to the District Engr., Dept. of Roads, Quebec, Que.

Transferred from the class of Student to that of Junior

Beaulieu, Gerard Olivier, B.A.Sc., C.E. (Ecole Polytechnique, Montreal), structural designer, Dominion Bridge Co. Ltd., Lachine, Que.

Bonney, Albert J., B.Sc. (Mech.), (Queen's Univ.), asst. chief engr., The Quaker Oats Co., Peterborough, Ont.

Hewitt, Robert, B.A.Sc. (Civil), (Univ. of Toronto), sales engr., General Supply Co. of Canada Ltd., Toronto, Ont.

Kazakoff, John, B.Eng. (Elec.), (McGill Univ.), supt., Bolivia Power Co. Ltd., La Paz, Bolivia.

Leahey, James C. P., B.Eng. (Elec.), (McGill Univ.), sales engr., Canadian SKF Co. Ltd., Montreal, Que.

L'Heureux, Paul-Emile, B.A.Sc., C.E. (Ecole Polytechnique, Montreal), asst. divn. engr., Quebec Roads Dept., Sherbrooke, Que.

Mitchell, Robert Walter, B.Eng. (Chem.), (McGill Univ.), departmental head, Merck & Company, Montreal, Que.

Rice, Joseph Donald, B.Eng. (Civil), (McGill Univ.), civil engr., International Petroleum Co. Ltd., Negritis, Peru, South America.

Tannenbaum, Joseph, B.Eng. (McGill Univ.), production engr., W. R. Cuthbert & Company, Montreal, Que.

Students Admitted

Brosseau, Lucien (Mont Saint Louis), dftsman., Canadian Car & Foundry Co. Ltd., Montreal, Que.

Hobson, William (McGill Univ.), 3601 Desery St., Montreal, Que.

King, John Shirley Lowe (Univ. of Toronto), 55 Walker Ave., Toronto, Ont.

MacKay, William Ronald (McGill Univ.), 534 Prince Arthur St. W., Montreal, Que.

Mackinnon, William Donald (Univ. of Man.), 45 Roslyn Apts., Osborne St., Winnipeg, Man.

Pauch, John Emil (Univ. of Man.), 558 Stella Ave., Winnipeg, Man.

Vance, Fenton Russell (Univ. of Man.), 97 Balmoral Place, Winnipeg, Man.

von Colditz, Herbert Ware (McGill Univ.), 1536 Summerhill Ave., Montreal, Que.

Yee, Thomas Marion (Univ. of Man.), 167 Furby St., Winnipeg, Man.

Students at the Ecole Polytechnique, Montreal, Que.

Audet, Henri, 5571 Hutchison St., Montreal, Que.
Baribeau, G. F. Benoit, 3708 St. Hubert St., Montreal, Que.
Belanger, Lucien, 249 Cote Ste. Catherine, Outremont, Que.
Boileau, Charles Antoine, 3870 St. Hubert St., Montreal, Que.
Boyd, Robert A., 365 St. Louis Sq., Montreal, Que.
Brazeau, Lucien, 4159 Harvard Ave., Montreal, Que.
Cadieux, Jean, 2829 Maplewood Ave., Montreal, Que.
Campeau, Charles Edouard, 6931 St. Denis St., Montreal, Que.
Dansereau, René, 271 Cote Ste Catherine, Outremont, Que.
deVillers, Raoul Albert, 5609 Woodbury Ave., Montreal, Que.
Drouin, Jacques, 290 St. Louis Sq., Montreal, Que.
Gagné, Germain R., 3490 Ste Famille St., Montreal, Que.
Girouard, Laurent, 192 Victoria St., St. Lambert, Que.
Grothé, P. André, 356 Redfern Ave., Westmount, Que.
Hebert, Guy P., 706 Champagneur, Outremont, Que.
Laberge, Paul, 320 St. Joseph Blvd. East, Montreal, Que.
Lalonde, Gaston A., 372 Lebrun Ave., Montreal, Que.
Lapierre, Maurille, 5096 Turcot St., Montreal, Que.
Lebel, Marcel, 4269 Chapleau St., Montreal, Que.
Marceau, Seraphin, 5079 Ste Clotilde St., Montreal, Que.
Melillo, Vincent, 32 Gregoire St., St. Johns, Que.
Noel, Joseph Ducharme, 5277 St. Denis St., Montreal, Que.
Normandeau, Laurent, 01160 Charlevoix St., Montreal, Que.
Rousseau, Antoine, 5209 Decelles St., Montreal, Que.
Salvas, Paul-Emile, 468 Cherrier St., Montreal, Que.
Simard, Joseph Edmond, 5035 4th Ave., Rosemount, Montreal, Que.

ANNUAL MEETING, HAMILTON, ONT., FEBRUARY 6th and 7th, 1941

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

Important administration changes recently made at the headquarters of the Royal Canadian Air Force in Ottawa affect some of our members. The move is intended to decentralize the administration of the British Commonwealth Air Training Plan, by re-allocating the duties of the Air Council member for organization and training, and the member for engineering and supply.

Air Vice-Marshal E. W. Stedman, M.E.I.C., former member of the Air Council for engineering and supply has been relieved of the supply duties and will now concentrate his efforts on engineering problems. Air Vice-Marshal Stedman who is a Whitworth Scholar and an Associate of the Royal College of Science, London, served from 1914 to 1919 in the Royal Naval Air Service and the Royal Air Force. He came to Canada in 1920 as director of the technical section at the Air Board, Ottawa. He became later chief aeronautical engineer, R.C.A.F.

Air Commodore G. O. Johnson, M.E.I.C., has been appointed to the newly created post of Deputy Chief of the Air Staff, and becomes a member of the Air Council. He served with the Royal Flying Corps in the Great War and won the Military Cross. Since the last war, he has been continuously engaged in aviation and has been in the Royal Canadian Air Force since its establishment.

Air Commodore S. G. Tackaberry, M.E.I.C., has been appointed member of the Air Council for Supply and promoted from the rank of group-captain. He was graduated from the University of Toronto in 1914 and entered the Department of Public Works at Ottawa. He went overseas in 1917 and until 1919 he acted as a technical officer in the Royal Flying Corps and the Royal Air Force. After the war, he returned to the Department of Public Works at Ottawa as a mechanical engineer. He has been equipment officer at the Royal Canadian Air Force headquarters since 1924, except for periods in England, attending the Royal Air Force Staff College and attached to Royal Air Force stations.

Armand Circé, M.E.I.C., director of the Ecole Polytechnique de Montreal has been named as one of the University of Montreal representatives on the new city council of Montreal.

H. A. Crombie, M.E.I.C., assistant manager of the Dominion Engineering Company is one of the representatives of the Montreal section of the Canadian Manufacturers' Association on Montreal's new city council.

Ernest Cormier, M.E.I.C., was presented with a medal for meritorious service in the field of architecture, at the 50th anniversary dinner of the Province of Quebec Association of Architects, held in Montreal last month. He was graduated in civil engineering from the Ecole Polytechnique of Montreal in 1906 and a few years later obtained his degree in architecture from the Ecole des Beaux-Arts de Paris. From 1915 to 1918, he was in Paris as an engineer in charge of concrete designs for the French government. Since 1918, Mr. Cormier has carried a private practice in Montreal as an architect and engineer, and has designed several important projects, among the latest being the University of Montreal new buildings on the Mount Royal and the Supreme Court building at Ottawa. Mr. Cormier is a past-president of the Province of Quebec Association of Architects.

Gordon McL. Pitts, M.E.I.C., was also one of the recipients of the medal presented to prominent architects by the Province of Quebec Association of Architects, on the occasion of the 50th anniversary of the association. Mr. Pitts who is a very active and well-known member in the Institute was president of the Province of Quebec Association of Architects in 1935.

C. E. Webb, M.E.I.C., of Vancouver was appointed as a member of the board of arbitration established by the International Joint Commission, to enquire into damages suffered because of the diversion of Goat river, B.C., which formerly emptied into Kootenay Lake and now empties into Kootenay River above the lake. Mr. Webb is the chairman of the Vancouver Branch of the Institute.

Wills Maclachlan, M.E.I.C., spoke on "The Electric Utility in Canada" in his presidential address before the Royal Canadian Institute, in Toronto last month.

R. M. Legate, M.E.I.C., has resigned his position of manager of the light department of the Town of Campbellton, N.B., to accept a position with the Hydro Electric Power Commission of Ontario, in Toronto.

J. J. O'Sullivan, M.E.I.C., is resident supervising engineer for the Allied War Supplies Corporation on the Welland Chemical Works job at Niagara Falls.

Victor Michie, M.E.I.C., has been appointed inspecting engineer for the western district with the Department of Munitions and Supply. Previous to accepting this position, Mr. Michie was carrying a consulting practice in Winnipeg.

D. S. Scrymgeour, M.E.I.C., has resigned as chief draughtsman of the London Structural Steel Co. Limited, London, Ont., to accept a position as sales engineer with the Standard Steel Construction Company of Welland, Ont. Mr. Scrymgeour was born and educated in England, and came to this country in 1928 as a checker for the Hamilton Bridge Co. Limited in Hamilton. Towards the end of 1928 he was appointed chief draughtsman of the London Structural Steel Company Limited in London, Ont.

R. W. Angus, Hon.M.E.I.C.

R. W. Angus, Hon.M.E.I.C., professor of Mechanical Engineering, University of Toronto, was given honorary membership in the American Society of Mechanical Engineers at the annual meeting of the Society in New York early this month. The fact that there are only nineteen honorary members makes the honour conferred on Professor Angus an especially gratifying one to all his friends. The Engineering Institute conferred an honorary membership on Professor Angus in 1937.

R. E. Stavert, M.E.I.C., vice-president of the Consolidated Mining and Smelting Company of Canada was elected chairman of the Montreal branch of the Canadian Institute of Mining and Metallurgy, last October.

Air Commodore G. O. Johnson, M.E.I.C.

Air Commodore S. G. Tackaberry, M.E.I.C.

Air Vice-Marshal E. W. Stedman, M.E.I.C.

Dean C. J. Mackenzie, M.E.I.C., acting president of the National Research Council and president elect of the Engineering Institute for 1941, addressed the thirty-fifth annual dinner meeting of the Washington Society of Engineers in Washington, D.C., on November 27th Dean Mackenzie spoke on Canada's part in the war.

Walter J. Manning, M.E.I.C., has been appointed district engineer at Quebec for the Marine Branch of the Department of Transport of the Dominion. Upon graduation from the Ecole Polytechnique in 1927, he went with the Bell Telephone Company of Canada in Montreal and was employed in the traffic department until 1929 when he left the company to engage in construction work. After completing an engagement on the construction of the Notre-Dame Hospital in 1932 he was appointed construction engineer with the Montreal Catholic School Board, a position which he retained until 1934, when he went with the Provincial Department of Colonization at Quebec as a road and bridge engineer. Since 1937, Mr. Manning has been with the Department of Public Works of the Dominion, first as a resident engineer at Rimouski, Que., and lately in the Montreal office.

H. C. Seely, M.E.I.C., has been appointed plant engineer with the East Malartic Mines Limited at Norrie, Que. For the past three years Mr. Seely had been master mechanic with Siscoe Gold Mines Limited, Siscoe, Que.

Ernest Dickinson, M.E.I.C., who was located in Regina, Sask., with the Montreal Engineering Company has been transferred to St. John's, with the Newfoundland Light and Power Company.

E. W. Richardson, M.E.I.C., has been appointed municipal engineer for West Vancouver, B.C. He was graduated from the University of British Columbia in 1932. For a few years after graduation he did general engineering and surveying work in British Columbia. In 1935 he became engineer for the Wells Townsite Company Limited, at Wells, B.C., a position which he occupied until his recent appointment.

Jean Doucet, Jr.E.I.C., has joined the staff of Collet Frères Ltée, general contractors, in Montreal. Upon his graduation from the Ecole Polytechnique in 1936 he went with the Canadian National Railways for a year. After a few months in the bridge division of the Department of Public Works at Quebec, he joined the Plessisville Foundry Limited, Plessisville, Que., and early in 1937 he was appointed general superintendent.

Flying Officer W. F. S. Carter, Jr.E.I.C., is now stationed at Patricia Bay, B.C. Previous to joining the Air Force he was employed with Canadian Ingersoll-Rand Company Limited in Montreal. He was graduated from McGill University in 1936.

René Dupuy, Jr. E.I.C., is now inspector in charge for the British Air Ministry at Canadian Vickers Limited in Montreal. Upon his graduation from the Ecole Polytechnique in 1935 he went with the Quebec Department of Highways until early in 1936 when he accepted a position with the Ontario Paper Company at Baie Comeau on the construction of the paper mill. In 1938 he was appointed assistant to the maintenance engineer. He left this position in the fall of 1939 to accept employment with the British Air Ministry. After a period of training in England, Mr. Dupuy returned to Canada early this year.

A. C. Northover, Jr.E.I.C., has taken a position as assistant production engineer with Trinidad Leaseholds Limited, at Trinidad, B.W.I. Previous to accepting this position he was employed as a junior research engineer with the Toronto Transportation Commission at Toronto, Ont. Mr. Northover was graduated in civil engineering from the University of Toronto in 1937.

Roland A. Lemieux, S.E.I.C., has been appointed assistant district engineer for the District No. 1 with the Roads Department of the Province of Quebec. He was graduated from the Ecole Polytechnique in 1937, and upon graduation he joined the Department of Roads.

D. O. D. Ramsdale, S.E.I.C., is with the English Electric Company of Canada Limited, in Toronto. He was graduated from McGill University in 1933.

J. M. Elliott, S.E.I.C., has now returned to Hamilton, and he is employed with the John Bertram and Sons Limited at Dundas, Ont. He was connected lately with the Kimberly-Clark Corporation at Niagara Falls, N.Y.

R. O. Peterson, S.E.I.C., is attending the Graduate School of Engineering at Harvard University, specializing in soil mechanics. He was graduated from the University of Saskatchewan in 1939.

Raymond F. Leblanc, S.E.I.C., has received the degree of M.A.Sc. from the Ecole Polytechnique, after completing one year of research work in industrial chemistry.

VISITORS TO HEADQUARTERS

W. Garrison Hamilton, Jr.E.I.C., Gold Coast Main Reef Limited, from Gold Coast Colony, W.A., on October 28th.

O. P. Keppel and S. H. Stackpole, Carnegie Corporation, from New York, on October 29th.

C. C. Cariss, M.E.I.C., Chief Engineer, Waterous Limited, from Brantford, Ont., on November 1st.

R. T. Bell, M.E.I.C, Jaeger Machine Company, from Toronto, Ont., on November 2nd.

V. C. Blackett, M.E.I.C., Secretary-treasurer, Moncton Branch of the Institute, from Moncton, N.B., on November 4th.

Pierre Warren, S.E.I.C., from Rouyn, Que., on November 4th.

Lieutenant G. V. Eckenfelder, Jr.E.I.C., 3rd Div. Signals, R.C.C.S., Barriefield Camp, from Kingston, Ont., on November 9th.

F. G. Goodspeed, M.E.I.C., Superintending Engineer, D.P.W. Canada, from Ottawa, Ont., on November 9th.

R. deB. Corriveau, M.E.I.C., Assistant Chief Engineer, Department of Public Works, Canada, from Ottawa, Ont., on 14th November.

D. D. Cunningham, Jr.E.I.C., Test Engineer, New Brunswick Electric Power Commission, from Newcastle Creek, N.B., on November 16th.

W. H. Kelly, M.E.I.C., from Hawkesbury, Ont., on November 19th.

P. C. Hamilton, Jr.E.I.C., District Engineer, Gunite & Waterproofing Limited, and Construction Equipment Company Limited, from Halifax, N.S., on November 21st.

D. A. Evans, M.E.I.C., Resident Manager, Powell River Paper Company Limited, from Powell River, B.C., on November 22nd.

Morris Fast, S.E.I.C., Demerara Bauxite Company Limited, Town of McKenzie, from British Guiana, on November 22nd.

Jean Morency, Jr.E.I.C., Inspector, Quebec Bureau of Mines, from Quebec, Que., on November 22nd.

H. F. Lambart, M.E.I.C., from Ottawa, Ont., on November 23rd.

A. Clairmont, S.E.I.C., Singer Manufacturing Company, Thurso, from Thurso, Que., on November 23rd.

J. W. Wright, S.E.I.C., from Parry Sound, Ont., on November 23rd.

James Ruddick, M.E.I.C., Consulting Engineer, Quebec' from Quebec, Que., on November 27th.

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Robert Gage Allan, S.E.I.C., died on October 12th, 1940. He was born at Chengtu in China on August 25th, 1907. He was educated at the College of Engineering of the University of Cincinnati, Ohio, and at Queen's University, Kingston, Ont., where he was graduated in civil engineering in 1937. Upon graduation he joined the Hydro Electric Power Commission of Ontario. Mr. Allan entered the Institute as a Student in 1937.

Walter Peck Chapman, M.E.I.C., died at his home in Toronto on October 25th, 1940. He was born at Abbotsley, England, on March 9th, 1857. He came to Canada in 1882, and a year later joined the staff of the Ontario and Quebec Railway. He later filled many responsible and important positions with railways, particularly in Ontario and Quebec, and specialized in bridge construction. He served at various times with the Canadian Pacific Railway, the Guelph Junction Railway, the Grand Trunk Railway and the Canadian National Railways.

Mr. Chapman joined the Institute as an Associate Member in 1889, and he became a Member in 1903. He has been a Life Member since 1926.

Edward Coulthurst Gibbons Chambers, M.C., M.E.I.C., died at Ottawa after a short illness on November 21st, 1940. He was born at Shortlands, Kent, Eng., on June 2nd, 1887, and was educated at Northampton Institute and at the City and Guilds, London. He came to this country as engineer for Langdon-Davies Motors Canada Limited, and was engaged in the installation of electric plants. He then occupied the position of manager for the same firm during three years until he proceeded overseas with the second Field Company, Royal Canadian Engineers, in July 1915. Upon demobilization, Captain Chambers became attached to the Department of National Defence at Ottawa as Adjutant in the Royal Canadian Engineers. In 1925 he was transferred to the headquarters of Military District No. 1 at London, Ont. He became District Engineer Officer, M.D. No. 11, Victoria, B.C., in 1930. In 1936, Lt.-Col. Chambers was appointed assistant director of engineer services in the Department of National Defence at Ottawa. He had lately been appointed director, with the rank of Colonel.

Colonel Chambers joined the Institute as an Associate Member in 1934.

Edward James Owens, M.E.I.C

Edward James Owens, M.E.I.C., died suddenly in Saint John, N.B., on November 8th, 1940. He was born at Fredericton, N.B., on June 12th, 1894 and was educated at the University of New Brunswick where he received the degree of Bachelor of Science in civil engineering in 1915. Upon graduation he spent a few months as a draughtsman and estimator with the Union Foundry and Machine Works at Saint John, N.B. For three years, 1916-1919, he was employed as office engineer with the St. John and Quebec Railway. He occupied the same position in 1919 and 1920 for the Highway Division of the Department of Public Works in New Brunswick. In 1920 he joined the New Brunswick Power Commission as resident engineer. In 1921 he was appointed office engineer, a position which he still occupied at the time of his death, along with that of purchasing agent. For a period of six months in 1923 he acted as chief engineer of the St. John and Quebec Railway, and later was appointed chief engineer.

Mr. Owens joined the Institute as a Junior in 1919 and was transferred to Member in 1925. He was a past-chairman of the Saint John Branch of the Institute, and at the time of his death was secretary-registrar of the Association of Professional Engineers of New Brunswick.

Arthur Cameron Macdonald, D.S.O., M.E.I.C., died at his home in London, Eng., on August 4th, 1940. He was born at Pictou, N.S., on October 25th, 1863, and was educated at the Royal Military College, Kingston, Ont., where he was graduated in 1885. His first appointment was that of a resident engineer on the East Georgia and Florida Railway and later in the same year—1886—he was engaged on the new Croton aqueduct for the water supply of New York. In 1887, he went to Panama for the American Contracting and Dredging Company, remaining until the following year, and, for some eight months, serving as acting chief engineer on this company's contracts in connection with de Lesseps' canal works. His next appointment was in Chile, where he spent the three years, 1889-92 as chief engineer on the location and construction of the Pahlmilla-Alconia Railway and the Huena Piden Railway. This was followed by three years as general manager of the San Agustin Mining Company, at Iquique, a post which he relinquished to become principal assistant engineer on the Huara Direct Nitrate Railway. From 1896 to 1900, he was chief engineer of the Agua Santa Railway and Nitrate Company, Limited, and from 1900 to 1905, of Borax Consolidated, Limited, for whom he explored the borax deposits in the Andes, constructed calcining works on the Bolivian border, and made surveys for two mountain railways.

In 1905, Mr. Macdonald founded the firm of Macdonald, Gibbs and Company, London, Eng., and since that date had been continuously engaged in road, railway and other large constructional works; except for the period of the Great War, when he commanded the 11th Labour Battalion, Royal Engineers, and later became chief engineer of the Albanian Relief Expedition to evacuate the Serbians through Albania, for which service he received the D.S.O. in 1916, and the White Eagle of Serbia. Later he was appointed A.D.F.W. (Aviation), after having been on the H.Q. in France for some months as a consultant.

Among the undertakings carried out under his supervision were the Mejillones and Collahuasi branches of the Antofagasta Railway, involving work at more than 4,800 m. above sea level; the San Pedro and Cerrillos pipe line; many surveys in South America, and for the Halifax and North-Eastern Railway in Nova Scotia; the construction of the Chilian Northern Railway, and, more recently, the surveys for the San Paulo Railway in 1926-27, the construction of the San Paulo-Parana Railway, in 1928-31, the 90 miles road from Bulnes to Concepcion in Chile, and the Mahomet Aly barrage in Egypt, completed about a year ago.

Colonel Macdonald was elected a Member of the Institute in 1898. He was also a member of the Institution of Civil Engineers as well as a Fellow of the Royal Geographical Society.

James Alexander Gordon White, M.E.I.C., died in the hospital at Toronto on November 24th, 1940. He was born at Woodstock, Ont., on August 28th, 1888, and was educated at McGill University where he received the degree of Bachelor of Science in mining in 1911. Upon graduation he went with the Mond Nickel Company where he was employed for two years. In 1913 he joined the staff of the Hydro Electric Power Commission of Ontario as an assistant engineer.

Enlisting shortly after the outbreak of war in 1914, he served continuously until the armistice in 1918. During his service he was awarded the Distinguished Service Order and the Military Cross. At the time of his demobilization he was a major of the Third Brigade of the Second Division.

Returning to Canada, Major White resumed his employment with the Hydro Commission. At the time of his death he was field engineer.

Mr. White joined the Institute as a Student in 1909 and he was transferred to Associate Member in 1920.

Robert Kendrick Palmer, M.E.I.C.

Robert Kendrick Palmer, M.E.I.C., died at his home in Hamilton on November 17th, 1940, after a short illness. He was born at Geneva, N.Y., on January 16th, 1872 and was educated at the University of Michigan where he received the degree of B.Sc. in civil engineering in 1894. Upon graduation he joined the American Bridge Works at Chicago as a draughtsman. During the following two years he was also employed in the same capacity with the New Columbus Bridge Company, Columbus, Ohio, and with the Elmira Bridge Company, Elmira, N.Y. He joined the Hamilton Bridge Works Company at Hamilton, Ont., as a draughtsman in 1896. In 1898 he became a checker, and in 1902 he was appointed chief draughtsman. From 1906-1910 he was designing engineer and in 1910 he was appointed chief engineer, a position which he occupied until a few years ago. At the time of his death he was vice-president in charge of operations in the same firm.

Mr. Palmer joined the Institute as a Member in 1919. He was chairman of the Hamilton Branch of the Institute in its second year of foundation.

COMING MEETINGS

Society of Automotive Engineers—Annual Meeting, Detroit, Jan. 6-10th.

Association of Professional Engineers of the Province of Ontario—Annual general meeting, Royal York Hotel, Toronto, January 18th. Secretary, Walter McKay, 350 Bay St. Toronto, Ont.

American Road Builders' Association—Annual Convention at the Pennsylvanic Hotel, New York City, Jan. 27 to 30th. Director Charles Upham, International Building, Washington, D.C.

American Institute of Electrical Engineers—Winter Convention, Philadelphia, January 27th to 31st.

The Engineering Institute of Canada—Fifty-fifth Annual General and Professional Meeting to be held at Hamilton, Ont., on February 6th to 7th.

American Institute of Mechanical Engineers—Annual Meeting, New York, Engineering Societies Building and Commodore Hotel, February 17th to 20th.

Canadian Institute of Mining and Metallurgy—Annual Meeting, Montreal, March 10th to 12th.

News of the Branches

Activities of the Twenty-five Branches of the Institute and abstracts of papers presented

CALGARY BRANCH

P. F. Peele, m.e.i.c. - *Secretary-Treasurer*
F. A. Brownie, m.e.i.c. - *Branch News Editor*

The first meeting of the Calgary Branch for the 1940-41 season, which was held on October 10th at the Palliser Hotel, was featured by a smoker and social evening. The early part of the programme consisted of a paper **Power Plants in Bolivia,** by Mr. J. K. Sexton of the Montreal Engineering Company which was read by Mr. G. Horspool of the Calgary Power Company. This paper was particularly interesting to the Calgary members in view of the unusual difficulties faced by construction men in Bolivia, which it described. Difficulties of transportation and dearth of the commonly found building materials largely dictate construction methods. The entire absence of roads and railways leads to the use of such local beasts of burden as the llama. This animal apparently introduces certain unique problems of its own and, of course, restricts the use of such bulky materials as cement.

The absence of local timber and even of suitable material for earth fills leads to the extensive use of rock for dams and suitable steel sections for transmission poles.

The paper was well illustrated by slides and was thoroughly enjoyed by the members. At its conclusion refreshments were served and the balance of the evening was spent in a social get-together.

At the second meeting, on October 24th, an informal talk on **Airline Problems** was presented by Mr. W. A. Straight of Trans-Canada Airways. He discussed in general terms the various problems that had to be met in organizing the T.C.A. and how they had been handled. Among the many things which had to be done were the construction of a system of airports and radio range stations, the development of a personnel of radio range operators, dispatchers, pilots trained to navigate on the radio range system and mechanics to work on high speed equipment.

That these problems have been successfully met is attested by the high place occupied by T.C.A. among the airlines of the world.

In connection with the training of a flying personnel, Mr. Straight spoke in the highest terms of the "bush fliers" of northern Canada, a number of whom joined the staff of T.C.A. These men, already noted as highly resourceful pilots, readily adapted themselves to the new technique of operating under modern airline conditions.

The unusually lengthy discussion which followed was evidence of the great interest in Mr. Straight's talk.

Branch Chairman James McMillan presided.

EDMONTON BRANCH

B. W. Pitfield, Jr.e.i.c. - *Secretary-Treasurer*
J. F. McDougall, m.e.i.c. - *Branch News Editor*

The Edmonton Branch of the Engineering Institute held its first regular dinner meeting of the 1940-41 session at the Macdonald Hotel on Friday, October 11th. Chairman E. Nelson, presided. Twenty-five members were present for dinner and several others arrived late to hear the speaker of the evening, Dr. J. M. Thomson.

Dr. Thomson is the vice-president of the Canadian Division of the American Institute of Electrical Engineers and is chief designing engineer of the Ferranti Electric, Limited, Toronto, Ontario.

The title of his address was **The Design and Operation of Instrument Transformers.** By means of slides and charts he explained the uses to which instrument transformers are put and told of the problems that arose in their design.

His paper proved to be one of great interest and after a lengthy discussion period, Mr. W. E. Cornish moved a hearty vote of thanks.

Mr. W. A. Straith, district traffic manager of the Trans-Canada Air Lines, Winnipeg, Man., addressed the second dinner meeting of the 1940-41 session of the Edmonton Branch on October 25th. His topic was **Some Problems in the Establishment of a Modern Air Transportation System.**

The speaker stated that a modern air line is a transportation system built on a sound economic basis.

In the United States, the air lines were built up and made possible by post office contracts. This was not the case in Canada where the early companies were started as local business enterprises. This had the advantage of building sound companies.

A few years ago the Hon. C. D. Howe made a survey of the lines that were operating in the United States. After his study he persuaded Mr. P. G. Johnson of Seattle to come to Canada and to bring a staff of experts with him. Their duties were to advise the Department of Transport on technical matters, to select equipment and to organize and train a group of Canadians to operate the Trans-Canada Air Lines. Mr. Straith was one of the group of experts.

They found that the existing Canadian airports, which had been started as relief projects, were five years out of date.

Previous to the arrival of Mr. Johnson and his staff a route had been surveyed through the Rockies which followed the lowest terrain. The American staff altered this and recommended a route which was actually the shortest possible distance between Vancouver and Lethbridge.

Radio range stations were established along the new route and landing fields designed to the requirements of modern airplanes were constructed. Because it was possible to draw upon American experience and to use the most modern equipment available, the route through the Canadian Rockies is the best protected route in North America.

The effect of the northern lights upon the radio ranges was studied and a frequency was chosen which would permit the most efficient operation of these ranges.

The construction of airports presented a problem, particularly as to runways, for few Canadian engineers had had experience in the construction of proper runway paving. This, coupled with the fact that the minimum length of runway is 3,300 ft. made a difficult problem.

Canadian pilots had to be trained to the art of instrument flying. They had anticipated difficulty in obtaining the co-operation of the pilots in this regard, but it was found that their fears were groundless.

A new meteorological service had to be started, for the existing service had been trained to meet the requirements of the agricultural industry, and their forecasts were of little use to an air line which needed more data. An air line must know what the weather will be like in area of 300 mile radius. It is really surprising how accurate modern forecasts are for an area of this size. The staff found that the meteorological personnel in Canada were very well trained.

Mr. Straith pointed out how every flight was an engineering problem. Before each flight the captain and co-pilot study the weather forecast along their route and decide on the height and manner of the flight. This decision is then given to the dispatcher at the flight's destination and he advises if any changes are necessary. It is necessary for complete agreeement between the land and air crews before the flight is allowed to start.

Crews had also to be trained for the maintenance and handling of high speed equipment.

The problem of co-ordinating the schedules of the Trans-

Canada Air Lines with the existing transportation facilities was handled by the Post Office Department.

The speaker also gave an outline of what the future holds for air travel and mentioned the difficulties that still had to be overcome.

The longest discussion period in recent years followed Mr. Straith's address.

Mr. A. W. Haddow moved a hearty vote of thanks to the speaker. Forty members were present at the meeting, as well as several local air men. Chairman E. Nelson presided.

HALIFAX BRANCH

L. C. Young, M.E.I.C. - *Secretary-Treasurer*
A. G. Mahon, M.E.I.C. - *Branch News Editor*

The October meeting of the Halifax Branch of the Engineering Institute of Canada was held at the Halifax Hotel during the evening of Wednesday, the 23rd, with approximately 50 members and guests in attendance. The feature of the evening was a paper read by Mr. Bernard Allen, chief economist of the Canadian National Railways, entitled **Rugged Individualism in Land Transportation.** This paper dealt mainly with present day competition between railroad and motor transportation throughout the Dominion. The reading of the paper was followed by considerable lively discussion, led by Messrs. W. A. Winfield and C. H. Wright, both of whom questioned certain points put forth by Mr. Allen.

Branch Chairman, S. L. Fultz, was in charge of the meeting, and introduced the speaker.

Mr. R. B. Stewart, president of the Association of Professional Engineers of Nova Scotia, was in attendance and spoke briefly, complimenting Mr. Allen on his paper.

HAMILTON BRANCH

A. R. Hannaford, M.E.I.C. - *Secretary-Treasurer*
W. E. Brown, Jr.E.I.C. - - *Branch News Editor*

Three Hamilton societies joined forces to share a most unusual meeting on the night of November 7th, 1940. 759 members and friends of the Advertising and Sales Club of Hamilton, the Hamilton Group, American Institute of Electrical Engineers and the Hamilton Branch, E.I.C. crowded the ballroom of the Royal Connaught Hotel.

A. Love, chairman of the Hamilton Branch, E.I.C., called the meeting to order and then handed over to D. W. Callander, chairman of the Hamilton Group, A.I.E.E.

Mr. L. B. Chubbuck of the Canadian Westinghouse Company introduced the speaker, Phillips Thomas, Ph.D., of the Research Laboratories of the Westinghouse Electric and Manufacturing Company. His subject was **Electricity at Work.**

The address of Dr. Thomas was unusual in that it was not only a talk but also an actual demonstration of the operation of the various devices which have been conceived in electrical research laboratories.

The speaker demonstrated the use of the photo-electric cell and the equally useful stroboglow lamp by which it is possible to see and examine high speed rotating machinery while in motion. Other devices illustrated were the sterilamp which, by means of ultraviolet radiation will kill germs almost instantaneously. He flashed on the screen the magnified view of ultraviolet radiation in action, killing teeming microscopic life in a drop of water. Striking quicker than lightning, the radiation literally exploded its victims. At one moment you see swarms of tiny orate organisms, known as paramecia, then with a sharp report the sterilamp hurls ultraviolet radiation at the organisms. In less than a thousandth of the time required to blink an eye, they are all dead.

With a model resembling a giant toadstool, Dr. Thomas demonstrated how the 60 ft. "atom smasher" at the Research Laboratories generates its tremendous voltage for bombarding the atom and producing radio-active materials. A direct current generator provided the electrical changes for his miniature "atom smasher."

Using the rays from a flashlight he played a set of chimes on a musical instrument and so demonstrated a possible means of secret communication over short distances for war manoeuvres.

Dr. Thomas also referred to U. 235 and its possibilities as a source of heat and energy if produced commercially. For example, one teaspoonful would heat a home at a constant temperature of 72 deg. F. for 51 winters.

The lecture had to be seen as well as heard to be really appreciated, but more than anything else Dr. Thomas brought to the layman in plain language a conception of what modern electrical research is providing for our every day needs and also the contribution which it is making to our war effort. It was a revelation to the average layman to discover the number and types of ingenuous electrical devices which are now in use.

C. H. Hutton, moved the vote of thanks expressing the meeting's appreciation for a very entertaining evening.

LETHBRIDGE BRANCH

E. A. Lawrence, S.E.I.C. - *Secretary-Treasurer*
A. J. Branch, M.E.I.C. - - *Branch News Editor*

The Lethbridge Branch of The Engineering Institute of Canada held its first meeting of the 1940-41 season at 8 p.m. Wednesday, Oct. 23rd, 1940, in the Marquis Hotel.

The chairman, W. Meldrum, opened the meeting with greetings to members and visitors and expressed his pleasure at the good attendance.

Routine business being deferred till the next general meeting, the chairman called on C. S. Donaldson to introduce the guest speaker, Senator W. A. Buchanan.

Senator Buchanan commenced his address by saying that engineering science, one of the most vital factors in modern warfare, is not appreciated by the layman. The peace time engineering development of the nation becomes exceedingly useful in wartime, making it possible to vastly increase the capacity of industry. Electric power that in peace time was more than ample for all needs may be taxed to capacity in war time. Here the speaker paid tribute to engineering efforts in the war of 1914-18 when it would have been impossible for the Allies to have succeeded without the Engineer. The same thing is true to-day, especially with regard to the nation's air effort, and we may take pride in the fact that men of our own district are gaining distinction in the services to-day; that Lieut. Gen. A. G. L. McNaughton, a Canadian engineer of note, in charge of Canada's forces in Britain, rates even higher in England than in Canada.

As Canadians, we have not fully realized our danger in this war. Britain is our only defence. But there is danger to Canada even if not attacked by Germany for with Germany dominant in Europe there would be no markets for Canada.

The activities of industry both present and future, and our air effort are of paramount importance. Government air engineers chose Alberta on account of its all-round suitability for air training. There was little plane industry in Canada prior to the war. Now this industry is on a basis to supply all demands, even those we may expect after the war. This industry will be turning out 360 planes per month next year. There is a possibility that steel propellers and instruments will be made in Canada. Automotive equipment will be produced at the rate of 600 units per day, and three or four 18-ton tanks per day in the near future.

All mechanical transport will be built in Canada. Chemical industries are expanding, with new factories being built including the manufacture of one new chemical not previously produced. Explosives in large quantities are being produced. It is to be noted that, in spite of very heavy demand, lumber has not greatly increased in price. 350,000 cattle hides have already been used in the making of boots and shoes for the forces.

Canada has been buying machine tools at the rate of $1,000,000 per month; there are 14 shell plants in eastern Canada; field guns, naval guns, and A.A. guns are being made in this Dominion. With $133,000,000 appropriated for the Navy in 1940, the Navy's contribution to industry is enormous; 52 corvettes are being built; Canada's Navy has already made a fine record in this war. It is well to remember that Canada's shipbuilding industry in peace time is bound to increase greatly as Britain will look to Canada after the war for ships and other industrial products.

It is likely that taxation will be greatly increased as the expense of the war effort to Canada is close to $3,000,000 per day and taxes will have to pay most of the cost and it is possible that the cost will increase in the near future.

We can be supremely thankful for the wonderful leadership in the British Empire of Winston Churchill, Prime Minister of Britain, who has spent a lifetime in service to his country and for years tried to arouse the people to a realization of the aims of Germany. It is our duty to stir up public opinion to a realization of the seriousness of this war to every individual in Canada.

N. H. Bradley moved that a vote of thanks be accorded Senator Buchanan for his inspiring address, and this was heartily endorsed by all present.

The meeting closed with the singing of the national anthem.

Refreshments were later served by the staff of the Marquis Hotel.

MONTREAL BRANCH

L. A. Duchastel, m.e.i.c. - *Secretary-Treasurer*

On October 24th, Mr. Allan H. Morgensen, an industrial consultant of considerable fame, addressed the Branch on **Work Simplification as an Aid to Defence.** He discussed the methods of simplifying work processes having in mind the accelerated tempo of Canada's war industries. A courtesy dinner was held at the Windsor Hotel previous to the meeting.

A joint meeting of the Montreal Branch and the Institute of Radio Engineers was held on October 31st, when Mr. Paul A. de Mars spoke on **Observations on Frequency Modulation Broadcasting.**

The meeting was well attended and the discussion could have extended to the early hours of the morning, had it not been stopped by the chairman. A courtesy dinner was also given at the Windsor Hotel before the meeting.

The largest attendance of the season was recorded on November 7th, when over 400 members and guests heard Dr. Phillips Thomas speak on **Electrical Marvels** at the Bell Telephone Auditorium. The talk was demonstrated by a number of unsual and fascinating experiments. A courtesy dinner was held before the meeting.

On November 14th a short business meeting of the Branch was held in order to select members to the Nominating Committee for branch officers for 1941.

Following the business meeting, the members heard Mr. R. Percy Adams talk on the **Montreal Citizens' Committee and the New City Council.**

Junior Section

On October 17th, the Junior Section held its opening meeting of the fall session at which time the chairman of the Branch, Mr. H. J. Vennes, spoke to the young engineers on The Engineering Institute of Canada. Later a film was shown through the courtesy of The Shawinigan Water & Power Company on the construction of the Rapide Blanc hydroelectric development. The evening was well ended by informal discussions, while refreshments were served.

On November 4th, Mr. Jacques Benoit addressed the section on **Chlorine, the Germicide of a Hundred Uses.** The paper was of general interest but dealt especially with the role played by chlorine for sanitation in industry and public utilities.

NIAGARA PENINSULA BRANCH

Geo. E. Griffiths, m.e.i.c. - *Secretary-Treasurer*
C. G. Cline, m.e.i.c. - - - *Branch News Editor*

A joint dinner meeting of the Niagara Peninsula Branch of The Engineering Institute of Canada and the Ontario Chapter of the American Society of Metals was held at the Leonard Hotel, St. Catharines, on November 1st, 1940. Mr. H. Thomasson, vice-chairman, American Society of Metals, presided and there was an attendance of 175.

The programme which followed the dinner started with a motion picture showing the various operations in the manufacture of cold drawn steel, from the smelting of the ore in the blast furnace to the polishing and packing of the finished product. This picture formed an introduction to the paper which followed, given by Mr. Thomas D. Taylor, metallurgical engineer, Bliss and Laughlin, Inc., on the subject: **Cold Drawn Steels and Their Application to Industrial Purposes.** Mr. Taylor described the various grades of cold drawn steel, including bessemer and open hearth carbon steels and alloy steels, discussed their relative suitability for various manufacturing operations, such as machining and case hardening, and mentioned special methods used in the mills to improve the characteristics of various steels. For example, he showed that an increase in the sulphur content of bessemer steel, or the addition of a minute quantity of lead, would make it possible to machine the steel at higher speeds without any serious decrease in its strength. The paper was followed by a discussion in which Mr. Taylor answered numerous questions from the audience.

OTTAWA BRANCH

R. K. Odell, m.e.i.c. - *Secretary-Treasurer*

J. A. McCrory of Montreal, vice-president and chief engineer of the Shawinigan Engineering Company, addressed the branch at the first noon luncheon of the fall series, held at the Château Laurier on November 7, 1940. He spoke on the **LaTuque Development and the St. Maurice River** in Quebec.

Mr. McCrory sketched, with the aid of lantern slides, the main characteristics of the new hydro-electric development and its relation to one of the great power streams of the Dominion. Forty years ago, he remarked, the St. Maurice valley was little more than a wilderness. Aside from a little fur trading and some lumbering, the age-long solitude of the river was unbroken, except at one place.

"For two years a little group of young men, visionaries, their contemporaries called them," he said, "had been persisting in the 'hair-brained' scheme of developing the Shawinigan falls and transmitting the power to Montreal, 90 miles away. They had a contract for 2,000 hp. when, as and if they could deliver it. Their hardest job was convincing anyone with money to invest that this was a good place to invest it. In 1901, to the surprise of everyone except themselves, they actually made delivery of the 2,000 hp. Two years later they were transmitting 4,000 hp. and, while their troubles were not over, they felt they were on the road to success.

"Transmission lines were built to other parts of the province and by 1913 the load had grown to such an extent that another power house had to be built, increasing the installed capacity at Shawinigan to more than 150,000 h.p. This was more than the river could stand. During certain seasons of the year, and at times for a considerable period, the flow of the river dwindled to such an extent that there was hardly enough to run the five turbines in the new power house, to say nothing of the old. There was only one thing to be done and that was to increase the flow.

"Fortunately, the government at Quebec shared their enthusiasm and the Quebec Streams Commission was formed, its first objective being a study of the storage possibilities on the St. Maurice. As a result of their efforts and those of the Shawinigan Company, storage reservoirs have been built that have increased the low flow at Shawinigan Falls from less than 6,000 to more than 20,000 second feet, the installed capacity on the river has reached a total of more than one million horse power and the wilderness of forty years ago has become one of the important industrial centres of the Dominion."

The first comprehensive study of the LaTuque development was made in 1927. During the next ten years, study of some kind connected with the development was being carried on in the field or the office, or the turbine testing plant until the fall of 1937 when the detailed design was begun. The construction of the development was begun in March, 1938, the specified date for completion being set for January 1, 1941.

Mr. McCrory detailed the course of construction and related difficulties due to extensive faulting and other geological considerations.

PETERBOROUGH BRANCH

A. L. Malby, jr.e.i.c. - *Secretary-Treasurer*
E. Whitely, jr.e.i.c.- - *Branch News Editor*

Proving itself a healthy organization, one capable of changing as its members' needs and interests change, the Peterborough Branch tried a new kind of meeting, at the Kawartha Golf and Country Club, Peterborough, on Saturday, October 19th. It was an encouraging success.

The Branch has a large percentage of electrical engineer members very actively engaged now in industry. They find it helps to meet occasionally to discuss their problems and share experience at their E.I.C. meetings. They also have friends, electrical engineers, too, who similarly make up the Toronto Branch of the A.I.E.E. It was reasoned, therefore, that the benefit each group found in its meetings might be greater if both met together once in a while to discuss some common interest.

A joint dinner meeting was arranged to discuss **Glass Fibres as Insulation for Electrical Conductors.** E.I.C. and A.I.E.E. members and guests gathered at the Club until about 2.30 p.m. Most then visited the Peterborough Works of the Canadian General Electric Co. Ltd. The rest could not resist a chance to play the excellent golf course at Kawartha.

All returned by 6.30 p.m. to a fine dinner. No doubt, in part at least, the enjoyment of the evening was due to the fact that the combined organizations swelled the attendance to 109. The customary toast, "Gentlemen, the King!" has an added meaning these days. It was evident that night.

Then tables were removed, chairs were re-arranged, pipes were lit, and the discussion began; supervised by two able chairmen, Mr. D. Geiger of the A.I.E.E. and Mr. R. L. Dobbin of the E.I.C.

A few short papers gave everyone a good background on the subject in hand. Dr. H. S. Bateson (Fiberglas Canada, Limited) described the manufacture of glass fibres for insulating wires in cloth, tape or spun form. He also pointed out distinctive properties of this form of insulation. This was well illustrated with slides. Mr. A. R. Jones and Mr. B. Ottewell (both of Canadian General Electric Co. Ltd.) presented an induction motor designer's and a D.C. motor designer's viewpoint. This aspect was carried further by Mr. J. T. Thwaites (Canadian Westinghouse Co. Ltd.) and Mr. W. F. Auld (Lincoln Electric Co. of Canada, Ltd.). The viewpoint of a wire manufacturer was given by Mr. K. M. Clipsham (Canada Wire and Cable Co. Ltd.).

Then followed a very lively general discussion with many members taking part.

The idea of engineering groups co-operating to enhance their contribution to their members is not new everywhere. But it was at Peterborough. Now, everyone is saying, "Why didn't we try it before ?."

SASKATCHEWAN BRANCH

Stewart Young, m.e.i.c. - *Secretary-Treasurer*

A joint meeting of the Saskatchewan Branch, E.I.C., the Association of Professional Engineers and the American Institute of Electrical Engineers, was held in Regina on Saturday evening, November 16, 1940, when a presentation, consisting of a dressing case, was made to J. J. (Joe) White, popular branch secretary and association registrar during the past four years. Flying Officer White is now with the R.C.A.F. Works Department, Winnipeg. Mr. L. A. Thornton made the presentation.

The meeting, with an attendance of sixty, assembled at 5.30 p.m., for a social hour before dinner at 6.30. After the presentation, Prof. W. G. Worcester, University of Saskatchewan, addressed the gathering on **Ceramics and Ceramic Engineering,** illustrating his subject with lantern slides. P. C. Perry was in the chair.

After briefly outlining the scope of ceramics—pottery, glassmaking, enamelware, abrasives, electric and thermal insulation, brick, tile and other building materials—Prof. Worcester stated that all these are produced from nonmetallic or industrial minerals. Of little value within themselves they are made useable by the application of heat.

Ceramic engineering as such is comparatively new; yet the industry itself dates back 4,000 years to the very early manufacture of bricks. Ohio State University was the first to provide a course of training in ceramics until now there are about 150 men graduating each year from several universities in Canada and the United States. A hearty vote of thanks was tendered the speaker on motion of Ben Russell.

SAULT STE. MARIE BRANCH

O. A. Evans, jr.e.i.c. - *Secretary-Treasurer*
N. C. Cowie, jr.e.i.c. - *Branch News Editor*

The Sault Ste. Marie Branch of the Engineering Institute of Canada held its sixth general meeting for the year 1940 on Friday, November 1st, when eighteen members and guests sat down to dinner at 6.45 in the Windsor Hotel grill room. The regular meeting began at 8.00 p.m. with A. E. Pickering in the absence of E. M. Macquarrie, occupying the chair. The minutes of the September meeting were read and adopted. F. Smallwood and L. R. Brown, moved that the bills be paid.

K. G. Ross, in the absence of J. L. Land, explained that no further broadcasts of the Institute's series would be had over the local radio station as the C.B.C. would not permit the re-broadcasting of its talks,

The point raised quite a discussion, some members were of the opinion that we should send a protest to the C.B.C. as its broadcast could not satisfy everyone from the Atlantic to the Pacific. Others were of the opinion that we should have the speeches recorded and handed to the local papers committee for a future meeting.

A. E. Pickering, m.e.i.c., then called for nominations for the nominating committee to pick a slate of officers for the year 1941. On motion of J. C. MacLeod and F. Smallwood, the following were proposed for the nominating committee. L. R. Brown, N. C. Cowie and W. M. Reynolds. A. H. Meldrum moved that the nominations be closed. This was carried.

A. E. Pickering then introduced the speaker of the evening, Paul P. Martin, chairman of the Algoma Travel Bureau. Mr. Martin treated the members to a series of moving pictures depicting the beauty of Algoma. The camera caught the denizens of the forest and stream in their natural haunts. The colouring was excellent in all the pictures which were taken from automobile, canoe, on foot and from an aeroplane.

L. R. Brown thanked the speaker of the evening for his very entertaining programme. On motion of N. C. Cowie the meeting adjourned.

TORONTO BRANCH

J. J. Spence, M.E.I.C. - - *Secretary-Treasurer*
D. D. Whitson, M.E.I.C. - *Branch News Editor*

The first meeting of the Toronto Branch of the Institute for the season 1940-1941 was held in the Debates Room, Hart House, on October 17th, under the branch chairman, Mr. Nicol MacNicol. A capacity attendance of about 200 taxed the accommodation available, and was a most encouraging feature of the meeting, auguring well for the success of the rest of the season. A continuance of such support and interest is earnestly hoped for and will naturally result to the benefit of the branch as a whole.

After brief introductory remarks by the chairman and an outline of the programme for the season given by Mr. H. E. Brandon, vice-chairman, three motion pictures were projected, Mr. R. B. Young and Mr. O. Holden providing illuminating commentaries on each subject as it was shown. Mr. Ross Lemire operated the projector.

The first picture, "Dancing Conductors," was of a strictly technical nature, and was a pictorial record, extending over several years, of the behavior of conductors of various types under certain conditions of loading and wind effect. These latter induce vibratory and wave movements of very considerable extent in the wire or cable. To most of those present it was a revelation that conductor suspended in comparatively short spans could develop as much motion in either the vertical or horizontal planes as was indicated. Instances of movement of as much as 5 ft. horizontally and 16 ft. vertically have been recorded for spans of the order of 600 ft.

The second picture was an exceptionally attractive coloured one, outlining the engineering and construction features of the 44,000 kv. wood pole transmission line between Uchi Mines and Pickle Crow Mines in the district of Patricia, north of Lac Suel and Lake St. Joseph. The photographic excellence of this picture, taken by Mr. Lemire when a member of the engineering staff on the ground, was remarkable.

The third picture was "The Bright Path"—a talking and sound picture produced for the Hydro-Electric Power Commission of Ontario, and outlining in a comprehensive manner the field and activities of the Commission. This also appeared to hold considerable interest for the audience.

Altogether, the evening was very largely a Hydro one, but nevertheless provided subjects of wide and general interest. After the appreciation of the meeting had been suitably expressed by Mr. Sanderson, adjournment was made to the Faculty dining room where refreshments were served.

The second meeting of the Toronto Branch also was held in the Debates Room, Hart House, on November 7th. The Toronto Branch of the American Society of Mechanical Engineers were guests for the evening. Although we did not quite reach the mark established at the first meeting, 85 members and visitors attended. The audience fully enjoyed and understood the talk as was evidenced by the numerous questions asked. The speaker told his story in a clear and understanding way. The working model was the centre of interest after the meeting was adjourned.

After preliminary remarks by the branch chairman, the guest chairman for the evening, Professor Angus, introduced the speaker of the evening. Mr. W. A. Osbourne, from Babcock-Wilcox & Goldie McCulloch Ltd. Mr. Osbourne commenced his engineering career at the School of Science, Toronto, and was president of the Engineering Society in his last year. He later became sales mangager for his present firm in Toronto and is now vice-president of the same company for Canada.

Mr. Osbourne explained that his subject, **Steam Generation**, covered so wide a field that he would confine his remarks particularly to pulverized fuel fired boilers.

The increase in the size of steam driven equipment gave rise to a corresponding increase in steam generator capacity, the trend being to design the generator and prime mover as a unit.

As the limit of coal burning rate on grates, and the practical limit of fuel bed dimensions was approached, a solution to the demand for increased capacity was seen in the burning of pulverized fuel in suspension, thus eliminating the fuel bed and its problems of clinkering and non-uniform combustion.

Naturally, new problems were encountered, and pioneering was confined to large public utilities who were in a position to spend large sums in the necessary development work. In this connection the speaker paid tribute to Mr. John Anderson of Milwaukee, as one of the outstanding figures in the early development, about 1920.

One of the more serious problems was the adherence and accumulation of liquid ash on the inner refractory and tube surfaces. Refractory problems were met by the introduction of water cooled walls in 1928. Furnace design was modified to prevent the formation of slag, and tube-wall bafflers placed to shield the first pass water tubes, from radiant heat so that liquid ash would not build up in the gas passage through the tube stacks.

A series of excellent slides were shown illustrating these features.

The method of ensuring dry steam from the steam drum, by means of diverting the upward flow from the tubes in the drum itself was shown and described.

The course of fuel and air supply was followed, from the ball grinder and preheater to the burner, and the method of control explained; several pictures of modern pulverized coal boiler rooms and their control boards were shown.

Consideration of the coal to be used was stressed as essential in the initial design of this type of steam generator. The furnace design is largely governed by the ash fusion temperature of the fuel.

In general a furnace designed for a low grade fuel with a low fusion temperature, would operate quite satisfactorily with higher grading fuel; the converse, however, does not hold.

The evening was thoroughly enjoyed by all, but the refreshments served at the first meeting were missing and could have been appreciated. We trust that they will be in attendance at the next meeting along with a few of our absentee members. The Toronto Branch appears to be out for one of the best years in its history.

Dr. Berry, when in Winnipeg recently, very much appreciated the interest shown in his visit and the kindly personal welcome he received from members of the local branch of the Institute. A cordial invitation is extended to any members of other branches who might be visiting Toronto, to get in touch with the branch secretary in order that their stay in Toronto may be made more pleasant and interesting.

VANCOUVER BRANCH

T. V. Berry, M.E.I.C. - - *Secretary-Treasurer*
Archie Peebles, M.E.I.C. - *Branch News Editor*

On Wednesday, October 23rd, members and friends of the Vancouver Branch heard addresses on the "King George VI Highway," given by Ernest Smith, assistant district engineer, Provincial Public Works Department, and Past President of the Vancouver Branch of the Institute; and Paul Beavan, surfacing engineer, Provincial Public Works Department.

Mr. Smith, speaking first, stated that the address was to have been delivered by Mr. H. Anderson, district engineer. The latter could not be present, however, and the speaker had kindly agreed to substitute for him.

The King George VI Highway is a new road connecting New Westminster, B.C., with the International Boundary at Blaine, Wash. Its location follows very closely that of the original Semiamho Trail, a wagon road laid out by James Kennedy in 1861. When the first bridge was built across the Fraser river at New Westminster in 1903, traffic became too great for this old road, and the present Pacific highway was built, being established as a provincial highway in 1881. It was paved 18 ft. wide with concrete in 1921 and 1923, and has carried a large volume of traffic up to the present time. The following figures show the rate of increase in traffic over this road:

1913	5,000 vehicles
1918	23,000 "
1920	42,000 "
1925	202,000 "
1939	400,000 "

This rapid growth caused many serious tie-ups at the old bridge when on certain days cars would be lined up for 13 miles waiting to get through the bottle-neck. To relieve this, the new "Patullo Bridge" was built across the Fraser river and opened in 1938. This is a high level structure, four lanes wide, giving uninterrupted passage to traffic. To provide a more direct and higher capacity highway from the bridge to the International Boundary, a new right of way 110 ft. wide was laid out. It shortens the distance from 16.61 miles to 14.4, a saving of 2.61 miles. A portion of this distance is over the existing road, which was previously widened to a four lane divided section. The present project, 14.11 miles long, has a maximum grade of 4 per cent (for 7,000 ft.) and maximum curvature of 4 deg. 20 min. These compare with an 11 per cent grade and a 35 deg. curve on the old road. Ultimately it will be a four-lane highway divided by a 5 ft. center strip, but at present is surfaced 22 ft. wide with 5 ft. oiled gravel shoulders. The subgrade is raised from 5 to 7 ft. above ground level using material borrowed from the right of way. Borrow pits are separated from the toe of the embankment by a 20 ft. berm. Culverts are of reinforced concrete and the three small bridges on the project are of composite construction embodying a creosoted timber substructure with a concrete deck and handrail. The deck is 24 ft. wide between wheel guards with a concrete sidewalk on one side. A gravel base 6 in. thick was laid on the subgrade, using crushed and graded gravel of 1¼ in. maximum size. The subsoil consisted of a highly capillary clay soil for a distance of six miles, while another section was 15 to 20 ft. of peat, covered by a thin layer of blue clay. On higher ground sandy soil was found, which made good borrow material. Total excavation for the subgrade amounted to 450,000 cu. yd. and 60,000 cu. yd. of gravel were required for the base course. Local traffic used the road for 11 months before it was paved.

The second speaker, Mr. Beavan, described paving materials and operations. The pavement was hot mixed asphalt laid in two courses on a primed base, and covered by a non-skid seal coat. Owing to the dusty condition of the base course after several months of use, the usual priming asphalt, MC1, could not be used, so a tar product, RT1, was applied cold at the rate of 0.4 gal. per sq. yd. This proved to be very satisfactory and did not pick up or break, even under the heavy traffic of the trucks hauling paving material. The two paving courses were of graded crushed gravel of 1¼ in. maximum size and the equivalent of SC6 asphalt binder. This grade of asphalt has a softening point of 90 deg. C., and is essentially the same as the softer asphalt cements. Mixing was done in New Westminster, and material reached the road surface at about 200 deg. F. Spreading was done by a Jaeger finishing machine, running on wooden side forms spiked down to true line and grade. Each course was rolled following the finishing machine. The asphalt content of the two courses was 2.92 per cent and 3.2 per cent for the bottom and top respectively. The seal coat required 0.2 gal. per sq. yd, of RC4 asphalt, covered with torpedo gravel which was dried and heated, reaching the road at 180 deg. F. This was rolled into the surface, providing an excellent non-skid finish. The quantity of mixed asphalt used was 1,760 tons.

A center line of Spectrolite paint is used, and all curves are marked by 6 ft. 6 in. wooden posts painted white and carrying white reflector buttons on opposite faces. These are set back from the edge of the shoulder, and are very effective in outlining the curves in advance of an approaching driver.

Several plans showing location and cross sections, as well as a sample cut from the pavement, were shown to the audience. Mr. W. O. Scott, vice-chairman of the branch, took the chair, and a vote of thanks was tendered by Mr. P. Buchan.

One of the most successful meetings of this year's programme was held on Monday, November 4, at the Forest Products Laboratory of the University of British Columbia. Mr. Roscoe M. Brown, superintendent of the laboratory, briefly described its organization and work, involving research in the growth and uses of wood, wood testing, wood products, etc. In addition to its research programme, which is used in the preparation of specifications and by industry, the laboratory also answers many industrial queries and does commercial testing of timber and other materials. Equipment for testing includes a 200,000 lb. machine and others of smaller capacity. In its organization, the laboratory operates as a branch of the Dominion Forest Service of the Department of Mines and Resources. Buildings are furnished by the University, and students have access to the laboratory for their work in strength of materials. Divisions of the work include seasoning and utilization of wood, timber mechanics, wood technology and pathology. Procedure is standardized with that of other countries, so that comparative results are obtained.

The principal speaker of the evening was Mr. J. B. Alexander, chief of the Division of Timber Mechanics, who addressed the audience on **The Growth and Structure of Wood—Factors which affect Strength.** Following are a few of the significant facts brought out by the address and the large number of lantern slides which accompanied it. A tree is a product of the air, more than of the soil, inasmuch as only one per cent of the growth is contributed by the latter. When branches and their leaves are no longer able to feed the tree because of lack of sunlight, these branches are bypassed by the sap carrying cells and die off, to be covered over by further growth of the tree and new bark. The fibre structure of wood was illustrated to show the difference between spring and summer wood in appearance, although their composition and cell frameworks are the same. Medullary or pith rays are cell groups at right angles to the main structure and radiating from the pith outwards. These produce the figuring in quarter cut oak, and also they affect the shrinkage of a stick, depending on the method of sawing. The relative percentages of spring and summer wood are important as they control the strength properties. A large percentage of spring wood indicates poor structural qualities, a fact which is incorporated into standard grading rules. Density and strength are also related, summer wood having a higher density.

The strongest material in a tree is found in the outside portion of the two butt logs, while the poorest structural material is in the center of the same portions. Cross grain in lumber is caused by sawing parallel to the pith instead of parallel to the bark, and will vary with the rate of taper in the tree. Spiral grain is an unexplained natural phenomena which seriously impairs the strength. A maximum slope of 1 in 15 is permitted in structural timber. Compression wood is produced when a tree does not stand vertically, and its appearance is similar to that of summer wood. In such logs the pith is off centre, and the material is not suitable for structural use. C.E.S.A. Specifications permit defects which will not impair the strength more than 25 per cent, when compared with that of clear timber.

Shrinkage of wood takes place across the cell walls, and is less in edge cut lumber than in flat grain, probably because of the bracing effect of the medullary ray cells. The strength of green lumber in bending is about one-third that of oven dried material, and in compression is about one-fourth or one-fifth that of dry material. The number of annual rings or yearly icrements of growth per inch influence the strength, and a minimum of six per inch should be allowed in structural grades.

The speaker described and illustrated the common enemies of wood and their effects. Limnoria or sea lice are about the size of a rice grain, and are found in salt water, from which they attack and feed on wood cells, reducing them to a powder. The Teredo or shipworm is hatched in salt water and enters wood when only one one-hundredth of an inch long. They do not feed on wood cellulose but merely use the wood as an habitat and protection for their soft pulpy bodies. By means of a hard spiral shell structure at the head they bore rapidly through timber, the size of the hole increasing with the parasites' growth. They feed on matter contained in sea water, a constant stream of which flows in and out of the bored cavity in the wood. They have been known to reach a diameter of 1⅛ inches, and a length of 12 ft. They are capable in certain waters of destroying timber structures in three years. Their principal point of attack is at the mud line. The termite is common on the Pacific Coast, where in some cities it has caused serious damage to buildings. Its food is wood cellulose, and when present in large numbers it can quickly devour solid timber. It is sometimes referred to as a flying ant as in its cycle of growth it appears with four large wings, in the late summer and early autumn. Wood rot is caused by a fungus which destroys the cell material or cellulose. It is reproduced as a fine dust-like spore, which the wind can easily spread to attack sound timber.

Fortunately, all these enemies of wood can be destroyed and the wood sterilized against attack, by the common processes of injecting preservatives such as creosote, zinc chloride, etc. Sufficient and uniform penetration of the preservative can only be insured through incising and complete pre-fabrication of structural members. Illustrations of timber structures in this process were shown. Following the address, demonstrations were carried out showing samples of wood defects, and the testing of a compression member and specimens of three and five-ply veneer.

The meeting was presided over by C. E. Webb, branch chairman, and a hearty vote of thanks was tendered by Major W. G. Swan. After adjournment, the party was entertained in the Brock Memorial Union building on the campus, where refreshments were served through the courtesy of Mr. J. G. Robson and Mr. T. Wilkinson, president and secretary-manager, respectively, of the B.C. Lumber and Shingle Manufacturers Association. Sixty members and guests were present.

VICTORIA BRANCH

Kenneth Reid, M.E.I.C. - *Secretary-Treasurer*

The Victoria Branch of the Institute held a very interesting general meeting on the evening of Oct. 22nd at Spencer's Dining Room, Victoria, B.C., which was preceded by a dinner. A large number of guests were present on this occasion and many pleasant acquaintances renewed.

Following the dinner and a brief business session the principal speaker of the evening, Mr. Kenneth Moodie of the Provincial Architect's Department presented a most interesting address on the subject, **Fuel and Our Use of It.**

Mr. Moodie referred to the ancient and prehistoric use of fire and its effect on the development and civilization of man from almost a mere brute to his present state. He quoted many authorities to show how exceedingly wasteful our use of the various fuels readily available have been and gave the more common efficiencies of the utilization of heating value, stating that an approximate boiler-furnace efficiency of 84 per cent could be obtained on the better installations to-day as a monthly or yearly average.

The speaker traced the history of the discovery of fuel in its various forms in America after the discovery of that continent, the first discovery of coal to be recorded was in the year 1654 by Nicholas Denys, Governor of Eastern Acadia. The first reference to the finding of coal in the United States was in 1660 by Joliet and Marquette.

Speaking of the future, Mr. Moodie summarized a paper presented by Dr. Ernest Berl at the recent meeting of the American Chemical Society on, "Coal and Oil from Plant Carbohydrates," which stated, "From farms instead of mines and oil wells will come the coal and gasoline of the future." He reviewed the progress being made in the laboratory for the production of crude oil, bituminous coals, asphalts and coke from materials like corn, wood, seaweed, leaves and molasses. It was stated that the process was "rather simple," and that the products have exactly the same properties as the natural products, although the process can not compete in price with crude oil obtained from the ground. All this is in preparation for the not-too-distant future when our natural supplies will be nearing exhaustion.

Following the address by Mr. Moodie the meeting was entertained by the showing of several reels of motion pictures filmed, edited and shown by Mr. Geo. J. Alexander of the British Columbia Department of Fisheries, the principal film being entitled, "British Columbia Salmon from the Sea to the Can." This was an exceptionally fine and interesting film depicting the methods of catching the various species of Pacific salmon, transporting the fish to the many canneries along the coast and the various steps in the preparation and canning in complete detail. The Department and Mr. Alexander deserve to be complimented on the very fine effort in the making of this picture.

Those present took the opportunity to ask Mr. Alexander many questions about the character and habits of the different species of Pacific coast salmon and a great deal of interesting information was brought to light. At the conclusion a very hearty vote of thanks was tendered to both Mr. Moodie and to Mr. Alexander for a most interesting and instructive evening.

Library Notes

Book notes, Additions to the Library of the Engineering Institute, Reviews of New Books and Publications

NEW CANADIAN STANDARDS

The Canadian Engineering Standards Association announces the publication of the revised and new standards mentioned below.

C.E.S.A. No.

C22.2 No. 16-1940—Pull-off Plugs for Electro-thermal Appliances (2nd edition).

C22.2 No. 57-1940—Insulated Conductors for Power-operated Radio Devices.
These two standard specifications come under Part 2 of the Canadian Electrical Code, the requirements of which must be met in order to obtain C.E.S.A. approval of the electrical equipment concerned. The standards were prepared in collaboration with interested manufacturers and industrial associations and are based upon laboratory tests and record in service.
Price 50 cents.

C68 (A)-1940 —Standard Specification for Paper-insulated Lead-covered Cable.
This is the first of a series of specifications covering insulated power cable, which is intended to apply to all sizes and classes of impregnated paper-insulated lead-covered cable used for the transmission and distribution of electrical energy, as customarily installed under average conditions. The specification has been prepared to ensure the manufacture of high quality cables, suitable for operation at the rated voltages given, and represents generally accepted Canadian practice.
Price $1.00.

B 29-1940 —Established Lists of Machine Screws and Square and Hexagon Machine Screw Nuts.
Changes which have developed in the methods of gauging rolled-thread machine screws for commercial purposes, and the advisability of standardizing Canadian and United States practice, have necessitated the revision of the C.E.S.A. Established Lists of Machine Screws and Square and Hexagon Machine Screw Nuts. In the new edition tables cover Class 1, 2, 3 and 4 Screw Thread Fits for both fine and coarse thread series, and an increase in the length of thread of machine screws is specified.
Price 50 cents.

NEW AND REVISED BRITISH STANDARDS

Issued during July, August and September, 1940

B.S. No.

12-1940—Ordinary Portland and Rapid-Hardening Portland Cements (Revision).
The 1931 edition has been completely revised. Figures for rapid-hardening cement are now included and a compression test on cement and sand mortar cubes is given as an alternative to the tensile test.

31-1940—Steel Conduit and Fittings for Electrical Wiring (Revision).
This British Standard covers the construction, dimensions and tests of steel conduits and fittings for electrical wiring.

90-1940—Graphic (Recording or Chart-Recording) Ammeters, Volt-meters Watt-meters, Power-Factor Meters and Frequency Meters (Revision).
In this revision several types of instrument are included for the first time, and the limits of error of previously existing types have been reduced.

185-1940—Glossary of Aeronautical Terms. (Revision).
This issue is a provisional issue of a revision which was in hand when the war commenced. Each section has been reviewed and brought up to date.

587-1940—Motors Starters and Controllers and Resistors Employed Therewith (Revision).
This revision of the 1938 edition contains, amongst other additional features, a mechanical endurance test and an appendix on clearances and creepages for motor control gear.

592-1940—Carbon Steel Castings for Ships and for Marine Engine and General Engineering Purposes (Revision).
This revision of B.S. 592-1935 which also supersedes B.S. 30-1907 Steel Castings for marine purposes and B.S. 5028-1924. Steel Castings for Automobiles, covers steel castings generally. Viz. 28 to 35 tons per square inch, 35 to 40 tons per sq. inch and a non-test grade.

598-1940—Methods for the Sampling and Examination of Bituminous Road Mixtures (Revision).
Includes a modified test for the rapid determination of bitument content and two tentative methods for the recovery of bitumen content.

866-1940—Part 1.—Schedule of Sizes of Tins and Cans for Food Products.
Part 2.—Schedule of Sizes of Tins and Cans for Commodities other than Food Products.
These war emergency standards for tins and cans for British packers in the U.K. for the Home trade are issued with the approval of the Minister of Supply.

889-1940—Flame-proof Electric Lighting Fittings.
Provides for flame-proof electric lighting fittings for use in coal mines and other places where inflammable gas or vapour may be present in the surrounding atmosphere.

902-1940—Methods of Testing Latex, Raw Rubber and Unvulcanised Compounded Rubber.

903-1940—Methods of Testing Vulcanised Rubber.
These methods of testing rubber have been prepared to co-ordinate the methods which appear in the various British Standards for rubber products, and to bring all such methods together in to convenient volumes.

912-1940—Bolted Flame-Proof Cable-Couplers.
For bolted flame-proof cable-couplers, primarily for use in mines, and having properties capable of being used as detachable dividing boxes.

913-1940—Pressure Creosoting of Timber.
All methods of pressure creosoting in general use in this country are referred to and details as to the conditioning of the timber, the pressure treatment and the minimum absorption of creosote to be achieved are given.

914-1940—Laboratory Porcelain.
Tests for Laboratory Porcelain, e.g., appearance, shape, weight, etc., porosity of body and imperfections in glaze (dye test), resistance to heat and sudden change of temperature, constancy of weight and resistance of glaze to high temperature and resistance of glaze to acid and alkali.

915-1940—High Alumina Cement.
This Specification is similar to B.S. 12 except that the compression test on cement and sand mortar cubes is the only strength test included. This test has two main advantages vis a vis the tensile test i.e., the results obtained by different gaugers are more consistent, and the strength of the cement mortar cubes can be related to the strength of concrete made with the same cement.

916-1940—Dimensions of Black Bolts and Nuts (Small Hexagon and Square) B.S. Whitworth and B.S. Fine.
This War Emergency Specification has been prepared to secure the utmost economy in steel consumption and provides for black bolts having heads and nuts smaller than those of the full "Whitworth" dimensions specified in B.S. 28. It covers B.S.W. and B.S.F. black bolts (hexagon and square) from ¼ in. to 6 in. diameter.

917-1940—Terms and Sizes of Envelopes.
This standard provides a glossary of envelope terms divided into two main styles, namely:—Bankers envelopes and pocket envelopes. A list of nominal sizes is also given.

918-1940—Aluminium Bars Containing Small Proportions of Copper and Zinc for General Engineering Purposes.
This war emergency specification provides for the alloy previously covered by Aircraft Specification 2 L.32. The chemical composition and mechanical properties are specified and rolling margins on the bars.

919-1940—Screw Thread Gauge Tolerances.
This War Emergency Specification has been prepared in collaboration with the Ministry of Supply and in co-operation with the National Physical Laboratory to provide for some slight relaxation in the N.P.L. limits for "go" plug gauges and to secure an increase in the useful life of the gauges.
Tolerances are given for plug, ring, and calliper gauges for Whitworth and metric threads up to 6 in. diameter, and B.A. threads down to No. 7.

Copies of these Standards may be obtained at prices quoted from the Canadian Engineering Standards Association, National Research Building, Ottawa, Ont.

BOOK REVIEW

Miscellanea Curiosa Mathematica

Quarterly. Printed for Edward Cave, London. Edited by Francis Holliday. Volume 1, 1749; and Volume 2, 1750, bound together. 498 pp. 9 in. x 7 in. One shilling per quarter.

Reviewed by T. Evans, m.e.i.c.*

"The study of mathematics is of infinite use, even to grown persons." Thus is John Locke quoted in the preface of this volume. The editor of the "Gentleman's Magazine" evidently believed this dictum. Mathematicians had asked him to publish their work but this would have "disgusted the polite and gay, the politician and the patriot, who delight in a very different form of amusement." So he launched the Miscellanea Curiosa Mathematica as a separate journal.

It consists largely of problems "suited to the capacity of beginners, as well as those who have made some proficiency in these speculations." These were solved by correspondents, the "eminent mathematicians" of the title-page. Several solutions to most of the problems are given, somewhat defeating the editor's avowed purpose: "to bring this part of learning into a narrower compass, and so leave more room for cultivating the mind with moral knowledge and virtue."

Anyone whose algebra is a little rusty might enjoy solving exactly this innocent looking question which conveys some of the book's flavour. "A Gent. having a bowling-green whofe length is 275 feet and breadth 206 feet, has a mind to raife the faid green one foot higher by a ditch that he will make round it. Quere the width and depth of the ditch ? Answer: The breadth and depth being supposed equal, they are 7.56214 feet."

None of the original material presented is important in mathematical history but it is all interesting. As an example, a "Bill of Mortality" for London agrees curiously with the American Experience Table from ages 71 to 80. Life expectancy is given as "the number of years which it is an even wager a person will live."

The only direct contributor whose name has survived in mathematical history is Duillier. Over his signature appear four theorems concerning the sun's parallax. De Moivre and Taylor are represented only by translations of part of their earlier Latin writings.

Much space is devoted to instruction in Fluents and Fluxions. One thinks with sympathy of the eagerness with which this rather abstruse explanation was awaited by the readers. Modern calculus texts seem like spoon-feeding by comparison.

British mathematicians of the 18th century have been criticized for retaining the Fluxional notation, thus shutting themselves off from the rapid progress made in Europe with the streamlined calculus of Leibnitz. If the editor and the contributors to this journal may be taken as typical of the English school they were more interested in instruction than in research. They were somewhat less than uninterested in European work, especially that of Leibnitz.

The latter side of the editor's character shines from the pages of this book. He was first and foremost British. "Johann Bernoulli is a boasting mathematical Hector," he wrote, and added a half page of beautiful invective. He also ridiculed another foreigner and exposed his answers "consuming twenty quarto pages" to a simple problem as "far enough from the truth."

This explains the restrictive phrase in the title, "Mathematicians of

> MISCELLANEA CURIOSA
> MATHEMATICA:
>
> OR, THE
>
> Literary Correfpondence of fome eminent Mathematicians in *Great Britain* and *Ireland*.
>
> CONTAINING
>
> A choice Collection of *Mathematical* Essays *and* Dissertations on what is moft valuable and really ufeful,
>
> NOT ONLY IN
>
> Algebra, Trigonometry, The Doctrine of Chances, Astronomy, Chronology, Geometry, | Gunnery, Infinite Series, Fluxions, Fluents, Exponentials, The Quadrature of Curves, &c.
>
> BUT LIKEWISE
>
> A curious Collection of 160 new Problems, with their Solutions, in moft Branches of the Mathematics, fuited to the Capacity of Beginners, as well as thofe who have made fome Proficiency in thefe Speculations:
>
> Volume I.
>
> Illuftrated with Copper Plates.
>
> *LONDON:*
>
> Printed for Edward Cave, at St *John's Gate*, and fold by *J. Fuller* at the *Bible* and *Dove*, in *Ave-mary-Lane*; and by *F. Holliday*, Mafter of the Grammar Free School at *Haughton Park* near *Retford*, *Nottinghamfhire*. M,DCC,XLIX.

Great Britain and Ireland." The only foreigners quoted are de Moivre and Duillier, probably because both resided in England, and Duillier supported Newton in the controversy with Leibnitz.

This volume should interest students of the history of mathematics and anyone in search of mental gymnastics.

**Assistant Superintendent, Montreal Island Power Co., St. Vincent de Paul, Quebec.*

ADDITIONS TO THE LIBRARY

TECHNICAL BOOKS

A.S.M.E. Mechanical Catalog and Directory 1941:

American Society of Mechanical Engineers, New York, 1940. 509 pp. 8½ by 11½ in.

Electric Circuits and Machinery:

By Frederick W. Hehre and George T. Harness, v. 1, Direct Currents. New York, John Wiley & Sons, 1940. 513 pp. illus., 9 by 6 in. $4.50.

Introduction to Abstract Algebra:

By Cyrus Colton MacDuffee. New York, John Wiley & Sons, 1940. 303 pp. 9¼ by 6 in. $4.00.

Sewerage and Sewage Treatment:

By Harold E. Babbitt, 5th ed. New York, John Wiley & Sons, 1940. 648 pp., 9¼ by 6 in., $5.00.

Textbook of Fire Assaying:

By Edward E. Bugbee, 3rd ed., New York, John Wiley & Sons, 1940. 314 pp., 9¼ by 6 in., $3.00.

Treatise on Advanced Calculus:

By Philip Franklin. New York, John Wiley & Sons, 1940. 595 pp., illus., 9¼ by 6 in., $6.00.

Working Heat-Treating and Welding of Steel:

By H. L. Campbell, 2nd ed. New York, John Wiley & Sons, 1940. 230 pp., illus., 9¼ by 6 in., $2.25.

PROCEEDINGS, TRANSACTIONS

Cleveland Institution of Engineers:

Proceedings of the Cleveland Institution of Engineers, Session 1939-40.

Mining Institute of Scotland:

Transactions of the Mining Institute of Scotland, 1940.

New Zealand Institution of Engineers:

Proceedings 1939-40. V. 26.

Society for the Promotion of Engineering Education:

Proceedings of the forty-seventh annual meeting, 1940. V.47.

REPORTS

American Concrete Institute:

A.C.I. Directory 1940.

Canadian Engineering Standards Association:

Established lists of Machine Screws and Square and Hexagon Machine Screw Nuts, B29-1940; Standard Specification for Cast Iron, S61-1940.

Canadian Government Purchasing Standards Committee:

Schedule of methods of testing textiles; specifications for petroleum lubricating oils; specification for aviation fuel; specification for graphite-petrolatum compound for spark plug threads; specification for castor oil for lubrication on aircraft; specification for treated castor oil for lubrication on aircraft.

North-East Coast Institution of Engineers and Shipbuilders:

Foundations of the electrical and mechanical transmission of energy by Prof. W. M. Thornton.

Ohio State University Studies—Engineering Series:

Development of superduty refractories from Ohio, Pennsylvania, and Kentucky Fire Clays by Ralston Russell, Engineering Experiment Station Bulletin No. 105; Photoelastic analysis of two and three-dimensional stress systems by Bernard Fried and Royal Weller, Experiment Station Bulletin No. 106.

Province of Quebec—Bureau of Mines—Geological Surveys:

Risborough-Marlow Area Frontenac County by Carl Faessler, Report No. 3; Lepine Lake Area, Destor Township, Abitibi County, by H. M. Bannerman, Report No. 4; Fortune Lake and Wasa Lake Map-areas Dasserat and Beauchastel Townships by G. S. MacKenzie, Report No. 5.

U.S. Department of Commerce—Building Materials and Structures:

Strength of soft-soldered joints in copper tubing by Arthur R. Maupin and William H. Swanger, Report BMS58.

U.S. Department of the Interior—Bureau of Reclamation:

Boulder Canyon Project final reports—part 7, cement and concrete investigations, bulletin 1, thermal properties of concrete; part 5, technical investigations, bulletin 6, model tests of arch and cantilever elements; part 5, technical investigations, bulletin 5, penstock analysis and stiffener design.

U.S. Department of the Interior—Geological Survey Bulletin:

Manganese deposits at Philipsburg granite County, Montana, 922-G; Tungsten deposits of Boulder County, Colorado, 922-F; Quicksilver deposit at Buckskin Peak National Mining district Humboldt County Nevada, 922-E; Chromite deposits of Grant County, Oregon, 922-D; Transit traverse in Missouri, part 7, Central Missouri 1902-37, 916-G; Transit traverse in Missouri part 5; Southwestern Missouri, 1900-37, 916-E; Transit traverse in Missouri, part 6, Northeastern Missouri, 1900-37, 916-F; Triangulation in Utah, 1871-1934, 913; Subsurface Geology and oil and gas resources of Osage County, Oklahoma, part 4, townships 24 and 25 north ranges 10 and 11 east, 900-D.

U.S. Department of the Interior—Geological Survey Professional Paper:

The gold quartz veins or Grass Valley, California, Paper 194.

U.S. Department of the Interior—Geological Survey Water-Supply: Paper

Hurricane Floods of September, 1938. Paper 867; Natural Water Loss in selected drainage basins, paper 846.

MANUSCRIPT PRESENTED*

Frazil and Anchor Ice:

Data concerning ice by John Murphy. Presented at Meeting of the International Joint Commission at Montreal, October 9th, 1920.

**John Murphy, M.E.I.C., Ottawa, Ont.*

BOOK NOTES

The following notes on new books appear here through the courtesy of the Engineering Societies Library of New York. As yet the books are not in the Institute Library, but inquiries will be welcomed at headquarters, or may be sent direct to the publishers.

AEROPLANE CARBURETTORS, Pt. 1. (Aeroplane Maintenance and Operation Series, Vol. 1.)

Ed. by E. Molloy and E. W. Knott. Chemical Publishing Co., New York, 1940. 124 pp., illus., diagrs., tables, 9 x 6 in., cloth, $2.00.

This volume deals with the maintenance and repair of the more popular types of Hobson aero carburettors, which are used on a large range of British airplane engines. A section is included on the Hobson induction pressure control. The directions are detailed and explicit, and are illustrated by many drawings and photographs.

AEROPLANE INSTRUMENTS, Pt. 1. (Aeroplane Maintenance and Operation Series, Vol. 2.)

LANDINGLEGS, WHEELS and BREAKS. (Aeroplane Maintenance and Operation Series, Vol. 3.)

AIRSCREWS, Pt. 1. (Aeroplane Maintenance and Operation Series, Vol. 4.)

Edited by E. Molloy and E. W. Knott. Chemical Publishing Co., New York, 1940. 132 pp. each, illus., diagrs., charts, tables, 9 x 6 in., cloth, $2.00 each.

These three volumes of a new series on airplane maintenance and operation give careful, thorough descriptions, with many illustrations, of the respective items of equipment listed:

Vol. 2. Aeroplane Instruments (Part I). Deals with the operation and maintenance of the Sperry gyropilot, Sperry aircraft instruments and Smith's aircraft instruments.

Vol. 3. Landing Legs, Wheels and Brakes. Deals with the maintenance and repair of various commercial types of landing equipment including landing legs, shock absorbers, tail-wheel units, brakes and tires.

Vol. 4. Airscrews (Part I). Deals with the maintenance and repair of the de Havilland controllable-pitch airscrews and hydromatic airscrews.

AIRCRAFT YEAR BOOK for 1940, 22nd ed.

Edited by H. Mingos. Aeronautical Chamber of Commerce of America, New York, 1940. 532 pp., illus., diagrs., maps, charts, tables, 9 x 6 in., cloth, $5.00.

This annual provides a record of developments in aviation during the past year, both at home and abroad. The work of the army and navy, the activities of the various Federal agencies and commercial firms are reviewed. Chapters are devoted to the present war, air lines, private flying, airports, training and other fields of interest. The book includes tables of aircraft specifications, descriptions of aircraft and engine designs, a chronology of events and records, an aeronautical directory, and statistics of the industry.

APPLICATIONS of CHEMICAL ENGINEERING

Edited by H. McCormack. D. Van Nostrand Co., New York, 1940. 431 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $3.75.

This textbook contains detailed directions for a series of laboratory procedures upon selected unit operations of chemical engineering, prepared by a committee of the Society for the Promotion of Engineering Education. Measurement of temperature, Flow of fluids and of heat, Evaporation, Distillation, Drying of Solids, Humidification and dehumidification, Gas absorption, Filtration, Classification and concentration of solids and Size reduction are the operations covered, seventy-five experiments being presented. Each division has a brief bibliography.

BUILDING ESTIMATOR'S REFERENCE BOOK

1701 pp., 6½ x 4 in., $10.00 Vest Pocket Estimator. 220 pp., 5½ x 2½ in., free with Building Estimator's Reference Book. By F. R. Walker. 9th ed. Frank R. Walker Co., Chicago, 1940. Illus., diagrs., charts, tables.

A comprehensive treatment of all the various items which may be required for the accurate estimation of a contracting job. Beginning with the general question of preparing a properly safeguarded estimate, the book discusses overhead expenses, and then continues with detailed information as to materials, costs, equipment and labor for everything from excavation to small hardware. A special feature is the illustrative set-ups of cost calculations, into which can be inserted local prices and costs. Condensed estimating information is found in the "Vest-Pocket Estimator," which accompanies the main volume.

CHEMISTRY IN THE SERVICE OF MAN

By A. Findlay. 5 ed. Longmans, Green & Co., New York and London, 1939. 398 pp., illus., diagrs., charts, tables, 8 x 5 in., cloth, $2.50.

The author's aim is to present a readily intelligible account of some of the more important general principles and theories of chemical science and of their intustrial applications. Among the topics considered are radioactivity, combustion, cellulose, catalysis, fertilisers, electrolysis, colloids and fermentation. The present edition has been revised and enlarged to cover developments within the last decade.

COAL MINE MODERNIZATION 1940 YEAR BOOK

Published by the American Mining Congress, Washington, D.C., 1940. 381 pp., illus., diagrs., charts, maps, tables, 9 x 6 in., cloth, $2.00, (5 to 9 copies, $1.75 each).

This volume contains the papers, discussions and committee reports presented at the seventeenth annual coal convention. A wide range of topics is discussed, including face and surface preparation, loading and conveying machinery, stripping practice, maintenance of equipment, safety and economic questions.

CONCRETE DESIGN AND CONSTRUCTION

By W. H. Gibson and W. L. Webb. American Technical Society, Chicago, Ill., 1940. 500 pp., illus., diagrs., charts, tables, 8½ x 5½ in., cloth, $4.75.

This textbook aims to provide a simple, concise treatment covering the composition and properties of concrete, the general theory and design of slabs, beams, columns, etc., and the mixing, transporting and placing of concrete. Only simple mathematical knowledge is required.

DESIGN OF CONCRETE STRUCTURES

By L. C. Urquhart and C. E. O'Rourke. 4 ed. McGraw-Hill Book Co., New York and London, 1940. 564 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.50.

The aim of the authors is to provide a text on concrete and reinforced concrete for both elementary and more advanced courses in engineering schools. The theory of concrete design is sufficiently developed to give the beginner a thorough understanding of the fundamentals. Complete designs of the commoner structures are given, to bring together all the fundamental theory involved. The new edition has been revised in accordance with current practice, and all tables and diagrams have been collected in an appendix for easier reference.

(The) DETECTION AND IDENTIFICATION OF WAR GASES. Notes for the Use of Gas Identification Officers. Ministry of Home Security, Air Raid Precautions Department, London.

First American Edition, Chemical Publishing Co., New York, 1940. 53 pp., tables, 9 x 5½ in., cloth, $1.50.

A brief discussion of the general properties of war gases precedes specific information about the physical and chemical properties of the important types. Principles and methods of gas detection and chemical identification are concisely presented, and the duties, responsibilities and equipment of gas identification officers are described.

ELECTRICAL CIRCUITS AND MACHINERY. Vol. 1. Direct Currents.

By F. W. Hehre and G. T. Harness. John Wiley & Sons, New York, 1940. 513 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.50.

This book is volume one of a two-volume treatment of Electric Circuits and Machinery, which is offered as a successor to the textbook with that title written by Morecroft and Hehre in 1933. Like its predecessor, it is intended as a general text for non-electrical engineering students and as an introductory text for students of electrical engineering; but the new work is, the authors say, much more than a revision of the former one. The present volume contains a chapter on electronics. Many problems are also given.

ELECTRICAL ENGINEERING LABORATORY EXPERIMENTS

By C. W. Ricker and C. E. Tucker. 4 ed. McGraw-Hill Book Co., New York and

London, 1940. 458 pp., diagrs., charts, tables, 9 x 6 in., cloth, $3.00.

This well-known guide to experimental work has again been revised to bring it closer to the present state of the art. Seventy experiments are included, with accounts of the theory involved and the procedure necessary to obtain certain desired results. The book has been considerably expanded.

ENGINEERING MECHANICS

By S. Timoshenko and D. H. Young. 2 ed. McGraw-Hill Book Co., New York and London, 1940. 523 pp., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

In this new one-volume edition, covering both statics and dynamics, the necessary reduction was accomplished by rewriting certain sections and omitting the more specialized discussions. The statics section contains general considerations of plane forces and space forces with a chapter on the principle of virtual displacements. Rectilinear and curvilinear translations and the motions of a rigid body were discussed in the dynamics section, including a short chapter on relative motion. Special attention has been given to selection of the problems with respect to their practical value.

FRENCH-ENGLISH SCIENCE DICTIONARY for Students in Agricultural, Biological and Physical Sciences.

By L. De Vries. McGraw-Hill Book Co., New York, 1940. 546 pp., 7 x 5 in., fabrikoid, $3.50.

This compact dictionary contains 43,000 scientific terms with the English equivalents. While intended to meet the needs of students of agriculture, biology and physics, it will be very useful to students and translators in any field of science, and is a welcome addition to the limited number of modern French-English dictionaries.

FUNCTIONS OF THE ALLOYING ELEMENTS IN STEEL

By Dr. E. C. Bain. American Society for Metals, Cleveland, Ohio, 1939. 312 pp., illus., charts, tables, 9 x 6 in., cloth, $4.00.

A series of lectures presented before the American Society for Metals is published in this volume. The topics of the five lectures are: the fundamental characteristics of steels; alloying elements in unhardened steels; effects of alloying elements in forming austenite; effects of the elements in hardening steel; effects of alloying elements in tempering. There are many illustrative graphs and diagrams.

GEOMAGNETISM, 2 Vols.

By S. Chapman and J. Bartels. Oxford University Press, New York; Clarendon Press, Oxford, England, 1940. 1049 pp., diagrs., charts, tables, 9½ x 6½ in., cloth $18.00.

This book aims to fill the need for a comprehensive modern treatise on geomagnetism, which will provide workers in that field and such related subjects as cosmic-ray physics, geophysical prospecting and radio communication, with an account of our present knowledge. Volume one gives a detailed description of the observed facts of geomagnetism and the ways in which they are measured, together with brief accounts of lunar and solar motions, the properties of the sun's atmosphere, earth currents, the aurora, the earth's upper atmosphere and magnetic prospecting. Volume two discusses the analysis and synthesis of geomagnetic data and the physical theories which attempt to explain the facts. A large bibliography is appended.

GEOPHYSICAL PROSPECTING FOR OIL

By L. L. Nettleton. McGraw-Hill Book Co., New York, 1940. 444 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $5.00.

While there is a voluminous periodical literature upon the subject, this appears to be the first work to give a connected presentation, in a single volume, of the principles and practice of modern oil prospecting by geophysical methods. The presentation is intended for students or lay readers, rather than for specialists, and the subject matter selected and its presentation are based upon the wide practical experience in the use of geophysical methods. Gravitational, magnetic and seismic methods are discussed at length. Electrical prospecting and well-logging methods, miscellaneous prospecting methods and operations in wells are described briefly. A section is devoted to interpretation of geophysical surveys.

Great Britain, Dept. of Scientific and Industrial Research. REPORT OF THE BUILDING RESEARCH BOARD for the Year 1939

His Majesty's Stationery Office, London, 1940. 60 pp., diagrs., tables, 10 x 6 in., paper (obtainable from British Library of Information, 50 Rockefeller Plaza, New York, $.30).

The report reviews the various investigations carried out in Great Britain during the year and affords a general survey of current research work in the building field. Appendices list the members of the staff and technical committees and also all publications of the year.

Great Britain, Dept. of Scientific and Industrial Research. BUILDING RESEARCH Technical Paper No. 21. STUDIES IN REINFORCED CONCRETE, IV. Further Investigations on the Creep or Flow of Concrete Under Load

By W. H. Glanville and F. G. Thomas, His Majesty's Stationery Office, London, 1939. 44 pp., illus., diagrs., charts, tables, 9½ x 6 in., paper, 1s. (obtainable from British Library of Information, 50 Rockefeller Plaza, New York, $.30).

Continuing the work presented in Technical Paper No. 12, results are given from further investigation of prolonged loading tests on small cylinders of plain concrete and on reinforced concrete columns. The scope of the investigation has been widened to include creep in pure tension, lateral movements under compression and the effect of creep on the deformation and ultimate strength of reinforced-concrete beams. An example from practice of the movements resulting from shrinkage and creep is included.

Great Britain, Dept. of Scientific and Industrial Research, BUILDING RESEARCH.

WARTIME BUILDING BULLETIN No. 4. Supplementary Type Designs in Structural Steelwork for Single Storey Factories. 19 pp.

WARTIME BUILDING BULLETIN No. 5. Economical Type Designs in Reinforced Concrete for Single Storey Factories. 13 pp.

WARTIME BUILDING BULLETIN No. 6. Pt. 1. Arch Construction Without Centering. 9 pp.; Pt. 2. Further Designs for Hut Type Buildings.

His Majesty's Stationery Office, London, 1940. illus., diagrs., tables, 11 x 8½ in., paper (obtainable from British Library of Information, 50 Rockefeller Plaza, New York, $.30 each).

Continuing the series of bulletins on wartime construction, the following information is given:

Bull. No. 4. Supplementary steelwork roof types particularly designed to facilitate camouflage are described.

Bull. No. 5. Type designs are given to illustrate the application of the broad principles of the use of reinforced concrete in wartime building (Bull. No. 2) to the problem of the one-storey factory.

Bull. No. 6. A centerless arch type of concrete-block construction for a span of 20 feet or less is described, and further diagrams of hut type buildings with applications to multiple span structures are given.

Great Britain, Dept. of Scientific and Industrial Research, BUILDING RESEARCH.

WARTIME BUILDING BULLETIN No. 8.

His Majesty's Stationery Office, London, 1940. 16 pp., diagrs., charts, 11 x 8½ in., paper, 1s. (obtainable from British Library of Information, 50 Rockefeller Plaza, New York, $.30).

This one of a series of bulletins on wartime building construction is devoted to factory buildings. Designs are given for walls, columns, tubular steel trusses and purlins, and heating and ventilating systems for one-story structures of economical design.

HISTORY OF THE COLT REVOLVER and the Other Arms Made by Colt's Patent Fire Arms Manufacturing Company from 1836 to 1940.

By C. T. Haven and F. A. Belden, with a foreword by S. V. Grancsay. William Morrow & Co., New York, 1940. 711 pp., illus., diagrs., tables, 11 x 8 in., cloth, $10.00.

This handsome volume is an authoritative account of the invention and development of the Colt revolver, based upon the records of the Company and other students and upon study of the revolvers themselves. The book includes a history of all Colt models, a complete list of all Colt revolvers prior to the twentieth century; a collection of letters, price lists, advertisements and other documents relating to their manufacture; and facsimiles of patents from 1836 to 1880. There are 163 halftone illustrations of Colt arms, as well as many other illustrations. The book will be welcomed by all collectors of fire arms and students of their history.

ILLUMINATION ENGINEERING

By E. W. Schilling. International Textbook Co., Scranton, Pa., 1940. 294 pp., illus., diagrs., charts, tables, 8½ x 5 in., lea., $2.75.

This elementary textbook is intended as a survey course for those who will go no further in the subject, as well as an introductory course for students specializing in illumination, and therefore covers considerable range. In addition to fundamental theory and calculations, practical information is given on interior, street and sports lighting, ultraviolet light and vapor lamps. There is a section of laboratory experiments, and problems and references accompany each chapter.

INSTALLATION AND MAINTENANCE OF ELECTRIC MOTORS. (Electrical Engineer Series, Vol. 3)

Edited by E. Molloy. Chemical Publishing Co., New York, 1940. 180 pp., illus., diagrs., charts, tables, 8 x 5 in., cloth, $2.00.

The installation and maintenance of both small and large electric motors are described in a clear, concise manner, treating both mechanical and electrical features. There are many starter wiring-diagrams among the numerous illustrations.

KINEMATICS OF MACHINES

By G. L. Guillet. 4 ed. John Wiley & Sons, New York, 1940. 300 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, $3.00.

Fundamental mathematical analyses and useful graphical constructions of motions in machines are presented in this elementary college textbook. The subject material has been selected with regard to the students' previous knowledge and the time allowed for the course. There is a group of drafting-room problems, and a set of review questions accompanies each chapter.

PRELIMINARY NOTICE

of Applications for Admission and for Transfer

December 2nd, 1940

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

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

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

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

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

The Council will consider the applications herein described in January, 1941.

L. Austin Wright, General Secretary.

*The professional requirements are as follows:—

A 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 attainment 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

AIN—JOSEPH, of 4309 St. Urbain St., Montreal, Que. Born at Swiswer, Poland, Dec. 1st, 1912; Educ.: B.Eng. (Civil), McGill Univ., 1939; 1930-35, electrician, Montreal Tramways; Summer work: estimating & supervision of residential bldgs. for bldg. contractors, also with Topog'l. Surveys of Canada; at present, instr'man., airport constrn., Dept. of Transport, Montreal, Que.

References—R. F. Dore, E. Brown, R. DeL. French, J. Weir, G. J. Dodd, F. J. Leduc, P. P. Lecointe.

CRANDALL—SEYMOUR ARNOLD, of 3 Granite St., Copper Cliff, Ont., Born at Kellogg, Idaho, U.S.A., Oct. 7th, 1919; Educ.: B.S. in Mining, Michigan College of Mining; 1936-39 (summers), rodman, junior instr'man., sampler, and surveyor, International Nickel Co. of Canada; 1940 (summer), asst. geologist, Nfld. Geol. Survey; At present, mucker, Creighton Mine, International Nickel Co. of Canada, Ltd., Copper Cliff.

References C. O. Maddock, J. F. Robertson, R. L. Peek, W. J. Ripley, F. A. Orange.

DIXON—WELLINGTON, of 2050 Claremont Ave., Westmount, Que. Born at Wallsend-on-Tyne, England, May 23rd, 1894; Educ.: 1910-15, Wallsend Technical School. 1910-15, ap'ticeship, and 1915-22, dftsman., Wallsend Slipway & Engineering Co.; 1924-31, elect'l. dftsman., and 1931 to date, asst. to elect'l. engr., Harbour Commissioners of Montreal, now National Harbours Board.

References—P. L. Pratley, I. S. Patterson, G. Gillett, A. Ferguson, J. P. Leclaire, G. R. Dalkin, H. S. Spark.

HAYHURST—WILLIAM JAMES, of Hamilton, Ont. Born at Hamilton, Sept. 1st, 1909; Educ.: 1929-31, Queen's Univ.; 1925-26, asst. to O. R. Blandy, O.L.S., City Hall, Hamilton; 1927, instr'man., T. & N.O. Rly.; 1928-29, asst. engr., Toronto, Hamilton & Buffalo Rly.; 1930, asst. to chief engr., Abitibi Power & Paper Co., power dam, Abitibi Canyon; 1931-32, asst. engr., Toronto, Hamilton & Buffalo Rly.; 1933-37, business life; 1937-38, layout engr., Ford Body Plant, Windsor, Ont.; 1938, asst. supt., Canadian Steel Corporation, Windsor; 1938 to date, plant inspr. (asst. to works mgr. in engrg. capacity), Frost Steel and Wire Co., Hamilton, Ont.

References—A. F. White, F. R. Leadlay, V. S. Thompson, A. R. Hannaford, J. P. Gordon.

LeBEL—PAUL, of Montreal, Que. Born at Montreal, June 25th, 1902; Educ.: B.A.Sc., Chem. & Civil Engr., Ecole Polytechnique, Montreal, 1926; R.P.E. of Que.; 1926 to date, with the Imperial Oil Refineries Ltd., Montreal East, Que., as follows: 1926-28, chemical work in lab.; 1928-31, i/c of certain refining operations; 1931-34, asst. chief chemist; and 1934 to date, technical service, as consltg. engr. to customers.

References—F. C. Mechin, J. A. Lalonde, E. Gohier, L. Perrault, A. Circe, J. A. Beauchemin, J. P. Lalonde.

LLOYD—WARREN G., of Toronto, Ont. Born at Hamilton, Ont., August 27th, 1902; Educ.: B.A.Sc., Univ. of Toronto, 1925; R.P.E. of Ont.; 1922-23, student course, Canadian Westinghouse Co.; with the Bell Telephone Company of Canada from 1925 to date—1930-31, divn. toll engr., 1932, divn. plant engr., 1933-38, district plant engr., and 1938 to date, divn. plant engr., western division.

References—L. G. Buck, J. E. McKinney, D. G. Geiger, G. H. Rogers, A. M. Reid.

METCALF—NEIL, of 50 Paisley Ave. North, Hamilton, Ont. Born at Bury, Lancs., England, Sept. 19th, 1899; Educ.: B.Sc., Univ. of Wales, 1925; 1919-24, gen. engrg. shops and steel plant training, pattern shop, foundry, machine shops, drawing office, laboratory, blast furnaces and steel plant, Ebbw Vale Steel Iron and Coal Co. Ltd. (partly dovetailed with Univ. training); 1925-26, open hearth melting shops, Guest, Keen and Nettlefolds Ltd., Cardiff, Wales; 1926-27, asst. metallurgist, Ford Motor Co., Manchester, England; 1927-28, open hearth and electric furnace melting shops, Ford Motor Co., Detroit, Mich.; 1928-36, chief metallurgist, Treadwell Engr. Co., Easton, Pa.; 1936 to date, chief metallurgist, Burlington Steel Co. Ltd., Hamilton, Ont.

References—N. A. Eager, W. L. McFaul, J. R. Dunbar, A. Love, E. M. Whitby, H. A. Cooch.

McCAVOUR—SAMUEL THOMAS, of 1416 Cuthbertson Place, Fort William, Ont. Born at Saint John, N.B., Aug. 9th, 1899; Educ.: B.Sc.(C.E.), Univ. of N.B., 1920; 1920 (summer), designing engr., American Bridge Co.; 1920-21, designing engr., Brompton Pulp & Paper Co., East Angus, Que.; 1921-23, asst. engr., Fort Francis Pulp & Paper Co., Fort Francis, Ont.; 1923 (Mar.-Nov.), asst. engr., E. H. Hussey, Consltg. Engr., Minneapolis, Minn.; 1923-25, res. engr., Backus Brooks Co., Kenora; 1925-29, res. engr., Kenora Paper Mills Ltd., Kenora; 1929-31, res. engr. with above company and the Great Lakes Paper Co. Ltd.; 1931 to date, chief engr. & joint manager, Great Lakes Paper Co. Ltd., Fort William, Ont.

References—R. B. Chandler, P. E. Doncaster, H. G. O'Leary, G. R. Duncan, S. L. Flook, E. L. Goodall, R. J. Askin.

PACKARD—ROYAL DAY, of La Tuque, Que. Born at Willimantic, Maine, July 14th, 1902; Educ.: S.B., Mass. Inst. Tech., 1926; 1926-27, junior asst. engr., Sanitary District of Chicago; 1927 to date, with the Brown Corporation as follows: 1927-29, dftsman., 1929-31, i/c of design, 1931-33, i/c of mtce., 1933-39, i/c of design, including development work and one year i/c steam plant operation, and 1939, i/c of all design, constrn. and mtce., except electrical, and at present, chief engr.

References—J. W. H. Ford, G. Rinfret, H. J. Racey, C. Luscombe, J. Asselin.

PHILLIPS—SIDNEY, Niagara Falls, Ont. Born at Chelsfield, Kent, England, June 24th, 1902; Educ.: 1st Class Diploma, Faraday House Electrical Engrg. College, 1922. Assoc. Member, Inst. E.E. (London); 1919-22, student work with Clement Talbot, London, Charing Cross City & West End Elec. Co., City of York Electric Lighting & Tramway Stn.; 1923-28, asst. elect'l. engr., and 1928-40, chief elect'l. engr., Lobitos Oilfields, Talara, Peru.

References—G. E. Kent, B. P. Rapley.

RAHILLY—THOMAS FRANCIS, Jr., of Sault Ste. Marie, Ont. Born at Sault Ste. Marie, April 8th, 1916; Educ.: B.Sc. (Mech.), Queen's Univ., 1939; with the Algoma Steel Corporation Ltd., Sault Ste. Marie, as follows: Summers 1935-38, junior engr., fuel office, steel moulder's helper, fitter's helper, repairman's helper and dftsman; 1939-40, asst. master mechanic, and Mar. 1940 to date, master mechanic.

References—J. S. Macleod, A. E. Pickering, K. G. Ross, F. Smallwood, C. Stenbol.

FOR TRANSFER FROM JUNIOR

BOOTH—KEITH ALEXANDER, of Kenogami, Que. Born at Austin, Man., June 15th, 1907; Educ.: B.Sc. (E.E.), Univ. of Man., 1934. B.Eng. (Mech.), McGill Univ., 1936; 1929, dfting., H.E.P.C. of Ont.; 1936-37, operating records clerk, and 1937 to date, engr. in charge of the operating records dept., Price Bros. & Co. Ltd., Kenogami, Que. (Steam calculations and black pile surveys). (St. 1936, Jr. 1938).

References—J. Shanly, G. F. Layne, A. Cunningham, J. W. Gathercole, N. D. Paine.

HENSON—GEORGE STANLEY GORDON, of 172 Edmonton St., Winnipeg, Man. Born at Winnipeg, June 12th, 1912; Educ.: B.Sc.(E.E.), Univ. of Man., 1935; 1926-32 (summers), constrn. work with Canadian Engineering & Construction Co. Ltd.; with the Winnipeg Electric Company as follows: 1934 (summer), water heater inspr., 1935 (summer), pole inspr., 1935-36, dftsman, 1936, engr. inspr. underpinning work, Dec. 1936 to date, asst. engr., real estate, taxes and insurance dept., (Jr. 1937).

References—F. F. Griffin, E. V. Caton, C. P. Haltalin, L. M. Hovey, D. M. Stephens.

LAMOUREUX—MARCEL, of 195 Augusta St., Ottawa, Ont. Born at St. Jean d'Iberville, Que., Oct. 7th, 1906; Educ.: B.Eng., McGill Univ., 1932; 1928-31 (summers), surveying, mining prospecting, etc.; 1933-34, asst. field engr., Corpn. of the Lake St. Louis Bridge; 1934-35, streams surveys, Quebec Streams Commn.; 1935-36, suptg. engr. for road contractor, Raymond & McDonnel & Co.; 1936, Quebec Provincial Relief Dept., technical work; with Dept. of Public Works of Canada as follows: 1936-37, junior engr. (temp.), 1937-38, asst. engr. (temp.), 1938, junior engr. (temp.), and Sept. 1938 to date, asst. engr. (perm.), Ottawa District. (Jr. 1934).

References—J. A. Beauchemin, R. DeL. French, O. O. Lefebvre, J. E. St. Laurent, E. Viens.

POOLER—GILBERT DOUGLAS, of 77 Gloucester St., Ottawa, Ont. Born at Ottawa, Aug. 13th, 1906; Educ.: B.Sc., Queen's Univ., 1929; 1926-27 (summers), Ottawa Car Co.; 1928-30 (summers), Flying training, R.C.A.F.; 1929-30, asst. engr., Dept. of Rlys. & Canals; 1935 (Jan.-July), examiner, inspection dept., Fairchild Aircraft; 1935 (Oct.-Dec.), steam plant, Price Bros. & Co. Ltd., Riverbend, Que.; 1935-36, stores officer, R.C.A.F., Camp Borden, Ont.; 1939-40, mech. dftsman., Dept. National Defence, Ottawa; Aug. 1940 to date, asst. inspr., arms inspection br., Dept. of National Defence, Ottawa, Ont. (St. 1928, Jr. 1937).

References—H. S. Rees, J. H. Parkin, L. O'T. Cooper, A. Ferrier, R. K. Odell.

SEELY—WALLACE ERROL, of 1463 Mansfield St., Montreal, Que. Born at Saint John, N.B., March 19th, 1906; Educ.: B.Sc. (C.E.), Univ. of N.B., 1930; 1930 (Feb.-May), detailer, Dominion Bridge Co., Lachine; 1930-31, bldg. inspr., C.N.R.; 1937 (June-Sept.), field engr., Ontario Paper Co., Baie Comeau; 1939, engr. supt., A. F. Byers & Co., field engr., Marine Industries Ltd., engr. supt., E. G. M. Cape & Co.; 1940, constrn. engr., Howard Smith Paper Mills, Beauharnois, field engr., Foundation Co. of Canada, engr., E. G. M. Cape & Co., asst. supervising engr., Anglin-Norcross Quebec, Ltd.; Sept. 1940 to date, junior engr., Air Force, Dept. of National Defence, Montreal, Que. (St. 1929, Jr. 1935).

References—J. B. Stirling, P. G. Gauthier, C. R. Lindsey, J. Stephens, E. O. Turner.

WILSON—THOMAS WHITESIDE, of Petawawa, Ont. Born at Peterborough, Ont., Nov. 7th, 1906; Educ.: B.A.Sc., Univ. of Toronto, 1933; 1928-31 (summers), rodman, D.P.H.O., engrg. staff, Falconbridge Nickel Mines, gen. road constrn. work; 1933, engr. with Municipal Contracting Co.; 1933-37, asst. mgr., mtce. dept., T. Eaton Co. Ltd.; 1937-40, Ontario representative, Engineering and Contract Record; at present, Lieut., R.C.E., Petawawa Camp, Ont. (St. 1932, Jr. 1938).

References—C. R. Young, R. E. Smythe, T. R. Loudon, J. G. Moloney, W. S. Wilson, H. A. McKay.

FOR TRANSFER FROM THE CLASS OF STUDENT

ANSLEY—FRED C., of 826 Argyle Road, Windsor, Ont. Born at Ramsgate, England, June 10th, 1908; Educ.: B.Sc., Queen's Univ., 1937; 1927-37, gen. bldg. constrn.; 1937 to date, field engrg., Ford Motor Co. of Canada, Ltd., Windsor, Ont. (St. 1937).

References—J. E. Porter, B. Candlish, C. G. Walton, H. S. Clark, G. W. Lusby.

BROWN—ERNEST F., of Ottawa, Ont. Born at Montreal, Jan. 22nd, 1911; Educ.: B.Eng. (Mech.), McGill Univ., 1935; 1935-36 dftsman. & designer, Northern Foundry & Machine Co. Ltd., Sault Ste. Marie; 1936-39, dftsman., designer, estimator, Dominion Bridge Co. Ltd., Lachine; Oct. 1939 to date, junior mech. engr., Dept. of Finance, Royal Canadian Mint, Ottawa, Ont. (St. 1935).

References—R. S. Eadie, F. Newell, E. Brown, C. M. McKergow, H. E. Ewart, R. H. Findlay, K. O. Whyte, D. B. Armstrong.

CLARKE—BRUCE PORTEOUS, of Lennoxville, Que. Born at Lennoxville, Nov. 14th, 1911; 1934-40, asst. hoist engr., Canadian Ingersoll-Rand Co. Ltd., Sherbrooke, Que. (St. 1934).

References—S. R. Newton, E. Winslow-Spragge, G. M. Dick, E. T. Harbert, H. V. Haight.

DELISLE—LUCIEN, of Waterloo, Que. Born at Montreal, Nov. 11th, 1911; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1937; 1937-38, asst. divn. engr., 1938 to date, divn. engr. Dept. of Roads, Waterloo, Que. (St. 1936).

References—A. Frigon, A. Gratton, T. J. Lafreniere, P. P. Vinet, L. Trudel.

FOGARTY—JAMES WILLIAM PATRICK, of Antigonish, N.S. Born at Moncton, N.B., Nov. 16th, 1910; Educ.: B.Sc. (Elec.), McGill Univ., 1931; 1929 (summer), electrn. & dftsman., International Paper Co., Dalhousie, N.B.; 1930 (summer), test course, Canadian Westinghouse Co., Hamilton; 1934-36, instructor in physics and maths., and at present, professor of engineering, St. Francis Xavier Univ., Antigonish, N.S. (St. 1929).

References—E. Brown, C. V. Christie, H. C. Brown.

GUENETTE—JOSEPH ANTOINE PAUL, of 5787 Cartier St., Montreal, Que. Born at Montreal, June 13th, 1908; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1939; 1934-35 (summers), C.O.T.C. course in signals, Camp Borden; 1938 (summer), industrial health inspr., Prov. Board of Health; 1939-40, industrial engr., T. R. McLagan & Associates, Montreal; at present, asst. res. engr., Dept. of Roads, Prov. of Quebec, Montreal, Que. (St. 1936).

References—A. Frigon, T. R. McLagan, L. Trudel, A. Gratton, A. Cousineau, J. A. E. Gohier, T. J. Lafreniere.

MARTIN—CLIFFORD DAVISON, of 14 Church St., Halifax, N.S. Born at Amherst, N.S., Aug. 16th, 1913; Educ.: B. Eng. (Elec.), N.S. Tech. Coll., 1938; 1933 (summer), N.S. Dept. of Highways; 1934-35, sales work, sales engrg., Consolidated Press, Toronto; 1936 (summer), Canada Electric Co. Ltd., Amherst, N.S.; 1936-37, college electrn., N.S. Tech. Coll.; 1937 (summer), plant and later paving inspr., and 1938 (summer), paving inspr., Milton Hersey Co. Ltd.; 1938-39, student engr., and Oct. 1939 to date, sales engr., power apparatus, wire and cable, pole line hardware, etc., Northern Electric Co. Ltd., Halifax, N.S. (St. 1938).

References—S. W. Gray, G. V. Ross, P. A. Lovett, J. R. Kaye, L. C. Young, J. J. Sears, A. D. Nickerson.

MEAGHER—ROBERT DOUGLAS, of Pointe aux Trembles, Que. Born at Ottawa, Ont., Oct. 24th, 1913; Educ.: B.Eng.(Chem.), McGill Univ., 1938; 1931-36 (summers), woodworking, lumbering, office work; 1936 (4 mos.), material balances, stock loss determinations, E. B. Eddy Ltd., Hull, Que.; 1938 to date, with the British American Oil Co. Ltd., Montreal East Refinery, as follows: lab. asst., asst. chemist, houseman, boardman, and at present stabilizer operator. (St. 1938).

References—E. Brown, C. M. McKergow, J. B. Phillips.

MILLER—ALEX. MATTHEW, of Sydney River, N.S. Born at New Waterford, N.S., Oct. 3rd, 1912; Educ.: B.Sc. (Civil), 1934, B.Eng.(Mech.), 1935, N.S. Tech. Coll.; 1932 (summer), chainman, 1935-36, instr'man., and 1936-37, asst. engr., Dept. of Highways of Nova Scotia; 1937, field engr., Highway Paving Co., Montreal; 1937-38, field engr., & supt., Dufferin Paving & Constrn. Co., Toronto; 1938, field engr., Highway Paving Co., Montreal; Apr. 1939 to date, refractory engr., Dominion Steel & Coal Corpn., Sydney, N.S. (St. 1935).

References—F. H. Sexton, A. B. Blanchard, C. Johnston, W. S. Wilson, J. A. MacLeod.

MOORE—ROBERT HUGH, of Flin Flon, Man. Born at Winnipeg, Man., Dec. 15th, 1910; Educ.: B.Sc. (C.E.), 1933, (E.E.), 1934, Univ. of Man.; 1930-31 (summers) concrete constrn., Carter Halls Aldinger, Winnipeg; 1934-36, ap'tice machine shop, and 1936 to date, mech. designer and machine erector, Hudson Bay Mining and Smelting Co. Ltd., Flin Flon, Man. (St. 1930).

References—E. S. Braddell, N. M. Hall, A. Taylor, M. K. T. Reikie, E. P. Fetherstonhaugh, G. C. Davis.

ZION—ALFRED BERNARD, of 5280 Byron Ave., Montreal, Que. Born at Ancon, Panama, Aug. 25th, 1913; Educ.: B.Eng., McGill Univ., 1935; Educ.: 1928-35 (summers), study of lock & key manufacture in sales dept., and 1936 to date, i/c of production and engrg., Dominion Lock Co. Ltd., Montreal, Que. (St. 1935).

References—E. Brown, C. M. McKergow, A. R. Roberts, R. DeL. French, R. E. Jamieson.

LIBRARY NOTES

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MANUAL OF INDUSTRIAL HEALTH HAZARDS

By J. B. Ficklen. Service to Industry, Box 133, West Hartford, Conn., 1940. 176 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $4.00.

This manual presents methods for evaluating the health hazards from exposures to various dusts, vapors and gases that occur in industry. The book opens with directions for air sampling. Following this, the occurrence, uses, properties, clinical symptomology, physiological response and method of estimation are given for over ninety noxious dusts and gases. An accompanying table shows the potential health hazards in various industries.

MODERN SHIPFITTER'S HANDBOOK

By W. E. Swanson. Cornell Maritime Press, New York, 1940. 269 pp., illus., diagrs., charts, tables, 7½ x 5 in., lea., $2.50.

Written for the shipyard worker, this handbook takes up in order the four major stages in a ship's construction: mold loft work and template making; structural shopwork and anglesmithing; preassembly of sections; and erection of parts and sections on the ways. Chapters on blueprint reading, riveting, rigging and welding are included, with a glossary of ship construction terms. There are many large working drawings.

NON-FERROUS FOUNDRY PRACTICE

By J. Laing and R. T. Rolfe. D. Van Nostrand Co., New York, 1940. 336 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, $6.00.

The whole field of foundry practice for non-ferrous metals and alloys is covered. Molding practice for each group of alloys is introduced by a detailed consideration of the constitution and properties of the whole range of alloys in the group. Mechanical test requirements, the effects of additions and impurities, and various uses of the alloys are treated. The first two chapters discuss molding sands and melting furnaces.

PRINCIPLES OF ELECTRICAL ENGINEERING

By W. H. Timbie and V. Bush. 3 ed. John Wiley & Sons, New York, 1940. 540 pp., illus., diagrs., charts, tables, 9 x 5½ in., cloth, $4.50.

The object of this text is to provide a first course on the really basic principles upon which electrical engineering rests, as a preliminary to detailed courses on electrical machinery. It is intended for students having a knowledge of calculus and physics, in sophomore and junior years. The new edition retains the general arrangement of earlier ones, but has been revised in the light of recent advances in theory and practice and also in methods of teaching.

PUBLIC WATER SUPPLIES

By F. E. Turneaure, H. L. Russell and M. S. Nichols. 4 ed. rev., John Wiley & Sons, New York, 1940. 704 pp., illus., diagrs., charts, maps, tables, 9½ x 6 in., cloth, $6.00.

The whole field of public water supply is covered in this comprehensive standard textbook. Part I on requirements and resources deals with the determination of the quantity of water required, sources of supply, the relation of drinking water to health and the examination of water supplies. Part II, on the construction of water works, covers hydraulics, wells, dams and reservoirs, sedimentation and coagulation, filtration and other purifying processes, pumping machinery, pipe lines, distribution, operation and maintenance. Literature references accompany most of the chapters.

(The) RIGID-FRAME BRIDGE

By A. G. Hayden. 2 ed. John Wiley & Sons, New York, 1940. 285 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.50.

The theory of indeterminate analysis is discussed, and detailed calculations are presented for the application of rigid-frame construction to various types of short-span reinforced-concrete and structural-steel bridges. The principles developed have had considerable use in actual practice, and a chapter on practical points on design and construction is included. Consideration is given to the architecture of short-span bridges.