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CONTENTS

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THE ENGINEERING JOURNAL

VOLUME 22 JANUARY 1939 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."

A MESSAGE FROM THE PRESIDENT

The Engineering Institute of Canada enters another year with greater opportunities than ever for serving the engineering profession, and it is better able to take full advantage of such opportunities than at any other period of its long and distinguished career. All that is necessary is a general appreciation of these opportunities by our membership and a properly directed progressive programme that will permit full advantage being taken of them. No one familiar with the personnel of the 1939 Council can doubt either its capacity to evolve an appropriate programme, or its ability to see that it is properly inaugurated.

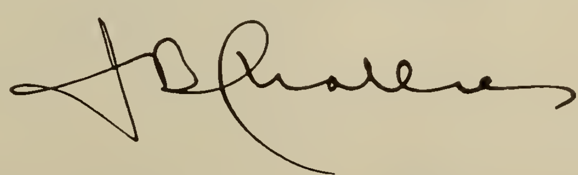
As to the opportunities. First and foremost, I would urge the continuation of the 1938 Council's policy of promoting closer relations with the provincial associations. Having visited each of the twenty-five branches of The Institute, and having conferred at length with their executive committees, I can say definitely that the great bulk of the profession, both within and without The Institute, desires some corporate co-operative arrangement between The Institute and the provincial associations. For the time being, in some of the Provinces they will be content with an informal *entente cordiale*, but only as a means to an end. Undoubtedly this end is an eventual agreement that will provide a COMMON MEMBERSHIP.

Thanks very largely to the wise policy pursued on behalf of Council by the Committee on Professional Interests, there is now a real prospect that the forward-looking agreement completed at Regina last October will be a forerunner of similar agreements in several other provinces.

The second important opportunity for serving the profession is of such basic importance that I intend emphasizing it in my valedictory address. Therefore, I merely mention it now. The Institute must without further delay evolve some better method than is now available to it for assisting the young engineer—the undergraduate and the recent graduate.

The third important opportunity for service is the promotion of closer relations with the Founder Societies of the United States. One of the most enthusing and helpful experiences of my year in office has been the many practical evidences of an earnest desire by those in authority in the American engineering bodies to understand the aims and ambitions of The Institute, and what is of particular significance, their very ready willingness to assist The Institute in achieving its desire to be a worthy centre for *all* branches of the profession.

There are, of course, many other, and important, opportunities open to The Institute for aiding the profession, but in my humble opinion they are ancillary to the three main opportunities to which I have briefly referred.



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SOME PROBLEMS INVOLVED IN THE EXPANSION OF CANADA

C. A. MAGRATH, LL.D., HON.M.E.I.C.*
Past Chairman, International Joint Commission

Paper to be presented before the General Professional Meeting of The Engineering Institute of Canada, at Ottawa, Ontario, on February 15th, 1939

SUMMARY—The author develops a theme whereby the interest of men of the "Empire Builder" type could be obtained as a means of helping to solve the western dry areas problem. Engineering investigations should be advanced and some definite move forward must be made without loss of time as there is a limit to the courage of even the best of a fine people. As an instance of other major problems in Canada requiring immediate solution, he also refers to the railway problem, advocating a unified management.

"Wherever I travel I try to point the vision of men and women to the great domain that lies beyond the reach of rails and roads and cities as the foremost of all Canada's possessions. What has been our attitude? What but to exploit and plunder for an individual's bank account! The common interest, the good of the nation, the legacy to the future—these have been handy bits of banquet oratory, but they have had little to do with the actual economic management of the country's natural resources."

Grey Owl's Message.

The above arresting statement by an amazing man, whose life was almost entirely spent in the wilds of our interior, was made in an effort to awaken the vision of our people. There is some excuse for those with "bank accounts," which includes our most capable business minds, not getting "beyond the reach of rails and roads," but none for not knowing more about the rural life of our country and its problems. The successful man in our large enterprises only became so through digging into the very vitals of the work he was expanding. The countryside is largely "known" to most of our prosperous men as seen from the windows of railway carriages or from motor cars.

Many can go abroad from time to time for a month or so, but would it occur to any to spend a few weeks in driving through large portions of our country, developing contact with people on the land—the real makers of a nation—and using that fine capacity of theirs to see in what way the condition of our people could be bettered? I quite understand that many would feel that they had no right to interfere in the affairs of others, but their object would soon become evident to and be appreciated by the people. Contact between what I will call the centre and the circumference should result before long in greater contentment in our rural sections, and it is certainly necessary. I believe that was the basic thought in the mind of Grey Owl when penning that message to our people.

The building of a country is largely the task of engineers, and in addressing the members of The Engineering Institute of Canada, I propose dealing with the subject in a large way—a fitting method for a country of Canada's dimensions. My main object is to bring to your attention a major problem on our western plains, a problem which calls for immediate consideration.

The European situation appears to be clearing up, and let us hope that a very definite improvement is but a short way ahead, so that we may pull ourselves together and courageously face some of the larger development problems involved in our expansion. It at once brings to my mind the necessity of reviving the "Empire Builder." Canada owes its foundation to the empire builders of the French regime; their descendants to-day are a splendid people, whom to know is to appreciate. Sometimes I express the wish that another Company of Gentlemen Adventurers would come along with a further supply of that stock brought to us via the Hudson's Bay. Then a little over half a century ago, a few Scots took hold of the Canadian Pacific Railway project, which turned out to be a great piece of empire building.

I fear our people do not appreciate what that project has meant to our country—an undertaking to extend a railway across the Continent, when Canada had less than five million people! I was out on our western plains all through the period when that road was being built. I believe I am well within the mark when I say that within the territory between Winnipeg and the Pacific Ocean—a distance of 1,400 miles—the total value of improvements, such as Hudson's Bay Posts, etc., did not at that time exceed a value of $1,000,000. That group of Scots had to contend with difficulties in crossing our mountain ranges greater than any other transcontinental railway. Look at the development to-day to be found in that territory, and largely due to the courage of those empire builders! Not only has their enterprise left us a great railway system, but a fleet of ships which are to be found sailing the "Seven Seas." It is true we gave them a considerable cash subsidy, as well as a large land grant. I believe their expenditures in promoting the settlement of those lands, and otherwise aiding in opening up our country, have been double the grant of money they received from Canada.

If we have no obligation to that Company, as some appear to think, we certainly have to our own pockets, which we do not seem to understand. I say this in view of our indifference to the necessity of bringing our two railway systems into one operating organization. I am absolutely against, not only our buying the Canadian Pacific Railway, but am equally opposed to our selling to that Company our National Railways, because it would be utter madness to attempt the former, and nothing short of disgraceful to do the latter, without obtaining for it some reasonable measure of its cost, which is well beyond the horizon of the present generation.

I am aware Great Britain had its "rotten boroughs" in the past. To-day its political system is second to none in the world, and it has a great public service as well. The reason largely is, that its people have a proper appreciation of their responsibilities to the public servant, which I regret to say is not yet properly understood in Canada, and to the detriment of our own fine service. I am aware our parliamentary methods are making good headway, though the principles of the cricket field would be helpful to us all, including political life. My definition of political partyism, made in a moment of levity, has a measure of truth in it. It is, that should the government of the day decide on a policy urging the people to work heavenwards, those in opposition would dissent, claiming that due to our rigorous Canadian winters, an occasional visit to Hades would have its advantages.

Such an attitude has destroyed in me any confidence in political party control of a business organization, no matter how absolutely fair the government may be to the management. In a privately owned property, the directors are behind their organization, in foul as well as in fair weather, but in the case of a publicly owned property, the moment the wind changes, be it a gentle zephyr or a wild hurricane, there are those amongst the opponents of the government on the alert to start a campaign against the property, even

*See page 30.

through an attack on the management of the property. In the meantime the public does not interest itself in the problem, apparently on that unsound assumption, "that which is everybody's business is the business of none."

If these two transportation organizations, operating in the same territory, were owned by the country they would quickly be brought under one management and the same thing would happen if they were privately owned. Both reached their present expansion largely before Canada started out to spend millions in the construction of highways. No one will criticize the expansion of our highways but we should not forget that they exist for transportation purposes, and consequently a revision of our railroad activities seems absolutely necessary.

In my time in Parliament, railway charters could be had for the asking, the doctrine being that competition would regulate railway rates. It failed in that respect, and left us overburdened with railroads. Is it unreasonable to say that if the State finds itself operating a public service—fairly recently acquired—in the same field as one it had authorized many years before, and is unwilling to have the two services reach common ground for the benefit of both, that it should be willing to come to the financial assistance of the privately owned one as well as its own?

As a result of my long experience as a member of The International Joint Commission, dealing with issues between Canada and the United States, I am not alarmed about "unification." Each country has been represented on this organization by three members, and with equal voting strength, it was astonishing how quickly confidence developed between the two groups. I have confidence in the capacity and integrity of the managements of our two railway systems, and I believe if they were brought together, on a basis of equal representation, the time would soon come when they would find themselves working as one unit, just as satisfactorily as they are now separately, and to the benefit of our country, which means the employees as well.

The development of our vast country, with our quite inadequate population, will at times force upon us large and difficult problems. Let me remind you that Canada's population moved forward about 6,000,000 in the last 37 years, and stands to-day at 11,000,000, while our good neighbours increased in the same period about 53,000,000, with a total now of about 129,000,000. I am quite satisfied that Canada has great natural wealth. It is not amiss, however, to occasionally bring together a few figures and give some play to our imagination as to our future.

It was the terms of British Columbia's entry into Confederation that forced upon us the construction of the Canadian Pacific Railway, which was only made possible by the use of some of our natural resources. Could they be put to better use than in helping to expand our country's opportunities, especially as we will still have the advantage of such wealth as they may afterwards produce?

Instead then of continuing the policy of handing over large blocks of our northern territory to our Provinces, with populations of but a few people per square mile, and nothing being done with the added territory, except by Ontario, which built a railway to James Bay, would it not be much better for our Dominion Government to retain the balance of that northern country, and see if it is not possible to work out a plan, by which some of its resources could be used in helping to finance large development projects, which our governments, Dominion and Provincial, are unable to further under existing conditions. I am not suggesting that it is an easy task to find such a plan, but it is our responsibility to make a determined effort to that end. Negative attitudes will not make Canada.

I cannot emphasize too strongly the necessity of our best business minds dropping that apparent indifference, when anything out of the ordinary, looking to an improvement in our national methods, is brought to their attention.

I now propose discussing a major problem, the one which is responsible for my undertaking this paper. The subject is the improvement of land settlement conditions on that area in our Mid-West frequently referred to in the past few years as the "drought area," and to others in the long past as "the treeless plains," fully 100,000 sq. mi. in extent. I find F. H. Peters, M.E.I.C., Surveyor General and Chief of our Hydrographic Service, has prepared a very interesting paper* on irrigation, the main agency for improving conditions in that territory. No one is better qualified to do so, as some years ago he was our Commissioner of Irrigation. I will therefore endeavour to develop my views on the same subject, without duplicating his arguments.

While I have never lost my interest in that western country, my close contact with it was during the thirty years ending in 1910. In the latter third of that period, settlers could not be kept off our public lands. Hardships did not deter them. Their sod huts were a common sight scattered throughout the country. To-day land settlement is shunned—another national problem that has to be faced at an early date.

I was on those plains shortly before the buffalo disappeared. Grass—much of it being a short curly variety and known as "buffalo grass"—was to be found everywhere for our horses, but this was not the case with water. My theory is that a territory with good soil and *ample* moisture in the state of nature will be found covered with timber; whereas if without timber, and the soil is good, then there must have been a shortage of moisture. Regardless, however, of theories, that particular area in the last sixty years to my knowledge has had its periods of insufficient rainfall, and towards the end of every such period, an agitation would develop for putting to use the available water for irrigation; especially was that true in the western end of the area. Then with the return of the "wet" seasons, the past would be quickly forgotten.

And so it continued until the recent drought period, probably the longest and certainly the most severe since those lands have been occupied. And now the subject of reclamation is again to the fore, and everyone interested in that western country knows that some definite move forward must be made, and without further loss of time, as there is a limit to the courage of even the best of empire builders.

The following rough estimates will give some idea of the situation in our so-called drought area, as well as in the area outside of it in Saskatchewan and Alberta. Probably 6,000 sq. mi. in south-western Manitoba have suffered from drought, but I am unable to give any details respecting that territory.

In the Provinces of Saskatchewan and Alberta, the drought area is about 100,000 sq. mi., and in this area there is a population of 788,829, and 6,691 mi. of railway. *Outside* of the drought area, there are 81,000 sq. mi. in which there is some settlement. Of this area 57,000 sq. mi. is partially wooded, and 24,000 sq. mi. is covered with bush. There are 914,866 people in this *outside* area, and 7,620 mi. of railway.

The above figures indicate that the drought area carries practically half of the entire development that has taken place in those two provinces since they were opened for settlement over fifty years ago. All things in life are more or less uncertain, but when uncertainties become abnormal, as for instance in the capacity of land to produce, it must be expected that it will lead to a lessened use of that land—hence in the interests of our Canadian Confederation we must do everything that is possible to vitalize that central link in our four separate settled areas extending across the continent—a link that in the past has produced a vast amount of wealth for Canada.

In 1904 I urged the late Sir Clifford Sifton, very shortly before he retired from public life, to have an intensive examination made of that "dry area" in order to see to what extent those waters wasting into Hudson Bay could

*See page 8

be used. While I have brought forward the suggestion at odd times since, I have never been dogmatic as to how far it would be possible to make use of the waters of those major streams, including the North Saskatchewan River, that flow out from the foothills of the Rocky Mountains. I believe it would be necessary to reservoir their spring freshets, if practicable in the river valleys, otherwise the amount of water available would not, I fear, justify such a large enterprise being undertaken.

I am aware that a couple of irrigation projects in Southern Alberta have been disappointing. One reason may be that the full "duty" of water was allotted to each land holding, whereas the rolling nature of those plains is such that only a percentage of the total area could be reached with water. Apart then from the objection of promoting large irrigation enterprises in rolling country, there is the objection in the case of the drought area of confining the very limited supply of water to a small area, with the water in wet seasons doing a minimum of service.

I therefore agree with Mr. Peters that the available water should be distributed over the widest possible area for stock purposes, tree culture, irrigation of small plots of land. In wet years the water should be conserved in reservoirs as far as practicable in order to supplement the supply in dry years. The evaporation, I appreciate, would be quite heavy.

What then is to be done about the drought area? I believe the Government has been doing excellent work in it during the past few years by making use of the water that falls within the territory, also in the treatment of soils, and otherwise helping the settlers. I was pleased to learn quite recently that the Reclamation Service of the Department of the Interior, which operated at Calgary some years ago, had accumulated a great deal of information regarding the surface of the drought area, thereby materially reducing the field work necessary to determine the possibility of distributing water throughout the territory.

My opinion is that, in the interests of those within the area, the Government should have the engineering investigations pushed forward to completion as early as possible, thereby putting an end to the discussions as to what is or is not possible in the way of stabilizing and increasing the production of the drought area through the use of water. I know the cost figures will be very large, and possibly so large that the undertaking would be impossible, but where so much is involved we are not justified in making any assumptions. My hope is that with maps and other details of a great project showing very definite benefits to the drought area, that it would appeal to the imagination of the empire builder type, and through the use of some of our resources in our north-land, the project could be financed, as was done in the case of the Canadian Pacific Railway. While in London last year, I tried to interest a few men in our expansion, drawing their attention especially to our drought area, and failed. I fear our Canadian independence, to which I will refer presently, had something to do with it.

We Canadians might as well realize that Canada is still very much in the making, and in a country of its vast dimensions great development projects are ahead of us if we are to succeed. Such development cannot be financed by our governments alone, especially under present conditions. This situation should not deter us from expounding these developments in such a way as might interest others in them. After all, that is our present day method of window dressing without which those in business would soon have to close their doors.

I will close with a reference to our British connection. At times we seem to go out of our way to claim that Canada is an independent nation, notwithstanding the fact that we are part of a great family. The more independent units this old world is broken up into, the wider the base of international distrust becomes. While I am unquestionably a Canadian, I also regard myself as British, even if I have not, so far as I know, a drop of English blood in my veins. I fear that sensitiveness about our independence may have been responsible for my experience in London to which I have referred—an unwillingness to intrude in the affairs of another nation. I sincerely hope I am wrong as to that.

Not only have we Canadians major undertakings which, due to our small population, cannot be financed in the usual way, but I believe it will be found that Australia and South Africa are in the same position, and probably New Zealand as well—each being under-populated. Great Britain, on the other hand, carries an excess of people. Assuming it would take say two or three billion dollars expended over a term of years, on major projects, to start our overseas Dominions on the up-grade again, enabling all of them to take many of their idle people away from their drab surroundings in centres of population, and place them, as well as others from Great Britain, out on land, are we going to admit that through team-play on the part of the members of the British Commonwealth, and the use of some of our territory with resources, we cannot find funds for a great movement of that character? Not to-day, I will admit, but what about to-morrow? This question may soon be urgent. Meanwhile let us list our major development problems, and bring together all details as to possible solutions, so as to be ready for the "Empire Builder."

I appreciate that many will say that there is no place for further agriculturalists in Canada to-day. I am not thinking of wholesale farm production through the use of machinery, but of the type of farming carried on in eastern Canada in my boyhood days, when it was a common expression "the farmer is the most independent man in the country," who produced probably 90 per cent of what he consumed and most of his clothing as well. The bright lights and other conveniences drew people from the land to the city. Now through electricity all that the city offered can be brought to those in and about rural communities out on the land. It is a problem that must be solved. Let us try and get away from the idea that our over-worked governments must find solutions for all our difficulties. I am aware of the efforts to revive British emigration to this country, and wish them every success. Real effort to find sound methods cannot fail to make progress.

I have gone far afield in this paper, as I am aware that none know better than the members of The Engineering Institute that Canada offers splendid opportunities to the exploring mind, and that great works are the outcome of that type of mentality plus the knowledge and capacity of the engineer.

Annual Meeting, Ottawa, Ont., Feb. 14, 15, 1939

MOUNTAIN WATER FOR THE PRAIRIE GRASSLAND

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Paper to be presented before the General Professional Meeting of The Engineering Institute of Canada, at Ottawa, Ontario, on February 15th, 1939

SUMMARY—The author expresses the opinion that irrigation waters should be spread over as large an area as possible, providing the maximum number of grain farms with sufficient water to ensure each year a good kitchen garden, and a sufficiency of fodder instead of looking for the maximum number of irrigable acres in any concentrated block. The argument is developed following a description of the dry grasslands, rivers and water supply with references to lack of rainfall, and to the absence of an organized plan. In conclusion, the benefits to be derived from the suggested plan are presented.

The official map titled Forest Classification of Canada outlines the grassland formation of southern Alberta and Saskatchewan. It includes the area known to westerners as the bald-headed prairie and with the exception of a few patches there is no natural growth of trees. Roughly, with a depth of two hundred and thirty miles north of the international boundary, the area stretches from the foothills of the Rocky Mountains, on the west, easterly to Regina and then tails off southeasterly to the west side of Manitoba. The measure of the area is 105,000 sq. mi. or 67,000,000 acres, and is equivalent to twice the combined area of New Brunswick, Nova Scotia and Prince Edward Island. The area includes or borders the following cities: in Alberta, Calgary, Lethbridge, Medicine Hat, Drumheller; and in Saskatchewan, Regina, Saskatoon, Moose Jaw, Swift Current and Weyburn.

From time to time opinions have been expressed as to the limits or boundaries of the dry area in the West. In the writer's opinion the grassland formation is nature's delineation of the dry area.

It is outside the limits of this paper to undertake any description of the grasslands in detail. Speaking broadly from the viewpoint of agriculture and animal husbandry, the grasslands have many good attributes. There is sunshine aplenty, a length of growing season sufficient to ripen the newer varieties of best milling wheat, good soil and the general smoothness of the surface with freedom from stones greatly facilitates the tilling of the soil. But one thing is lacking and that is an adequate natural supply of water to ensure successful crop-raising over a period of years. Subject to cycles of wet and dry years the natural precipitation is insufficient for permanent agriculture. To repeat, the natural precipitation over the grasslands is insufficient because this is the predominant condition of nature affecting the welfare of this country.

Over the grasslands the normal total annual precipitation ranges from 11 inches to 17 inches. It may be fair to quote a general figure of 15 inches. For comparison the total annual precipitation is, at Winnipeg 20 inches, at Ottawa and Toronto 33 inches, at Montreal 40 inches, at Saint John, N.B. 46 inches and Halifax 55 inches.

What has been written above draws attention to the fact that over the prairie grasslands there are cycles of wet years and dry years, but on the whole the natural water supply is insufficient. A number of things have been done and can be done to ameliorate this condition. The intention of this paper is to discuss some of these things which would require the undertaking of large engineering works.

The prairie grasslands are flanked on the west by the high Rocky Mountains where there is a plenitude of natural precipitation and the natural drainage of the eastern slopes is down through the foothills to the grasslands which continue to slope gently away to the east. These high mountain snow lands give birth to a number of large rivers which discharge a great volume of water and it is possible to handle this water so that it can be put to beneficial use on the grasslands. The general condition is that these rivers cataract down the mountains and flow swiftly through the foothills on top of the land but immediately they reach the very deep soil of the grasslands they cut into it and thereafter course away to the east in deep wide troughs with the river beds far below the general level of the land. If these rivers are controlled they can be diverted at the edge of the foothills into artificial channels so constructed that the water will be carried through the dry areas on top of the land where it can be used to augment the natural supply which is insufficient.

The natural physiography of the country limits the extent to which this can be done. From the international boundary north to Medicine Hat the adverse slopes of the Cypress Hills bar the way farther east and from Medicine Hat to Saskatoon the valley of the South Saskatchewan river is in general the easterly limit of the area over which the mountain waters can be conducted. For the purposes of this paper, then, the prairie grasslands should be divided into a westerly portion and an easterly portion by a line running north from the international boundary through the middle of Pakowki lake to a point on the South Saskatchewan twelve miles west of Medicine Hat and thence following the river northerly and easterly to Saskatoon. The area of the westerly portion is 50,000 sq. mi. or 32,000,000 acres and of the easterly portion 55,000 sq. mi. or 35,000,000 acres.

Considering water supply, the difference between the two portions is that in the easterly portion it is only possible to conserve the scanty natural precipitation falling within the area itself, but in the westerly portion, in addition to conserving the natural precipitation, it is possible to augment the water supply by utilizing the plentiful run-off from the eastern slopes of the Rocky Mountains.

The average annual discharges in acre-feet of the large mountain rivers are: Oldman river near Lethbridge 2,660,000; Bow river near Bassano 3,200,000; Red Deer river at Red Deer town 1,530,000; North Saskatchewan river near Rocky Mountain House 3,750,000. The total of these is 11,140,000 acre-feet, which indicates the measure of the total amount of mountain water available and flowing down to the westerly portion of the grasslands.

The easterly portion is not devoid of possibilities of irrigation but compared to the westerly portion they are small, as indicated by the following average annual discharges in acre-feet of a number of streams arising in the highlands of the Cypress Hills from which water is diverted for irrigation: Lodge creek 29,200; Battle creek 33,200; Frenchman river 90,200; Maple creek 19,200; Swift Current creek 58,200. The total of these is 230,000 acre-feet. The South Saskatchewan Project should be noted here because it would utilize mountain waters from the South Saskatchewan river. It has been investigated and reported on with alternative points of diversion near Riverhurst and The Elbow, but it is a pumping proposition with a high lift and comes in a somewhat different category from the other large works or projects which divert by gravity canals. It has, however, the distinction of being the oldest project.

The idea of utilizing the mountain waters on the prairie grasslands is not a new one, as anybody will discover for himself who undertakes to review the bibliography on irrigation in western Canada which goes back to 1859 when Professor Hines suggested the possibilities of diverting water from the South Saskatchewan river to the Moose Jaw-Regina district. There is an abundant literature mainly in

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*See page 30.

the old reports of the Department of the Interior and the Western Canada Irrigation Association discussing the pros and cons of irrigation. Many small and several very large irrigation works have been constructed and operated and provide a history of practical experience. With the facts available concerning the reclamation projects undertaken in the western United States there is ample knowledge available of the economic and human problems which have to be faced in undertakings of this kind.

The first Irrigation Act dates from July 23, 1894, in which year the Canadian Irrigation Surveys were commenced by the Department of the Interior. Since 1894 a great deal of topographical knowledge has been accumulated through surveys which have been conducted, and since 1908 hydrometric surveys to measure the flow of the rivers and streams have been on an organized basis. Further detailed surveys, particularly for reservoiring, are required, but sufficient accurate and reliable information is now available to indicate what the physical possibilities are for further development in supplying water to the land.

It is impossible, within the limits of this paper, adequately to describe in words all the irrigation works which have been constructed and all the irrigation projects which have been surveyed. A study of the map, pp. 10 and 11, together with the schedule which is referenced to it, gives a fairly good picture of the whole situation the highlights of which are as follows:

The map shows large blocks of land which can be supplied with the mountain waters, and fairly well distributed over the westerly portion of the grasslands extending, south of the Red Deer river as far east as Medicine Hat, Alberta, and north of the Red Deer as far east as Saskatoon about one hundred and forty miles into Saskatchewan. In the whole area there are 32,000,000 acres of land of which 3,000,000 acres, or about 10 per cent, may be supplied with water by artificial means by utilizing about 7,500,000 acre-feet of water, or about two-thirds of the annual supply of mountain water. Under the constructed and operating works there are about 1,000,000 acres which can be irrigated, all in Alberta, and under the surveyed projects there are an additional 2,000,000 acres which might be supplied with water, of which 925,000 acres are in Saskatchewan.

It will be appreciated from what has been set forth that the possibilities of ameliorating the natural conditions by supplying water have by no means been exhausted. There is still a great quantity of water available and there are still large areas of land where it can be utilized. Insofar as engineering is concerned the situation is clear; there are no problems of peculiar difficulty and the present day knowledge of engineering is adequate to deal with all of them. In the field of economics and the humanities there are, on the contrary, many problems demanding most careful consideration before further work on any large scale is undertaken.

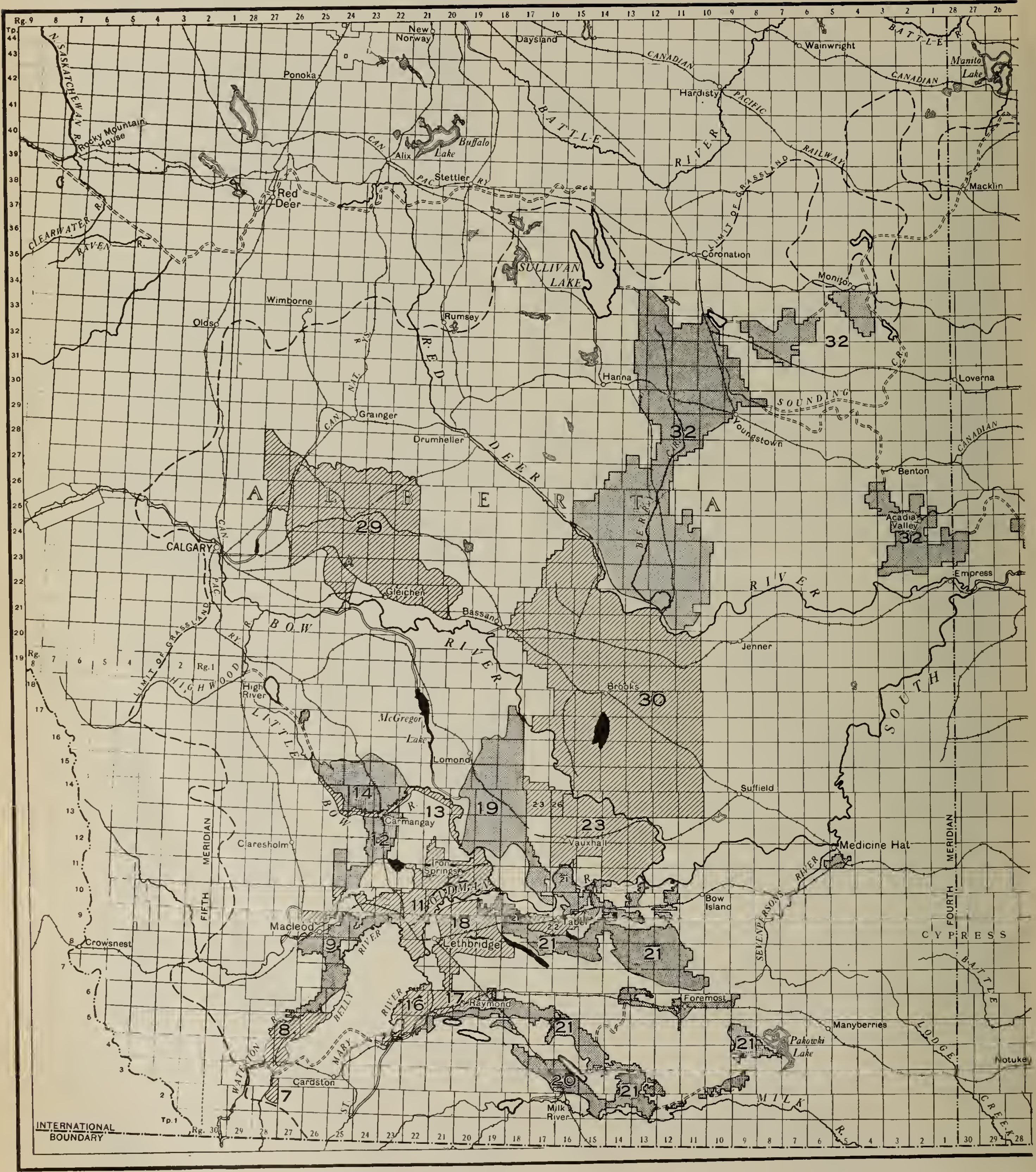
Before leaving this part of the paper it is important to note that a large proportion of the mountain water runs off in the spring floods and to conserve sufficient water for the total acreage mentioned large primary reservoirs would be necessary. Particularly in the southern parts where most of the low water river flow has already been appropriated, the prime necessity for further development is inherently one of large reservoirs in the mountains or in the foothills capable of receiving and storing large portions of the high and flood flows of the main rivers.

It is very difficult to make any brief and generalized statement describing the times and the circumstances under which the presently constructed and operated irrigation works were developed, but it is true that none of them were designed as part of any organized plan to produce the greatest good for the grasslands as a whole. Each scheme was undertaken as a separate entity with the necessity of

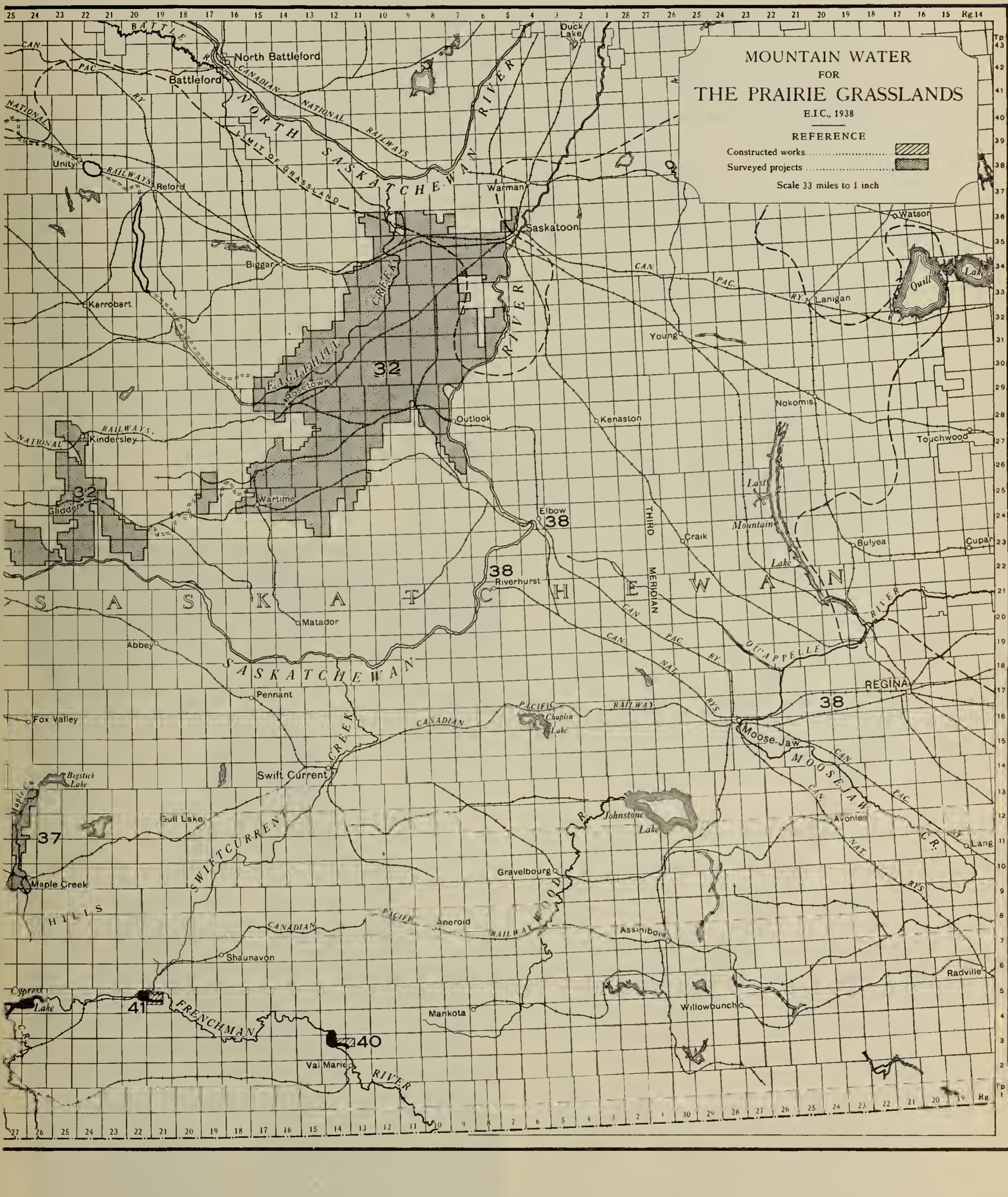
Principal Irrigation Projects Surveyed or Constructed in the Grasslands

Number (See Map)	Name	Constructed	Surveyed	Source of Supply	Acres in Tract	Irrigable Acres	Approx. Cost per Irr. Acre
				WESTERN PORTION			$
16	Magrath District	x	..	St. Mary river	89,600	6,980	..
17	Raymond District	x	..	St. Mary river		15,130	..
18	C.P.R. Lethbridge Section	x	..	St. Mary river	128,000	100,000	19
22	Taber District	x	..	St. Mary river	28,800	21,500	13
21	Lethbridge South Eastern	..	x	Waterton, Belly, St. Mary, Milk rivers	553,600	315,000	40
20	Warner	..	x	Milk river	89,600	17,000	37
7	Mountain View District	x	..	Belly river	9,600	4,200	10
8	United District	x	..	Belly river	57,600	34,170	15
9	South Macleod	..	x	Waterton river	112,000	52,963	30
11	Lethbridge Northern District	x	..	Oldman river	236,800	96,870	54
12	Barons-Carmangay	..	x	Oldman river	73,600	30,000	..
13	Little Bow District	x	..	Highwood river	38,400	3,090	10
14	Highwood River	..	x	Highwood river	134,400	52,460	39
19	Retlaw-Lomond	..	x	Bow river	288,000	55,514	41
26	New West District	x	..	Bow river	281,600	4,560	46
23	Canada Land and Irrigation	x	..	Bow river		130,000	50
30	Eastern Irrigation District	x	..	Bow river	1,244,800	400,000	30
29	C.P.R. Western Section	x	..	Bow river	665,600	218,980	25
32	North Saskatchewan Project	..	x	N. Saskatchewan and Red Deer rivers	3,200,000	1,411,000	75
				EASTERN PORTION			
35	Medicine Hat Eastern: Ross Creek	..	x	Ross Creek	....	1,338	13
	Medicine Hat Eastern: Bulls head Creek	..	x	Bulls head Creek	....	1,600	7
37	Maple Creek Valley	..	x	Maple Creek	....	5,870	9
38	South Saskatchewan Project	..	x	South Saskatchewan	Pumping project		
40	Val Marie District	x	..	Frenchman river	....	4,500	30
41	East End District	x	..	Frenchman river	....	1,570	50

For additional information see "Report on Proceedings under the Prairie Farm Rehabilitation Act for the fiscal year ending March 31, 1938." Acres in tract were measured from the map and are approximate. The figures showing irrigable acres and cost per irrigable acre are taken from official reports. Small private schemes have been built to irrigate a total of 56,000 acres in Alberta, and 50,000 acres in Saskatchewan by diverting from the smaller streams.



New Norway
Daysland
Ponoka
Wainwright
Manito Lake
Hardisty
Rocky Mountain House
Alix
Buffalo Lake
Stettler
Red Deer
Macklin
Coronation
Sullivan Lake
Monitor
Wimborne
Olds
Rumsey
Hanna
Loverna
Grainger
Drumheller
Youngstown
Benton
Acadia Valley
Calgary
Empress
Gleichen
Bassano
Jenner
High River
Brooks
McGregor Lake
Lomond
Suffield
Carmangay
Claresholm
Vauxhall
Medicine Hat
Iron Springs
Bow Island
Macleod
Crowsnest
Lethbridge
Taber
Raymond
Foremost
Manyberries
Pakowki Lake
Cardston
Milk River
Notukeu
A L B E R T A
Canadian Pacific Railway
Battle River
Red Deer River
Bow River
South Saskatchewan River
Clearwater R.
Raven R.
Highwood R.
Little Bow R.
Belly River
St. Mary River
Waterton R.
Milk R.
Sounding Creek
Lodge Creek
Cypress
Limit of Grassland
Fifth Meridian
Fourth Meridian
International Boundary


MOUNTAIN WATER
FOR
THE PRAIRIE GRASSLANDS
E.I.C., 1938
REFERENCE
Constructed works
Surveyed projects
Scale 33 miles to 1 inch
North Battleford
Battleford
Unity
Reford
Biggar
Kerrobert
Kindersley
Glidden
Rosetown
Wartime
Outlook
Saskatoon
Warman
Duck Lake
Watson
Lanigan
Quill Lake
Young
Nokomis
Touchwood
Kenaston
Elbow
Craik
Last Mountain Lake
Bulyea
Cupar
Riverhurst
Matador
Abbey
Pennant
Fox Valley
Swift Current
Bigstick Lake
Gull Lake
Maple Creek
Chaplin Lake
Moose Jaw
Regina
Johnstone Lake
Avonlea
Lang
Gravelbourg
Aneroid
Assiniboia
Shaunavon
Radville
Willowbunch
Mankota
Val Marie
Cypress Lake
NORTH SASKATCHEWAN RIVER
SASKATCHEWAN RIVER
LIMIT OF GRASSLAND
EAGLE HILL CREEK
SWIFTCURRENT CREEK
FRENCHMAN RIVER
QU'APPELLE RIVER
MOOSE JAW CR.
CYPRESS HILLS
THIRD MERIDIAN
CANADIAN NATIONAL RAILWAYS
CANADIAN PACIFIC RAILWAY
S A S K A T C H E W A N
32
37
38
40
41

showing a satisfactory financial statement to secure the construction costs.

It is the fact common to each scheme that the object striven for was to gain the maximum number of irrigable acres at the minimum cost per acre. The natural result was the selection of a concentrated block of land as near as possible to the source of water supply with provision made at the outset to deliver water to every possible acre under the ditches. This is the orthodox irrigation scheme as proved successful in a desert country where irrigation is necessary every year to raise a crop, but it may be questioned, for the future, whether this method of development is that best suited to the prairie grasslands which are not a desert area and where irrigation is not necessary to raise a crop in every year.

It is suggested that for the future there should be a re-orientation of ideas and the question should be studied in the light of the situation which has to be faced in western Canada, and not in the light of conditions which exist in Egypt, British India or California.

The situation is that the present day development of the prairie grasslands is founded on grain farming and it is likely that grain farming will continue to be the major agricultural industry of this country. If this forecast of the future is correct, then from a national aspect the predominant need is for something to help the grain farmer to tide over the lean periods of the dryer years. The suggestion is that for the future the aim should not be to look for the maximum number of irrigable acres in any concentrated block but instead to endeavour to spread the water over as large an area as possible and strive to provide the maximum number of grain farms with sufficient water to ensure each year a good kitchen garden and sufficient fodder for the cow and the pig and the work horses.

Without intending to state precisely the unit which would best suit this purpose we might consider thirty or forty acre-feet or sufficient to water twenty or twenty-five acres on each homestead. If twenty-five acres were selected as an average unit it might be utilized as follows. One and a half acres for a kitchen garden, including small fruits and perhaps a few crab apple and plum trees. Eight acres of permanent hay, preferably alfalfa which could be counted on to yield around three tons to the acre of cured hay annually. Eight acres of grain which if planted to oats would yield from 40 to 70 bushels to the acre. The remaining seven and a half acres as a permanent pasture would have a carrying capacity of one and a half to two mature head of stock per acre from early June until stubble fields were available in the fall.

If future development were planned on the suggested basis of spreading the water over as large an area as possible then what would be the limits of its application? This question is answered by consulting the accompanying map. The additional areas which might be helped and stabilized by the water are included in the outlines of the surveyed projects. The gross area included is approximately 4,451,000 acres. The gross area included in the constructed works is approximately 2,781,000 acres. If we add the two together the resultant 7,232,000 acres represent 23 per cent of the whole area of the westerly portion of the prairie grasslands.

This paper approaches a great problem in suggesting a practical method to help and to stabilize a large portion of the prairie lands in two provinces of the Dominion. If the idea is worthy of consideration, it must naturally undergo much probing and examination, and the author would use the concluding words to reiterate that the examination should be from a broader viewpoint than that of irrigation, as it has usually been discussed in the past.

Perhaps the first point of examination might be as to the cost. This question cannot be answered here because the estimates made have all been on the basis of supplying water to the maximum number of acres and it requires reconsideration and re-estimation to determine any definite cost figures. Two things, however, are obvious, the one is that to supply each homestead on a project with a limited amount of water will greatly reduce the total cost of the project and the other is that it will increase the cost of each irrigated acre. If the cost per irrigated acre is to be the test of the undertaking, as it has been for the orthodox irrigation scheme referred to before, then the suggestion to spread the water as far as possible will be condemned; putting the same statement in other words, it would not be acceptable to private enterprise charging all the cost against the acres actually irrigated. But if the problem is viewed from the broader aspect of helping the great areas of dry land which occupy such a strategical position in the national domain—then it is different because other factors than that of investment to yield immediate interest at commercial rates enter into the question. Especially during the dry cycles of years which will reoccur in the future as they have occurred in the past, every drop of water that can be carried on to the grasslands will help to turn the dead brown that follows drought into a live green and the accruing benefits will not be confined to the irrigated fields alone but will invisibly spread out and fortify the roughly estimated two billions of dollars of national wealth we now have in the western grasslands.

The idea of getting more water on to the dry lands has occupied the minds of many people in the west for a long time; this paper suggests a new method of approach and urges a careful study of available water supplies and the areas which need them in order to ascertain where a combination of conditions would make the application of the suggested ideas economically feasible.

Annual Meeting, Ottawa, Ont., Feb. 14, 15, 1939.

IRRIGATION DEVELOPMENT, ITS POSSIBILITIES AND LIMITATIONS

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Paper to be presented before the General Professional Meeting of The Engineering Institute of Canada, at Ottawa, Ontario, on February 15th, 1939

SUMMARY—Mr. Hays deals with the subject largely from an economic and humanitarian point of view, and after discussing the costs, and the benefits, direct and indirect, of irrigating dry areas, he reaches the conclusion that the cost of irrigation development is warranted as a national undertaking, but it is not a matter for private enterprise.

The paper gives an historical sketch and a physical description of the drought area. It discusses problems which arise in dealing with the farmer, and the necessity for the adaptability of settlers.

About seventy years ago, Captain John Palliser explored the prairie regions of our present western provinces and reported his findings to the British Government. In what respects his reports may have been taken into account in the development of the prairies, is a matter of history.

He reported varying conditions of natural prairie growth in trees, bush or grass which by direct inference had a bearing on the suitability of the areas for habitation. He outlined what has since been called the "Palliser Triangle" which included a large area of land situated in Saskatchewan and Alberta.

In this area he saw conditions of natural growth which indicated a scarcity of rainfall and a general deficiency in streams and water resources. It appears from information on the subject that he was not favourably impressed. He had no records of rainfall for preceding years and it is not probable that any such records taken by him during his travels would have been of any use. But as a practical man he gauged past conditions of rainfall by what he saw in natural growth on the land. To this day the same practical methods apply. Accordingly the principal points for consideration are the possibilities of agriculture in:—

(1) The heavy wooded sections where rainfall is adequate.

(2) Intermediate park lands where wheat can be grown successfully in most years and

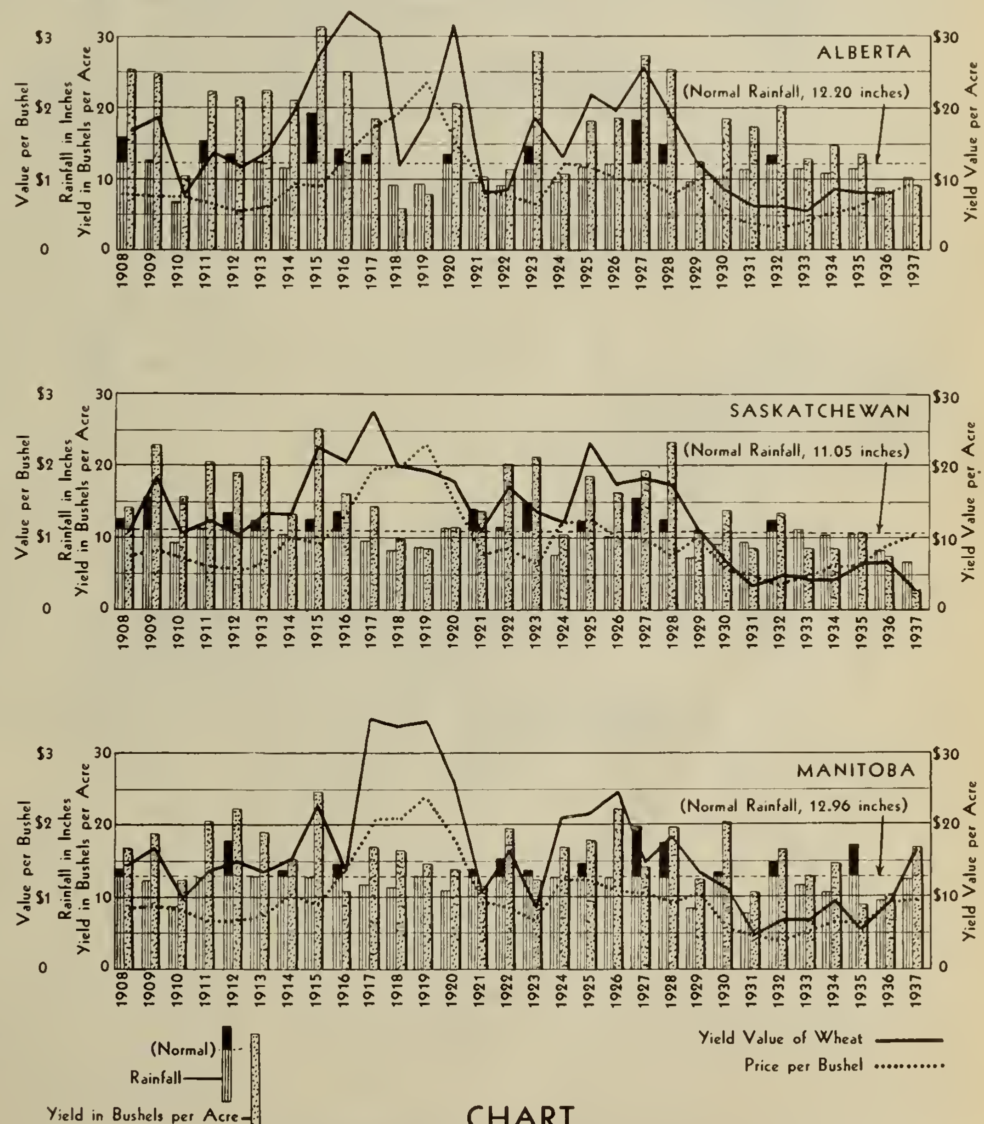
(3) The grassland areas lacking trees and bush, in most parts too dry to grow wheat commercially although abundant crops have occasionally been harvested.

Insofar as divisions (1) and (2) are concerned, it is only necessary to have a knowledge of their locations and potentialities as a possible refuge, opportunities permitting, for the individuals now living in drought areas where nothing can be done to improve the existing conditions.

*See page 30.

The Grasslands or Drought Areas

Early settlement of the grasslands, except for a few small and isolated areas, dates back some thirty years, say, to 1908, from which date estimates of crop returns are continuous to the present time. In the course of the following fifteen years, to 1922, a large amount of settlement took place. For ten years of this period, to 1917, rainfall in the prairie provinces was generally above normal. Good crops were grown and optimism prevailed. Then followed a period of nine years during which average rainfall was below normal but prices were generally high, which compensated for the reduced yields. 1927 was the wettest year of record since 1908, excepting 1915 in Alberta. During these ten years



CHART

SHOWING RAINFALL, YIELD, PRICE AND YIELD VALUE OF WHEAT IN THE PRAIRIE PROVINCES

1908 to 1937

Note: Rainfall includes previous fall, August to October inclusive and months April to July inclusive. Snowfall November 1 to March 31 not included. Price per bushel is net to farmer all grades. (Dominion Bureau of Statistics)

Fig. 1

occurrence of either good crops or high prices taken as an average for the prairie provinces, resulted in a reasonable degree of prosperity in the grain growing areas. The west was settled, built and bonded on this basis.

There have since followed ten years of low average rainfall and crop yields, with prices for most of the period at abnormally low figures. The results during these years have been difficult enough in the best grain growing areas and calamitous in those areas where rainfall was least. With regard to the six year period 1917 to 1922 inclusive, it is pertinent to state that had the average yields of wheat been sold at prices comparable with those obtaining from 1931 to 1936 inclusive, the economic conditions in this period would have been quite as difficult as they have been during the past six years. It was the price which saved the situation at that time.

The above general comments relate to average conditions for the western provinces. Figure 1 represents these average conditions for the period 1908 to 1937 inclusive. It is obvious to all who live in the west, and to those who have studied western conditions, that averages of rainfall or crop production for the provinces at large give no indication of the disturbing conditions which prevail in certain areas which make up the totals. Details are needed, by which a clearer understanding is obtained of the deficiencies in rainfall and crop production which beset individuals in certain areas in the business of farming. The price factor is a result of world conditions and can only be altered by bonus or pegged price at the expense of the public. Even these attempts to alleviate misfortune are of little value if crop production is low or negligible.

The research department of the Searle Grain Company Limited has compiled extensive data on rainfall for various crop districts in the prairie provinces, records for which were obtained from the Meteorological Service of Canada and other reliable sources. The two maps in Fig. 2 are compiled from data supplied by this company.

The upper map of Fig. 2 shows the long time average annual precipitation which occurred during the growing season April 1st to July 31st inclusive and the previous fall, August 1st to October 31st inclusive. Precipitation, mainly snowfall, November 1st to March 31st is not included. The records of rainfall are from 187 points and vary in duration from 61 years to 10 years.

The lower map in Fig. 2 shows the percentage of drought years, or years with less than a total of 8 inches of precipitation, which have occurred in a long period of time.

In connection with its data, the Company states:

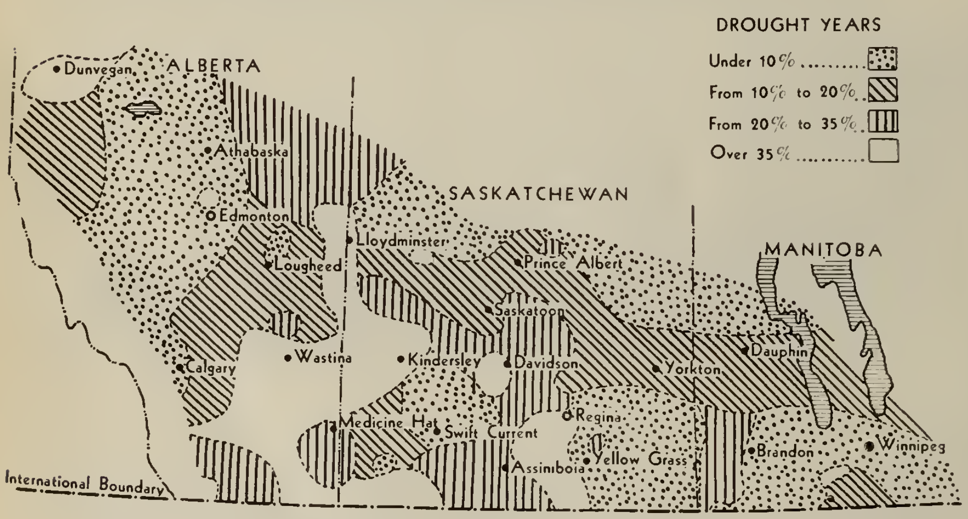
"Our conclusion, based on these studies and arrived at purely in an empirical fashion, is that in areas which have less than 10 inches of precipitation for the annual periods mentioned, wheat yields will be such that farming families, engaged mainly in wheat production, will probably find difficulty in maintaining for themselves what is often spoken of as a Canadian standard of living."

"We conclude also that in such areas, *i.e.*, those with less than 10 inches of rainfall, where in addition the proportion of 'drought' years exceeds 35 per cent, it will be almost impossible for farming families to maintain themselves decently, over a period of years, without considerable assistance from Government or from other sources."

Having regard to the large amount of data which has been compiled by the Searle Grain Company, the importance of the above quotations is significant, and the experience of many people living in the drought areas confirms them.

LONG TIME AVERAGE ANNUAL PRECIPITATION

which occurred during the growing season April 1 to July 31 and previous fall August 1 to October 31.
Records obtained from 187 points varying from 61 to 10 years.



PERCENTAGE OF "DROUGHT" YEARS IN THE PRAIRIE PROVINCES

Years with less than a total of 8" of precipitation which have occurred in a long period of time.
Records obtained from 187 points varying from 61 to 6 years.

Reduced from maps compiled by the Research Department of Searle Grain Company Limited

Fig. 2

Climatic conditions change from time to time in some degree, but in the light of existing information, there is no prospect of such improvements in rainfall as will warrant a continuation of dry farming in some of the more adversely situated areas.

Something should be done to provide for permanence in the use of these areas.

Various adjustments will be required with the probable need for a considerable shuffling of people and occupations. Much land should go back to grass for grazing and stock raising. Certain lands can be irrigated. Other land may fill an intermediate position where, with good soil and some known advantages in rainfall conditions together with improved farming methods, a fair prospect remains for successful operation. These marginal areas neither warrant irrigation nor can they be classed as good dry-farming lands. They are likely to go into large scale farming operations where by use of modern large power machinery and ability to do work cheaply, low average yields will pay profits. These adjustments are necessary or the country must continue to suffer the consequence of an impaired and disheartened citizenship and huge costs in various forms of relief.

Irrigation Development

As a premise to what may follow, it should first be stated that the views expressed herein are on the presumption that irrigation shall be paid for by the settlers on a fair basis according to the benefits they can receive from it, that the costs for development of irrigation projects shall be partly self-liquidating, and that the projects once built shall be self-sustaining. It must be recognized that the costs for irrigation development are generally in excess of the amount that can be repaid by production from the land handicapped as it is by our northern climate. Moreover, the costs for operation and maintenance on any irrigation project are in excess of what the farmer can pay during the early stages of development. It costs as much to operate and maintain a main canal to supply 2,000 acres of land as it would to supply 50,000 acres. Every irrigation project will operate at a deficit until the growth of settlement is sufficient to offset certain overhead costs. It may be argued at this point as to whether any irrigation development is worthwhile. The owners of every company project, based on the questions of revenues and profits, would say no. But from a national viewpoint a very different position arises in the general worth of these projects, namely, their results in greater national wealth, in new industries, in increased taxable land, in indirect taxation and excise duties, in the growth of towns and cities, and in the general business activity of the urban and rural population extending through railways to remote centres of industry. On these grounds irrigation is worthwhile. Irrigation costs money but so does relief.

If Governments are to undertake development work in irrigation and achieve the results and benefits indicated, then some references to the various problems affecting company projects and irrigation districts may be in order. On this assumption it is the purpose of the author to deal with some of the difficulties experienced in the development of irrigated lands. These relate to settlement, to the adaptability of settlers to irrigated lands, to the advice and direction which new settlers require, to the effect of market facilities on the success of irrigation projects and in general to the economic needs for future irrigation developments.

Settlement

Early undertakings in the development of irrigation projects seem to have consisted of locating an area of land suitable as to soil, topography and water supply, building the irrigation works and then looking for settlers. The result has been large expenditure for works (in which dams, reservoirs, and main canal make up 60 to 80 per cent of the total cost) to be followed by the lapse of years of time and the addition of sundry overhead expenses in interest charges, colonization and maintenance costs before the works were even partly utilized. The larger the project the greater the disparity in the ratio of costs versus settlement and revenue.

In more recent years irrigation districts have been formed where the lands were already partly occupied or were at least in private ownership. In these districts, the settlement problem was partly solved and perhaps in some degree market facilities were available either through local centres of business and in surrounding grazing lands and livestock occupations. The success of these irrigation districts has varied according to the degree to which settlement was completed, to the development of markets and to the adaptability of those on the land to the changes from their previous occupations to that of irrigation farmers. These advantages have put irrigation districts a long step ahead of projects which had to start with raw and unpopulated lands.

In the colonization of irrigation projects and districts, some care has been taken in the selection of settlers, but in the problem at hand where groups of people in these drought areas are under consideration having various capabilities and resources, it is apparent that something more than the usual facilities for help and direction will be necessary if most of them are to attain reasonable success, should irrigation be provided for them.

As a general policy in the settlement of irrigated land, a trial of a prospective settler's capability or adaptability should be obtained before any final agreement for permanent land tenure is entered into. To this end a form of lease-option for purchase is advised for a stated period, sufficient for a man of ordinary attainments to prove himself. The following is quoted from the preamble of lease-option agreements in use on two projects:—

"And whereas irrigation farming is a very specialized type of farming and it is not proposed to enter into an agreement for sale of irrigated land unless and until the lessor is satisfied as to the ability of the lessee to successfully carry on farming operations thereon and unless and until the lessee has fulfilled the terms and conditions of this lease to the satisfaction of the lessor."

The terms and conditions as a measure for a reasonable showing in farm operations may be varied to suit the peculiarities of different projects.

The lease-option gives certain advantages to the prospective settler in getting started on the land without the handicap of book charges in water rental, taxes and land charges which will occur under any usual land or water contract. It has a psychological effect on the attitude of the individual in his knowledge that he is on trial but with some security beyond that of a renter. On the other hand, it safeguards the project against misfits whereby in the fair discretion of the project or district, the lease-option may be allowed to terminate at its date of expiry and not be renewed.

Adaptability of Settlers to Irrigated Lands

The individuals who have settled on irrigated lands in recent years are very largely farmers who have been previously engaged in growing wheat by dry farming methods and generally come from the drought areas. Practically no farmers leave good dry-farming areas and go to the irrigated districts. They are successful and satisfied to remain where they are as wheat growers. Those who come from the drought areas have suffered the handicaps common to farming operations in those areas and in consequence of this they are usually poorly equipped to start farming anew anywhere, least of all under irrigation concerning which they have had no experience. Irrigation presents many new problems to these farmers. They are advised that their lands should be prepared for irrigation and that they may grow various kinds of crops. They encounter problems in irrigating the land which differ in every quarter section. They are advised to irrigate the land sufficiently and uniformly and are told not to put on too much water as it will wash out plant foods and water-log the land. They are confronted with new weed problems and are advised to rotate crops and carry on mixed farming. They become somewhat bewildered.

The Dominion and provincial governments have carried out experimental work extensively for dry farming and livestock operations and less extensively for irrigation farming. The work done, in a general sense, has been experimental and to a less extent demonstrative, particularly as it may relate to general farm economics. Various illustration stations have also been used here and there, where demonstrations are obtained on small tracts of land in the hands of farmers having some capabilities and perhaps particularly a tractability to advice given. These things are necessary if these stations are to show commendable results.

The capable and practical farmer looks to the government agricultural station as a place from which he may obtain advice and from time to time he will visit the station. He is able to absorb what he sees and put into practice what he considers to be to his economic benefit. The less capable farmer neither visits the station nor enquires nor does he read. He looks on the station as experimental. If by chance he should visit it he may be impressed by the volume of buildings, equipment, lawn, trees and good crops which he attributes to the amount of money back of it all and promptly dismisses any idea of putting into practice most or all of what he sees because of his lack of resources. It is probably not unfair to state that 75 per cent of all farmers react in this manner.

If successful irrigation farmers are to be created out of a miscellaneous group and this is to be accomplished within a reasonable time, it is essential that advice and demonstrations not only must be virtually brought to them, but for economic reasons, the farming operations demonstrated must be limited and carried out on a basis comparable with that of a farmer having average resources in his possession or available to him if reasonably assisted.

To this end it is advised that irrigated farms, on a unit in size best adapted to the peculiarities of any project and its market facilities, should be started and carried on under the auspices of the Dominion or provincial governments. The work done should be capable of copy by the average farm settler with his limited resources and have as its objective farm and livestock profits and a comfortable farm home.

If the test proves successful and good results are obtained, the demonstration would be self-sustaining and profitable both directly and indirectly to the governments:—profitable directly, because it would return more money than is spent on it, but what is more important, profitable indirectly, because these farms by close contact, would aid and speed up hundreds of irrigation farmers in their business of making a successful living, resulting in increased business activity in other lines of industry throughout the country.

Markets for Irrigated Farm Products

The growing of wheat has been and is the primary farming industry of the prairie provinces. The farmer who goes from the drought areas to the irrigated districts continues to have wheat growing foremost in mind. He knows how and when to plant and harvest wheat and that he will have a cash market for it as soon as it is in the elevator. He will continue to grow wheat on irrigated lands but in the course of a few years he will find that his lands have become weedy, that soil fertility is depleted because of continued grain growing and that yields are becoming less and less. He is advised that crop rotation in alfalfa or hoed crops will clean the land and that soil fertility will be improved by alfalfa, sweet clover or other legumes. Hoed crops involve a considerable amount of work which is more than the individual farmer can undertake over a large area, moreover hoed crops require a market.

Industries designed to take the products and by-products of farms lag behind production on new irrigation projects. Dairies, sugar beet factories, canneries and other industries used in processing and handling the products of irrigated farms, are not built until there is a demand for them and until it is evident that when built they can be operated at fair working capacity.

An irrigation project will care for the feed requirements of stock from a very large area of range land but there is a limit to the availability and accessibility of range lands by which irrigated areas can be benefited. One irrigation project of 125,000 acres, all irrigated, grows hay crops on about 20,000 acres or one-sixth of the gross area. A part of the hay is required for farm use and there is surplus hay for sale. The remainder of hay, plus stubble pasture from the project at large, meets the feed requirements for 3½ million acres of range. In the crop requirements for wheat, the growing of which will continue, one-fourth to one-third of the gross area of land should be under crop rotation, or roughly, excess hay considered, twice the area mentioned in the above example. But there is not another 3½ million acres of available and accessible range land. On another project 4,000 acres of hay out of 35,000 acres irrigated, more than meet the requirements of about 400,000 acres of range.

There is a direct and mutual advantage in the relation of the irrigated farms and the range up to a point, but insofar as the irrigated lands are concerned, that point is too quickly reached, at least under present range conditions, for want of range area. No large project can properly succeed in any fair relation to its costs if dependent only on the stock which can be grazed on accessible range lands.

It is probable that by good conservation of the range, more stock may be pastured on it. It is also possible and advisable that more stock should be raised on irrigated pastures of domestic grasses and sweet clover, and more extensive feeding operations carried on, subject to advice to the individual farmers regarding the business of feeding and marketing livestock, about which the grain farmer has little knowledge. No effort should be spared to create larger and more active livestock markets by which prices may be better stabilized and greater encouragement given to the business of fattening stock.

Another irrigation district is an example of well-balanced agriculture. This district contains about 21,500 acres all irrigated. Approximately one-third of the area is in grain. Another one-third is in crops of sugar beets and canning products, one-sixth in hay crops and the remaining one-sixth in seed crops, pasture, etc. The average farm unit is 69 acres, although by competent authority, the most economic unit for this district is considered to be 80 acres. An average of 10,000 sheep and 500 cattle are fed here per year. Approximately 450 field hands are employed alternately on lands growing canning products and sugar beets and 250 are employed in the canning factory itself during the factory run. The car loading of produce out of the district in the year 1937 approximated 1,240 cars including as a side-line to irrigation, 5 cars of honey. Approximately $25,000 per year is paid as sales tax on canning products.

It is axiomatic that outgoing shipments create a large import movement in foodstuffs, textiles, machinery, etc. Thus transportation and employment is created reaching distant points. The project has been operating about 20 years, its people are contented and are making money and good homes.

Still another example is that of a small irrigation project in a ranching district situated in the foothills of the Rocky Mountains. The surrounding area is devoted to summer pasture for cattle and sheep. Winter feed for breeding stock is an essential requirement and a needed protection during winter storms and deep snow. Irrigation is used on the natural prairie from which good crops of hay are obtained, and also on fields planted to timothy, red top, clover, etc., and oats for green feed. The lands are rolling and steep and there is little other than hay crops and small garden produce by which the district as a whole can materially benefit by irrigation. The project is nevertheless a valuable asset to the livestock industry of the neighbourhood. Thus does another factor enter into the value and use of irrigated lands, where such lands can be irrigated within reasonable limits of cost.

In the older irrigation projects industries for processing farm products are established or may be reached with permissible transportation costs. They provide a dual advantage to the irrigation farmer. For example—sugar beets produce a high yield-value in the crop itself and high yield-value for other crops the subsequent year. The crops have been rotated and the land kept clean. Canneries provide a similar advantage. Dairies provide for diversification and rotation of crops of hay, coarse grains, vegetables and pasture. These advantages accrue to the farmer and indirect benefits accrue to the country in increased taxes on the land and in excise duty and sales taxes of processed goods. Transportation and employment are increased.

The sale of sugar bears an excise duty of one cent per pound, concerning which the following figures are of interest. The amount of excise duty on sugar from two factories at Raymond and Picture Butte, Alberta, in 1936, was $653,991. The area of land planted to beets was 18,326 acres, hence the excise duty in one year was the equivalent of $35.68 per acre. This is considerably above the total sale value of the land and water on which the beets are grown. The excise duty paid on sugar from the Raymond factory in five years, 1932 to 1936, and in one year from the Picture Butte factory (this factory having first started in 1936) was over $2,792,000. This sum would build two factories. In 1936, 2,850 men were employed in the fields and 650 in the factories during the factory run. The average yield-value of beets per acre was $73.95 and production costs $40.46. In 1937, these two factories paid out $386,000 for coal, lime rock, coke, bags and boxes and $545,000 for railway freight. It is estimated in the United States that a factory of 1,000 to 1,200 tons capacity per day will directly and indirectly give a living to 10,000 people.

Thus there exists a variety of conditions in the use to which irrigated lands may be put. Conditions may lend themselves to the growing of specialized products according to location and markets. Variations will occur in the size of economic farm units according to use and kinds of products grown. While the growing of wheat will be largely continued on irrigation projects, it is the side lines of agriculture and livestock that make the difference between farming by irrigation and dry-farming methods. It is in the diversification of crops that a step is taken toward that balance between agricultural and livestock production which the prairie provinces so sadly need. It is in securing the indirect benefits of increased national wealth, in taxation direct and indirect, in transportation and employment, and in a busy and self-sustaining citizenship, that the cost for irrigation development is warranted as a national undertaking. It is not a matter for private enterprise.

Economic Limits in Irrigation Development

In the history of irrigation development during the past, contentious problems have arisen as to the price for land and water, together with costs for operation and maintenance (or water service charges) which can be paid for by farmers out of the products of the land. It is evident that this may vary according to crops, markets and not least of all to the capabilities and resources of the individual farmers.

In the Province of Alberta in 1936, a commission was formed to inquire into various phases of irrigation development in all irrigation projects. The commission consisted of one appointee each, chosen by the Dominion and provincial governments respectively, with a chairman to be selected by the appointees of the two governments.

The Order-in-Council listed for enquiry various things, among which were the following:—

(1) the value of land with water right, as determined by the possibilities for production of crops and livestock on irrigated land of good quality.

(2) the ability of farmers of average attainments in resources, industry, management and agricultural knowledge to pay for land with water right, having regard to economic conditions over a period of years.

The Commission made exhaustive enquiry over all projects in the province. In dealing with item (1) in its report the Commission stated:—

"It is apparent that the potential possibilities for the production of crops and livestock depend upon many varying conditions and upon many variable factors. Some of these are as follows:—

(*a*) The quality of the soil.
(*b*) The production of specialized crops and elimination of straight grain growing.
(*c*) Proper rotation of crops.
(*d*) Maintenance of high soil fertility by recognized methods.
(*e*) The skill, business methods, and willingness of the individual farmers."

Under item (2) the Commission stated:—

"The Commission has endeavoured to arrive at an average ability to pay, based upon average production having in mind average capacity and average conditions."

With respect to the value of land with water right, the Commission fixed a price for several irrigation projects at $20 per acre for land having a rating of 70 per cent. This is equivalent to a value of $28.57 per acre for land having a rating of 100 per cent. Rating is established by soil, topography, location and water-area factor. Where a division is made in the value of land and water right, water is valued, according to location, at four-sevenths to six-sevenths of the combined value for land and water.

With respect to "ability to pay," the Commission based its findings on the production of wheat, oats and hay or pasture, subject to yearly crop shares to be delivered by the farmer. The Commission stated, "According to this assumption the crop share would equal $3.16 per acre."

With respect to development costs the following comment was made: "The Commission has been made fully aware that irrigation authorities now agree that the full capital costs of an irrigation project should not be charged up to the land immediately benefited. The conversion of a non-productive area into lands intensively farmed benefits not only the irrigation farmer but also the community, the province and the Dominion, as well as many private enterprises such as railways and factories."

Future Irrigation Development

In the general scheme of things which must be brought about to rehabilitate the drought areas of the prairie provinces, it is apparent that irrigation will take a prominent part. Irrigation is the only means by which certain areas of land can be made productive and habitable with any degree of success to the people, rural and urban, who now occupy these areas or who may move to these areas from localities which cannot be irrigated. Reference has already been made to the need of a shuffling of people and occupations in an effort to get all of them into gainful pursuits.

In these circumstances there arise various important lines of investigation in deciding upon future action and policy:—

Firstly—What areas of land can be irrigated within practical limits of costs for construction and maintenance coupled with relative advantages or disadvantages in colonization, markets, etc., and on what areas can no rehabilitation of the existing conditions be made, so that their inhabitants must be moved to other localities or left to shift for themselves with continued problems of relief?

Secondly—What is to be the disposition of the people in these latter areas who will move or can be moved to other localities, and if to irrigated lands, where? For example, are they to be moved to new projects to be built or to existing projects or extensions thereof which are already under way and which provide relatively immediate opportunities?

Thirdly—Existing irrigation projects in Canada have struggled along for the past fifteen to twenty-five years, but not one of them operating as an irrigation district or a private company will recover the investment costs nor reach a position of being 100 per cent completed, if that point can ever be reached. These projects have been financed and built by private funds, the repayment of which, in the case of irrigation districts in Alberta, is guaranteed by the province. No one suggests that these debts owing to individuals should be dishonoured. It would be in the interest of the community if these projects were brought to a better state of self-sufficiency and by the same act save costs for future irrigation requirements by the amount of developments already made.

Fourthly—Inasmuch as water resources are an important national asset to the needs of the present and in the years to come, no effort should be spared to retain these assets. Canada is jointly interested in certain international water resources. It is indeed fortunate that this joint interest exists between two friendly countries. In both countries use of water is a perquisite to the right of use and our friendly neighbour to the south is not neglecting to use its available water resources. Tenure of right is guaranteed by treaty but it is not inconceivable in the course of time that diligence in the use of water on the one hand may abrogate a potential right weakened by negligence and non-use. The water resources of the St. Mary's and the Milk rivers and their tributaries are points in question in which Canada's potential use of water lies largely if not wholly in irrigation.

In conclusion, no better or apt statements and contrasts to the needs of the problem in Canada could be made than are contained in an address entitled "Conquering Climate," delivered by the Hon. Harold L. Ickes, Secretary of the Interior for the United States, at the banquet of the Seventh Annual Convention of the National Reclamation Association held at Reno, Nevada, October 13th, 1938.

The following paragraphs are quoted from this address:—

"One of the celebrated quips of Mark Twain, who once lived in an historic camp near Reno, was that everyone talks about the weather but no one ever does anything about it. Here in the West so very much has been done through the conservation storage and control of water and irrigation to mitigate the effect on an arid climate that Mark Twain's wisecrack is no longer in point. We are doing something about it; we are conquering an arid climate." . . .

"Even during more recent times, now happily on their way out, many in other sections that are blessed by nature with a humid climate, did not understand the need for irrigation. . . . There was no clear and general understanding of the conditions that make irrigation essential to habitation of much of this region which constitutes one-third of all the United States. There was little sympathy with the titanic efforts to make the West livable; to make it contribute to the wealth of the country; a sturdy block in our up-building nation. With a clearer understanding of the national benefits of irrigation that time has all but gone." . . .

"Federal Reclamation has resulted to date in providing water for 3,000,000 acres of land that formerly was so dry as not to be usable. On this irrigated land 51,834 farms and 254 towns with a combined population of almost 900,000 persons have been created. When completed, projects now under construction will add another 2,500,000 acres to lands irrigated in the West. On this new land another 800,000 or more persons eventually will live." . . .

"These and the other smaller but still important projects now under construction hold a great promise for the West. In years to come the power from their dams and the water from their reservoirs will work side by side in arid valleys to create new empires rivaling those which already in like manner have sprung from the sage brush. They will support homes, farms and cities and bring renewed hope to hundreds of thousands. Prosperous new communities will take their place within these states and pour additional wealth into the trade channels of the whole nation." . . .

"Adhere to a sound and wise reclamation programme and you will protect the future of the West. Abuse it to satisfy a present greed, either for land at a reckless cost or for political power, and you will drive your children and their children out into the waste lands instead of sheltering them in safe homes on projects yet unbuilt. To-day engineering skill, science and public approval are ready to support a reclamation policy that is economically sound and socially desirable."

Chateau Laurier, Ottawa

Headquarters for the Annual General and General Professional Meeting, February 14th and 15th, 1939.

(See announcement, pp. 24 and 25)

Abstracts of Current Literature

Contributed abstracts of articles appearing in the current technical periodicals

THE CONTROL OF DIESEL RAIL CARS

By Major W. G. Wilson, Diesel Railway Traction, Supplement to the Railway Gazette, November 25th, 1938

Abstracted by J. L. Busfield, m.e.i.c.

This article is abbreviated from a paper read before the Institution of Mechanical Engineers on November 13th, 1938. There are two alternative systems of transmitting power from the Diesel engine to the wheels of a rail car, namely electric transmission, or mechanical transmission.

Some of the electrical control systems keep the output of the engine constant at a certain position of the controller. The main generator exciting windings in most of these systems are so arranged that as the voltage changes the current is varied to keep the generator load constant. In other systems the generator voltage is regulated through the engine governor in such a way that output for each working cylinder is maintained constant.

The author describes in some detail the Brown Boveri-Sulzer system of electric control, and the English Electric torque control system.

Under mechanical transmissions various types of gearbox are described, first is the Wilson epicyclic gearbox, which is pre-selective and by the rotation of the cam shaft the driver can set the mechanism in such a way that when the gear engaging lever is operated the selected gear will be picked up and engaged. Either electric or compressed air operated mechanism may be used.

The Mylius gearbox is a constant-mesh spur gear drive pneumatically operated. The gear control is pre-selective and electro-pneumatic valves are used for both pre-selection and gear engagement.

The Ganz mechanical system is a constant-mesh all-gear transmission employing plate clutches and operated by compressed air. With the change speed gear neutral, no air can be applied to any of the gear operated systems. When the gear lever is moved to the first position air is admitted to the cylinder which disconnects the drive friction clutch attached to the engine. The arrangement is such that it is impossible for two gears to be engaged simultaneously as the valves have an overlap and provide a neutral speed between the gears.

Reference is also made briefly to the application of fluid couplings and variable torque hydraulic transmission.

POLAROID WINDOWS IN PASSENGER TRAINS

From an article "Electric Heat and Controlled Daylight," the Railway Electrical Engineer, December, 1938.

Abstracted by R. G. Gage, m.e.i.c.

An interesting application of polaroid has been made in the windows of an observation car of a recent train put into service by the Union Pacific Railway. Each of the windows consists of two polaroid discs 27 inches in diameter. The outer disc is stationary and the inner one may be rotated through 90 deg. by turning a small handle or knob. Dehydrated sash are also installed in each window, consisting of an exterior plate glass and an interior safety glass. A complete cycle from minimum to maximum transmission of the windows occurs with 90 deg. rotation of the inside circular plate.

To visualize this action of polaroid each light ray can be thought of as being something like a tiny metal rod and the polaroid can be thought of as a slot that flattens the rod into a ribbon when the rod has passed through it. In every inch of a sheet of polaroid, there are billions of optical slots formed by tiny parallel crystals embedded in the polaroid material. When the slots in the second sheet of polaroid are parallel to the slots in the first the ribbons of light will pass through unchanged. If the slots of the second sheet cross those of the first at a slight angle, some light passes but part of the ribbon is shaved off. But if the slots in the second sheet are turned at right angles to those of the first, the light is blocked altogether.

In the open position the polaroid screens pass about 30 per cent of the total light flux, the equivalent of light shade sun glasses. In the closed position the screens pass only .5 per cent of the light; 99.5 per cent is cut off. The colour change is barely noticeable in the open and intermediate positions. It is approximately neutral with a barely noticeable absorption of the blue. In the closed position the colour is deep purple-black. The ultra-violet absorption is substantially complete below 3,800 Angstrom units including those bands generally considered undesirable in vision.

The use of a polaroid screen in the window tends to make the sky look dark. This is because a large portion of the sky light is reflected light and hence polarized. The same is true of light reflected from the surface of water. Total energy consumption is about 73 per cent, including infra-red radiation in the dark position. This means that the air-conditioning system is relieved of somewhat more than two-thirds of the sun heat through the windows when the screens are closed.

TRANSPORTING THE GRAIN HARVESTS OF THE WORLD

Abstract of paper by Mr. Cecil Bentham in Engineering, November 11, 1938

There are some 2,000,000,000 of people on this planet who have to be fed, and for a large proportion of the world's population bread is a staple food. The production and distribution of the grain harvests of the world is therefore a matter of universal interest, and one with which virtually every form of transport by land and water comes into contact.

There would be great advantage in free interchange of wheat not only from the point of view of quantity but also from the point of view of quality. Geographical conditions have imposed upon Great Britain the necessity of importing wheat; moreover, the home-grown product cannot compete in all respects with wheat imported from other countries. Wheat is the most important of the grain crops and its cultivation is spread very widely over the surface of the world. This ensures a continual supply, which is of great importance to the British Isles, and simplifies the overseas transport by creating a more uniform factor for shipping and other transport services. The total world production of wheat, maize, barley, oats and rye amounts to some 400,000,000 tons annually, all of which has to be transported to the consumer, who may be situated in industrial districts remote from the harvest fields, or in a foreign country. Approximately 370,000,000 tons of grain are consumed in the country of origin or in adjacent countries available by road, rail or water transport. An average quantity of about 30,000,000 tons of grain is transported annually across the ocean from one continent to another. It will be observed that this amount is only 7½ per cent. of the total production, and although there is a tendency for this exportable percentage to receive major attention in Great Britain, it is unwise to lose sight of the fact that practically all grain is transported some distance in the country of origin—in some cases over thousands of miles. The British Isles is by far the largest single importing country in everything except rye.

The great bulk of the world's grain is produced in those countries which neither export nor import any large quantities of grain. On account of their relatively small populations, Canada, the Argentine and Australia are able to rank as the world's greatest exporters of grain, although their actual production is less than that of many other countries. Canada, for example, with a crop representing only 5.5 per cent of the world's total wheat production, is, nevertheless, able to provide nearly half the total world exports of wheat. The Argentine, with only 8.4 per cent of the world's maize production, supplies 71 per cent of the total world exports of maize. At the same time, all three of the great grain exporting countries possess enormous undeveloped reserves of production. When studying the problem of grain transport, the relative importance of bag and bulk handling necessarily arises; although there is a world-wide tendency to change from bag to bulk, progress is slow. Approximately 300,000,000 tons are still transported in bags and, at some stage, are stored in this manner. Approximately 110,000,000 tons are transported in bulk throughout or at some stage of transit.

THE COKE AND GAS INDUSTRY IN CANADA, 1937

Dominion Bureau of Statistics, Ottawa

Abstracted by A. A. Swinnerton, A.M.E.I.C.

This publication gives detailed statistical information regarding the production of coke and gas, imports and exports, distribution, costs, wages, rates, etc. A brief summary is as follows:—

Coke produced during 1937 amounted to 2,570,385 tons with a factory selling price of $18,466,068, and gas manufactured amounted to 46,131,322 M ft., valued at $19,922,809, and other products worth $3,314,052. The total value of products, $41,702,929, was 4.6 per cent greater than that of 1936.

Thirty coke and gas works were operated in 1937, of which 17 were in Ontario. Approximately 90 per cent of the coke was produced in by-product and beehive coke ovens, and about 10 per cent from gas works. Of the 2½ million tons of coke produced, approximately one million was sold for domestic use, the remainder being used for metallurgical purposes, for fuel and water gas production at the works, or for other purposes.

Coke imports dropped from 610,000 tons in 1936 to 420,000 tons in 1937, while coke exports increased from 18,000 tons in 1936 to 37,000 tons in 1937.

Of the 46 million M cu. ft. of gas produced, approximately 76 per cent were from by-product ovens and 24 per cent from gas works. Of the 15 million M cu. ft. sold, about 55 per cent was from by-product ovens and the remainder from gas works. Most of the remaining gas was used as fuel, either at the producing plants or at their associated metallurgical works.

The number of customers served with manufactured gas, in 1937, amounted to 476,965, the total length of distributing mains was 3,729 miles, the average calorific value of gas ranged from 450 to 533 B.t.u. per cu. ft., and the price varied from $2.50 to $0.65 per M cu. feet.

THE DESTRUCTIVE DISTILLATION OF COAL

Melchett Lecture to the Institute of Fuel by Prof. R. V. Wheeler, Journal of the Institute of Fuel, October, 1938, also Engineering, October 21, 1938

Abstracted by A. A. Swinnerton, A.M.E.I.C.

This lecture is a review of the work carried out by Prof. Wheeler and his associates, from 1908 onwards, for the purpose of elucidating the constitution of coal, a subject which has proved to have direct application to two problems of safety in coal mines—coal dust explosions and spontaneous combustion of coal.

The work commenced, in collaboration with M. J. Burgess, with some observations upon the volatile products evolved from coal at carbonizing temperatures from 500 to 1,100 deg. C. These preliminary experiments indicated a definite decomposition point between 700 and 800 deg. C., below which paraffins were evolved from the coal, and above which a great increase in the evolution of hydrogen. A study of the composition of the gases evolved led to the conclusion that coal contains two types of compounds, and that the hydrogen-yielding constituents were derived from the celluloses and the paraffin-yielding constituents from the resins and gums of the coal-measure plants.

In 1913, in association with A. H. Clark, it was found possible to separate the "resinic" and "cellulosic" fractions by treating coal with pyridine and chloroform. While the deductions from these early experiments were not entirely in accord with the results of later work, this investigation indicated the possibility of resolving coal into a number of simpler units.

Attention was, therefore, next directed to the liquid products, and by 1914 a technique had been developed for distilling coal in a vacuum, which enabled the liquid products to be collected and examined. The tar was found to consist of a mixture of hydrocarbons and phenols, and in order to determine the origins of these various classes of compounds, the fractions of the coals, separated by solvents, were separately distilled. It was found that the "cellulosic" fractions yielded phenols, while the "resinic" fraction yielded paraffins, olefines, and naphthenes.

The course of the investigations was then profoundly influenced by the recognition by Dr. Marie Stopes, of the banded constituents of bituminous coal, viz., clarain, vitrain, fusain, and durain. Her recognition of these four types of materials and her insistence on the difference between them has profoundly influenced the course of coal research throughout the world.

Careful separation by hand of each of the banded constituents was followed by distilling each sample separately, and the volume temperature curves for hydrogen, paraffins, etc., were found to follow one another closely, but in definite gradation for vitrain, clarain, and durain. This led to the conclusion that the coal substance contains "reactive" and relatively "inactive" bodies, and that the difference between these three banded constituents lay in the proportion of each that they contain.

Similar studies with dopplerite, a black jelly occurring in peat and apparently bearing the same relation to peat as vitrain does to coal, suggested an explanation of the nature of the reactive material in coal, and thus enabled the observed differences between vitrain, clarain, and durain in the same seam of coal to be explained. Old peat is found to be permeated with ulmins, and this material was believed to have its analogue in coal, in the amorphous cementing material in which the numerous plant structures are imbedded. It was concluded that the reactive material in the clarain and durain consisted of a derivative of the ulmins. Moreover, chemical examination of the ulmins showed that they were the same whether they were derived from clarain, vitrain, or durain from the same coal, so that the ideas obtained from destructive distillation were confirmed. The investigation was in this way divided into two lines, viz., a study of the ulmins and a study of the structured plant entities.

A comparison of the distillation products of the plant remains obtained from coal with those of similar portions of modern plants, showed the similarity in character between the cuticles in each case. With the information obtained in this way, it became possible to trace the contributions made by the major constituents of the coal conglomerate to the various volatile products of distillation of coals of widely varied type. Reference is made to the "rational" analysis of coal whereby the proportions of ulmins, plant entities, hydrocarbons, and resins in coal can be determined, and it is considered that this method of analysis should prove of greater value than the proximate and, even possibly, than the ultimate analysis of a coal.

An apparatus and method of distillation in a vacuum has been developed, by which it is possible to ascertain the contribution of each type of compound to the distillates.

The general conclusions drawn from this work upon the destructive distillation of bituminous coal are as follows:— No active decomposition occurs below 300 deg. C., but the major part of the free hydrocarbons distil unchanged. Slightly above 300 deg. C., the plant entities begin to decompose, giving water and heavy oils. Around 365 deg. C., the ulmins start decomposing, yielding gaseous paraffins water, and oils; the decomposition being completed within some 25 deg. C. of the initial decomposition point. Above this active decomposition temperature of the coal ulmins, the plant entities and the resins decompose and distil simultaneously, yielding a complicated mixture of liquid products. The amount of resins distilled unchanged is usually less than that which can be extracted from the coal by solvents, but it may approach that quantity if the coal also contains a fairly high percentage of plant remains, and it is presumed that some of the resins may be "vapour-distilled" by the hydrocarbon oils evolved from the plant entities.

In conclusion, Prof. Wheeler stated that a knowledge of the constitution of coal was necessary for its efficient utilization, because there are so many problems in the use of coal that cannot be solved without a knowledge of its composition.

HIGH-PRESSURE BOILERS FOR MARINE SERVICE

Abstract of an article in Engineering

At the present time there is available a considerable variety of marine boiler types, more or less in the experimental stage, designed to operate at pressures, steam temperatures, or evaporative ratings to which the overworked epithet "high" may be deservedly applied. Neither the small tube marine boiler nor the latest form can be considered as a separate type, both being merely developments of the water-tube principle; but whereas the small-tube boiler originated as a marine boiler, the modern "high-pressure" boiler of the small-tube variety has been developed primarily as a land unit, although the inherent special features have naturally caused its sponsors to pay attention to marine possibilities as well.

The small-tube marine boiler was hampered from the outset by considerations of space, and was unable to consume efficiently the quantities of fuel that could be thrust into its cramped combustion chamber, even though the firing was by hand throughout the initial development period. The present high-pressure boiler is usually free from this restriction. It is fired mechanically, whether with coal or oil, and knowledge of combustion and heat transference is now both more exact and more widely diffused, so that a skilled designer can predict with some certainty the performance to be expected under normal operating conditions. Professor A. L. Mellanby, in a paper on "Service Results with High-Pressure Boilers," which he delivered recently before the Institute of Marine Engineers, commented specially on this aspect, observing of the six types reviewed that there was "no particular reason why one type should be more efficient than another, well-designed boilers of all classes being equally capable of transforming the heat of the fuel into steam production." Any eventual elimination of competing types, or broad subdivision such as evolved in the case of the marine water-tube boiler, is likely, therefore, to be governed by qualities other than steaming capacity.

The six boilers considered in Professor Mellanby's paper were the La Mont, Velox, Loeffler, Schmidt, Benson and Sulzer designs, and except that all employ tubes of small diameter, there is not much that is common to all six. The first four retain steam and/or water drums as an essential feature, and therefore satisfy one main requirement of those who insist on the necessity for some reserve capacity; although, at the high rates of steaming which these boilers are designed to maintain, the reserve is only small. Only one of all the six, the Schmidt boiler, relies on natural circulation. In two of the remaining types, the Benson and the Sulzer designs, the water is pumped but has a unidirectional flow which can hardly be described as "circulation." The Loeffler boiler uses a pump, primarily to circulate steam, a portion of the superheated steam thus circulated being combined with the pumped flow through the economizer section, causing it to evaporate, and as it is this steam which the pump circulates, the Loeffler boiler may be considered to be in the same category as the La Mont and Velox types, in which a pump circulates the boiler water.

SOIL EROSION

Abstract of a paper by Dr. H. Chatley in Engineering

The calamitous deterioration of the prairie lands in the United States of America and Canada, due to the removal by rain and wind of the humus layer, has drawn serious attention to the effects of human activities on erosion. In China, similar changes have long been in progress and the extension of grain cultivation to the forest and grass lands in North China, Inner Mongolia and Manchuria has been followed by similar excessive erosion there. It is probable that this same process is partially responsible for the deterioration of many other areas, such as Mesopotamia, where the demand for grain led to an imprudent extension of agriculture. The problem is to some extent interlinked with that of deforestation and its possible inter-relation with rainfall.

The simple facts appear to be that the breaking up of ground by ploughing on a sloping surface inevitably leads to perceptibly increased run-off which is accompanied by very greatly increased erosion. The land is thereby deprived of humus, presently becomes sterile, and finally becomes a fan of gullies. The eroded material generally passes into rivers and so to deltas or the sea bed, but in so far as it may fill up swamps or raise flood plains there may be a little compensation. As, however, the eroded material in its later stages is sterile subsoil this may be of no immediate benefit and in any case can only in the rarest cases be comparable with the loss experienced on the sloping lands. In the natural state, prairie lands are covered with a mat of roots which holds back an appreciable fraction of the rain, and, except on very steep slopes, there is very little erosion. Similarly in the forests, the leaves retain a good deal of rain and the soil beneath is covered with scrub, moss, etc., which serves the same purpose as grass in reducing erosion.

PLYWOOD MAKES A BUILDING

By E. H. Horn in Engineering News Record, November 3rd, 1938

Abstracted by D. S. Laidlaw, A.M.E.I.C.

A gymnasium was recently built for a school at White Salmon, Washington, in which the roof and wall panels were of plywood supported on plywood arches. The building, of cruciform shape, contained twelve rigid frame arches of 43-foot span, three in each wing, and two intersecting arches of 61-foot span, all resting on concrete footings, having a clear height in the centre of 20 feet, and legs, all of the same section, 20 feet in length to the eaves.

The arch ribs consisted of a core, 10 inches thick, made up of laminations of 9/16 inch rough sheathing grade plywood, to the edges of which were attached layers of 9/16 inch Douglas fir to take the bending stresses. In these layers, four on the tension and two on the compression side, the 10-inch width was made up with 4-inch and 6-inch strips. All joints were carefully staggered, and the wood was bonded together with glue. Both nails and clamps were used to hold the pieces together until the glue set.

Wall and roof panels, each of a size capable of being handled by four men, consisted of a frame, having verticals at 16-inch centres, and longitudinals top and bottom, all of ⅞-inch by 1¾-inch clear Douglas fir, to which was glued, inside and out, surfacing of 5/16 inch unsanded plywood. Rock wool insulation was placed in the panels as they were fabricated.

In erection, the arches were set up in halves, joined with connectors and steel gussets, and temporary tie rods were inserted for bracing. The wall and roof panels were set to marks on the arches and glued in place. Blind nailing was used to hold the panels until the glue set. Horizontal joints in the walls were used for architectural effect. Vertical joints were routed out and filled in with a spline set in glue and sanded off smooth, this being a patented process.

Frames for windows and doors were set in openings provided, and trimmed in the usual manner. The building was finished with two coats of a synthetic resin base plastic-type paint, sprayed on at a cost of 5½c. per square yard, giving a surface comparable to that of good stucco or masonry. The building has proved economical to heat, and has displayed remarkable acoustical efficiency.

The building was designed by Walter H. Roth, Architect, of Yakima, Washington, and the general contractor was the Speedwall Co., of Seattle, who make a business of prefabricating plywood buildings. The design principles are similar to those developed at the Forest Products Laboratory, Madison, Wisconsin.

THE BELL SYSTEM MEETS ITS GREATEST TEST

By J. S. Bradley, Bell Telephone Quarterly, October, 1938

Abstracted by Trevor C. Thompson, A.M.E.I.C.

This article is the story of the destruction caused by the storm of September 21, 1938, in New York and the New England States, and the mobilized effort of the Bell System to bring order out of chaos and to restore service. It is illustrated by over 100 photographs showing awesome havoc and conditions under which emergency service and repairs were effected.

The disaster started on September 17, when steady rain commenced in New England and Eastern New York. Suddenly, there were floods; the smaller streams and rivers became torrents inundating all the low land of the territory. Though great damage was done by the high water of the two great rivers, the Merrimac and the Connecticut, yet, fortunately, neither reached the level attained in 1936.

Simultaneously, on Sunday, September 18th, a tropical hurricane was born near the West Indies. It raced across the Atlantic, striking the northeastern seaboard and sweeping a path of destruction north as far as Canada. Sustained wind velocities of 90 to 120 m.p.h. were reported, and one gust of 186 m.p.h. was recorded at Harvard University.

This hurricane swept through the flooded country, leaving a path of levelled trees and buildings. The falling trees tore down the utility circuits, isolating whole areas from electric light and power and communication.

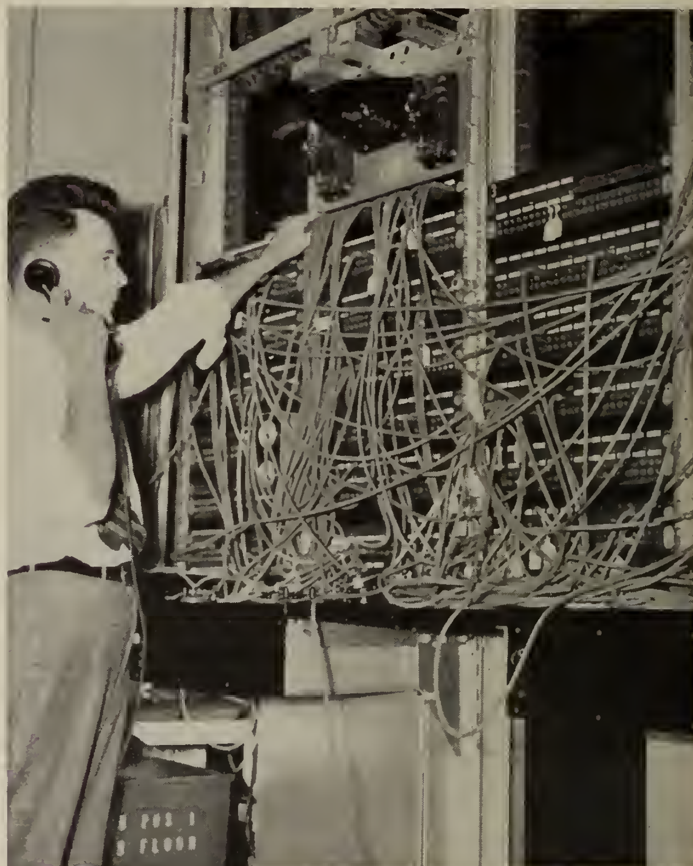
Then following the wind came a tidal wave (properly speaking—a "storm wave") some 15 to 30 ft. high which completely destroyed hundreds of buildings and homes, and left parts of the seacoast almost unrecognizable.

Finally came the last tragedy—fire! Although a holocaust threatened, the fire remained localized, but added to the damage to plant. Its effect raised the already incredible traffic load being handled by crippled facilities.

Eight states: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York and New Jersey, and four telephone companies of the Bell System: New England Telephone and Telegraph Co., Southern New England Telephone Co., New York Telephone Co., and the New Jersey Bell Telephone Co. were directly affected.

Half a million telephones were out of service—in N.J. 35,000, N.Y. 56,000 (of which 30,000 were on Long Island and 15,000 up-state), Connecticut 105,000. Even after a number had been restored, new out of service reports kept coming in reporting trouble caused by damage to plant in clearing other wreckage such as trees from highways, etc. The New England Co. had some 79,000 such cases. To repair the damage the two New England companies estimated the pole requirements at 20,000 poles.

Most of the central offices were able to carry on operations through stand-by power equipment—gasoline engines permanently provided for emergency purposes or portable motor generator units set outside the central offices to charge the batteries within. Measures that had been developed during the 1936 floods were again brought into use and effectively proved their worth. In Hartford, Conn., bulkheads for ground floor windows and doors allowed operations to continue without interruption from abnormal water level alone.



Re-routing "Patches" in Long Distance Building, New York

The failure of the bridge at Chicopee Falls, Mass., carried away important long distance cables. A line was finally shot across the 700-foot wide torrent by a coast guard Lyle gun and crew, brought to the scene by airplane from a Long Island station. The coast guard again provided a similar service near Occum, Conn.

Ultra short wave radio telephone service provided the only telephone communication between Cape Cod and the rest of the world. Over the Keene, N.H.-Boston radio link, composed of apparatus flown from Florida, traffic averaging more than 50 messages per day was handled, reaching peaks of more than 100 messages per day.

In New London, where a brick building next to the telephone exchange was blown to bits, and fire threatened the telephone building, a truck was held in readiness to demolish a fence at the rear should emergency escape be necessary.

Only the complete standardization of materials, tools, records, construction practices, specifications, trained personnel and organization made it possible to cope with the critical situation and to restore service to the half million stations out of service in the record time of two weeks.

Assistance was provided from far and wide in the system, and, no matter whence they came, men could do their work without detailed instructions, and materials and tools would fit all requirements. 2,385 men and 615 trucks were mobilized from 14 Bell System companies to supplement the staff of 3,700 men of the New England companies. These men came from many states, Virginia, Nebraska, Arkansas, Michigan, Indiana, Illinois, with their own trucks, their own tools, their own supervisors, and did a job as familiar to them as if they were effecting repairs in their own home town. Operators from Philadelphia, Cleveland, Detroit, were entrained to New York and flown to Boston.

Enormous quantities of materials were required to restore service in the storm area. Here again it was possible to meet these demands for supplies and equipment only because of standardization and the organization of the manufacturers and suppliers for the companies concerned.

THE FIELD FOR LOW HEAT CEMENT

By H. S. Meissner and W. T. Moran in Engineering News Record, November 10th, 1938

Abstracted by D. S. Laidlaw, A.M.E.I.C.

The authors describe low-heat Portland cement as a special product developed from the research undertaken for the Boulder Dam, containing less lime and more silica and iron, and being ground slightly finer, than standard Portland cement. Up to the present time, the U.S. Bureau of Reclamation has used 4,860,000 barrels of it in four dams, and, at Boulder Dam, the average mill price was $1.46 per barrel as compared to $1.40 for standard cement.

The article reviews the considerations that led to the development of low-heat cement, refers to the experimental program that developed it and to several papers (notably one by J. L. Savage, entitled "Special Cements for Mass Concrete," containing an extended treatment and excellent bibliography of the subject, delivered at the Second Congress of the International Commission on Large Dams, World Power Conference), and presents the principal results of the research.

Low-heat cement generates about one-third less heat than standard, and that more slowly and over a longer period of time, with the result that its benefits are to a certain extent dependent on the shape of the structure in which it is used, as well as on the speed of construction. The growth of strength is shown to be roughly parallel to the production of heat, with a final strength at one year practically the same as that of standard cement. Low-heat cement required considerably longer curing, shows slightly less permeability, and shows better resistance to cracking, than standard cement.

Modified cement is a by-product of the research with low-heat cement, developed to retain the initial strength of standard cement while reducing slightly its heat of hydration. It is fast replacing standard cement on all work for the Bureau of Reclamation, and has been used for some mass concrete work. Modified cement may show no higher final internal temperatures than low-heat cement in mass work, if the construction schedule is such that the next lift is poured before the latter has developed a considerable temperature rise. The resistance to cracking of modified cement is intermediate between that of standard and low-heat cements.

The first low-heat cement was used on the Morris Dam for the city of Pasadena, and it has since been used on the Rodriguez, Boulder, Bartlett, Parker, and Marshall Ford Dams, sometimes for its low heat-producing qualities, sometimes for its resistance to cracking. It was found possible to produce the same slumps with less water, when low-heat rather than standard cement was used, but it was sometimes necessary to blend the two to obtain enough initial strength in the concrete to maintain the construction schedule. It was found possible to produce low-heat cement in ordinary cement mills without material change, except that it was necessary to grind to a fineness giving 92 per cent passing the No. 200 sieve. Manufacturing experience from three mills is quoted.

UNUSUAL CONCRETE RIGID FRAME TEST

Engineering News Record, November 17th, 1938

Abstracted by D. S. Laidlaw, A.M.E.I.C.

When it became necessary, owing to channel improvements, to demolish and replace the Central Avenue Bridge at Glendale, California, a well-designed reinforced concrete rigid frame structure only two years old, the city engineer, J. C. Albers, decided to carry out full-scale loading tests.

The dimensions of the bridge were as follows:

Clear span, face to face of legs, short distance	43 ft.
Width, on centre-line of channel, out to out of slab	60 deg.
Skew angle	25 -24 min.
Length of leg, bottom of footing to top of slab	18 ft.
Thickness of slab at haunch	3 ft.
" " crown	18 in.
Width of footing	6 ft.
Depth of footing	2 ft. 6 in.

The bridge was designed for an H-20 loading on each of the six traffic lanes, following very closely the method of analysis first proposed by A. G. Hayden of the Westchester County Park Commission with 2,000-pound concrete and structural grade steel. No consideration was given to the effect of the approach fills against the abutments. Longitudinal reinforcing steel was placed parallel to the sides of the bridge.

Loading was effected by placing 3,000 pound steel ingots on timbers placed parallel to the centre-line of the channel in a strip about three feet wide at the centre of the span. Stresses were measured on the longitudinal and transverse steel with 10-inch Whittemore strain gauges, or, where there was not room for these, a 2-inch Berry strain gauge. Gauge points were taken on 40 top longitudinal bars at each haunch, and on 40 bottom bars at the crown, as well as at 18 other places on the transverse bars. In addition, the deflection at the crown was taken at three points, and, by means of horizontal and vertical gauges set on timbers cantilevered out from the approach fills, the vertical and lateral movements of bolts set in the slab at the four corners were determined.

The ingots were placed on one-half of the roadway until a load of 129 tons had been reached, and, after a rest of three hours, the same load was placed on the other half of the bridge. The following day, loading was continued on one-half of the bridge until that half carried 231 tons, making a total of 360 tons for the whole structure. After a rest of one hour, loading was continued until an almost uniform load of 430 tons had been placed. The following day, one-half of the bridge was unloaded completely, leaving 250 tons on the structure, which was shortly after removed. Deflection gauges were read while loading progressed, and all the gauge lengths measured at the beginning and end of each loading operation, and again 12 hours after unloading. To test the properties of the materials, several bars and four-inch by eight-inch cores of concrete were cut out.

In the article, some of the test results are given in graphical form. With one side loaded with 129 tons, the stress in the haunch steel was found to be fairly uniform, except that in the loaded obtuse angled corner it rose slightly. The uniform load of 430 tons produced differences in stress in the haunch steel, at one abutment of about 3,000, at the other of about 7,000 pounds per square inch, between the obtuse and acute angled ends, showing that there were definite concentrations of stress at the obtuse angled corners of the bridge. The stresses at the crown showed a definite falling off at the edges, probably due to the influence of the concrete handrails. The movements of the four corners were found to be generally in the same direction, but some of these observations were felt to be of questionable accuracy.

Chairmen of Special Committees for the Annual Meeting

Photos—Left
J. W. LUCAS, A.M.E.I.C. Chairman of Dinner and Dance Committee
Centre
S. H. de JONG, A.M.E.I.C. Chairman of Luncheon Committee
Right
H. E. TREBLE, A.M.E.I.C. Chairman of Registration Committee

Photos—Bottom—Left
J. H. IRVINE, A.M.E.I.C. Chairman of Finance Committee
Centre
R. C. PURSER, A.M.E.I.C. Chairman of Publicity Committee
Right
S. D. LASH, A.M.E.I.C. Chairman of Closing Social Function Committee

Fifty-third

ANNUAL GENERAL MEETING

and

GENERAL PROFESSIONAL MEETING

Under the Distinguished Patronage of

THEIR EXCELLENCIES THE GOVERNOR-GENERAL AND LADY TWEEDSMUIR

PROGRAMME (PRELIMINARY)

TUESDAY, FEBRUARY 14th

9.00 a.m. - - Registration, Chateau Laurier.

10.00 a.m. - - Opening of Annual Meeting.

12.30 p.m. - - Luncheon.

2.30 p.m. - - Resumption of Annual Meeting.
Reception of Special Guests.
Report of Scrutineers.
Retiring President's Address.

7.30 p.m. - - Annual Dinner—
Guests of honour, Lord and Lady Tweedsmuir.
Guest speaker, Colonel Willard Chevalier, "The Engineer faces a New World."
Presentation of Honorary Membership and Prizes.

10.00 p.m. - - Dance.

OTTAWA— TUESDAY AND WEDNESDAY FEBRUARY 14 and 15, 1939

WEDNESDAY, FEBRUARY 15th

10.00 a.m. - - Technical Sessions, Chateau Laurier.
Papers on Western Drought Problems.
American Industry Looks Towards Canada.
The Canadian Malartic Mine.

12.30 p.m. - - Luncheon—Guest speaker, The Hon. J. G. Gardiner, Minister of Agriculture.

2.00 p.m. - - Resumption of Technical Sessions.

8.00 p.m. - - Social gathering (members and ladies) with entertainment.

This meeting will be notable on account of the representation from the Founder Societies of the United States. It is anticipated that the presidents and secretaries of the major societies and of the Engineers Council of Professional Development will all be present.

Photo—top left
J. L. RANNIE, M.E.I.C. Chairman of General Committee

Photo—bottom right
H. V. ANDERSON, M.E.I.C. Vice-Chairman of General Committee

Editorial Comment...

THE JOURNAL

Some time ago the members of The Institute answered a questionnaire expressing their opinions regarding The Engineering Journal, and supplying data in connection with their technical reading. The information obtained in this way was very carefully studied by the Publication Committee, and in due course a report was presented to Council recommending certain changes which it was felt would have the effect of modernizing the Journal and of making it more acceptable to the membership. It was not possible to make the changes overnight, nor was it desirable to make any sweeping transformation which would have the effect of altering the character of the publication which has been firmly established for over twenty years.

There have been improvements in the past few issues, but advantage has been taken of the opportunity in this, the first number of a new volume, to bring into effect additional features which it is hoped will better meet the requirements of the readers.

The size of the Journal has for many years been a subject of discussion. A happy solution has now been reached, whereby it is reduced slightly, thereby facilitating filing, especially of clipped articles, without introducing any of the difficulties which arise in connection with a major reduction in size.

As previously announced a number of very attractive designs for a new cover were submitted by members, but after serious consideration it was finally decided to retain the fundamental character of the present design but with some improvement in typographical detail. In this way the cover has been improved without in any way detracting from the value of its well established character. A new weight and texture of paper has been employed for the cover material.

Certain of the inside pages which have had an established form for many years, such as contents, officers of The Institute, branch officers, also have been changed, with the hope that the use of more modern type and format will have an increased "eye appeal." Similarly, changes in form of types have been introduced with the definite knowledge that there will be a greater facility in reading. Owing to the comprehensive character of Institute activities and the wide scope of professional interests of its members, it has been very difficult in the past to provide sufficient technical papers to meet the needs. It is anticipated that the introduction of the section headed "Abstracts of Current Literature" will agreeably broaden the interest and increase the diversification of the contents.

Perhaps it would be appropriate at this point to remind members that the Journal does not just "happen," nor does it spring from the editorial mind, but to make it effective there must be a degree of support from the membership at large. Advisory members of the Publication Committee devote much time to the selection and preparation of material for the abstracts; news of the Branches can only be published through the co-operation of Branch officers; the personal columns depend on news submitted by members from all parts of the country; and the technical papers themselves are the result of effort on the part of members. Without such support, the Journal could not be maintained at the high level which has already been established. With continued co-operation it is hoped that even new levels may be reached in the future.

THE ENGINEER IN HIGH PLACES

The frequent recent announcements of the appointment of engineers to high executive positions, serve to emphasize the great width of the field in which our profession practises. In Canada, as in other countries, the engineer has satisfactorily filled a great variety of positions, all the way from the humblest in his calling to the most exacting in the land. The proportion of executive positions occupied by engineers is steadily increasing, which would seem to prove that such men are well qualified for the responsibilities of leadership.

It must be inspirational for students and young engineers to read such announcements. To see men who have had just the same professional education as theirs, who started in the same unpretentious manner, and who have attained outstanding success in executive positions, must give them great hope for the future, because it indicates that their education is right, and that the chosen profession offers a field so wide that it will never restrain them if they have the merit and ability to become big men in it.

Karl T. Compton, President of the Massachusetts Institute of Technology, gives some interesting figures on this subject in Mechanical Engineering of November, 1937. After explaining that he has based his calculations on a census and survey of American industry made by Dr. R. H. Spahr, director of instruction and curricula at the General Motors Institute of Technology, he says: "If we examine the influence of the type of college in which the education was secured, we find the following results which, at first glance, are decidedly startling. In one group we consider those who were educated at an engineering or technical college, and in the other group those who attended any other type of college such as liberal arts, law, business, and the like. Here we find that an engineering-college man is 12 times more likely to be found in the presidential position than if he had attended a non-engineering college. He is 5 times as likely to be treasurer, 30 times as likely to be in production, 174 times as likely to be in engineering, and 24 times as likely to be in sales. Grouping all offices together, any engineering-college graduate is 30 times as likely to find himself an officer in American industry as is a graduate of a non-engineering college."

He goes on to say that in a study of the Alumni of his own Institution, he finds that "70 per cent of the graduates of 14 years standing are now holding positions that involve some jurisdiction over the policies of their employing companies. While complicating uncertainties of interpretation are present, I believe that figures such as these must be accepted as evidence that the colleges of the country are making a significant contribution to business leadership."

Up until fairly recent times it has seemed that of the professions only the legal profession had offered the opportunity to reach the better fruit which is at the top of the business tree. It is comforting to know that day by day senior members of our profession have been changing this situation, and proving for us as for the public, that the engineer is capable and competent and much at home in these high places of distinction and responsibility.

THE INSTITUTION OF CIVIL ENGINEERS

Presidential Address

Abstracted by P. L. Pratley, M.E.I.C.

The presidential address of William James Eames Binnie, M.A., President of the Institution of Civil Engineers, dealt with engineering work in the far past, commencing with the great fire at Alexandria, which must have destroyed a vast store of engineering records as well as other contents of that famous library, as much engineering had been done in Egypt and Phoenicia in the previous centuries. One only has to speculate as to how the pyramids were constructed, to realize that engineering principles were understood and applied in those days. The quarries from which the granite came for the various temples inside the pyramids are situated close to the present Aswan Dam, some two hundred miles away from Thebes, and there are evidences from which it can be ascertained that the material was quarried in substantially the same manner as is used to-day.

Mr. Binnie made reference to the engineering of the Romans in pre-Christian times, and to their ideas regarding the nature of materials and forces. Archimedes, who lived between 287 and 212 B.C., is well known to most engineers as the originator of the screw system and also as one who appreciated the practical value of the lever. He is also supposed to have discovered the means of determining the specific gravity of solids by immersing them in water; but in addition to this he was apparently a capable military engineer and actually built cranes with swinging booms which were used for grabbing the prows of galleys when the fleet of the Roman general Marcellus attacked his native town of Syracuse. Mr. Binnie also referred to his own sphere of engineering, that of water supply, when dealing with the exploits of Sextus Julius Frontinus, who was born about A.D. 35, was Governor of Britain in A.D. 80 and was given the office of chief engineer in charge of aqueducts in Rome on being returned from military service abroad. He wrote a book in connection with this work of supplying Rome with water and was evidently much impressed with the importance of the undertaking, and in his introductory sentence makes a statement which might well be remembered by modern engineers,—"I therefore considered it to be the first and most important thing to be done, as has always been one of my fundamental principles in other affairs, to learn thoroughly what it is that I have undertaken." Mr. Binnie then goes on to describe many of the aqueducts which were either repaired or reconditioned or constructed by Frontinus during his very active career and quotes him in another place as having been able to increase the capacity of various aqueducts by the simple method of blocking up the illicit branch pipes through which they were secretly despoiled.

Another interesting quotation which Mr. Binnie reproduces is taken from the report of the hydraulic engineer of the third legion, Nonius Datus, who was transferred to Algeria to supervise the construction of rock tunnels where he found everyone "sad and despondent," as it appeared that the two ends of the tunnel, having been begun from different sides of the mountain, had each been excavated beyond the middle without effecting a junction. Nonius Datus proceeds as follows: "As always happens in these cases, the fault was attributed to the engineer, as though he had not taken all precautions to insure the success of the work. What could I have done better ? I began by surveying and taking the levels of the mountain; I marked most carefully the axis of the tunnel across the ridge: I drew plans and sections of the whole work, which plans I handed over to Petronius Celer, the Governor of Mauritania; and to take extra precaution, I summoned the contractor and his workmen, and began the excavation in their presence, with the help of two gangs of experienced veterans, namely, a detachment of marine infantry and a detachment of Alpine troops. What more could I have done ? Well, during the four years I was absent (on other work), expecting every day to hear the good tidings of the arrival of the water at Saldae, the contractor and his superintendent had committed blunder upon blunder; in each section of the tunnel they had diverged from the straight line, each towards his right, and had I waited a little longer before coming, Saldae would have possessed two tunnels instead of one." It would appear from this that the engineer had a sense of humour in the old Imperial days and was also an expert at drawing up reports that would place the blame where it belonged, namely, on the contractor.

Truly our noble profession reaches back into the ages, and the practice of it, like human nature, has not changed so very much.—P.L.P.

CANADA AND THE REFUGEE PROBLEM

A Subject of Real Interest to Engineers

The civilized world has been profoundly moved by the pitiable condition of thousands of refugees who are being forced to leave their countries in Europe, and for whom no adequate help is yet available. Their paths are beset with difficulties as diverse as their classes and circumstances. Canada is being called upon to shoulder her share of the burden of their rehabilitation, and it therefore becomes necessary to give consideration to ways and means.

Actually the problem is not simply one of dealing with unskilled workers, agriculturalists or small shopkeepers with their dependents. It involves skilled craftsmen, technicians and members of the recognized professions, and should therefore receive the attention of all members of professional or industrial organizations whose interests seem likely to be affected. For this reason, The Institute becomes particularly interested and it seems desirable that readers of The Engineering Journal should have before them some account of the general situation and the steps which are being taken in Canada to deal with it.

With the authorization of the League of Nations Society in Canada there has been recently established a "Canadian National Committee on Refugees and Victims of Political Persecution." Its purpose is to seek to co-ordinate all efforts in Canada on behalf of those refugees in Europe and Asia, both Aryan and non-Aryan, who are being exiled from their homes and deprived of their means of livelihood. This committee held its first meeting in Ottawa on December 6th and 7th, 1938, and The Institute was one of the many organizations which were asked to send representatives. At the request of President Challies, Messrs. M. F. Cochrane and W. H. Munro, M.M.E.I.C., of Ottawa, attended the meeting on behalf of The Institute. The organizations represented also included the Royal Architectural Institute of Canada, the League of Nations Society in Canada, the principal religious denominations, the National Council of Women, the Social Service Council of Canada, the Canadian Welfare Council, and other bodies interested in sociological and philanthropic questions.

After prolonged discussion the meeting adopted a main resolution, which commended the Dominion Government for its participation in the recent refugee conference at Evian, which was called by President Roosevelt. Appreciation was also expressed of the Dominion Government's further actions looking to amelioration of the lot of refugees or potential refugees in Europe. The committee considered that humanitarianism and loyalty to democratic principles make it imperative for Canada to render all possible help in the distressing situation in which these unhappy people find themselves. The meeting further believed that the immigration of carefully selected individuals or groups of refugees to Canada would prove of value by introducing skilled workers and new arts, crafts and industries, and also urged that the Government consider the possibility of making appropriations, in concert with other nations, towards the cost of rehabilitation of such refugees as may be established in other countries.

After this point had been reached, a delegation from the meeting waited upon the Prime Minister and laid its conclusions before him and members of the Cabinet. The interview was cordial, but Mr. Mackenzie King did not commit himself as to the Dominion's course of action.

At a further meeting of the National Committee it was decided that the formulation of an effective educational programme should be a primary duty of the committee, and that a campaign for raising funds must be launched. In order to carry out these objects an executive committee was named, with Senator Cairine Wilson as chairman, and an executive secretary was appointed.

From the discussions which took place at the meeting, and from many communications received by the committee, it seems clear that the Canadian public does not yet realize either the importance of the problem, the urgent need for action, the number of refugees involved, or the effect which a wrong or mistaken course of action in this matter may have upon the future of Canada.

The nature and extent of the emergency were eloquently described by Lord Baldwin in a radio broadcast which he gave on December 8th. He pointed out that there are some 500,000 Jews and more than 100,000 so-called non-Aryan Christians who are being driven from their homes in Germany and deprived of their possessions, and who seek a refuge where they may be permitted some means of existence. There are at least 50,000 children whose parents are appealing to the British Refugee Committee, of which Lord Baldwin is chairman, to take them out of Germany even though the parents may never see them again. And there are many Christian husbands or fathers who have married women of Jewish faith or descent, and who refuse to abandon their wives and their children.

The potential number of refugees during the next five years is much greater than the above figures indicate, since the non-Aryan populations of Lithuania, Poland, Hungary, Rumania, Yugoslavia, Bulgaria and Greece, numbering in all nearly a million souls, would be affected by the pressure upon the whole non-Aryan population of central and eastern Europe which is generally regarded as an inevitable consequence of German ascendancy in those countries

This multitude of refugees, actual and potential, naturally consists of people of the most varied character and calling. But they are largely urban dwellers, some of whom have been engaged in technical or professional work. In their new homes those who have such professional or technical qualifications must either be permitted to compete with the professional men of their adopted countries or some other means of livelihood will have to be found for them. Such difficulties as these make it imperative that plans for migration should be properly co-ordinated and have the support of the public as well as the government in each of the various countries that may be able to offer some sanctuary to the refugees.

The conditions affecting the participation by Canada in this task were outlined to the National Committee by Miss Charlotte Whitton, of the Canadian Welfare Council, in a memorandum in which she urged the necessity for great care and restraint in any action which may be undertaken. In her opinion the committee should not permit itself to be carried away by impetuous action no matter how humane the motive. There were other refugees than those driven out of Germany—refugees in Spain, Poland, Italy, parts of Russia, the Baltic States and in China. As to the Canadian economic problem and the possibilities of absorption, a distinguished Royal Commission had been appointed to make an extensive investigation. The National Committee should confine itself to the very broad principles and not deal with details on which it was not competent to act. Nothing would be worse than to concentrate increasingly larger groups of people in our larger centres of population. The Government should be asked to survey present occupational possibilities in Canada. It should be remembered that only one-third of Canada's land was available for agricultural purposes, the greater part of this was occupied, and a good deal of the remainder was far from roads and other necessary services. Even in the professions there was already bitter opposition to certain forms of immigration regarded as competitive. Finally, attention should be given to the possibility of the Government giving money for the establishment of refugees elsewhere.

Fortunately the press is now beginning to devote space to the refugees and their treatment, and the public is beginning to learn something of the implications of the question. There is a special reason for this interest so far as Canada is concerned. We may well ask whether this vast country, capable of supporting many more inhabitants than at present, can long escape the attention of aggressor nations. How can we effectively defend a huge area which is inadequately populated ?

Perhaps our idealism should be helped out by a moderate admixture of self-interest. R.J.D.

COUNCIL MEETINGS

Another "away-from-headquarters" Council meeting was held at Peterborough, Ont., on Saturday, November 26th, 1938, at which there were present: President J. B. Challies in the Chair; Past-President A. J. Grant (St. Catharines); Vice-Presidents J. A. McCrory (Montreal), E. V. Buchanan (London), and R. L. Dunsmore (Halifax); Councillors W. E. Bonn (Toronto), J. L. Busfield (Montreal), P. H. Buchan (Vancouver), R. H. Findlay (Montreal), A. B. Gates (Peterborough), L. F. Grant (Kingston), O. Holden (Toronto), H. A. Lumsden (Hamilton), J. A. Vance (Woodstock), E. Viens (Ottawa) and the General Secretary. There were also present by invitation officers of the Association of Professional Engineers of Ontario and of the Peterborough Branch of the Institute and others, who were cordially welcomed by the President.

It was decided that the Annual General Meeting of the Institute should be convened at Headquarters at eight o'clock p.m. on Thursday, January 26th, 1939, and then adjourned to reconvene at the Chateau Laurier, Ottawa, on Tuesday morning, February 21st, 1939. (*Note: This has been changed to February 14th, 1939*).

A discussion took place with regard to the general nature of the programme and as to progress with regard to the papers being prepared for the General Professional Meeting to be held on the second day (Feb. 15th) of the meeting. The President reminded members that there would be a very important Council meeting held on the Monday previous to the opening of the Annual Meeting and that the President's dinner would be held on the Monday evening.

A proposed change or addition to section 76 of the Institute's by-laws providing for the name "Component Association" to be applied to a provincial professional association entering into an agreement with the Engineering Institute was approved.

It was also decided to submit to the membership changes to sections 32 and 35 of the by-laws; the former providing for the entrance fees to be as follows: Members and Associate Members or Affiliates $10.00, Juniors $5.00; the latter providing for a pro rata application of the first annual fee.

A discussion took place regarding the proposals for a change in the nomenclature of the Institute membership, as advanced by the committee on Membership and Management, and it was decided that every member of Council should be asked to discuss this matter with his Branch Executive and then come to the Council meeting at Ottawa in February prepared to voice the opinion of his Branch on this important matter, or to communicate such opinion in writing prior to this meeting.

The question of re-organization of the Council which had also been thoroughly investigated by the committee on Membership and Management, also received serious consideration, and it was decided to confirm the decision of the Regina meeting to the effect that for the present it would be inadvisable to make any changes in the constitution of Council.

The desirability, or otherwise, of re-establishing provincial divisions of the Institute, especially for the purpose of facilitating negotiations with professional associations, was discussed at some length, and proposals for setting up such divisions in Alberta and in Ontario were referred to the Institute's Committee on Professional Interests.

The President reported briefly on the plans for a joint meeting with the American Society of Civil Engineers, American Society of Mechanical Engineers, Institution of Civil Engineers, and Institution of Mechanical Engineers in New York during the week of September 4th, 1939.

The President reported that under the aegis of the Committee on International Relations, hc had visited a number of branches of the Founder Societies during his return trip from the West Coast, particularly at Seattle, Chicago and Detroit.

At the request of the Toronto Branch it was decided to make special recognition in the way of prizes for their papers on engineering subjects to four students attending the University of Toronto.

A meeting of the Council of The Institute was held at Headquarters on Friday, December 16th, 1938, with President J. B. Challies in the chair. There were also present Vice-Presidents J. A. McCrory, (Montreal), and H. O. Keay, (Three Rivers), Councillors W. E. Bonn, (Toronto); J. L. Busfield, (Montreal); J. B. D'Aeth, (Montreal); A. Duperron, (Montreal); R. H. Findlay, (Montreal); F. S. B. Heward, (Montreal); A. Lariviere, (Quebec); W. R. Manock, (Fort Erie North); F. Newell, (Montreal); J. A. Vance, (Woodstock), and E. Viens, (Ottawa), Treasurer deGaspe Beaubien, Secretary-Emeritus R. J. Durley and the General Secretary.

A resolution was passed recording the great regret of Council at the death of Past-President Colonel J. S. Dennis.

Past-President J. M. R. Fairbairn, chairman of The Institute Committee on International Relations, attended the meeting at the President's request, and described the arrangements which are being made for the participation by The Institute in an engineering congress in New York to be held next September under the auspices of the Institution of Civil Engineers, the American Society of Civil Engineers, and the Engineering Institute of Canada. He pointed out that a visit to the United States at that time was also being contemplated by the Institution of Mechanical Engineers, and that in arranging for the joint meeting, that Institution and the American Society of Mechanical Engineers were also being consulted.

Together with the President and the General Secretary, Dr. Fairbairn had had several meetings with the officers of the Societies in New York. Dr. Fairbairn was himself proposing to visit London in January and discuss the matter with the British Institutions, after which final arrangements could be decided upon.

Dr. Fairbairn also explained that the question of Canadian papers to be presented at these meetings was receiving attention, and he hoped soon to be able to present a further report. The President briefly thanked Dr. Fairbairn for his valuable efforts in the matter.

Mr. Busfield reported that it had been found advisable to change the dates for the Annual General Meeting from those previously announced, February 21st and 22nd, to February 14th and 15th. This change was approved.

With reference to the suggestion regarding the setting up of a Provincial Division in Alberta, which had been received from the Calgary and Edmonton Branches, it was pointed out that immediate compliance with this request might lead to some conflict with the activities of the existing Alberta sub-committee of The Institute Committee on Professional Interests. It was noted also that a similar situation would exist in Ontario should a Provincial Division be set up there. After considerable discussion it was decided that the chairman of The Institute Committee on Professional Interests should take the matter up further in regard to Alberta, and that, with two Ontario councillors, he should confer with President Muntz, who had suggested a Provincial Division in Ontario, with regard to the best method of having the Ontario members of The Institute represented in any conference which might take place with the Association of Professional Engineers of Ontario.

Four resignations were accepted; one Member was reinstated, and three Life Memberships were granted.

The Secretary presented a list of members of all classes who are in arrears for three years or more, and from whom no reply had been received to various communications, including a special letter on July 21st, 1938. On the recommendation of the Finance Committee it was unanimously resolved that these members be advised that unless a remittance or some communication is received from them by the end of the year their names will be removed from the list of members.

The names of the newly elected officers of the Vancouver Branch were noted.

A resolution was presented from the London Branch deploring the apparent absence on the engineering staff for the proposed Falls View Bridge at Niagara Falls of any Canadian consulting engineer. Mr. Vance having explained the somewhat complicated situation which now exists regarding the construction of this bridge, it was decided that the President should take the matter up with the Minister of Highways of Ontario.

A letter was presented from Mr. R. C. Chapman, the Secretary of a Joint Committee on Engineering Co-operation Overseas, which has been established by eight of the principal British engineering institutions. This letter suggested that if co-operation with the Engineering Institute could be arranged, the purposes of the Joint Committee regarding the members of British institutions who may be resident in Canada would be materially furthered. The chairman of the Joint Committee, Mr. F. Gill, could come to Canada during February next, following a visit he is making to New York. After discussion the General Secretary was directed to write inviting Mr. Gill to attend the Annual Meeting of The Institute in Ottawa, and Dr. Fairbairn kindly undertook to discuss the whole question with the institutions when he is in London, assuring Mr. Chapman that the Engineering Institute will welcome any opportunity for co-operation.

Council noted with appreciation that Lieut.-Colonel C. G. DuCane, O.B.E., M.E.I.C., had presented to The Institute library a facsimile reproduction of the first minute book of the Smeatonian Society of Civil Engineers, which is believed to be the oldest engineering society in the world, and which is still active. The thanks of the Council were accorded to Colonel DuCane for this valuable addition to the library.

A letter was presented from Mr. C. A. Magrath accepting Honorary Membership in The Institute and expressing his thanks to Council for the honour.

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

Elections		Transfers	
Members	2	Assoc. Member to Member	3
Assoc. Members	3	Junior to Assoc. Member	1
Juniors	4	Student to Junior	3
Students admitted	15		

PRESIDENTIAL ACTIVITIES

At noon on Tuesday, December 6th, 1938, the President and Past-President J. M. R. Fairbairn attended a meeting in New York of a committee of members of the Board of Direction of the American Society of Civil Engineers which is arranging a programme for the congress of British and American engineers in New York between September 4th and 9th, 1939, under the auspices of the Institution of Civil Engineers, the American Society of Civil Engineers and The Engineering Institute of Canada. The same evening these representatives of The Institute were guests at a dinner at the Engineers' Club, New York, of the Board of Direction of the American Society of Mechanical Engineers prior to that Society's Honours Night. The next evening they were guests at the Annual Banquet of the same Society.

The President presided at the regular December meeting of Council at Headquarters on Friday evening, December 16th.

Accompanied by Councillor Newell, chairman of the Council's Committee on Professional Interests, and by the General Secretary, the President spent the 18th of December at Arvida, as guests of the Saguenay Branch. The following evening the same party were guests of the Quebec Branch at dinner at the Chateau Frontenac.

At Ottawa on December 22nd, and at Toronto on December 28th, the President, Past-President Fairbairn and the General Secretary had important conferences with Government officials and members of The Institute regarding arrangements for Canadian participation in the congress of engineers that will take place in connection with the World's Fair in New York next September.

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

HONORARY MEMBERSHIP

Charles Alexander Magrath, LL.D., F.R.S.C., HON.M.E.I.C., D.T.S., O.L.S. This distinguished name has been added to the roll of Honorary Members of the Engineering Institute of Canada, by unanimous ballot of Council, as required by the Institute's by-laws.

Mr. Magrath was born in North Augusta, Ontario, in 1860, and has lived to enjoy an international reputation as an expert in the conservation and use of water resources. He was a pioneer in the development of the West; a prominent surveyor with a commission to practise in every province; and a successful engineer specializing in irrigation practice, and in general water resources investigations. In view of these phases of his career, it is very appropriate that Mr. Magrath has prepared a paper for presentation at the Annual General Meeting to be held in Ottawa, February 15th, on the subject of "The Development of Canada's Natural Resources," which is reproduced on page 5 of this issue of the Engineering Journal.

C. A. Magrath, Hon.M.E.I.C.

While Mr. Magrath was engaged on Dominion Land Survey work from 1878 to 1885, his actual commission was issued in 1881, and was followed by Ontario Land Surveyor in the same year, Quebec in 1882, British Columbia in 1897, Prince Edward Island and Nova Scotia in 1915, Alberta and New Brunswick in 1930.

From 1885 to 1906 he was engaged in general engineering work with the Galt interests, developing irrigation enterprises in Southern Alberta, retiring from the managership of the Alberta Irrigation Company at the end of this period.

Mr. Magrath became distinguished in the public life and in the public service of Canada, including municipal, provincial and federal activities. He entered public life in 1892 when he became a member of the Northwest Territories Legislature, retiring therefrom in 1898, in which year he vecame a Minister without portfolio in the administration of Sir Frederick Haultain. He became Mayor of Lethbridge, Alberta, in 1901, and represented the constituency of Medicine Hat in the Dominion House of Commons from 1908 to 1911.

From 1911 to 1915 Mr. Magrath was a member of the International Joint Commission, and chairman of the Canadian Section from 1915 to 1936. In 1913 he was appointed chairman of the Advisory Committee created by the Government of Ontario to report upon a comprehensive system of highways for that province.

During the great war Mr. Magrath was a member of the War Trade Board, and of the Patriotic Fund executive. He was also appointed Fuel Controller in 1917, and appointed a member of the Advisory Fuel Committee of Canada in 1922. In the year 1920 he was appointed chairman of a special committee to investigate and report upon the agricultural conditions in Southern Alberta.

Perhaps one of the most important public positions held by Mr. Magrath was that of chairman of the Hydro-Electric Power Commission of Ontario between the years 1925 and 1931.

He retired from active work in 1937 and is now living in Victoria, B.C.

F. H. Peters, M.E.I.C., author of the paper "Mountain Water for Prairie Grassland," which appears on page 8, was born at Quebec. He received his early education at Victoria, B.C., and later attended Upper Canada College and the Royal Military College. Upon graduating from the latter institution in 1904 with honours, he became first assistant engineer on an Upper Ottawa survey party. The following year he commenced his services with the Georgian Bay Ship Canal survey, which continued for three years. He then entered the Department of the Interior and in 1910 was appointed to make special investigations of all international streams in Alberta and Saskatchewan for advisory purposes in regard to the Waterways' Treaty between Canada and the United States. In 1927 he was promoted to Surveyor General of the Department of the Interior and in 1937 received the title of Chief of the Hydrographic Service of the Department of Mines and Resources. Mr. Peters has been an active member of The Institute since 1904.

David Walker Hays, M.E.I.C., author of the paper "Irrigation Development, Its Possibilities and Limitations" which appears on page 13, was born at Bridgeport, California. He received his technical training at the Mackay School of Mines, Nevada, obtaining the degree of B.S. there in 1900. After a period in charge of a party making preliminary surveys for irrigation works in California and Nevada and in making hydrographic surveys of rivers and constructing irrigation systems, he entered the U.S. Reclamation Service in 1903 as assistant engineer. In that capacity, and as engineer, he was employed on the Truckee Carson Project until 1909. He retained his appointment as engineer in the U.S. Reclamation Service until 1916, and at the same time was permitted to engage in private work in connection with irrigation projects in Nevada and elsewhere. From 1912 to 1917 he held the position of chief engineer for the Southern Alberta Land Company. He then became associated with the Canada Land and Irrigation Company as general manager, the position which he holds to-day in Medicine Hat.

J. M. R. Fairbairn, D.SC., M.E.I.C., chief engineer of the Canadian Pacific Railway, retired on December 31st, 1938, after 38 years with the company. Mr. Fairbairn was born at Peterborough, Ont., and graduated from the University of Toronto in 1893, which presented him with the degree of D.SC. in 1921. Following several years spent with the Department of Railways and Canals and in private practice, Mr. Fairbairn joined the staff of the Canadian Pacific Railway in 1901. His promotion was rapid and his ability recognized by his appointment as principal assistant engineer, followed by engineer, maintenance of way, in 1910, later assistant chief engineer and in 1918 chief engineer. When Mr. Fairbairn joined the company it had only about 8,500 miles of line. He played a major part in building the mileage to more than 17,000 miles. He is an active and valuable member of The Institute, having served as a member of Council, vice-president and president. He is at present Chairman of the International Relations Committee. (*See page 44.*)

John E. Armstrong, A.M.E.I.C., has succeeded J. M. R. Fairbairn, M.E.I.C., as chief engineer of the Canadian Pacific Railway, having been assistant chief engineer since 1928. Born in Peoria, Ill., Mr. Armstrong graduated from Cornell

John E. Armstrong, A.M.E.I.C.

University in 1908 and was subsequently until 1912 assistant on the engineer corps of the Cleveland and Pittsburgh Division of the Pennsylvania Company at Cleveland, Ohio. He joined the engineering department of the Canadian Pacific Railway in 1912, since which time he has been engaged on many important works including the Quebec joint terminals, the waterfront development at Saint John, railway revision during the war, and the construction of the Toronto viaduct from 1924 to 1930.

In 1927 Mr. Armstrong was a director in the American Railway Engineering Association, in the following year he became second vice-president, and in 1934 was elected to the office of president.

F. W. Alexander, M.E.I.C. has been appointed assistant chief engineer of the Canadian Pacific Railway with headquarters in Winnipeg, Man. Mr. Alexander was born in New Brunswick and after a number of years of general railway engineering experience entered the service of the Canadian Pacific Railway in 1903 as a transitman, from which time he has received successive promotions in the engineering department in Western Canada. In 1917 he was district engineer with headquarters at Winnipeg, then he moved to a similar position at Calgary. In 1927 he was appointed engineer, maintenance of way for western lines, with headquarters at Winnipeg, which appointment he has held to the present time. Mr. Alexander was admitted to The Institute as an Associate Member in 1907 and transferred to the class of Member in 1917.

Frank Taylor, M.E.I.C., has retired from the position of right of way and tax agent of the Canadian Pacific Railway. He had been employed by the railway for 49 years, having joined the company in 1889 in the division engineer's office, Montreal. He was promoted to draftsman in 1893, assistant engineer in 1899 and resident engineer in 1902. In 1905 he was transferred to the chief engineer's office, Montreal, as assistant engineer and in 1908 went to North Bay as division engineer. In 1912 he returned to Montreal as division engineer, became right of way and lease agent in the same year, and right of way and tax agent in 1916.

J. H. Forbes, A.M.E.I.C., has been promoted from assistant right of way agent to right of way and lease agent of the Canadian Pacific Railway. Mr. Forbes graduated from McGill University in 1908 with the degree of B.SC. in civil engineering and immediately entered the service of the Canadian Pacific Railway. He has served in the capacities of division engineer at Smith's Falls, Ont., division engineer Montreal terminals, assistant district engineer, Quebec district and assistant district engineer, Montreal.

J. L. Rannie, M.E.I.C., is chairman of the Ottawa Branch committee responsible for the arrangements for the Annual Meeting being held in Ottawa on February 14th and 15th (see pp. 23 and 24). He has had many years experience in Institute affairs and has held such offices as Branch chairman, councillor and chairman of a number of special committees, with great credit to all concerned.

Mr. Rannie is a graduate of the University of Toronto, and now occupies the position of chief of the Triangulation Division of the Geodetic Service of Canada.

Major F. L. C. Bond, M.E.I.C., has been appointed vice-president and general manager of the central region of the Canadian National Railways, succeeding W. A. Kingsland, retired. Major Bond graduated from McGill University in 1898 and shortly thereafter entered the service of the Grand Trunk Railway as assistant to the resident engineer of the Eastern Division. He was soon promoted to the position of resident engineer, which he held until he went overseas with railway construction troops. At the conclusion of the war, he was cabled the appointment of chief engineer of the Grand Trunk Railway System.

F. L. C. Bond, M.E.I.C.

Upon the formation of the Canadian National Railways, Major Bond was transferred to the position of chief engineer of the central region with headquarters in Toronto, while in 1924 he received an appointment as general superintendent with headquarters in Montreal. In 1936 he was promoted to the position of general manager, central region, Toronto, which position he still holds in conjunction with the vice-presidency.

Henry E. Ewart, M.E.I.C., has been appointed Master of the Royal Canadian Mint in Ottawa, succeeding J. H. Campbell, who retired last April. The announcement by the Department of Finance of the appointment of Mr. Ewart to this position has caused very favourable comment as he is the first Canadian to be appointed to this office.

Mr. Ewart entered the service of the Government in the Department of Public Works in 1894 and joined the staff at the Mint when it opened in 1908, since when he has been continuously connected therewith. In recent years he has had great responsibility in supervising extensions to the Mint.

Charles E. Nix, Jr.E.I.C., formerly assistant engineer to the cost accountant with the Shawinigan Water and Power Company, Montreal, is now managing director of Consumers of Canada, Inc., Box 134, Montreal, and is located in Maxville, Ont.

C. E. Webb, M.E.I.C., district chief engineer, Dominion Water and Power Bureau, Department of Mines and Resources, was elected President of the Association of Professional Engineers of British Columbia at their annual meeting on December 3rd. Mr. Webb graduated from the University of Toronto in 1910 with the degree of B.A.Sc., and since 1913 has been in the service of the Dominion Government. In 1925 he was promoted to his present position.

C. E. Webb, M.E.I.C.

Fred. J. Ryder, Jr.E.I.C., has accepted a position with the Canadian Bridge Company in Toronto. Since graduating from McGill University in 1929 he has been associated with Motor Products Corporation, Walkerville, Ont., and with Taylor and Gaskin, Detroit, Mich.

Mr. Ryder has been an active member of the Border Cities Branch and has rendered valuable service as Branch News Editor.

F. W. Taylor-Bailey, M.E.I.C., vice-president and general manager of Dominion Bridge Company Ltd., has been appointed recently to the board of directors of the company.

H. G. Welsford, A.M.E.I.C., general manager of the Dominion Engineering Company Limited, has been added recently to the board of Directors of the company.

Dr. Charles Camsell, C.M.G., LL.D., M.E.I.C., Deputy Minister of Mines and Resources, has been elected a director of the American Institute of Mining and Metallurgical Engineers for 1939.

Brig.-General C. H. Mitchell, C.B., C.M.G., D.ENG., M.E.I.C., has recently been appointed director of the Consumers' Gas Company of Toronto.

Lt.-Col. E. V. Collier, D.S.O., M.E.I.C., formerly general manager of the Simplifix Couplings Limited, London, England, is now a director of Victor Collier and Company Limited, civil and mechanical engineers, 57 Victoria Street, London. Mr. Collier spent considerable time with the Anglo-Persian Oil Company, Limited, in Persia.

J. B. Bryce, Jr.E.I.C., is now junior hydraulic research engineer with the National Research Council, Ottawa. Mr. Bryce, who graduated from the University of Toronto with the degree of B.A.Sc. in 1935 and that of M.A.Sc. in 1936, has been previously employed by the Hydro-Electric Power Commission of Ontario.

Julian C. Smith, LL.D., M.E.I.C., President of the Shawinigan Water and Power Company and a past president of The Institute, has been appointed Vice-President of the Royal Bank of Canada.

T. R. Durley, A.M.E.I.C., has entered the Inspection Department of the Associated Factory Mutual Fire Insurance Company, Boston. At a later date Mr. Durley will be transferred to Montreal. Prior to accepting this position he was with the Canada Cement Company, Montreal.

Bruce B. Shier, A.M.E.I.C., has been transferred recently to the Head Office Sales Department of the Canadian Telephones and Supplies Limited, Toronto, with the position of assistant to the sales manager.

Fraser S. Keith, M.E.I.C., former General Secretary of The Institute, (being in the South at the time), represented the Institute at the request of the International Relationship Committee at the annual meeting of the American Society for the Advancement of Science, which was held at Richmond, Va., during the week of December 16th, 1938.

Obituaries

It is with deep regret and sympathy to relatives that the following deaths are recorded:

Archie Burgess Crealock, M.E.I.C., consulting engineer, at his home in Toronto on December 21st. He was born in Toronto on January 9th, 1893, and received his education there, attending the Parkdale Collegiate Institute and later the University of Toronto. He received the degree of B.A.Sc. from the latter in 1915 and began work with the Civic Transportation Committee of Toronto, drafting and estimating on radial railway entrances. The next year the Imperial Ministry of Munitions engaged him for work on brass inspection. In 1917 he was made chief inspector on this work and remained in this position for a year, when he was transferred to the aeronautical engine division as metallurgist. In March, 1919, he entered the Bridge Department of the Ontario Department of Highways and held the position of bridge engineer until 1929 when he and the late E. V. Deverall, A.M.E.I.C., entered into partnership in Toronto as consulting structural engineers. This partnership was dissolved in 1932 by Mr. Deverall's death.

Archie B. Crealock, M.E.I.C.

Mr. Crealock designed and supervised the construction of many bridges. Recently he completed his work on the Keewatin Channel Bridge near the Lake-of-the-Woods, an important link in the Trans-Canada Highway.

Mr. Crealock has held a membership in the Association of Professional Engineers of Ontario for fifteen years and from 1933 to 1936 was a member of the council of that body. At one time he served as vice-president and at the time of death occupied the position of registrar and secretary-treasurer.

Entering The Institute as a student in 1915, Mr. Crealock had always been active in its affairs. He transferred to

Associate Member in 1923, becoming a Member in 1935. He has also served on the Council.

David William Harvey, M.E.I.C., general manager of the Toronto Transportation Commission, at Toronto, on December 6th, 1938.

Mr. Harvey was born at London, Ont., on February 24th, 1887. He received his early technical training at the London Collegiate Institute and later attended the University of Toronto, obtaining the degree of B.A.SC. in 1910. Upon graduation he entered the employ of the Ontario Power Company at Niagara Falls, Ont., and in a year's time joined the works department of the City of Toronto. Later he was placed in charge of the construction and operation of the civic street car system which became a part of the Toronto Transportation Commission's system on September 1st, 1921. At this time he was made assistant manager and acted in that capacity until 1924, when he became general manager, retaining this position until his death.

Mr. Harvey's professional career closely followed the development of municipal transportation in Toronto. He was responsible for the introduction of the new streamlined street cars in Toronto when they were first being designed. It is of interest to note that Mr. Harvey invented the three-door trailer. Tribute was paid to his ability when, in 1928, he was selected as a consultant to aid in reorganizing the unified metropolitan transport system of London, England.

In 1927 he became president of the Gray Coach Lines Limited.

Mr. Harvey joined The Canadian Society of Civil Engineers as a student in 1909, became an Associate Member in 1914 and a Member of The Institute in 1932.

Joseph Pettus Newell, M.E.I.C., on December 5th at his home in Portland, Oregon.

Mr. Newell was born on May 11th, 1866, in Portland, Oregon. From 1884 to 1887 he followed the civil engineering course at the Massachusetts Institute of Technology and shortly after graduation returned to Portland, to begin a long period of service for the old Oregon Railway and Navigation Company, now a part of the Union Pacific system. For ten years he worked on the construction of the road as assistant engineer. From 1904 to 1907 he was division engineer of the Oregon Division in charge of maintenance of way. From this time until the date of his death he was engaged in private practice.

During his career Mr. Newell was a recognized authority in his field. He was an expert witness in hearings before the U.S. Reclamation Service, the Interstate Commerce Commission, Oregon State Highway Department and various courts. Mr. Newell was at one time construction engineer for the Oregon Public Service Commission. In 1918 he was associated with the Department of Railways and Canals in the Canadian Northern Arbitration and later in the Grand Trunk Arbitration.

Mr. Newell joined The Institute in 1921 as a Member.

Fitz James Bridges, A.M.E.I.C., at Riverside, Ont., on November 23rd, 1938.

Mr. Bridges was born at Windsor, Ont., on July 20th, 1887. He was educated at the Windsor Collegiate Institute and at the University of Michigan, Ann Arbor. From 1905 to 1907 he worked as draughtsman in the office of a patent attorney in Windsor, Ont. The years from 1909 to 1912 he spent in Detroit, Mich., in the head office of the Trussed Concrete Steel Company, drawing, estimating and designing various reinforced concrete structures. In 1912 he began a long connection with the Department of Public Works of Canada, in the office of the district engineer in London and later in Windsor. For a short time before he retired from active work he was employed by the Ford Motor Company at Windsor, Ont.

Mr. Bridges joined The Institute in 1918 as a Junior, becoming an Associate Member in 1922. He was for years an active member of the Border Cities Branch until his health forced him to give up many of his former activities.

Robert Ridgway, Past President and Honorary Member of the American Society of Civil Engineers, on December 19th in New York. He was an expert in subway construction in New York, San Francisco, Chicago and Japan. His various activities throughout the country and his fine character endeared him to all members of the profession. He was well known in Canada and made many friends in The Institute in 1925 when the American Society of Civil Engineers met in Montreal under his presidency. About one thousand engineers attended his funeral on December 23rd.

ELECTIONS AND TRANSFERS

At the meeting of Council held on December 16th, 1938, the following elections and transfers were effected:

Members

Gregor, Michael, chief aeronautical engr., Canadian Car and Foundry Company, Fort William, Ont.

McHenry, Morris James, B.A.SC. (E.E.), (McGill Univ.), director, sales promotion, Hydro-Electric Power Commission of Ontario, Toronto, Ont.

Associate Members

Mitchell, Keith Weston, B.SC., (Queen's Univ.), engr., Canadian Western Natural Gas, Light, Heat and Power Co. Ltd., Calgary, Alta.

Ross, Donald Kenneth, B.SC., M.SC., (Univ. of Man.), mgr., Montreal and Maritime District, Donald-Hunt Ltd., Montreal, Que.

Weir, Charles Victor Fraser, B.A.SC., (Univ. of Toronto), field engr., city of Edmonton power plant dept., Edmonton, Alta.

Juniors

Dernier, Herbert Clarence, B.SC. (C.E.), (Univ. of N.B.), instr'man, Dept. of Public Works of N.B., South Devon, N.B.

Drake, Edward Michael, B.ENG., (McGill Univ.), sales engr., Northern Electric Co. Ltd., Montreal, Que.

Fair, John Lowther, B.A.SC. (E.E.), (Univ. of Toronto), Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

Smith, Donald Sinclair, B.A.SC., M.A.SC., (Univ. of B.C.), sales engr., Northern Electric Co. Ltd., Montreal, Que.

Transferred from the class of Associate Member to that of Member

Dawson, William Ash, B.SC. (MECH.), (Queen's Univ.), plant mgr., E. Long Ltd. Engineering Works, Orillia, Ont.

Mechin, Frederick Charles, B.A.SC., (Univ. of Toronto), mgr., Montreal Refinery, Imperial Oil Limited, Montreal, Que.

McCammon, John White, B.SC. (E.E.), (McGill Univ.), controller, Provincial Electricity Board, Montreal, Que.

Transferred from the class of Junior to that of Associate Member

Crossland, Charles Wilfred, B.SC., (McGill Univ.), M.SC., (Mass. Inst. Tech,), senior asst. engr., Dept. of National Defence, Ottawa, Ont.

Transferred from the class of Student to that of Junior

Brown, Ralph Cuthbert Chisholm, B.SC. (MECH.), (Queen's Univ.), junior aeronautical engr., Dept. of National Defence, Ottawa, Ont.

Desmarais, Jean René, B.A.SC., C.E. (Ecole Polytechnique), Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

Stephenson, Stephen, (Oundle School), engr., Whiting Corpn. Canada, Ltd., Toronto, Ont.

Students

Ingram, Wallace Wellington, (Univ. of Man.), 681 Cathedral Ave., Winnipeg, Man.

Malmgren, Harvey R., (Univ. of Man.), 292 Union Ave., Winnipeg, Man.

Papik, Edward, (Univ. of Man.), 343 Redwood Ave., Winnipeg, Man.

Ripley, Herbert Angus, (Univ. of Alta.), P.O. Box 74, University of Alberta, Edmonton, Alta.

Tait, Eric, (McGill Univ.), 463 Mount Stephen Ave., Westmount,Que.

Students at the Ecole Polytechnique, Montreal, Que.

Amyot, Jean, 222 St. Georges St., St. Josaphat de Chambly, Que.
Dauphinais, Ernest, 1072 Berri St., Montreal, Que.
Dufresne, André, 4040 Sherbrooke Street East, Montreal, Que.
Joncas, Louis, 4525 Boyer St., Montreal, Que.
Lavigueur, Alex. Bernard, 980 Cherrier St., Montreal, Que.
Manseau, Marcel, 5173 Garnier St., Montreal, Que.
Mercier, Charles Edouard, 120 Sherbrooke St. West, Montreal, Que.
Quintal, Robert Henri, 374 Sherbrooke St. West, Montreal, Que.
Ravary, L. Robert, 3447 Berri St., Montreal, Que.
Rousseau, Jean Melville, 4145 Marlowe Ave., Montreal, Que.

News of the Branches

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

BORDER CITIES BRANCH

J. F. Bridge, a.m.e.i.c. - *Secretary-Treasurer*

That character counted more in the engineering profession than in any other, was the theme of an address given at a dinner meeting of the Border Cities Branch on November 18, 1938, by Roy E. McFee, engineer of design of the Grand Trunk Western Railroad.

The speaker suggested that lawyers and doctors get paid for trying, but the engineer is judged only by results, and expressed the opinion that there is no reason why men from other professions should outnumber engineers in public life. The opinions of men who are not engineers are being quoted regarding matters about which engineers only are competent to speak.

The importance of mathematical training was stressed by Mr. McFee and he stated that specialization in this line could give one good opportunities in the engineering field, but that it was also necessary for the engineer to be able to write better reports and to present his views more fluently when given orally.

The situation now existing, however, will not endure. Engineers are entering a wider field and becoming city managers, custodians of public health and heads of industrial corporations. The engineer is the guardian of nature's resources. He must preach conservation of her mineral wealth and raw materials. At the conclusion of Mr. McFee's address many of those present took part in a lengthy discussion.

At the conclusion of the meeting, the Chairman, E. M. Krebser, a.m.e.i.c., paid tribute to the services of F. J. Ryder, jr.e.i.c., as Branch News Editor since 1934, and expressed the gratitude and appreciation of the Branch. Mr. Ryder is taking over a new position and will be transferred to the Toronto Branch of the Engineering Institute.

CALGARY BRANCH

B. W. Snyder, a.m.e.i.c. - *Secretary-Treasurer*
J. S. Neil, a.m.e.i.c. - - *Branch News Editor*

Dean C. J. Mackenzie, m.e.i.c., of the University of Saskatchewan, addressed a meeting of the Calgary Branch held in the Palliser Hotel on the evening of November 18th on the subject "**World Revolution by Science.**" An exceptionally interesting and instructive evening was held, the speaker being an outstanding figure in public life as well as in the engineering profession.

The Dean pointed out that owing to lack of experience the world runs along in a baffled state, both economically and politically. He told, for example, of recent findings of scientists to the effect that two parallel lines will finally meet, gravity is only curved space, length is only relative, the circumference of a circle is not equal to $2\pi r$, the angles of a triangle do not add up to 180 degrees and mass and energy are interchangeable. In view of such discoveries, are we really as sure as we were exactly what democracy means? Are we as sure as we were of our responsibilities towards unemployment? He said, "Socially, economically and politically, we do not know where we are, because we have not had enough experience in working out the various new forms of government by which we have completely changed the world during the past few years. Political figures are continually speaking in figures of speech which are a carry-over from the dark ages. The masses of the people have been taught to fit themselves into a society where existence becomes impossible without constant and uninterrupted activity."

More and still more industrial regulation was the answer in the Dean's opinion, and he thought that we should not allow ourselves to become too pessimistic over our difficulties. "Is it not possible," he asked, "that society two hundred years from now, may not be just as far ahead of ours, as ours is ahead of that of two hundred years ago?"

Delving into population statistics, Dean Mackenzie said that the population of the world in 1800 was only 640 millions, while to-day it is approximately 3,000 millions. But only two hundred years ago, he showed, the production rate was only one-fifth what it is to-day. In this regard, he pointed out, the population of the United States, between 1900 and 1937, had increased only from 70 millions to 120 millions, while the production rate had increased from 20 million mechanical horsepower to 1,200 million horsepower. If the ordinary man worked eight hours in a day he would be worth about one-seventh of a horsepower, hardly enough to run an electric fan. In the year 1900, each person of the population was assisted by approximately one-third of a mechanical horsepower, while in 1937 he had ten, proving that man was becoming more dependent on mechanics as the years pass.

At the conclusion of the address the speaker was tendered a hearty vote of thanks by the chairman, E. W. Bowness, m.e.i.c., on behalf of those present, and all expressed the wish to hear Dean Mackenzie again, in the not too distant future.

HALIFAX BRANCH

R. R. Murray, m.e.i.c. - - *Secretary-Treasurer*
A. D. Nickerson, a.m.e.i.c. - *Branch News Editor*

At the November meeting held at the Halifax Hotel on November 24th, J. J. Doolan, General Superintendent of the Light and Power division of the Nova Scotia Light and Power Co. spoke on "**Rural Electrification.**"

In the more sparsely settled rural areas electrification had been made possible only by government aid rendered through the Rural Electrification Act. This Act in Nova Scotia provides aid (under certain conditions) in cases where a company can secure an average of three contracts per mile, and there is a potential average of six customers per mile. Similar acts in some of the other provinces had likewise stimulated the electrification of rural areas in those provinces.

In a great many rural areas government aid was not necessary since the line was self-supporting. The majority of rural mileage built by the Nova Scotia Light and Power Co. in the past year had not required government aid.

How to reduce the capital cost of rural distribution lines had been the problem that faced all utilities attempting rural coverage. Lighter and stronger conductors making possible greatly increased pole spacings, improved line hardware, and lower capacity transformers of a simplified type, had all helped to reduce capital costs in recent years. Although costs vary widely in different areas, a figure of $1,200 per mile could be considered a fair average cost of rural line construction.

A survey of appliances used by rural customers had indicated a fair proportion of the smaller wattage units in use. Considerable advertising and propaganda work was still necessary to make the average rural customer fully aware of the many benefits which electric power offered.

In spite of the large mileage of rural lines built in recent years, Nova Scotia, and Canada as a whole, still lagged behind many European countries. The speaker pointed out that rural areas in Holland were completely electrified, in Germany 90 per cent and in Sweden 60 per cent. This more intense coverage was possible because European farms are generally small and the customer density large. In Canada farms are large and the customer density is consequently small.

The address was followed by a thorough discussion in which many public utility engineers and executives took part. Comparisons between the type and amounts of government aids to rural electrification in the various provinces were brought out. It was felt that the average capital cost per mile in Nova Scotia compared very favourably with costs elsewhere. Most rural areas are within reasonable transmission distance of a backbone network of generating stations and high-tension lines. In isolated areas, however, small generating stations (usually of the Diesel type) have been necessary. Such stations greatly increase the cost of serving any territory.

The enthusiasm with which electrical supply was greeted in some communities was a very encouraging factor to the utilities. In certain rural areas the citizens had offered to give their labour free for construction of the line if their community could be assured of service.

HAMILTON BRANCH

A. R. Hannaford, a.m.e.i.c. – *Secretary-Treasurer*
W. E. Brown, jr.e.i.c. – – – *Branch News Editor*

Another successful joint meeting between the Hamilton Branch of the Institute and the Hamilton members of the American Institute of Electrical Engineers was held at McMaster University on Tuesday, Dec. 13th. W. J. W. Reid, a.m.e.i.c., was in the chair.

A newspaper report in connection with the new bridge at Niagara Falls occupied the attention of the meeting and after careful discussion the following motion on behalf of the Hamilton Branch of the E.I.C. was unanimously carried: "That this meeting deplores the apparent absence of any Canadian consultant as evidenced in the newspaper report regarding the appointment of consulting engineers by the Niagara Bridge Commission for the Falls View Bridge at Niagara Falls, this resolution to be forwarded to Dr. Challies to be used as he sees fit."

E. P. Muntz, m.e.i.c., introduced the speaker of the evening, W. P. Dobson, m.e.i.c., chief testing engineer of the Hydro Electric Power Commission of Ontario. Mr. Dobson's subject was **"Testing and Research in an Electrical Utility,"** the paper being illustrated by lantern slides.

The speaker outlined the work done by the commission for testing and inspection of all materials and equipment purchased by the commission, including field tests. Of particular interest was the testing of concrete and the development of methods of controlling concrete in order to maintain a predetermined quality. The Hydro Electric Power Commission was the first large organization to adopt strength specifications for concrete and to use the "water-cement ratio" as the method of controlling quality. Another phase of the work was the testing and inspection of materials in service and the resultant information which dictates the necessity for special treatment or replacement.

Mr. Dobson then described the work of the research committee. This committee is composed of 14 sub-committees, each having its own particular project, and the laboratory staff performs the bulk of the experimental work.

One of the major problems investigated was the vibration of line conductors. The problem first came to the attention of power companies about 1923 when longer spans and higher mechanical tensions gained favour among designers in their endeavour to make the most economical use of materials. The vibration due to wind in these longer spans was of such a magnitude as to cause actual fatigue breaks of the conductor material at the clamps. Much valuable work has been accomplished (1) by finding materials more capable of withstanding the vibration, and (2) by finding means of reducing the vibration to harmless proportions. One method is to clamp a torsional damper to the conductor just in front of the clamps and this damper absorbs a large portion of the vibration.

The speaker outlined other research work carried out on insulating materials, concrete, wood poles to prevent ground decay and the testing of paints.

Another subcommittee is studying rural applications of electricity in agriculture and floriculture, and its problems have been soil heating, the effect of artificial illumination on the growth of flowers and the development of electrically heated pig brooders.

In conclusion the speaker pointed out that testing and research in the Hydro Electric Power Commission had accomplished: improved methods of construction and operation; improved methods of treating materials to prolong life; development of new specifications or improvement of existing specifications for the purchase of materials, and the development of new equipment for special applications.

C. A. Price moved the vote of thanks to the speaker for his very interesting lecture. The attendance was 153.

LETHBRIDGE BRANCH

E. A. Lawrence, s.e.i.c. - *Secretary-Treasurer*

A ladies' night was held by the Lethbridge Branch on November 5th, 1938, and was attended by forty-three members and guests. R. F. P. Bowman, a.m.e.i.c., chairman of the Branch, presided over the meeting which commenced at 6.30 p.m. with a dinner. The Entertainment Committee later took charge of the meeting and community singing together with a number of solos was enjoyed.

The chairman called on C. S. Clendining, a.m.e.i.c., to introduce the speaker for the evening, Miss Hazel Watson, who addressed the gathering on her trip to Europe, illustrating her talk with a series of photographs in natural colour.

E. A. Lawrence, s.e.i.c., moved a vote of thanks to Miss Watson for her most interesting talk, which was thoroughly enjoyed by all present.

The regular meeting of the Lethbridge Branch was held in the Marquis Hotel on Saturday, November 19th, 1938, at 6.30 p.m.

R. F. P. Bowman, a.m.e.i.c., was chairman at the dinner, which was attended by 27 members and guests. An instrumental quartette rendered many delightful selections during the dinner, which was followed by community singing and vocal solos.

After a few introductory remarks the chairman called on Major F. G. Cross, m.e.i.c., to introduce the speaker of the evening, C. J. Mackenzie, m.e.i.c., Dean of Engineering, University of Saskatchewan, Saskatoon, who gave a splendid talk entitled **"World Revolution by Science"** (*see Calgary Branch News*) which brought forth questions from many of the audience.

J. Haimes, a.m.e.i.c., moved a hearty vote of thanks to the speaker for his excellent talk.

The regular dinner meeting of the Lethbridge Branch was held at the Marquis Hotel, Saturday evening, Dec. 3rd, under the chairmanship of R. F. P. Bowman, a.m.e.i.c.

The speaker of the evening, John P. Liebe, b.a., ph.d., Instructor, Lethbridge Technical School, was introduced to the meeting by W. Meldrum, a.m.e.i.c.

Dr. Liebe gave a very interesting address on the history of the development in Germany of the rigid airship by Graf Ferdinand von Zeppelin and said that his interest in lighter-than-air craft was first aroused after having witnessed the first major flight of a craft of this type at Dresden in 1908.

Of particular interest were Dr. Liebe's remarks concerning the fate of the airships constructed during the war years. Of the fifty airships constructed for the army, thirty-four being Zeppelins, twenty-five were lost, either shot down or wrecked by storms, and the other twenty-five were dismantled. Of the seventy-eight constructed for the navy, sixty-five being Zeppelins, fifty-two were lost, nine were dismantled, four were used as training ships and thirteen were left in 1919. Of the fifteen that were left in 1919, including two under construction, four were destroyed by soldiers, one was dismantled to show vital parts, three were turned over to France, three to Italy, one to Japan, two to England, and the records do not reveal the fate of the last one.

Dr. Liebe stated that he concurred with Dr. Hugo Eckener's opinion that airships were not suitable for warfare, being too easy a target for aeroplane attack. He said that airships had not been developed yet to a point where they could be considered as a commercial success, but voiced the belief that they could be made so under international sponsorship, with no country having the majority of control. He used the record of the Graf Zeppelin as an illustration of the performance that might be expected of airships in the future. Since the Graf Zeppelin made its world cruise in 1929, covering a distance of 21,300 miles in 301 hours, it has made 505 flights, including 100 ocean crossings, without accident. He also stated that non-inflammable gas was essential to the success of airships.

LONDON BRANCH

D. S. Scrymgeour, A.M.E.I.C. - *Secretary-Treasurer*
J. R. Rostron, A.M.E.I.C. - - *Branch News Editor*

The regular November meeting was held on the 23rd in the Public Utilities Board Room, City Hall. The speaker was Lt. R. M. Crowe, R.C.R., and his subject "**Chemical Warfare.**"

In the absence of Mr. Wolff, the chair was taken by H. F. Bennett, M.E.I.C., who introduced the speaker.

Mr. Crowe, who has completed a course on gas warfare at Kingston, pointed out that chemical warfare, both offensive and defensive, is the responsibility of the military engineer.

In 1925 certain nations agreed not to use gas, but as many have chemical units it is necessary to be prepared. Britain has such a unit but does not intend to use it unless forced to do so and is concentrating her activities in this direction on defensive measures.

The chief kinds of gas are tear gas, nose gas, mustard gas, and Lewisite. About 3,000 tests of various gases have been made, of which only about 17 or 18 were found to be practical and only seven useful. One factor, that of persistency, is very essential.

Chlorine and phosgene gas attacks all the air passages and lungs as a choking irritant and come under the heading of nose gas. Both of them are three times as heavy as air but phosgene may be said to be stronger, and although its action is delayed it will affect the heart in 24 hours. Chlorine was used in the Great War and out of 15,000 casualties 5,000 were fatal. These gases can be dispelled by the wind.

Tear gas causes a profusion of tears and temporary blindness from that cause. It is very persistent and clings to the clothes and person. Once clear, however, its effect passes off.

Mustard gas and Lewisite—the action of both of these is similar but the latter is more severe. These are oily liquids which freeze at 58 deg. F. and boil at 350 deg. Above freezing point they vaporize. The liquid is poisonous, soluble in fat and absorbed by the flesh. It will sink through clothing and even through brick or concrete. One drop on the back of the hand is not felt for some hours, then it begins to redden and itch. In 24 hours a large blister forms and this must receive medical attention; if it should burst a second infection will follow. If it gets into the eye a gritty sensation is experienced, reddening follows, the eye closes and sight is lost. The vapour acts in the same way but covers a larger area. From four to six weeks under treatment is required for healing.

Persons exposed to these gases must go at once to a decontamination camp and immediately discard all their clothing.

Several means of discharging these gases were described including gas released from cylinders under pressure and gas dispersed by wind, projectors worked electrically and throwing drums of gas and mortars fixing bombs and shells.

Aircraft are employed for discharging explosive, incendiary and gas bombs. Tanks of gas are carried under each wing, the contents being released at the rear and dispersed by the slip stream from the propellors. Mustard gas will lie in a layer on low ground for six months. Troops marching over an area of this kind three months after it was formed have been burnt.

Defence Measures—The most important of these is the gas-mask. The speaker described the latest type consisting of face piece with goggles and tube with inlet and outlet valves down to the container. The contents of the latter are not generally known—one of the materials used, however, is charcoal. Special clothing and boots are needed for protection. Troops are supplied with yellow pieces of special paper as "detectors." If these become spotted then it is known that they are in a gas zone and must be treated by the decontamination platoon which forms a unit of all regiments.

Active work is being done in Britain in the way of defence measures. These include detailed arrangements for evacuating city dwellers to the country by train and car—billeting at country houses and arrangements for food from the various stores in villages and towns, the construction of trenches in back yards and open spaces, black curtains for windows, sand in attics, with long-handled shovels for putting out fire. A city is divided up into sections and trained instructors are placed in each area to tell the people what to do in case of an air raid. Stores of gas masks are established ready for distribution. A balloon barrage is under construction and trial round London. This consists of a series of captive balloons at a height of some 20,000 feet. The fear of these in night raiding is expected to be an effective deterrent.

The following points were brought out in the discussion which followed. To clear the streets of mustard gas they had to be well hosed, then covered with bleaching powder and then scrubbed. The mixing of gases was not considered feasible as some are heavier than others.

Contaminated soldiers entering dugouts would pass through a series of air-locks formed with gas-proof curtains on their way to the wash-up.

In the case of air raids on cities it is desirable to avoid congregating with others; about as safe a place as any is in one's own house, as the streets and open spaces between the houses form a much bigger target than the houses themselves.

A vote of thanks to the speaker was proposed by W. C. Miller, M.E.I.C., and unanimously carried.

MONTREAL BRANCH

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

On Wednesday, October 26th, a meeting under the auspices of the Civil Section discussed "Some Practical Considerations of Concrete." J. A. Freeland, A.M.E.I..C, presided, and the principal speakers were J. M. Breen, of the Canada Cement Co., W. G. Hunt, of W. G. Hunt & Co., and W. A. Cook, of Ready Mix Concrete Limited.

On Thursday, October 27th, a paper by Wm. Bennett, Principal Surveyor for Lloyds for the U.S. and Canada, on "**Welding in Ship Construction,**" was read in the absence of the author by Alex. Hislop, Montreal Inspector for Lloyds. During the course of the paper it was explained that the swing to welding was probably due to the saving of about 10 per cent in the ultimate weight of the vessel as compared with a rivetted ship. During the discussion, it was stated that Canada was leading the world to-day in the construction of wholly or partially welded ships.

A meeting of the Junior Section of the Branch was held on Monday evening, October 31st, on which occasion H. W. Johnston, PH.D., A.M.E.I.C., gave an address on the subject of **"The Engineer in the Pulp and Paper Industry."**

On Thursday evening, November 3rd, W. B. Cartmel, M.E.I.C., of Montreal, addressed the Branch on the **"Michelson-Morley Experiment and the Theory of Relativity."** Mr. Cartmel stated that no problem has been so exhaustively studied, and at the same time so misunderstood as the Michelson-Morley problem. Theorists chose to believe that the careful measurements of Michelson and Morley were erroneous, but a lifetime of work by Dayton C. Miller has completely verified what they found.

On November 10th, D. Anderson, A.M.E.I.C., electrical superintendent of Quebec North Shore Paper Company, gave a description of the **"Baie Comeau Electrical Installation,"** including the high tension switching, full details of the mill sub-station, the mill power distribution system, the paper machine drives, mill lighting, town distribution system, telephone and fire alarm systems, and so forth.

H. A. Terreault, M.E.I.C., former City Engineer of the City of Montreal, and now chairman of the Town Planning Commission, addressed the Branch, on November 17th, on **"Town Planning Achievement in Montreal,"** covering the work done by his commission, ways and means of eliminating traffic congestion, grade separation, ward zoning, the slum question, etc.

The collapse of the Falls View Bridge at Niagara was dealt with by P. L. Pratley, M.E.I.C., on November 25th, in a very interesting address.

A forerunner of the annual meeting papers dealing with the drought situation in Western Canada was the paper by Dr. E. S. Archibald, Director of the Experimental Farms at Ottawa, presented on December 2nd. Dr. Archibald explained the work carried out in prairie farm rehabilitation during the past five years, and stressed the benefit which was resulting from organized crop rotation and strip farming.

On December 9th, Warren Worthington, Consulting Engineer of Pittsburgh, described the new Merchant Mills of the Steel Co. of Canada recently installed in Montreal, and dealt with the general practice of rolling steel from billets into round, square and flat sections. The members of the Branch had visited the plant of the Steel Company on the previous evening.

"Power Line Carrier Communication" was the subject of a paper by S. Sillitoe, Jr.E.I.C., presented on December 15th. Mr. Sillitoe's paper dealt with development in power line carrier telephony since 1922, with special reference to equipment which he had designed. The author recounted experience with this equipment in Canada.

OTTAWA BRANCH

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

At the noon luncheon on December 1, at the Chateau Laurier, a most interesting address was given before the Ottawa Branch by Haanel Cassidy of Toronto, Ont., his subject being **"Impressions of Japan"**. Mr. Cassidy, who was born in Japan, the son of a professor in a Japanese university, graduated in 1930 from the University of British Columbia and went to Japan on an H. R. MacMillen scholarship, intending to remain for a year only. Actually he has been there until very recently, teaching English for the Japanese Government.

Dr. J. B. Challies, Montreal, President of the Engineering Institute of Canada, was a guest at the meeting and extended thanks to the speaker. Other Montreal guests included Past-President J. M. R. Fairbairn, M.E.I.C., and J. L. Busfield, M.E.I.C. W. F. Bryce, M.E.I.C., chairman of the Branch, presided.

Mr. Cassidy's address contained many interesting observations on the life, customs, and viewpoint of the Japanese people. His position had not allowed him to take any interest in politics or economics while in Japan and he also had to be discreet in taking photographs. Practising photography as a hobby, he had, nevertheless, to abide by the government regulations regarding picture-taking, which are stringent in many ways. The Japanese have an acute fear of espionage, a fear that has been immeasurably increased during the past few years, and that has given rise to these regulations.

The Japanese people, in assimilating a new culture, as they are now doing, place great emphasis in their educational system upon memory work. They are endeavoring to adopt many of the physical and material advantages of western culture without taking over the western philosophy. The speaker gave a brief outline of the present set-up of the government and the educational system, with the changes that had come about during the past several decades. The general feeling about current Sino-Japanese military activities is one of "reluctant acquiescence." The idea of war does not appeal to the people, he felt, but they are willing to endure it if that is the wish of the leaders. The critical thing in the present situation is economic. "Whatever Japan may do in China in a military sense," stated Mr. Cassidy, "it will take several generations to catch up financially."

Japanese tradition placed the army at the top of the social scale, and business men at the bottom. This was the system that was given a constitution in Japan in the nineteenth century. The Cabinet was responsible to the Emperor and not to the Diet. The war and naval ministers were completely independent of the government's authority and had extraordinarily strong influence.

Mr. Cassidy displayed a unique collection of mounted photographs of Japanese scenes. Most of these he had taken himself during the earlier part of his sojourn in Japan. They were of an artistic rather than a factual nature and formed a very interesting exhibit at the meeting.

Dr. Charles Camsell, C.M.G., M.E.I.C., deputy minister of the Department of Mines and Resources, spoke at the noon luncheon on December 13, and described recent mineral developments in the Northwest Territories, where he had recently been on an inspection trip. Dr. Camsell is convinced that these territories have a future so far as mining is concerned. The work of opening up the country and carrying on these operations will, however, have to be carefully done.

Dr. Camsell traced the history of the region with particular reference to the Yellowknife area. Wide attention was focussed upon this region as a result of the intensive geological investigations undertaken under the "million dollar scheme" for such investigations throughout Canada undertaken by the Dominion Government in 1935.

As a result of these investigations it was indicated that some three or four thousand square miles of territory in that general locality were promising from a point of view of mineralization and were favourable to prospecting. This and later work by the Government have stimulated prospecting and last year many, including some from United States, were in the country. The country itself was easy to prospect. About 40 per cent of it is not covered by any overburden, timber is sparse and small and, travelling over the area by plane, the geological structures are easy to spot from the air. Many of the more recent and spectacular finds have been made in this manner. After sighting what looks like a favourable formation the plane merely has to fly to the nearest lake and land while the prospectors examine the formation on foot. Prospectors have ranged widely and claims so far have been staked over 6,000 sq. mi. of territory, even to the headwaters of the Coppermine river. With about 5,000 claims already recorded the recording staff have at times been almost swamped.

Actually the cost of mining operations in the district, estimated the speaker, would be from 25 to 30 per cent higher than those in northern Ontario, for instance. In addition to distance from the base of supplies and costs of transportation, other problems will have to be faced such as availability of power and fuel. There are power sites on the Yellowknife and other nearby rivers but so far these have not been developed. At the moment oil from Norman on the Mackenzie river is brought in by tank barge and wood is also used.

In the opinion of the speaker, the use for fuel of the wood of the forests of the district was a decided mistake. It will have a far more valuable use in building and for mining construction. He was shocked to see the vast amount of devastation caused by forest fires. The danger from fire in the country was great and such fires are likely to have a serious effect upon the native population. When the caribou moss is burned up as well as the trees the course of migration of the caribou is sure to be altered with disastrous results to the natives. It takes, furthermore, about 20 years for the moss to grow again to its former state.

PETERBOROUGH BRANCH

A. L. Malby, Jr.E.I.C. - *Branch Secretary-Treasurer*
J. L. McKeever, Jr.E.I.C. - *Branch News Editor*

The outstanding function of the season, the annual dinner of the Branch, was held on Saturday, November 26th, at the Kawartha Golf and Country Club. This year the dinner was particularly outstanding due to the presence of the President of the Institute, Dr. J. B. Challies, and a large delegation of Councillors, who honoured the Peterborough Branch by holding their regular Council meeting in the afternoon in the rooms of the Peterborough Club.

Among those present at the Council meeting and later at the dinner were President J. B. Challies; General Secretary L. Austin Wright; Vice-Presidents E. V. Buchanan of London, J. A. McCrory of Montreal, and R. L. Dunsmore of Dartmouth, N.S.; Councillors W. E. Bonn and O. Holden of Toronto, H. A. Lumsden of Hamilton, J. A. Vance of Woodstock, R. H. Findlay and J. L. Busfield of Montreal, P. H. Buchan of Vancouver, and A. B. Gates of Peterborough. Representatives of other Branches included Past-President A. J. Grant, of St. Catharines; Lt.-Col. L. F. Grant and H. G. Conn, Kingston; E. P. Muntz, of Hamilton; Prof. D. S. Ellis, of Queen's University; W. E. Ross, C. E. Sisson, W. P. Dobson, and John Spence, of Toronto, and W. H. Munro, of Ottawa.

W. T. Fanjoy, A.M.E.I.C., chairman of the Branch, spoke a few words of welcome to the members of Council, after which he called upon R. L. Dobbin, M.E.I.C., to introduce Dr. Challies, the principal speaker of the evening.

Dr. Challies took as the subject of his discourse his experience on his recent trip to the West, in the course of which he visited the various branches of the Institute across the country. Dr. Challies stressed particularly the spirit of co-operation that is growing among the Branches and the various Professional Associations across Canada and expressed himself as very optimistic for the closer association of these organizations in every province. (*Ed. Note:—Details of the President's Western trip which formed the subject of the foregoing address appeared in the December issue of The Engineering Journal.*)

At the conclusion of Dr. Challies' address, the chairman called for a few words from each of the three vice-presidents in attendance and the meeting also had the pleasure of hearing a few words from Past-President Grant, a former resident of Peterborough, a man widely known for his work on the Welland canal, and held in high esteem by the whole profession. At the conclusion of these remarks the local member of the Dominion Parliament, J. J. Duffus, M.P., made a few remarks adding to the welcome Mr. Fanjoy had already extended to the visitors.

The Chairman then called the attention of the meeting to the novel decorations which had been arranged. These included, among other things, a large "E.I.C." Neon sign, and working representations of various types of electrical machines, including a direct current generator, an alternator, an induction motor, and a high frequency generator. In between times a little nonsense was provided for the amusement of the gathering, largely centering around a push-button which the President was requested to operate, in keeping with the times, and emulating the example of many famous people. The effect was, of course, a spectacular and nerve shattering "surprise" to those present.

The evening concluded with a comedy skit, or burlesque, presented by the Junior Section of the Branch.

ST. MAURICE VALLEY BRANCH

L. B. Stewart, S.E.I.C. - *Secretary-Treasurer*

A dinner meeting of the Branch was held at the St. Maurice Hotel, Three Rivers, on Saturday, December 10th, under the chairmanship of H. J. Ward, A.M.E.I.C.

The guest speaker at the meeting was E. R. Jacobsen, A.M.E.I.C., of the Dominion Bridge Co., Lachine, P.Q., who gave an illustrated address on **"The Use of Rigid Frames in Building Construction."** Mr. Jacobsen's paper was based on the construction of four churches, recently completed, in which all-welded frames of rigid design were used. He outlined the problems which had been met with in the design and analysis of this new type of construction, and stated that the type had been found to be very satisfactory both from the economic and the æsthetic points of view. Colored slides were used to illustrate very effectively the points brought out by the speaker.

H. O. Keay, M.E.I.C., of Three Rivers, moved a vote of thanks to the speaker. There were 64 members and friends present at the dinner.

Previous to the dinner the film, **"Steel—Man's Servant,"** was shown at the Rialto Theatre, Three Rivers,to an audience of over four hundred. This film was produced by the U.S. Steel Corp. and was loaned to the Branch, for this showing, by the U.S. Steel Products Co., Montreal. The picture was greatly enjoyed by all who saw it, and the Branch wishes to express its thanks to the owners for the privilege of showing it.

VANCOUVER BRANCH

T. V. Berry, A.M.E.I.C. - *Secretary-Treasurer*
J. B. Barclay, A.M.E.I.C. - *Branch News Editor*

Forty-two members and friends sat down to the annual dinner in the York Room of the Georgia Hotel on Monday, November 21st. At the head table with the Branch chairman, Lieut.-Col. J. P. MacKenzie, D.S.O., M.E.I.C., sat Past-Presidents Geo. Walkem, M.E.I.C., and Dr. E. A. Cleveland, M.E.I.C., Past Chairman H. N. Macpherson, M.E.I.C., Councillor-elect James Robertson, M.E.I.C., and Mr. K. M. Cameron, M.E.I.C., of the Ottawa Branch, Chief Engineer of the Department of Public Works, who was visiting in Vancouver.

Following dinner the annual business meeting was held, at which time reports by the chairman and the secretary-treasurer showed the Branch affairs to be in a healthy condition.

The election of officers resulted in Ernest Smith, A.M.E.I.C., being elected Branch chairman for the year 1939.

The guest speaker for the evening was Ivor Jennings, M.A., LL.B. (Cantab), LL.D. (London), Reader in English Law at the London School of Economics (University of London), and Exchange Professor at the University of British Columbia. He chose as his subject **"Some Principles of British Public Finance."** Professor Jennings outlined the factors contributing to the strength of the British Government financial system. Ever since the British nation became the predominant factor in world finance, the permanent officials of the British Treasury have been the foundation of that system. Well trained in the many phases of public finance, these men, true to the traditions of conservative British finance, have resisted all attempts to introduce many of the newer but untried palliatives for world economic ills.

The outstanding reason for British financial solidarity during times of world financial and economic stress has been the determination to carry on the pay-as-you-go plan as far as possible.

A substantial part of the cost of the great war was financed by taxation. This enormous burden resulted in a post-war period of very high taxes when the income tax rate rose to 5/6 in the pound. During this time Great Britain was forced off the gold standard by world financial conditions, but despite this further handicap the country was able to escape the disastrous effects of inflation. France, on the other hand, financed the whole cost of the great war by loan, with serious consequences during the post-war period, during which the franc fell from an equivalent of 25 to the £ to 180 to the £ Sterling.

The burden of unemployment relief from 1920 to 1932 was partly covered by borrowing, but after investigation by a Royal Commission the benefits were reduced so that now the fund is more than paying its way. Funded debt has been retired and extensions of benefits can now be made.

The vast rearmament effort of the last two years cannot be all financed from increases in taxation, loans in excess of £200,000,000 having already been made.

Great Britain has been a low tariff country for many years. The control of the tariff structure is vested in the hands of an independent group known as the Import Duties Advisory Committee. It can be said of this committee that it is biased in favor of tariffs as a principle but not politically biased. Before this committee must be presented in public any representations on the part of interested groups for tariff changes, with the consequence that lobbying of private members of Parliament for their influence in such matters does not exist.

The placing of government contracts is in open competition whenever possible. In cases where the public interest or other circumstances prevent this, as in the placing of certain contracts for the Air Ministry, Admiralty or War Office, contracts are awarded without open competition, the prices being fixed by the government after comparison with detailed unit costs of the costs of production gathered over a number of years and a fair profit allowed on the prime cost. This was the practice with the contracts awarded during the last war for war material, when the Ministry of Munitions investigated the costs of every factory making munitions.

In the realm of municipal finance, the British people have every reason to be proud of their record. Municipal borrowing can only be made with the permission of a government department, usually the Ministry of Health. Loans may be rejected by this department if in their opinion they are extravagant, undesirable or for the undertaking of a wrong project. The Ministry of Health sets the period of the loan and this period is in no case longer than the life of the structure to be built with the proceeds of the loan. Sinking fund payments for the amortization of the loan are rigidly insisted upon, and of recent years it has been the policy of the Ministry of Health not to permit borrowing against any but tangible assets.

As a result of this rigid control of municipal borrowing there have been no defaults whatsoever during the post-war period by municipalities, and consequently municipalities enjoy comparatively low rates of interest. Recently the London County Council borrowed on the London market £10,000,000 at a rate of 3½ per cent which was only ¼ per cent higher than the government rate at that time.

Naturally the rigid so-called Treasury control of government finances, be they federal or municipal, comes in for its share of criticism. It is charged that Treasury control discourages the expansion of industry and is too conservative in its outlook. However, the solid foundation on which British Government finance has been built, as evidenced by the nation's ability to withstand war and economic stress, has been the envy of the nations of the world, and is an example which younger countries might do well to study and apply to their own problems.

A vote of thanks proposed by J. N. Finlayson, M.E.I.C., Dean of the Faculty of Applied Science, University of British Columbia, to Dr. Jennings for his interesting and informative address was heartily applauded.

The meeting ended with the showing of two interesting talking films loaned by the Department of Visual Education, Vancouver School Board.

WINNIPEG BRANCH

J. Hoogstraten, A.M.E.I.C. - *Secretary-Treasurer*

At a joint meeting of the Winnipeg Branch and the Association of Professional Engineers, held on Nov. 17th, J. W. Dorsey, Associate Professor of Electrical Engineering, University of Manitoba, gave an interesting paper on **"Electrical Precipitation."**

In discussing the theory, Prof. Dorsey divided the process into the following stages: Charging the particle, attracting the particle to the collecting electrode, discharging, and mechanical removal. The characteristics of various voltage sources were discussed, the types being tubes or mechanical rectifiers, voltage doubling circuit and three-phase full wave.

The actual process of precipitation was very efficiently demonstrated by apparatus set up for the purpose, and several voltage source units, ionizer models, and new rectifier tubes were exhibited.

At a joint meeting held on Dec. 1st, Mr. G. R. Fanset, Manager for Manitoba, Ducks Unlimited Inc., spoke on the reclamation of lands for waterfowl breeding purposes, under the title **"Weeds to Waterfowl."**

Mr. Fanset pointed out that many of the lakes in duck breeding country have been considerably reduced in size, and in many cases completely dried up. Lakes with only a few inches of water in the spring are particularly dangerous, for they dry up in early summer before the ducklings are large enough to fly in search of water. Dried-up lake bottoms are covered with weeds, and the peaty soil has a low fertility that makes it practically useless for other purposes.

In preliminary field inspections, the areas involved, and the possibility of raising the water level are studied, in addition to surveying the quantity and quality of the food suitable for raising ducks. At Big Grass Ditch, for instance, two dams will flood 30,000 acres of land; in Saskatchewan, 12,000 acres are being flooded and another 24,000 are planned for.

In the "no man's land" lying between the agricultural areas and the Pre-Cambrian Shield, many of the lakes are reduced in size, from 5 to 90 per cent. A decrease in the number of beaver in this area is held partly responsible for the early run-off, resulting in dried-up peat beds, large areas of which are being consumed by fire, resulting in large tracts of land incapable of sustaining life for many years to come.

It is proposed that large areas of this land be set aside as game reserves, especially on the southern fringes, implying a necessity for dams, look-out towers and restoration of beaver. It is hoped in this connection, that the resident Indians will be able to take over some of this work in return for the privilege of taking off muskrat under supervision.

News of Other Societies

Items of interest regarding activities of other engineering societies or associations

THE INSTITUTION OF CIVIL ENGINEERS

For the third time within the history of the Institution, a son of a Past-President occupies the chair once associated with his father's name. At the recent annual meeting William James Eames Binnie, M.A., was introduced to the presidential chair by the retiring incumbent, Sydney Bryan Donkin. Mr. Binnie is the distinguished son of a distinguished father, Sir Alexander Binnie, whose name is known through the Empire, and who was President of the Institution in 1905.

The four Vice-Presidents elected to office were Sir Clement D. M. Hindley, K.C.I.E., M.A., M. F. Wilson, Sir Leopold H. Savile, K.C.B., and Professor Charles E. Inglis, O.B.E., M.A., LL.D., F.R.S.

Unlike procedure in The Engineering Institute, the President's address is given at the inauguration of his year of office, rather than at the termination. On this occasion, Mr. Binnie, whose reputation is widespread in connection with major engineering works in the field of water supply, made the theme of his address, engineering of the Egyptians and Romans, largely in pre-Christian days. An abstract of Mr. Binnie's address is reproduced on page 26.

THE AMERICAN SOCIETY OF CIVIL ENGINEERS

Plans are nearly completed for four days of technical and social activity, comprising the Society's 86th annual meeting, which will be held in New York City, January 18th to 21st, 1939. A final programme of the meeting with complete details will be published in the January issue of Civil Engineering. The annual meeting, which will be held on the opening day, will have as its principal feature the impressive ceremonies that accompany the conferring of honorary memberships, and the awarding of prizes. The second day will be devoted to sessions of the technical divisions, while the third and fourth days are to be taken up by inspection trips to engineering works. At the conclusion of the meeting a cruise to Bermuda has been organized.

The Board of Direction has unanimously adopted a proposed change of the Society's by-laws, establishing a Committee on Professional Objectives, the functions of which shall be to recommend, and upon approval put into effect, methods and procedures calculated to encourage the discussion of problems of a general professional nature, public relations, social responsibilities of the engineer, the development and maintenance of high standards of practice and ethics, thus to increase the usefulness of the profession to society. It shall also give particular consideration to the economic and social status of the engineer.

ASSOCIATION OF PROFESSIONAL ENGINEERS OF BRITISH COLUMBIA

At the nineteenth annual meeting of the Association, which was held on December 3rd, 1938, the retiring president, C. V. Brennan, after referring in feeling terms to the loss sustained by the Association in the death of its Registrar, E. A. Wheatley, M.E.I.C., reviewed the progress of the organization during the past year, noted the recent work of the Dominion Council, particularly in regard to the question of uniformity in requirements for admission to the profession, and discussed the possible improvement of the British Columbia Engineering Act. The Association has to-day 847 members, 382 engineers-in-training and 312 engineering pupils. He questioned the desirability of any definite relationship between the professional association and the "specialized voluntary societies."

In his address, the incoming president, C. E. Webb, M.E.I.C., drew attention to the strengthening of the position of the profession in British Columbia which will result from the passing of the Association's amended Act. He urged the importance of proper publicity, making the general public familiar with the professional engineer's status and achievements. To effect this the closest co-operation between all branches of the profession would be necessary.

In Mr. Webb's view the recent visit to British Columbia of the headquarters delegation of The Engineering Institute of Canada had done much to remove misconceptions regarding the movement for closer relations between the Institute and certain provincial professional associations. He pointed out that The Institute's attitude on this matter had been defined by President Challies, as the wish to develop a co-operative understanding with any provincial association if and when that association so desires.

Mr. Webb congratulated the Association in securing as its new Registrar so able and efficient an engineer as J. C. Oliver.

The following members took office in the Council of the Association for the ensuing year: President, C. E. Webb, M.E.I.C.; Vice-President, E. Redpath; Members, J. N. Finlayson, M.E.I.C., F. W. MacNeill, H. R. Younger, A.M.E.I.C.

THE SOCIETY OF CHEMICAL INDUSTRY

The Perkin Medal for 1939 was presented on January 6th to Dr. Walter S. Landis, Vice-President of the American Cyanamid Company, at a joint meeting of the American Section of the Society of Chemical Industry and the American Chemical Society, held at The Chemists' Club, New York City. Mr. Victor G. Bartram of Montreal, President of the Society, presided over the meeting. Dr. Wallace P. Cohoe, Chairman of the American Section, opened the programme with a commemoration of former medallists. After a talk on Dr. Landis, the man, by Mr. Floyd Parsons, and a talk on the scientific accomplishments of the medallist by Dr. C. M. A. Stine, the medal was presented to Dr. Landis by Professor Marston T. Bogert. After the presentation Dr. Landis gave his medal address entitled "Argon."

THE INSTITUTION OF ENGINEERS, AUSTRALIA

During the month of September, 1938, an engineering conference was held by Australian engineers at the city of Canberra, Australia's national capital. All divisions of the Institution of Engineers, namely, Adelaide, Brisbane, Canberra, Melbourne, Newcastle, Perth, Sydney, and Tasmania, were well represented. On the opening day the conference was welcomed by the Rt. Hon. J. A. Lyons, Prime Minister of the Commonwealth of Australia, following which there was an inspection of Parliament House. In the evening His Excellency the Rt. Hon. Lord Huntingfield, K.C.M.G., acting Governor General, addressed the gathering.

Following the opening ceremonies, the period of the conference was then largely devoted to tours and visits of inspection, as for example to the electricity supply generating station, broadcasting stations, to the Canberra airdrome, the Royal Military College, Canberra water supply pumping station, the Cotter Dam, Mount Stromlo Solar Observatory, sewage treatment works, brick works, forestry school, research laboratories, Lake George mines, and other places.

An extraordinary general meeting of the Institution was also held under the chairmanship of the Hon. F. P. Kneeshaw, O.B.E., M.I.E.Aust., President, at which resolutions were passed ratifying the action of the Council in accepting the Royal Charter granted to the Institution by His Majesty the King, Honorary Patron of the Institution.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Latest developments in the field of mechanical engineering were presented and discussed at the Fifty-Ninth Annual Meeting of The American Society of Mechanical Engineers, which was held in New York City from December 5th to 9th.

Approximately 2,500 engineers and guests from all parts of the United States and Canada attended to present or to listen to reports of results of studies and researches in a dozen allied fields, particular emphasis being given to the subjects dealing with aeronautics, applied mechanics, fuels, graphic arts, hydraulics, iron and steel, machine shop practice, management, oil and gas power, steam power, process industries, railroads, and textiles. Delegates from the Society's seventy-one local sections in the United States and Canada met to consider methods of increasing the usefulness of the organization to the individual member and to his community. For the first time in many years, a conference of representatives from the seventeen professional divisions of the Society was held for the purpose of correlating division activities so as to better promote the art and science of mechanical engineering as a whole.

In addition to meeting in twenty-eight technical sessions, members and guests gathered at the annual dinner, which was attended by about 900 persons, including J. B. Challies and J. M. R. Fairbairn, representing the E.I.C., and at the traditional Honors Night, awards were conferred upon a number of the Society's distinguished members and Gerard Swope, president of General Electric, delivered the Towne Lecture on "Mechanical Engineering—Materials, Methods and Men." Awards presented and recipients thereof were: *Holley Medal* to Francis Hodgkinson for his work in connection with the steam turbine; *Worcester Reed Warner Medal* to Lawford H. Fry, railway engineer; *Melville Medal* to Alphonse I. Lipetz, American Locomotive Co.; *Pi Tau Sigma Medal* to Wilfrid E. Johnson, General Electric Co.; *Charles T. Main Award* of $150 to Edward W. Connolly, of Detroit; and *Junior and Student Awards* to Arthur C. Stern, Marshall C. Long, and Donald C. McSorley.

Canadian-born Alexander Graham Christie, professor of mechanical engineering at Johns Hopkins University, Baltimore, Md., was elected president of the Society and formally took office on Friday, Dec. 9, at the first meeting of the 1939 Council, which also included the following new officers: Henry H. Snelling, Wm. Lyle Dudley, Alfred Iddles, and James W. Parker, vice-presidents; and Clarke Freeman, William H. Winterrowd, and Willis R. Woolrich, managers.

THE AIR RAID PROTECTION INSTITUTE

The inaugural meeting of the Air Raid Protection Institute was recently held at the Royal Society of Arts, Adelphi, London. In opening the proceedings, the President (Mr. O. E. Simmonds, M.P.) said that the Institute had been started to provide a common forum for the discussion of the complicated and urgent technical problems connected with air raid protection. It would follow other learned bodies in granting the qualifications of Fellow and Associate Fellow to those who reached the appropriate standard and would welcome as members those whose interest in the matter was less technical. Several panels to study special aspects of the question had already been formed, and he appealed to architects in particular to consider the advantages and drawbacks of the structures they designed from the point of view of air raid protection.

—*Engineering*

THE INSTITUTE OF PETROLEUM

With the object of widening its scope, the Institution of Petroleum Technologists, which was founded in 1913, has recently changed its name to the Institute of Petroleum, and its main object will now be "to encourage and co-ordinate all aspects of the study of petroleum and its allied products." In order to inaugurate the Institute in its new form, a conversazione was held on Tuesday, November 8, at the House of the Royal Geographical Society in Kensington Gore, London, the members and guests being received by the President, Lt.-Col. S. J. M. Auld, O.B.E., M.C., and Mrs. Auld, and also by Captain H. F. C. Crookshank, M.P., H.M. Secretary for Mines. The greater part of the evening was occupied with a lecture on "The Search for Oil in Britain," by Mr. G. W. Lepper, technical adviser to the Government Petroleum Department.

—*Engineering*

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Edison Medal Award

Doctor Dugald C. Jackson, professor emeritus of electrical engineering, Massachusetts Institute of Technology, has been awarded the 1938 Edison Medal of the American Institute of Electrical Engineers "for outstanding and inspiring leadership in engineering education and in the fields of generation and distribution of electric power." The presentation will be made on the evening of Wednesday, January 25, during the annual winter convention of the Institute, which will be held in the Engineering Societies Building, New York.

Doctor Jackson was born at Kennett Square, Pa., in 1865, and received the degree of Civil Engineer from the Pennsylvania State College in 1885. He spent two years in graduate study in electrical engineering at Cornell University.

In 1891, he formed a consulting engineering firm with his brother, W. B. Jackson, and also became professor of electrical engineering at the University of Wisconsin, which position he retained until 1907, when he was appointed professor and head of the department of electrical engineering at the Massachusetts Institute of Technology, in which position he notably wove research into the fabric of engineering education.

The consulting engineering firm of Jackson and Moreland, organized in 1919, specialized in the fields of electric power production and distribution of railway electrification with a nation-wide and international list of clients. Doctor Jackson continued as senior partner until 1930. He retained his position at the Massachusetts Institute of Technology until 1935, when he retired as professor emeritus.

Doctor Jackson joined the American Institute of Electrical Engineers in 1887, and became president in 1910. His keen interest and highly effective participation in professional and educational activities have been continued to the present time.

Doctor Jackson's broad vision, his untiring efforts, and his outstanding qualities as a leader of men have not only produced a high reputation in both engineering practice and education, but have also made him the recipient of many notable honors, including the Lamme Medal of the Society for the Promotion of Engineering Education in 1931, and election as president of that society for 1905-06. He accepted an invitation from the Institute of Electrical Engineers of Japan to give a series of lectures in Japan, in 1935, under the Iwadare Foundation.

He is a Chevalier, Legion of Honour (France) and President of the American Academy of Arts and Sciences, Fellow of the American Philosophical Society, the American Society of Mechanical Engineers, and the American Physical Society, Member of the American Society of Civil Engineers, the Institution of Electrical Engineers (London), the Société Française des Electriciens (Paris), and the American Institute of Consulting Engineers (President 1938), Engineers' Council for Professional Development, and other important societies.

Doctor Jackson is the author of a number of books on electrical engineering and many articles related to engineering projects and engineering education. Columbia University conferred upon him the honorary degree of Doctor of Science and Northeastern University, the honorary degree of Doctor of Engineering.

Library Notes

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

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.

AIR CONDITIONING

By J. A. Moyer and R. U. Fittz. 2 ed. New York, McGraw-Hill Book Co., 1938. 455 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

A full and practical treatment of air conditioning, both on its theoretical side and in the selection and operation of equipment for a wide variety of applications. This second edition contains data on sun effect and on methods for calculating and selecting unit air-conditioners. Useful tables and a group of practical problems are appended.

AIR CONDITIONING FOR COMFORT

By S. R. Lewis. 3 ed. Chicago, Keeney Publishing Co., 1938. 285 pp., diagrs., charts, tables, 9 x 6 in., cloth, $2.50.

A general treatment of the field, covering thermodynamical and physical fundamentals, heat transmission, heating and air conditioning systems, refrigeration systems and refrigerants, air distribution and noise control. A final brief chapter includes certain codes and regulations.

AIR NAVIGATION

By P. V. H. Weems. 2 ed. New York and London, McGraw-Hill Book Co., 1938. 587 pp., illus., charts, maps, tables, 9 x 6 in., lea., $5.00.

The beginning chapters are devoted to fundamental concepts, types of maps and charts, map reading and compasses. The later chapters take up the equipment, methods and practice of navigation by dead reckoning, blind flying, and the various systems of celestial navigation, including both preparatory work and actual flight operations. There is considerable information on meteorology and airways.

AIR PILOTING, Manual of Flight Instruction

By V. Simmons. New York, Ronald Press Co., 1938. 284 pp., illus., diagrs., tables, 8 x 6 in., cloth, $3.00.

This book aims to supply in detail the instructions needed by student pilots preparing for the examinations for flying certificates, and by pilots who aspire to certificates of higher grades. Included are lists of questions taken from official examinations, with answers that have been accepted as correct.

THE CAUSES OF ECONOMIC FLUCTUATIONS

By W. I. King. New York, Ronald Press Co., 1938. 353 pp., charts, tables, 8 x 6 in., cloth, $3.50.

Business depressions are considered from the economic viewpoint. The author, after describing the characteristics of depressions, discusses various misleading or inadequate explanations of their origin and offers a further explanation, a resumé of forces which influence depressions, and possible ways to forecast and minimize depression.

CHEMICAL ENGINEERING ECONOMICS

By C. Tyler. 2 ed. New York and London, McGraw-Hill Book Co., 1938. 241 pp., diagrs., charts, tables, 9 x 6 in., cloth, $3.00.

In describing the application of economic principles to chemical engineering practice the author considers the following topics: organization, research and development, project analysis, plant location and design, unit operation costs, fuels and energy, operation and control, sales problems, cost accounting, patents, and the general industrial setup.

A COURSE OF STUDY IN CHEMICAL PRINCIPLES

By A. A. Noyes and M. S. Sherrill. 2 ed. rewritten. New York, Macmillan Co., 1938. 554 pp., diagrs., charts, tables, 9 x 6 in., cloth, $5.00.

The subject matter consists mainly of a development of the atomic, kinetic and ionic theories through consideration of the physical properties directly related to them, and a treatment, with the aid of these theories, of the principles relating to the rate and equilibrium of chemical reactions from mass-action, phase, and thermodynamic viewpoints; accompanied by practical, illustrative problems.

COMBUSTION, FLAMES AND EXPLOSIONS OF GASES

By B. Lewis and G. von Elbe, Cambridge, England, University Press; New York, Macmillan Co., 1938. 415 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $5.50.

A co-ordinating and critical appraisal of the literature concerning the numerous investigations in combustion phenomena of recent years. The material is considered under four main headings: chemistry and kinetics of the reactions between fuel gases and oxygen; propagation of flames; state of the burnt gas; problems in technical combustion processes. Various thermochemical and other tables and diagrams are appended.

DIESEL ENGINEERING

By J. W. Anderson. New York and London, McGraw-Hill Book Co., 1938. 269 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.00.

This college textbook on the fundamentals of the subject emphasizes the theory and principles of thermodynamics, combustion, mechanics of engine design, and installation principles. Such subjects as governing, cooling and lubrication are also considered.

ECONOMICS FOR ENGINEERS

By E. L. Bowers and R. H. Rowntree. 2 ed. New York and London, McGraw-Hill Book Co., 1938. 591 pp., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

This is a practical presentation of economic principles for engineers and engineering students, in which the subject is treated as concisely as possible and the engineering aspects of economic theory and business activity are emphasized. This new edition has been entirely rewritten and several chapters have been added.

ELECTRICAL MACHINERY, a Practical Study Course on Installation, Operation and Maintenance

By F. A. Annett. 2 ed. New York and London, McGraw-Hill Book Co., 1938. 429 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.00.

This well-known book aims to provide a course of home study for electricians, power-plant men and others who work with electrical machinery. Theory and practical applications are explained in clear, simple language, beginning with the fundamentals of electricity and continuing through the usual equipment. This new edition has been considerably enlarged and thoroughly modernized.

ESTIMATES AND COSTS OF CONSTRUCTION

By F. W. Stubbs. New York, John Wiley & Sons, 1938. 234 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.00.

The purpose of this book is to outline some of the important steps in the development of a construction project, especially the preliminary financial investigations and the studies that must be made before and during the actual construction. Only enough cost data to illustrate the discussion are included. There is a bibliography.

FORMULAS FOR STRESS AND STRAIN

By R. J. Roark. New York and London, McGraw-Hill Book Co., 1938. 326 pp., diagrs., tables, 9 x 6 in., cloth, $3.00.

The book brings together the formulas, facts and principles pertaining to the strength of materials which are required in the more precise and accurate methods of stress analysis imposed by modern engineering trends. Part one contains definitions of terms. Part two discusses general principles, methods of stress analysis and the behavior of material under stress. Part three discusses the behavior of structural elements under various conditions of loading and gives extensive tables of formulas for the calculation of stress, strain and strength. Numerous lists of references are included. The volume should be a very useful reference book for the designing engineer.

GASEOUS ELECTRICAL CONDUCTORS

By E. L. E. Wheatcroft, Oxford, England, Clarendon Press; New York, Oxford University Press, 1938. 265 pp., illus., diagrs., charts, tables, 10 x 6 in., cloth, 21s., $6.50 U.S.A.

This book for the technical man interested in vacuum tubes and similar apparatus discusses first the fundamental facts of atomic structure, ionization and emission. Succeeding chapters cover modern views on the nature of glow, corona, arc and spark, and the final chapters deal with the application of the principles to various types of apparatus, such as vacuum and gas-filled tubes, rectifiers, circuit-breakers and lamps.

GETTING A JOB IN AVIATION

By C. Norcross. New York and London, McGraw-Hill Book Co., 1938. 374 pp., illus., 8 x 6 in., cloth, $2.50.

Designed for young men in search of a vocation, this book describes the kinds of jobs available in aviation and the ways to get them. What workers do, their pay and working conditions, the requirements and opportunities are explained. Advice is given concerning training and its cost, and the future of the industry is considered.

GREAT BRITAIN—Dept. of Scientific and Industrial Research. Building Research Technical Paper No. 23. Studies in Reinforced Concrete VI. The Strength and Deformation of Reinforced Concrete Columns under Combined Direct Stress and Bending

By F. G. Thomas. London, His Majesty's Stationery Office, 1938. 42 pp., illus., diagrams, charts, tables, 10 x 6 in., paper (obtainable from British Library of Information, 270 Madison Ave., New York, $0.30).

While considerable study has been made of strengths of reinforced-concrete members in pure bending or axial compression, this pamphlet claims to be the first publication for the intermediate case of combined compression and bending. Two series of experiments were made, one under constant, the other under continuously changing eccentricities of loading.

GREAT BRITAIN—Dept. of Scientific and Industrial Research. Fuel Research Technical Paper No. 47. The Production of Active Carbon from Bituminous Coal

London, His Majesty's Stationery Office, 1938. 55 pp., illus., diagrs., charts, tables, 10 x 6 in., paper (obtainable from British Library of Information, 270 Madison Ave., New York, $0.40).

A report on the production from lump coal of an active carbon which is suitable for use in gas respirators. Discusses the choice of coal, the laboratory method, the transfer of the process to semi-technical and full technical scale, and the application of carbons to industrial processes.

HANDBOOK OF REFRIGERATING ENGINEERING

By W. R. Woolrich, New York, D. Van Nostrund Co., 1938. 425 pp., diagrs., charts, tables, 7 x 5 in., cloth, $5.00.

Information concerning all phases of the refrigeration field for the use of those desiring to take up or now engaged in that work. Covers fundamental definitions and thermodynamic principles, refrigerants, systems and equipment, air cooling and conditioning, preservation of foodstuffs, and special units.

HEROES OF THE AIR

By C. Fraser, rev. ed. New York, Thomas Y. Crowell Co., 1938. 808 pp., maps, 8 x 5 in., cloth, $2.50.

A popular account of famous flights provides a record in considerable detail from the first crossing of the Atlantic, in 1919, to the year 1937. The book is a readable addition to the history of aviation.

INDUSTRIAL CHEMISTRY

By W. T. Read. 2 ed. New York, John Wiley & Sons, 1938. 605 pp., illus., diagrs., tables, 10 x 6 in., cloth, $5.00.

A comprehensive survey of the chemical industries. The opening chapters deal with such general considerations as the relation of chemistry to industry, organizations, literature, analytical control, chemical economics, unit operations, and materials of construction. The last seventeen chapters consist of brief discussions of the main principles used in the various major fields and descriptions of methods and equipment.

INDUSTRIAL HYGIENE

By L. B. Chenoweth and W. Machle, with a foreword by H. Schneider. New York, F. S. Crofts & Co., 1938. 235 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $2.00.

This is a simple, practical manual of hygiene and toxicology intended for use by engineering students, works engineers and plant managers. Information is given upon the various hazards to which workmen may be exposed and to acceptable means for preventing them or treating those affected.

INTRODUCTION TO INDUSTRIAL MANAGEMENT

By F. E. Folts. 2 ed. New York and London, McGraw-Hill Book Co., 1938. 566 pp., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

A presentation of the essentials of industrial management by means of actual cases exemplifying major management topics, followed by discussion of the principles involved. Each topic is accompanied by from one to four problems which necessitate the application of these principles. The intention has been to emphasize the business aspects of management.

LUMBER, Its Manufacture and Distribution

By R. C. Bryant. 2 ed. New York, John Wiley & Sons, 1938. 535 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $5.00.

This book is intended as a text and reference book for instructors and students in forest schools. The text discusses equipment for manufacturing lumber, methods of manufacture and markets and marketing. There is a bibliography and a glossary. The new edition has been revised and brought up to date.

McRAE'S BLUE BOOK and Hendrick's Commercial Register

46th Annual Edition, 1938-39. New York and Chicago, MacRae's Blue Book Co., 1938. 3,604 pp., illus., 11 x 8 in., cloth, $15.00.

The forty-sixth annual issue of this well-known directory follows the established pattern, but has been thoroughly brought up to date. It provides an index of manufacturers and wholesalers and their local distributors, with addresses; a carefully indexed classified list of manufacturers; a directory of commercial bodies, banks, railroads and warehouses in towns of one thousand or more population; and a list of trade names.

THE MANAGEMENT OF LABOR RELATIONS

By G. S. Watkins and P. A. Dodd. New York and London, McGraw-Hill Book Co., 1938. 780 pp., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

The subjects considered in the six parts of this book are as follows: The nature and development of personnel and labor relations, and the general functions of personnel management; psychological aspects of labor relations; technique of selection and placement, including job analysis and intelligence and ability tests; labor turnover, attendance problems, transfers and promotions, incentives, executive training, and health and disability problems; civil service personnel; employee representation, collective bargaining, and unions.

MECHANICS OF MATERIALS

By P. G. Laurson and W. J. Cox. New York, John Wiley & Sons, 1938. 408 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.75.

The fundamental treatment of general stresses, joints, torsion members, beams, columns and combined stresses is covered in the first fifteen chapters. The next eight chapters discuss more specialized material, elastic energy, webs, eccentric loading, etc. A large number of problems are included, and various derivations and tables are appended.

AN INTRODUCTION TO METALLURGY

By J. Newton. New York, John Wiley & Sons, 1938. 537 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

A presentation of fundamental metallurgical principles to serve as groundwork for advanced courses. Discusses structure, shaping and heat-treatment of metals and alloys, ores and ore dressing, hydrometallurgy and electrometallurgy, sampling, and the production of industrial metals.

MODERN FURNACE TECHNOLOGY

By H. Etherington. Phila. & New York, J. B. Lippincott Co., 1938. 524 pp., diagrs., charts, tables, 9 x 6 in., lea., $12.00.

An explanation of the scientific principles underlying the various phases of modern furnace design and operation, and their application in achieving operating improvement. Combustion, gas flow, heat transfer, and physico-chemical theories are covered, and there is a long chapter on refractory materials. Diagrams and tables of practical data are included to assist in the practical application.

OXYACETYLENE WELDING

By R. J. Kehl, rev. by M. H. Potter. Chicago, American Technical Society, 1939. 130 pp., illus., diagrs., tables, 9 x 6 in., cloth, $1.25.

A practical elementary text dealing with the equipment and technique of oxyacetylene welding as applied to different metals and under varying conditions. Certain special applications of the equipment, as for soldering, cutting, etc., are also discussed.

PRACTICAL DESIGNS FOR DRILLING AND MILLING TOOLS

By C. W. Hinman. New York and London, McGraw-Hill Book Co., 1938. 171 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $2.50.

The object of this treatise is to reveal some of the principles involved in the design of drilling jigs and milling fixtures and to cite practical applications for them. The treatment is concise and practical, and the book should be of value to all designers.

PRACTICAL OIL GEOLOGY

By D. Hager. 5 ed. New York and London, McGraw-Hill Book Co., 1938. 466 pp., illus., diagrs., charts, maps, tables, 8 x 5 in., lea., $4.00.

A presentation, in handbook form, of practical information on the occurrence of oil and its geology. Subjects covered include stratigraphy, structural geology, prospecting and mapping, factors in oil-well drilling and oil production, water and its relationship to oil, natural gas and, in this revised edition, geophysics and paleontography.

PRACTICAL SEISMOLOGY AND SEISMIC PROSPECTING

By L. D. Leet. New York and London, D. Appleton-Century Co., 1938. 430 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $6.00.

The first four chapters are devoted to a comprehensive discussion of earthquake phenomena, the laws governing the propagation of elastic waves in the materials of the earth and the instruments and methods for recording vibrations. The last chapter describes the commercial and scientific use of elastic vibrations to investigate rock structures. There is a list of patents.

THE PRINCIPLES OF CANE SUGAR MANUFACTURE

By J. G. Davies. London, Norman Rodger, 1938. 144 pp., illus., diagrs., charts, tables, 10 x 6 in., cloth, 10s.

The manufacture of cane sugar is presented for the non-technical reader. The book is mainly concerned with the processes and machinery for raw sugar production, but there are chapters covering the manufacture of direct consumption sugars and fancy molasses and on transport problems.

PUBLIC UTILITY RATE MAKING AND THE PRICE LEVEL

By E. M. Bernstein. Chapel Hill, University of North Carolina Press, 1937. 142 pp., tables, 9 x 6 in., cloth, $2.50.

The purpose of this study is to show how the rate making rule and its procedure were developed, to consider the difficulties experienced under this rule, to discuss the new methods of rate making that commissions used during the period of rapid fluctuation in prices, and to offer a reasonable solution for the problem of rate making.

THE RAILWAY AGE

By C. B. Andrews. London, Country Life, Ltd.; New York, Macmillan Co., 1938. 145 pp., illus., 10 x 7 in., cloth, $3.00.

An introduction to the study of the early British railways, and of the various reactions that followed. Interest is lent to the brief historical treatment of the trains, stations, passengers, and the changing attitude of the general public by the numerous illustrations, reproduced from contemporaneous prints, woodcuts and sketches.

STANDARDS ON TRANSMITTERS AND ANTENNAS, 1938

New York, Institute of Radio Engineers, 1938. 42 pp., diagrs., 9 x 6 in., paper, $0.50.

Pertinent terms are defined, graphical symbols are depicted, the factors to be considered in various methods of testing transmitters and antennas are discussed, and there is a brief section on the propagation of radio waves.

STEEL CONSTRUCTION

By H. J. Burt and C. H. Sandberg. Chicago, American Technical Society, 1939. 438 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.50.

This practical text on structural steel framework design contains such explanations of underlying principles as are essential to proper use of the facts and formulas given. Many pictures and figures supplement the information, including sets of structural plans for a power house and a four-storey school building. Various codes and specifications are appended.

TENTATIVE RECOMMENDED GOOD PRACTICE CODE AND HANDBOOK on the Fundamentals of Design, Construction, Operation, and Maintenance of Exhaust Systems

Developed by A. F. A. Industrial Hygiene Codes Committee. Chicago, American Foundrymen's Association, 1938. 141 pp., charts, diagrs., tables, 12 x 9 in., lea., $4.00.

This code prescribes rules for systems used in foundries and allied departments for the removal of dust, refuse, fumes, vapors, etc., for health protection, safety and good housekeeping. The code was developed by the Industrial Hygiene Codes Committee and has the approval of the Board of Directors of the Association.

TEXT BOOK OF APPLIED HYDRAULICS

By H. Addison. 2 ed. rev. and enl. New York, John Wiley & Sons, 1938. 435 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $5.50.

A compact summary of the fundamental principles of hydraulics, and of the manner in which they are applied by the engineer. The book is intended particularly for readers, such as electrical engineers, whose work is not directly connected with hydraulics, but who need to know the main outlines of hydraulic practice. Two-thirds of the text is devoted to turbines, pumps, hydraulic transmissions and other practical applications. The new edition has been revised and slightly enlarged.

TIMBER, ITS STRUCTURE AND PROPERTIES

By H. E. Desch. London and New York, Macmillan & Co., 1938. 169 pp., illus., diagrs., charts, tablss, 9 x 6 in., cloth, $4.50.

The aim of this work is to present a summary, in simple, concise language, of the knowledge of the structure, properties and proper handling of wood which has resulted from the scientific investigations of the various research laboratories which are studying wood.

WELDED STEEL CONSTRUCTION

By R. S. Hale, New York and Chicago, Pitman Publishing Corp., 1938. 170 pp. illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.00.

The aim of this work is to provide a simple, concise presentation of welded steel construction, adapted to the needs of engineers, contractors and others familiar with structural engineering who are interested in the possibilities of welding in that field. The design of such structures is explained and the principles illustrated by examples of their application.

ADDITIONS TO THE LIBRARY

PROCEEDINGS, TRANSACTIONS, ETC.

The Engineering Society of Detroit:
Membership Directory, 1938.

The Institution of Mechanical Engineers:
Proceedings Vol. 139, April-May, 1938.

The Institution of Naval Architects:
Transactions, Vol. 80, 1938.

The Royal Society of Canada:
List of Officers and Members and Minutes of Proceedings, 1938.

REPORTS, Etc.

Aluminum Research Laboratories:
Column Strength of Various Aluminum Alloys; Model Tests of Latticed Structural Frames (Technical Paper Nos. 1 and 2).

The Association of Professional Engineers of Manitoba:
The Engineer and the Public.

Bell Telephone System: Focussing an X-Ray Beam by a Rocksalt Crystal; Loudness, Masking and Their Relation to Hearing and Noise Measurement; Variable Equalizers; Studies of Telephone Line Wire Spacing Problems; Radioactivity—Artificial and Natural; the Common Battery Anti-sidetone Subscriber Set; the Occurrence and Effect of Lockout Occasioned by Two Echo Suppressors; Characteristic Time Intervals in Telephonic Conversation; Thyratrons for Grid-Controlled Rectifier Service; Arrangement of Molecules in a Single Layer and in Multiple Layers; Stability of Two-Meter Waver; Certain Guided Waves in Slightly Noncircular Tubes; Diffraction Produced by Obstacles and Plates; Spectrochemical Analysis in Communication Research; Magnetic Shielding of Transformers at Audio Frequencies; (Monographs B1065, 1067, 1069-1081, 1083, 1084.)

Canada Department of Transport:
Annual Report, 1938.

Engineers' Council for Professional Development:
Sixth Annual Report, 1938.

Oregon, State Board of Engineering Examiners:
Ninth Biennial Report, 1938.

University of California:
The Burge Fauna, a Lower Pliocene Mammalian Assemblage from Nebraska, by Paul O. McGrew. 1938.

University of Oklahoma:
Proceedings of the Second Annual Highway and Street Conference November 18, 19, 20, 1937.

Photo Associated Screen News

Sir Edward Beatty pays tribute to J. M. R. Fairbairn, M.E.I.C.

Sir Edward Beatty, Chairman and President of the Canadian Pacific Railway, honoured J. M. R. Fairbairn, M.E.I.C., retiring Chief Engineer, at a dinner at the Mount Royal Club, Montreal, on December 29th, 1938. Sir Edward personally reviewed the career of Mr. Fairbairn from the time he joined the Canadian Pacific, and stressed the great recognition accorded him as an outstanding engineer.

D. C. Coleman, the Company's senior Vice-President, presented Mr. Fairbairn with a tray bearing the engraved signatures of the fifty officers present.

Congratulations were extended to John E. Armstrong, who succeeds Mr. Fairbairn as Chief Engineer.

Industrial News

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

BOILER METERS

A new bulletin, No. 46, issued by the Bailey Meter Co. Limited, 980 St. Antoine St., Montreal, describes the construction, installation and operation of Bailey boiler meters.

The Bailey boiler meter is primarily a boiler operating guide which enables the operator to get best results from each unit with respect to combustion efficiency, heat absorption efficiency, maintenance and capacity, revealing how the boiler is performing at every instant and furnishing information necessary to correct faulty conditions when they occur, so that maximum steam generating economy may be secured continuously.

ELECTRIC UNIT HEATERS

A four-page pamphlet of reference data has been issued by Canadian General Electric Company describing and illustrating the G-E Electric Unit Heaters. These units are available in capacities up to 20 kw. and can be operated on 550 volts or below, 60 or 25 cycles, and three-phase or single-phase. They are complete self-contained heating units. The data includes features of the design and construction of the heater and tables of ratings and required heater capacity under various conditions. Similar information is given covering the G-E Portable Heater.

INDUSTRIAL AIR HEATERS

The G-E Industrial Air Heaters are described in a four-page bulletin just issued by the Canadian General Electric Company, which contains illustrations of various models, standard ratings, dimensions and a general description of the design, application and control equipment. These heaters are of the natural convection type for circuits of 550 volts and below and in capacities from 1 kw. to 10 kw.

MODERN COMPRESSOR DESCRIBED IN NEW BULLETIN

A new catalogue recently printed by the Canadian Ingersoll-Rand Company Limited illustrates and describes their new line of Class "ES" horizontal, belt driven air or gas compressors.

"ES" compressors are the modern version of the company's straight-line "EL" and "ER" compressors, and incorporate the sound structural features of the earlier types, but in addition are equipped with anti-friction roller bearings and channel valves.

A series of cylinder sizes has been developed for each stroke size in which the compressor is built. These combinations give an extensive range of pressures and capacities, with piston displacements as follows: 138 to 686 cubic feet per minute at standard one hundred pounds pressure; 180 to 2,000 c.f.m. at various pressures of 75 pounds and below, and a few sizes of pressures above 100 lbs. Units for special high pressures, vacuum conditions, and steam drive are also described.

Copies of the new bulletin, No. K-328, can be obtained from any of the company's branches or from the head office in the New Birks Building, Montreal, Quebec.

ALGOMA PRODUCING GRINDING BALLS

Grinding balls for the mining trade are now being produced at Sault Ste. Marie by the Algoma Steel Corporation. The new plant went into operation about a week ago and is now in regular production.

A forecast of this development was contained in a statement issued by the Corporation earlier in the year when plans for construction of a tinplate mill and oil storage tanks were also announced.

The plant which has been established at Sault Ste. Marie for the production of grinding balls is completely up to date. The product is a forged steel ball which is designed to meet the highest requirements of the trade. The present range of sizes is 2½ to 5 ins. inclusive, but it is intended to cover later the entire range of sizes 2 to 5 ins. inclusive.

NEW TWO-STAGE REGULATORS

Dominion Oxygen Company Limited, Toronto, Ont., announces three new regulators: the Purox Oxygen Regulator, Type R-201 (for ordinary welding and light cutting); the Purox Oxygen Regulator, Type R-202 (for heavy-duty cutting); and the Purox Acetylene Regulator, Type R-203.

These regulators utilize the principle of two-stage regulation. A fixed "first stage" reduces the pressure of oxygen or acetylene from cylinder pressure to a moderate figure, below which it is regulated by the variable second stage of regulation. Stem-type valve mechanisms insure a uniform flow of oxygen and acetylene at the lower pressures at which the gases are used and in quantities sufficient for practically all welding and cutting operations.

CRANES AND HOISTS

The Northern Crane and Hoist Works Ltd., Walkerville, Ontario, have issued a 56-page loose-leaf catalogue describing and illustrating their various types of equipment.

NICKEL ALLOY STEELS

International Nickel Co. of Canada Ltd. are distributing a revised edition of Section No. 3 for insertion in the "Nickel Alloy Steels Data Book," which they have compiled and supplied to users of these products. The revised section deals with properties and uses of some cast nickel alloy steels.

MATERIAL IN STEAM SPECIALTIES

An interesting eight-page pamphlet, entitled, "The Third Essential in Steam Specialties," has been published by the International Nickel Co. of Canada Ltd., Toronto, Ont., and deals with the use of Monel for the vital parts of steam specialties.

AERIAL TRAMWAY TO BE ERECTED

Immediate start on the construction of an aerial tramway for Algoma Ore Properties Ltd. of Ontario is announced by Col. J. P. Mackenzie, M.E.I.C., general manager of Hamilton Bridge, Western Ltd. of Vancouver, formerly Western Bridge Co. Ltd.

The tramway will carry iron ore from the Helen Mine of the Algoma company to Wawa station, a distance of about three miles, 162 miles from Sault Ste. Marie. It will have a capacity of 165 tons per hour, 122 buckets carrying a load of 2,500 pounds each. Three hundred thousand tons of 50 per cent Sidarite ore will be moved per year.

Hamilton Bridge, Western Ltd., has for some years specialized in mine tramway design and equipment and has made several successful installations including those at Gold Mountain, Red Buck, Base Metals and Spud Valley Mines.

WEATHERPROOF PUSH BUTTON STATIONS

A new line of weatherproof, heavy-duty, momentary-contact push-button stations for use in the control circuits of magnetic controllers, is announced by Canadian General Electric. These new stations are of rugged construction and are designed to materially reduce installation and maintenance costs. They employ cast enclosures, and are available in one-, two-, three-, and four-button forms.

STURTEVANT APPOINTMENT

The B. F. Sturtevant Co. of Canada Limited, Toronto, announce the appointment of H. V. Hagborg as sales engineer. Formerly district manager for the Detroit Stoker Company, Mr. Hagborg is well known in heating and ventilating circles.

EXCAVATING EQUIPMENT

Priestman Brothers Limited, of Hull, England, have issued an attractive six-page pamphlet entitled "Priestman Knows No Bounds," which contains many illustrations of Priestman excavating and material handling equipment in use throughout the world.

COMBUSTION CONTROL

Bulletin No. 102-B, entitled, "Air Operated Combustion Control," has been published by Bailey Meter Co. Limited, Montreal, and in its 32 pages contains much useful and interesting information dealing with the principles of automatic combustion control and its application.

CHEMICAL STONEWARE TOWERS

Doulton & Co. Ltd., Lambeth, London, England, have published a 16-page booklet of illustrations, diagrams and dimensional tables dealing with their chemical stoneware towers, connecting pipes, cocks, tower packing, etc.

NEW OXY-ACETYLENE CUTTING ATTACHMENT

A new oxy-acetylene cutting attachment is announced by Dominion Oxygen Company Limited, Toronto, Ont., which will be useful for shops where the amount of cutting does not justify the purchase of a separate cutting blowpipe, and for those operations in the field where incidental cutting is to be done or where a minimum of equipment is desired.

The new attachment will cut any thickness of steel up to eight inches. Due to an improved injector principle, it operates with exceptionally accurate control of gases, and performs equally well with low-pressure or medium-pressure acetylene. It can be used with either the W-17 or W-22 Oxweld welding blowpipes.

MONTREAL APPOINTMENT BY C.G.E.

According to a recent announcement by Canadian General Electric Co. Ltd., Lyman I. Playfair has been appointed Assistant District Manager, Montreal District. Mr. Playfair is well known throughout the electrical industry. In 1925 he was transferred from Toronto office to Montreal, and for several years has been Manager of the Apparatus Sales Division, Montreal District.

NICKEL IN THE BRASS FOUNDRY

Canadian Nickel Products, Ltd., 25 King St. West, Toronto, have issued a circular chart listing some twenty-seven of the more generally used brass and bronze foundry mixtures to which the addition of nickel has proved to be commercially advantageous.

The chart is conveniently designed, utilizing the revolving disc principle, and provides data covering the chemical composition and mechanical properties for castings intended for specific applications.

SKIP-PIPE UNDERDRAIN

The Robinson Clay Product Company of Akron, Ohio, and Toronto, Ont., are distributing a six-page leaflet dealing with Robinson Skip-Pipe for sub-drainage.

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

SALES ENGINEERING REPRESENTATIVE wanted in Toronto district, on commission basis, to handle a complete line of material handling equipment, built in Canada by an established and responsible manufacturer. It can be handled with other lines of industrial equipment if desired. Apply to Box No. 1821-V.

COMBUSTION ENGINEER, experienced in heat balance calculations and in the design of modern steam generating equipment and general boiler construction. Apply giving full details of training and experience to Box No. 1822-V.

DRAUGHTSMAN, experienced in detail design and construction of all types of steam boilers. Apply giving full details of training and experience to Box No. 1823-V.

BOILER OPERATING ENGINEER, holding second-class papers and experience in installing, starting and servicing modern steam boilers and firing equipment. Apply giving full details of training and experience to Box No. 1824-V.

DESIGNING DRAUGHTSMAN, capable of acting as group leader in design of boilers and combustion equipment with ability to handle routine correspondence and calculations. Applicants should state education, experience in detail and also age, when available and salary expected. Apply to Box No. 1828-V.

SITUATIONS WANTED

PAPER MILL ENGINEER, A.M.E.I.C. Married. Ten years experience in the design, construction, maintenance and costs of pulp and paper mills, is seeking a permanent position. Available on short notice. Apply to Box No. 150-W.

CIVIL ENGINEER, M.A.SC., A.M.E.I.C. Eight years survey and municipal engineering experience, and three years draughting, detailing steel, concrete, and timber structures Apply to Box No. 467-W.

CIVIL ENGINEER, B.SC. (McGill '20), A.M.E.I.C. Married. Twelve years experience in pulp and paper mill design, and six years general construction. Available immediately. Location immaterial. Apply to Box No. 547-W.

CIVIL ENGINEER, B.A.SC. (Toronto '27). Age 34. Married. Five years railway and construction work as building inspector and instrumentman. Level engineer and on construction of a long timber flume for a pulp and paper mill. Field engineer for a sulphite company, in charge of the following mill buildings, acid, digester, blow pit, barker room, chip storage and acid towers. Available immediately. Apply to Box No. 714-W.

ELECTRICAL ENGINEER, B.SC. '31 (U.N.B.), JR.E.I.C. Age 30 years. Single. Experience in electrical wiring, construction of concrete wharves, inspection of piling, rip rap, concrete reinforcing, forms, and dredging. Also junior engineer. Available at once. Apply to Box No. 722-W.

CIVIL ENGINEER, B.SC., M.SC., R.P.E.; Lieut. C.E., R.O. Sixteen years municipal, highway and construction. Five years overseas. Married. Read, write and talk French. Will go anywhere. Apply to Box No. 737-W.

ELECTRICAL ENGINEER, B.SC. '31, JR.E.I.C. Age 31. Experience includes: eight months on installation of power and lighting equipment; three years as supervisor of an electrical and service dept.; seven months testing power and radio equipment; one year as inspector on electrical equipment and control. At present employed. Available on one month's notice. Location immaterial. Apply to Box No. 740-W.

CIVIL ENGINEER, A.M.E.I.C. Experienced in general construction, buildings, gravel and asphalt roads. Acting in charge P.W.D. West Africa. Chief field engineer refinery construction. Survey Angola Rly. West Africa. General Office work. Apply to Box No. 765-W.

TECHNICALLY TRAINED EXECUTIVE. General experience administrative, organization and management in business and industrial fields, including: business, plant, property and estate management; plant maintenance, modernization, production and personnel; economic studies, company reorganizations and amalgamations, valuations; railroad, highway, hydro, pulp, newsprint, housing, industrial surveys, investigations and construction; B.Sc. degree in engineering, age 49, married, Canadian. Apply to Box No. 1175-W.

CHEMICAL ENGINEER, grad. McGill '34, experienced in meter repairs, control work; and also chemical laboratory experience. Apply to Box No. 1222-W.

ELECTRICAL ENGINEER, B.SC. '31. Age 35. Experience in oil field work and railway construction survey. Two years on installation and maintenance of mine equipment, and two years industrial plant engineering on design and layout of equipment. Available immediately. Will go anywhere. Apply to Box No. 1249-W.

MECHANICAL ENGINEER, B.Eng. (McGill). Age 25. Experience includes: one year marine engineering, Diesel and steam; over two years general engineering work in paper mills including draughting, building and equipment layouts, power plant work, mill maintenance planning and costing. Seeking permanent position to acquire thorough knowledge of operation and maintenance. Available immediately. Apply to Box No. 1272-W.

FIELD ENGINEER AND DRAUGHTSMAN, A.M.E.I.C. Age 36. Married. Fifteen years experience in civil engineering, general draughting and instrument work. Experience covers office and layout work on construction of sewers, water mains, gas mains, 6" to 30" dia.) and transmission line structures; topographic and stadia surveys. Draughting covers general civil, reinforced concrete and steel design, mechanical detailing and arrangements, and mapping. Present location Montreal, but willing to locate anywhere. Available at once. Apply to Box No. 1326-W.

CIVIL AND ELECTRICAL ENGINEER, JR.E.I.C. (Univ. of Man.). Married. Age 25. Good draughtsman. Four months draughting, one year instrumentman on highway location and construction, inspection and miscellaneous surveying and estimating. Six months as field engineer on pulp and paper mill construction. Prefer electrical or structural design. Available at once. Apply to Box No. 1633-W.

ELECTRICAL ENGINEER, JR.E.I.C., B.SC. Age 25. At present employed, but desiring change of location. Three years maintenance and test work, toll and automatic telephone equipment; two years sales engineering, telephone and electrical equipment. Prefer to remain in telephone field, but would be interested in any opportunities in electrical engineering. Apply to Box No. 1817-W.

CIVIL ENGINEER, B.E., JR.E.I.C., age 28. Married. Desires position with reliable construction firm. Intends to make construction, life work. Over five years experience on permanent highway construction, inspection, estimates and instrument work. Available on short notice. Apply to Box No. 1820-W.

ELECTRICAL ENGINEER, B.A.SC. '33. Age 27. Married. JR.E.I.C. One year's experience in power plant operation and over three years experience in hydro-electric development and construction. Expert draughtsman and instrumentman, including experience in steam gauging, and reinforced concrete design and construction. Available at once. Apply to Box No. 1829-W.

CIVIL ENGINEER, B.A.SC. (Toronto '35), JR.E.I.C. Age 26. Experience in highway layout and construction, concrete bridge construction, draughting, office work, and surveying. Further details on request. Good references. Available immediately. Location immaterial. Apply to Box 1832-W.

ELECTRICAL ENGINEER, B.SC. (Manitoba '36), S.E.I.C. Practical and theoretical experience in radio. Have done experimental work. At present doing radio service work. Available at once. Apply to Box No. 1833-W

CIVIL ENGINEER, B.SC. '37, S.E.I.C. Age 22. At present employed, desires position with construction firm. Experience includes field instructing of transit and chain survey crews, draughting for geologist, instrument work and general supervision on highway construction work, purchasing in paper mill. Available on few weeks' notice. References and details on request. Willing to locate anywhere that offers required class of work. Apply to Box No. 1840-W.

FOR SALE

PRISMATIC COMPASS, 3in. diameter, made by Stanley, London; Box Sextant, 3in. diameter, made by W. & S. Jones, London; Steel Tape, 50ft. Location Montreal. Apply to Box No. 25-S.

COMING MEETINGS

The Engineering Institute of Canada, annual general and general professional meeting, Chateau Laurier, Ottawa, February 14th and 15th, 1939.

Hamilton Branch, annual meeting and banquet, January 13th, 1939, in the Rock Garden Lodge. Guest speaker Mr. Frank Dowsett, Advertising Manager of the Gutta Percha & Rubber Limited, subject, "The Buttress of Humor."

London Branch, annual meeting January 25th, 1939, followed by an address on "Modern Application of Diesel Engines," by J. L. Busfield, M.E.I.C.

Montreal Branch, smoking concert at the Windsor Hotel, Montreal, Thursday, February 2nd, 1939. (Regular Thursday night meetings every week.)

PRELIMINARY NOTICE

of Applications for Admission and for Transfer

December 23rd, 1938.

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, 1939.

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

BLACK—ROBERT, of 4440 Lafontaine St., Montreal, Que. Born at Saltcoats, Ayrshire, Scotland, Dec. 14th, 1902; Educ.: Junior Matric., 1920; evening courses, Ardrossan Academy, 1920-25; Assoc. Member (by examination, 1938), Inst. Struct'l. Engrs. (Great Britain); 1920-24, dftsman., shipbldg., Ardrossan Dry Dock & Shipbldg. Co.; 1927-29, dftsman., struct'l. steelwork, Redpath Brown, Edinburgh; 1929-33, checking & design, struct'l. steelwork, Canadian Vickers, Montreal; 1933-34 and 1936-37, asst. to plant engr., Canadian Copper Refiners, Montreal East; 1935-36, overbridge & constrnl. engrg., London, Midland & Scottish Railway, London; 1937 to date, dftsman, engr. dept.. Canadian Industries Ltd., Montreal, Que.

References: I. R. Tait, E. B. Jubien, D. A. Killam, R. C. Flitton, M. W. Kerson.

BLACK—WILLIAM STEELE, of 17 Williamson Apts., Regina, Sask. Born at Weyburn, Sask., June 19th, 1909; Educ.: B.Eng. (Civil), Univ. of Sask., 1933; 1935 (summer), geol. survey party; at present, dftsman. and estimator, Imperial Oil Limited, Regina, Sask.

References: C. J. Mackenzie, W. O. Longworthy, T. S. McKechnie, J. J. White, H. A. Jones.

DUGAS—ALEXANDRE, of Montreal, Que. Born at Montreal, Sept. 1st, 1909; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1933; 1929-30-31, (summer), chainman, instr'man., Quebec Streams Comm.; 1932-33, asst., Geological survey, Quebec Bureau of Mines; 1935 (6 mos.), representing Town of LaTuque's consltg. engr. in constrn. of a wood stave pipe 7½ miles long, 43 in. diam.; 1936-38, technical secretary to the chief engr., and at present engr. on inventory staff, Provincial Electricity Board, Montreal, Que.

References: O. O. Lefebvre, A. Frigon, J. A. Beauchemin, A. Plamondon, J. R. Desloover, E. M. Van Koughnet, J. W. McCammon, R. Laplante.

GAYMER—JOHN EDWARD IVENS, of 5549 Queen Mary Road, Montreal, Que. Born at North Walsham, Norfolk, England, Jan. 22nd, 1909; Educ.: 1927-31, Faraday House Electr'l. Engrg. Course, Diploma, 1st Class Honours, 1931; 1927-28, pump assembly and testing, Mather & Platt, Manchester, England; 1928 (2 mos.), switchgear and turbine assembly Metropolitan Vickers Co., Manchester; 1930-31, engrg. test course, General Electric Company, U.S.A.; 1931-36, production engr., Peterborough, and 1936 to date, apparatus sales engr., Montreal, Can. Gen. Elec. Co. Ltd.

References: I. S. Patterson, K. O. Whyte, A. N. Budden, A. D. Ross, R. A. Yapp.

HAMELIN—DOUGLAS FRANKLIN, of 2319 Cornwall St., Regina, Sask. Born at Melita, Man., Mar. 4th, 1903; Educ.: B.Sc., Univ. of California, 1928. 1929, one year post-graduate at Stanford Univ.; 1925, asst. to the geologist, McIntyre Mines, Schumacher, Ont.; 1929, supt., Flintoba Mines (exploration company), and exam. of mining claims in B.C.; 1929-30, geologist, Hudson Bay Mining & Smelting Co., Flin Flon; 1936 to date, water administration engr., Water Rights Br., Dept. of Natural Resources, Regina, Sask.

References: C. J. McGavin, B. Russell, M. H. Marshall, H. J. deSavigny, T. Hogg.

MACNAMARA—WILLIAM STAFFORD, of 130 Ontario Ave., Hamilton, Ont. Born at Hamilton, Ont., Sept. 4th, 1896; Educ.: 1910-14, one year High School, three years, Hamilton Technical School. 1920-24, struct'l. design course, three years night school at Technical School; Home study since 1929; 1914-16, ap'tice, and 1920-25, detailer, Hamilton Bridge Co.; 1925-26, detailing and checker, Heyl & Patterson Inc., Pittsburgh, Pa.; 1926, checker, Moss Iron Works, Pittsburgh; 1926-27, checking and designing, Heyl & Patterson Inc.; 1927-29, checker, and 1929 to date, estimating and designing, and at present struct'l designer, Hamilton Bridge Company, Hamilton, Ont.

References: R. K. Palmer, O. E. Leger, G. A. Colhoun, V. S. Thompson, H. B. Stuart, A. Love, N. Wagner.

NICOL—WILLIAM BROWN, of 84 Martha St., Burlington, Ont. Born at Bon'ess, West Lothian, Scotland, Jan. 28th, 1906; Educ.: 1920-27, Heriot Watt College, Edinburgh. seven years' study, evening classes, certs. in civil and mech'l. engrg.; 1920-21, ap'tice engr. (shop), 1921-25, ap'tice dftsman., 1925-27, dftsman., Scottish Oils Ltd.; 1927-28, dftsman. Mechans Ltd., Glasgow; 1928-34, designer (struct'l. steel), Canadian Vickers Ltd., Montreal; 1934-36, designer (struct'l. steel), Sir Wm. Arrol & Co. Ltd., Glasgow; 1937 to date, designer (struct'l. steel), Hamilton Bridge Co. Ltd., Hamilton, Ont. (Also during the periods 1928 to 1934 and 1937 to date, on loan to the following firms for the purposes given: Canada Cement Co. Ltd., Montreal, design of steelwork for Montreal plant; Canadian Copper Refiners Ltd., Montreal, design of steelwork for refinery extensions; John Stadler, M.E.I.C., Montreal, design of steel work for pulp mill.)

References: O. E. Leger, R. K. Palmer, J. Stadler, G. A. Colhoun, V. S. Thompson, A. Love, F. L. Smith.

OULTON—ROGER REYNOLDS, of 39½ Edward St., Halifax, N.S. Born at Sackville, N.B., July 19th, 1913; Educ.: B. Eng., N.S. Tech. Coll., 1938; 1933-37 (summers), asst. on surveys, and 1937, and two mos. 1938, instr'man., Town of Truro, N.S.; July 1938 to date, head of inventory party for Engineering Service Co., Halifax, N.S.

References: J. R. Kaye, P. A. Lovett, G. V. Ross, G. H. Burchill.

SARGENT—ALBERT ELBRIDGE, of 4675 Victoria Ave., Montreal, Que. Born at Montreal, Dec. 15th, 1887; Educ.: B.Sc., M.E., McGill Univ., 1913; 1913-14, air conditioning engrg., Warren-Webster & Co., Camden, N.J.; 1914-19, Overseas, C.F.A.; 1919-24, in partnership with brother, Frick Ice & Refrigeration Co., design and installn. of equipment; 1924 to date, with the National Breweries Ltd., as follows: 1924-25, i/c constrn. of new Dow brewery incl. installn. and testing of all equipment; 1925-27, mech. supt., and 1927 to date supt. of Dow Brewery.

References: J. G. Hall, F. S. B. Heward, B. R. Perry, C. K. McLeod, G. K. McDougall, F. J. Friedman, R. E. Jamieson, I. R. Tait.

SHARPE—RUSSELL NEVILLE, of 121 Sherburn St., Winnipeg, Man., B.Sc. (Civil), Univ. of Man., 1938; 1933-36 (summers), chainman, axeman and concrete mixer: 1938 (two mos.), asst. to engr. i/c Morden-Sprague Road; 1938 (June-Oct.), inspr. foreman, intermediate airport, Rivers, Man.

References: S. E. McColl, G. Affleck, A. E. Macdonald, G. H. Herriot, D. N. Sharpe.

SMITH—MAURICE HOWIE, of 93a Roncesvalles Ave., Toronto, Ont. Born at Edholm, Nebraska, Dec. 20th, 1901; Educ.: B.Sc. (E.E.), Univ. of Man., 1935; 1936 (seven mos.), elect'l. constrn. and mining engrg., Argody Gold Mines Ltd., Cassumit Lake, Ont.; 1937 to date, factory course, Massey-Harris Co. Ltd., Toronto, Ont.

References: J. S. Campbell, R. E. Smythe, E. P. Fetherstonhaugh, N. M. Hall, G. H. Herriot.

THURSTON—ARTHUR MUNROE, of Montreal West, Que. Born at Toronto, Ont., July 7th, 1912; Educ.: B. Eng., McGill Univ., 1936; 1936-38, student ap'tice, and at present, engr., dept. of development, Shawinigan Water & Power Company, Montreal, Que.

References: F. S. Keith, J. B. Challies, J. M. Evans, C. V. Christie, R. W. Hamilton, A. L. Patterson, J. M. Crawford, G. R. Hale.

MORTON—PHILIP S. A., of 3670 Lorne Crescent, Montreal, Que. Born at Barrie, Ont., Oct. 4th, 1903; Educ.: B.A.Sc., Univ. of Toronto, 1928; Test Course, C.G.E.; with the Canadian General Electric Co. Ltd., as follows: 1929-30, asst. foreman, test dept., and 1930-32 engrg. dept., Peterborough; 1935 to date, asst. to district service engr., Montreal Office. (*Jr. 1931.*)

References: L. DeW. Magie, W. E. Ross, W. M. Cruthers, V. S. Foster, H. R. Sills, S. J. Hayes.

McALPINE—ROBERT FRASER, of 101 Cromarty St., Sydney, N.S. Born at Sydney, N.S., March 7th, 1903; Educ.: B.Sc. (Mech.), N.S. Tech. Coll., 1928; 1923-27 (summers), shop work, etc., Dom. Coal Company; 1929-37, sales engr., Wm. Stairs Son & Morrow Ltd., Halifax, N.S. Work included selling, installing and servicing boilers, stokers, pumps, heaters, evaporators and general boiler plant equipment, tractors, plows, road equipment, Diesel engines, lighting plants, and accessory equipment. 1928 to date, Cape Breton Manager of engrg. dept. of same company at Sydney, N.S. Responsible for management and operation of new sales engrg. branch. (*Jr. 1929.*)

References: R. R. Murray, S. C. Mifflen, W. S. Wilson, Y. C. Barrington, J. A. Russell.

McINTYRE—DOUGLAS VALLANCE, of 60 Evan St., Welland, Ont. Born at High River, Alta., April 28th, 1903; Educ.: B.Sc. (E.E.), Univ. of Alta., 1931; 1931-32, asst. on hydro-electric constrn., Can. Gen. Elec. Co.; 1929 and 1933, instr'man. and dftsman., C.N.R.; 1936-38, Electro Metallurgical Co. of Canada Ltd., Welland, Ont., i/c layout and constrn. of bldg. additions and kilns, and layout of mech'l. and elect'l. equipment. (*St. 1930, Jr. 1936.*)

References: H. D. Davison, J. C. Street, W. K. Leach, W. E. Cornish.

FOR TRANSFER FROM THE CLASS OF STUDENT

CADRIN—PAUL EMILE, of St. Anselme, Que. Born at Victoriaville, Que., July 16th, 1911; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1936; 1936-37, mtce. engr., A. E. Marois Ltd.; June, 1937, to date, road engr., and at present asst. divn. engr., Quebec Road Dept. (*St. 1935.*)

References: A. Frigon, J. A. Lefebvre, A. Paradis, J. Saint Jacques, A. Gratton, S. A. Baulne.

TATHAM—WILLIAM CARLYLE, of 3647 University St., Montreal, Que. Born at Guelph, Ont., July 3rd, 1911. Educ.: B.Eng., McGill Univ., 1935; 1932 (summer), in charge placer operations, Fort McLeod, B.C.; 1935-36, East Geduld Mines Ltd., Springs, South Africa, res. engr's. dftsman., layout and design of mine machy., bldgs., associated apparatus, equipment, etc.; 1936-38, with the Grootulei Proprietary Mines Ltd., Springs, S.A., as follows: 1936-37, asst. to chief engr., i/c all excavations, foundations and erection of all mach'y. at new six-compartment shaft; 1937 (Apr.-Nov.), i/c all underground constrn. and mtce.; 1937-38, ventilation officer and i/c of study department; at present, asst. engr., Courtlands (Canada) Limited, Cornwall, Ont. (*St. 1935.*)

References: E. Brown, C. M. McKergow, W. G. McBride, A. R. Roberts, R. DeL. French.

WEATHERBIE—WESTON EWART, of 36 Young St., Truro, N.S. Born at Tatamagouche, N.S., April 19th, 1905; Educ.: B.Sc. (Civil), N.S. Tech. Coll., 1931; 1929 (summer), prospecting in Labrador; 1930 (May-Dec.), res. engr. i/c constrn. at Halifax Municipal Airport; 1931 (May-Sept.), inspr. i/c laying of asphalt pavement, Halifax, N.S., for the city engr.; 1931-32, res. engr. i/c concrete paving, Sackville, N.B., for J. T. Donald & Co., Montreal; 1933 (Sept.-Oct.), instr'man., Beauharnois Light, Heat & Power Co. Ltd., Montreal; 1934-35, asst. divn. engr. on mtce., 1935-36, instr'man. on constrn., 1936, asst. res. engr. on constrn., and at present, acting res. engr. on constrn., Dept. of Highways of Nova Scotia. (*St. 1931, Jr. 1932.*)

References: E. A. Crawley, H. W. B. Swabey.

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

FRASER—ISAAC MATHESON, of Saskatoon, Sask. Born at Pictou, N.S., Nov. 1st, 1890; Educ.: B.Sc., McGill Univ., 1919; 1920-21, dftsman., Dominion Engrg. Works Ltd., 1921-26, asst. professor of mech'l engrg., 1926 to date, professor of mech'l engrg., and at present, head of dept., University of Saskatchewan, Saskatoon, Sask. (*Jr. 1920, A.M. 1928.*)

References: C. J. Mackenzie, R. A. Spencer, A. M. Macgillivray, H. S. Carpenter, C. M. McKergow, A. R. Roberts.

McQUEEN—ANDREW WILLIAM FRASER, of Niagara Falls, Ont. Born at Lowestoft, England, Feb. 7th, 1898; Educ.: B.A.Sc., 1923, Civil Engr., 1932, Univ. of Toronto; R.P.E. of Ont.; 1923-27, asst. engr. of tests, H.E.P.C. of Ontario; 1927-32, asst. engr., and 1933 to date, hydraulic engr., H. G. Acres & Co. Ltd., Niagara Falls, Ont. (*St. 1920, Jr. 1927, A.M. 1929.*)

References: H. G. Acres, R. L. Hearn, T. H. Hogg, O. Holden, J. J. Traill, A. U. Sanderson, J. A. Aeberli, H. S. VanPatter.

WILLIAMS—GUY MORRIS, of Saskatoon, Sask. Born at Crete, Nebraska, Jan. 12th, 1888; Educ.: B.S. in C.E., Univ. of Nebraska, 1911; 1911-20, with U.S. Bureau of Standards, Washington, D.C., 1913-20, in charge of investigations and bldg. constrn., and various studies; 1920 to date, professor of civil engr., University of Saskatchewan, Saskatoon, Sask., (*A.M. 1920.*)

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

FOR TRANSFER FROM THE CLASS OF JUNIOR

BROWNELL—HAROLD ROSS, of 96 Burnside Drive, Toronto, Ont. Born at Truro, N.S., Aug. 28th, 1903; Educ.: B.Sc. (Mech.), McGill Univ., 1929; 1930 to date, with Bailey Meter Co. Ltd. of Montreal, 1930-33, located in western Canada, and 1932 to date, representative in Toronto and Northern Ontario, engaged in sales, service and application of metering and combustion control equipment, incl. automatic control of combustion and process. (*St. 1927, Jr. 1932.*)

References: E. W. R. Butler, F. A. Becker, T. C. Main, N. M. Hall, W. L. Thompson.

GIBBON—HUBERT S. V., of 101 Ruskin Ave., Ottawa, Ont. Born at Saint John, N.B., May 21st, 1904; Educ.: 1921-23, Mt. Allison Univ., engrg. course; 1923-24, partial student, Sch. of Arch'ture, 2nd year subjects McGill Univ.; 1922-23 (summers), asst. on precise levelling party; 1924, asst. field engr., 1924-25, engrg. asst. in office, E. G. M. Cape Co.; 1925-26, asst. field engr., Foundation Co. of Canada; 1926-27, field engr. i/c survey party, Duke-Price Power Co.; with the Bell Telephone Company of Canada as follows: 1927-37, field engr., transmission and outside plant design, 1937, traffic asst., dial equipment problems, and at present, field engr. on preparation of outside plant estimates. (*Jr. 1927.*)

References: G. S. Ridout, L. N. Moore, J. B. Stirling, J. H. Irvine, C. B. Bate, J. E. Clark, J. A. Loy.

LOCKHEAD—STUART GEORGE, of 66 Strathearn Ave., Montreal West, Que. Born at Montreal, May 18th, 1905; Educ.: B.Eng. (Civil), McGill Univ., 1938; 1927-28, dftsman., Dominion Bridge Co.; 1928-29, chief of party and instr'man., forest surveys dept., Canada Power and Paper Corpn.; 1929-36, engr., City of Westmount, gen. municipal engrg.; Summer 1937, and 1938 to date, dftsman., Dominion Bridge Company, Montreal. (*St. 1928, Jr. 1931.*)

References: F. J. McHugh, R. E. Jamieson, P. G. Delgado, D. C. Tennant, A. Peden, M. Wolff.

GEAR TRANSMISSIONS

An analysis of the mechanical action of the now universally applied synchronizers in gear transmissions of automobiles is given by Professor George B. Upton of the Sibley School of Mechanical Engineering in Bulletin No. 25 of the Cornell University Engineering Experiment Station, just off the press. "It is offered," says the preface, "as showing the type of analytical work which automotive engineers perform in connection with every detail of the vehicles which so many people now use, and are interested in knowing about."

The bulletin first discusses the problems of shifting gears without special synchronizing devices. In "up-shifts," as from low to second and from second to high, he points out, the oil in the transmission tends to aid synchronizing, since it slows the speed of the engine clutch. In "down-shifts," however, as from high to second and second to low, the engine clutch needs to be speeded up. To do this with hand or foot accelerator and to mesh the gears without clashing is an operation requiring considerable skill.

Successful synchronizers have "balking elements," which prevent gear meshing, either on up-shifts or down-shifts, until the gears mesh without clashing. Such synchronizers are so constructed that impatience on the part of the driver, expressed by greater pressure on the gear shift lever, hastens the action of the synchronizers.

MORE WORK FOR ENGINEERS

The January issue of Mechanical Enginerring contains a statement under the above heading by the president of the American Society of Mechanical Engineers, Alexander Graham Christie, in which he reviews modern trends and developments in mechanical engineering leading to the conclusion that more work for the engineer is indicated.

Mr. Christie expresses the opinion that business is slowly but steadily improving, which means more work for mechanical engineers, which may be still further increased if they are encouraged to proceed with new developments. There are new products to be made in present plants, new services for the public, and greater comforts to be made available to all our population.

The present movement in utilities will call for many turbine generators and boilers of large capacity, with the trend towards higher pressures and temperatures, and to the use of hydrogen cooling of generators. Certain developments are also proceeding to the point where oil engines will have even greater application in transportation and in small power developments than they have to-day.

Much less has been said lately, says Mr. Christie, concerning technological unemployment, . . . "what is needed now is the encouragement of new ideas and their industrial applications. Thus, as in the past, technology will provide the means of creating new jobs."

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DROUGHT, A NATIONAL PROBLEM

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Paper to be presented at the General Professional Meeting of The Engineering Institute of Canada, at Ottawa, Ontario, on February 15th, 1939

SUMMARY—The author outlines the position of the drought area in our national economy and the activities of the Government under the Prairie Farm Rehabilitation Act with particular reference to the work of the engineer in providing water supply. The problems of water conservation are discussed and the importance of the fundamental data gathered by the technical services of the Government is stressed.

The author points out the interdependence of agriculture and industry and shows that prosperity can only be brought about through the co-operation of all sections of the community.

In the drought area of the three prairie provinces hundreds of millions of dollars of Canadian money are invested in railways, utilities and other facilities. It is this very area that produces the world's best wheat and wheat is the most valuable single item in our export trade. With building construction on the prairie at a standstill for years past and with deferred replacements of farm machinery piling up, it offers a large potential market for the products of Canadian industry. With more really fertile land in this area than in all the rest of Canada combined, and with almost all of the good land in eastern Canada already under cultivation, the efficient utilization of this very area will determine in a large measure the future prosperity of Canada.

The prairie in the first instance was settled haphazardly without much regard to or knowledge of the rainfall or of the wide variations in fertility. The following years of more than average rainfall and high prices of wheat resulted in the land being overvalued, particularly in the less fertile sections. To start with, few of the settlers had any capital. They mortgaged the land up to the hilt to provide farm buildings and machinery. In this they were encouraged by some of the lending institutions and by the high-pressure salesmen of the implement companies. Many of the farmers applied their profits to the reduction of their debts, but others acquired at inflated prices more land than they could handle to advantage and a few made no provision against the day when conditions might not be so favourable. Of late years the combination of low wheat prices and of poor yields, as a result of drought, rust or grasshopper damage, has made it hard for the farmer. Even so, the skilful and thrifty farmer on dry but fertile land has been able to make a good living, although his less competent neighbour on similar land may be destitute.

Optimism is justified,—there is no occasion for pessimism; the means whereby a prosperous and stable agricultural economy in the drought area can be brought about are well known to many and are being applied currently under the Prairie Farm Rehabilitation Act. Soil moisture can be retained from one season to the next by summer fallow, and the spring run-off can be conserved in the soil by contour ploughing. Even in extreme cases soil drifting can be brought under control by listing and can be kept under control by strip farming. Crop yields can be increased by agricultural research and by the dissemination of information through the experimental farms. The population can be made more nearly self-sustaining in times of drought through providing water for domestic and stock watering purposes and for farm gardens, by sinking wells where suitable ground water is available and by conserving the scanty local run-off in "dugouts" and small reservoirs. Even the poorer lands can be put to beneficial use by converting them to community pastures and reseeding them with suitable grasses. In conjunction with adjacent fertile lands and minor irrigation projects for raising feed such lands help build up a balanced and stable agriculture economy.

As regards irrigation the day will come when every drop of the limited water supply will be conserved and utilized for this purpose. While the most prosperous agricultural communities in the whole of the prairie, and those most free from relief, are situated in irrigated territory, large scale irrigation does not offer an immediate means of rehabilitation. Its place lies in the gradual development of those areas too dry to raise wheat commercially as suitable settlers trained in the radically different type of farming become available, and as markets can be obtained for the specialized crops that can only be grown to advantage on irrigated lands. On account of the relatively small acreage required per family and consequent ease of supervision, irrigation projects offer favourable resettlement prospects for farmers now attempting to raise field crops on land suitable only for grazing. These lands might also lend themselves to colonization schemes for the unemployed or for selected groups of immigrants. Irrigated land with the intensive cultivation of high priced crops will support ten times the population that wheat land will, but the markets for such crops are slow to develop and will depend to a large extent on the industrialization of the prairie, which, judging by what has happened in California, is only a question of time.

Except in favoured localities, the cost of providing water for irrigation is beyond the capacity of the average farmer alone to bear, but the benefits of irrigation are so widespread that the expenditure of Government funds, either directly or as subsidies to irrigation co-operatives or companies, is in most cases justified, as the Government will be reimbursed through the increase in taxable wealth of the community at large. With one or two exceptions there is no immediate need, however, of constructing further major irrigation works. The projects on the Bow River between Calgary and Medicine Hat and those on the St. Mary's and Oldman River north and east of Lethbridge with whatever enlargements or extensions may be necessary or feasible have plenty of vacant land that can be irrigated and the sensible thing to do is to concentrate on completing the colonization of these before undertaking new major projects.

It would be far cheaper to move settlers who cannot make a living out of dry farming to these areas, than it would be to provide their present farms with water for irrigation. Furthermore, much of the land that can be successfully worked under proper dry farming methods does not lend itself to irrigation, the soil constituents or topography being unsuitable.

Storage works are urgently required in connection with St. Mary's and Milk Rivers. Both rise on the eastern slope of the Rockies in northern Montana and flow northward into Canada, but the St. Mary's River drains into Hudson Bay whereas the Milk doubles back into the States to find its way via the Missouri and the Mississippi to the Gulf of Mexico. On the American side of the line a canal has been in operation for a number of years diverting a portion of the flow of the St. Mary's into the Milk, the water again being diverted out of the Milk after passing through Canada, while on the Canadian side only the waters of the St. Mary's are being used to any extent. Each country under the International Waterways Treaty is entitled to a definite share of the natural flow and the necessary gauging stations are maintained jointly by the U.S. Geological

Survey and the Dominion Water Power and Hydrometric Bureau.

The thriving towns of Cardston, Magrath, Raymond and Taber, and to a large extent the City of Lethbridge itself, owe their very existence to the irrigated area supplied from the St. Mary's. Settled originally in the most part by Mormons, who are irrigation minded, this prosperous district can be extended to advantage provided reservoirs are constructed to store the flood and winter flow of the St. Mary's. Effecting as it does so vitally the future of this important district we should put to beneficial use our share of the flow of this international stream before it is too late.

The natural flow of the other important rivers is at some seasons barely sufficient for present requirements and the full utilization of even the irrigation projects now in existence will entail the development of extensive storage works. On the most important stream, the Bow River, 150,000 acre feet of storage has already been developed for power purposes. When the occasion arises the power company concerned would no doubt be willing to make available such storage as is necessary provided it is compensated for any additional steam power that has to be generated by reason of such use of its storage, and this would at the outset be a far cheaper way of obtaining storage than by constructing reservoirs expressly for irrigation. While there is naturally some conflict in the use of storage for irrigation, for power and for flood control, it is not so serious as would at first appear. Reservoirs having a large capacity in relation to the water supply tributary to them would in any event be impounding the entire flow at the time the river is in flood and so would be fully effective for flood control purposes. The remaining ones could in most cases be held down or lowered in anticipation of the flood without much risk of there not being enough surplus water to fill them in the remainder of the high water season. In the use of the stored water the problem is not so simple. The streams rising in the Rockies are characterized by low winter flow and high flow from melting snow and ice throughout the summer. Thus the release of stored water for power purposes is required in the very season the farmers do not irrigate. However, the irrigation projects almost without exception draw water through long main canals on which are situated secondary reservoirs, from which the water is supplied to the farmer in accordance with his needs. As the draught on these secondary reservoirs increases with the fuller exploitation of the projects, it will be necessary either to enlarge the main canals at great expense or to utilize them for the winter filling of these secondary reservoirs. If this latter course proves feasible, the irrigation projects will automatically benefit by storage created and used for power purposes.

A more serious difficulty in the storage and use of water lies in the conflict in interests between the Dominion and the various provinces. The principal river, the Saskatchewan, derives a large part of its supply from national park areas on the eastern slope of the Rockies. On its course to Lake Winnipeg it traverses first Alberta, then Saskatchewan and finally Manitoba, Lake Winnipeg draining into Hudson Bay via the Nelson River. All three provinces are interested in the regulation of the flow from the standpoint of flood control, Alberta, and to a lesser extent Saskatchewan, from the standpoint of irrigation, and Alberta and Manitoba from the standpoint of power. The consumption of water for irrigation in Alberta commensurately reduces the supply available for Saskatchewan and irrigation in both provinces would be somewhat detrimental to Manitoba's interests in the important undeveloped power sites on the Nelson. The situation will be further complicated if the National Park officials continue their uncompromising opposition on sentimental ground to any further storage development within the parks. As some of the largest and most economical storage sites lie within the parks, the ban on storage development would increase the cost of extending the existing irrigation works as well as reducing the area that can ultimately be irrigated. It is to be hoped that by the time this question becomes acute machinery will have been set up to deal with it on broad national lines.

The possibilities of electric pumping should not be overlooked. Cheap and efficient pumps are now available and in the Eastern Irrigation District at Brooks they are being used with great success, both for supplying land above ditch level and for reclaiming drainage. Where cheap power can be secured water can in some instances be pumped for less than the carrying charges on the alternative of gravity canals. Canals have to be built for the ultimate capacity whereas the pumping charges are low initially and increase only as the project becomes colonized, usually a long process. Lands can be supplied by pumping that it would otherwise be impracticable to irrigate and this has the advantage that small projects can be dotted around to provide green feed in grazing areas. The power companies have shown a disposition to co-operate. In Saskatchewan "off peak" power is sold for this purpose at six-tenths of one cent per kilowatt hour, which barely covers the cost of fuel, and in Alberta it is available for the irrigation season at ten dollars per horsepower.

So far the projects under the Prairie Farm Rehabilitation Act have been small but numerous. Even these require engineering advice and supervision is required. With minor dams where a washout would not be disastrous, engineering judgment is needed to determine just how far the sections, the spillway capacity and the rip-rap can be cut down to save cost. With small earth fill dams as with large ones, the water has to be raised gradually so as to allow the fills to consolidate, and after their completion they should be frequently inspected and their maintenance supervised by engineers, if costly washouts are to be avoided. Major projects such as the St. Mary's River storage require months of field investigation by engineers and geologists, and engineering skill of the highest order is indispensable in the design and construction of the requisite works. The dams in many cases would be high, the foundation conditions are as a rule none too good, necessitating earth fill dams, and high flood flows have to be contended with. The problems of unwatering and of providing spillway capacity are therefore difficult. The grave consequences of the failure of a large dam make it imperative that the best engineering advice in Canada be sought.

The engineer is dependent upon the fundamental data collected by the various technical departments of the Government. Ground water studies by the Geological Survey show whether or not a potable water supply is likely to be obtainable from wells and geological maps are highly informative in studying foundation conditions for important structures. Good topographical maps save expense on reconnaissance surveys, and often reveal possibilities of development that might otherwise pass unnoticed. Long term meteorological and stream flow records and soil surveys are indispensable in the sound design of irrigation projects, however small. It is imperative that the collection of such data be continued and enlarged by the departments concerned.

The attitude of provincial and federal agricultural agencies to date may quite fairly be described as constructive and worth while. While a few of the projects currently carried out under the coordinating influence of the Prairie Farm Rehabilitation Act may be open to criticism, it cannot but be admitted that there has been provided an admirable framework for a sound national policy of rehabilitation and agricultural expansion. The agricultural side of the programme has received due prominence. Through the establishment of the experimental substations in conjunction with the Experimental Farms of the Dominion Government, considerable progress has been made in having the farmers adopt recommended practices. Regrassing projects have been successful in helping to restore areas to grass which had previously been a menace to the community at large. Community pastures offer promise in connection with the breeding of western yearling cattle for refinishing in the east. The work of publishing the findings of the technical branches of the governmental services has also been greatly extended. Through the formation of agricultural societies the wider dissemination of proven agricultural methods has been aided.

Insofar as the water development programme is concerned, it may be stated that the programme as a whole has been admirably conceived, concentrating as it does upon the smaller water projects. Showy projects of little moment have been largely avoided. In aiming to promote, through the smaller farm or community projects, a greater measure of self-sustenance in good years and bad, the work has been such as to convey permanent benefit to the maximum number of people. Throughout the greater part of the area, the sound projects are all small and most of them are already completed, but confined to certain localities there still remain important major projects that can be proceeded with to advantage. It is of the utmost importance to the future of the country that this highly desirable work be continued and it is to be hoped that a programme so well conceived and so ably initiated will not be marred by unwise interference.

Owing to depressed world trade and unsettled political conditions, Canadian wheat has had to compete in a restricted market in recent years. All transactions, whether internal or external, are by nature barter, money serving merely as a means whereby goods and services can be conveniently exchanged, and we can only sell our wheat abroad provided foreign countries want it or are unable to do without it. That the policy of European countries to raise their own wheat has been aided to no small extent by a series of extremely favourable crop years cannot, however, be denied. While no immediate relief may be expected, the long term future should favour Canada by reason of its high quality wheat and the ease with which it can in most years be produced. In the meantime it would seem prudent to explore the possibilities of expanding our home markets for agricultural products by increasing our population, and by developing through research better means of preserving and storing our own fruit and vegetables for the season of the year in which we are now largely dependent upon imports.

A wider appreciation of the difficulties the western wheat farmer has to contend with will lead to a more tolerant and constructive attitude in dealing with his problems. The direct cause of much of his distress is that a bushel of wheat today, even at the government pegged price, which applies only to wheat, will purchase for him only two-thirds of what it would before the war (Searle Grain Co. letter, Dec. 20th, 1938), and debts contracted under one set of circumstances may work a hardship when widely different conditions prevail. With transportation and marketing charges relatively inflexible, a small change in the price to the consumer makes a large difference in what the farmer receives, whereas the price of manufactured articles is comparatively stable due to the rigidity of wages and the upward trend of taxes in a depression. Industry of course suffers through loss of markets resulting in unemployment and elimination of profits, the construction industry being particularly affected.The fact stands out that agricultural prosperity is an indispensable prelude to better times in industry and in other fields of our economic endeavour.

The departments of agriculture, in striving to increase the efficiency of farm operations, have gone to the root of our troubles and this very plan extended to other fields of endeavour would further speed up the return to normal. The higher the efficiency with which goods can be produced and their exchange effected, the larger will be the volume of such exchange, and as a result unemployment will be decreased and all will enjoy a higher standard of living, which after all should be the aim of our national economy. The chief impediments to the free exchange of goods and services are perhaps the cost of government and transportation, and in both these fields too many men are engaged in unproductive activities. As high wages are essential for a high standard of living, it is not the wages of the railway running trades that are objectionable but rather those conditions of employment imposed by the unions that render efficient operation impossible. The unions should be persuaded that the best interests of the men would be served by gradually working around to a condition whereby the numbers would be reduced to those required for efficient operation and these men would be assured of a good annual income, for which they would render a full year's work instead of being employed as at present intermittently and at high hourly rates. In the transportation field there is plenty of room for constructive co-operation between capital and labour, as well as between the various transportation interests.

One phase of our economic problem in which the engineer is vitally interested is the stagnation in the construction industry, arising from the lack of inducement under presently prevailing legislation to invest money in house building or industrial expansion. The excessive real estate taxes, the high sales tax, municipal and provincial income taxes on top of the double Dominion taxation on profits derived through companies, in contrast to the system in England of taxing all income only once, the multiplicity of statistical returns required by law, the forcing of shorter hours in seasonal employment, the petty restrictions imposed under the guise of regulation, the legislation favouring the debtor at the expense of the creditor, the duplication of governmental activities, the harassing of business by political investigations and the fear of competition from tax-free state enterprises are all having their effect and unemployment with reduced demand for agricultural products is the result.

During the latter part of 1937 and the early months of 1938, the "Rowell" Commission collected in its travels a curious conglomeration of controversial opinion and sectional grievances. While this complicated the task of the Commission, there can be no doubt but that it has brought to every section of the country a realization that no other section is without its own peculiar problems. A greater measure of national co-operation on mutual problems and farsighted compromise with respect to questions of sectional interests remains as ever Canada's primary need.

In this connection, the record of our efforts to alleviate the problems of drought distress have perhaps been a striking object lesson to all of Canada. Governmental action has been confined, generally speaking, to its proper sphere. Leaving farming to the farmer, it has nevertheless been of inestimable service in supplying co-ordination and guidance through technical and experimental branches strikingly qualified to render such assistance. It has also been both prompt and successful in drawing upon the knowledge and ability of corporate officers and engineers experienced in dealing with the problems involved. Real progress would be made in fields no less important if the same foresight and constructive thought were being applied to our national economy as a whole. Our industrial corporations must receive tolerance and co-operation if they are to bear their full share in the restoration of normal conditions and the free exchange of goods and services.

As an example of what can be accomplished by working together, most of the country elevators in Alberta were electrified in the very depth of the depression through the co-operation of the elevator companies, the electrical manufacturers, labour, and the power company concerned. If industry at large would work with agriculture, capital with labour, and the east with the west, our basic difficulties would quickly resolve themselves. The engineer, by reason of his education and experience, can make a definite contribution to the solution of our economic problems, and in this he can be of real service to the country as a whole.

AMERICAN INDUSTRY LOOKS AT CANADA

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Paper to be presented at the General Professional Meeting of The Engineering Institute of Canada, at Ottawa, Ontario, February 15th, 1939.

SUMMARY—The author deals with the factors which have a bearing on the establishment of American branch factories in Canada, and frankly discusses the attitude of the American businessman towards Canada. He makes a strong plea for concrete action on the part of Canada and Canadians for the organization and administration of a nationally undertaken study of the natural wealth of the country, its practical application and utilization. "The collectivists may have taught us something, might we not show them what voluntary collective action can accomplish in a democracy?"

My work is industrial engineering as applied to the development of railway traffic through the extension of industrial activity along the lines and in the areas served by the railway system and more particularly those developments based on capital originating in the United States. I have assumed that a more-or-less first-hand report as to what our nearest neighbors think of us industrially and commercially, the extent to which they are observing and participating in our progress, and their view of Canada as a field for expansion might be of interest. To this, there will be added some observations bearing on national development in Canada.

It seems unlikely that the average Canadian living at home fully realizes how sharply the eyes of the world are regarding his country to-day, or that he is fully awake to the position that Canada may be called on to occupy in world affairs. Furthermore it is doubtful if many of us have yet given much thought to setting our economic stage for responsibilities that may be in store for us.

It is not necessary to sketch the new political patterns that are shaping in the world picture, the re-grouping that is being brought about in the European and Asiatic countries, and the sharp political and economic divisions developing between the authoritarian and the democratic schools of thought. How far these re-groupings may proceed and in what direction no one can do more than speculate, but it seems inevitable that events will cause a closer bond of sympathy and co-operation amongst the remaining democracies and that this action will tend to centre in that group of common origin, language and culture—the English-speaking nations.

This movement is in progress. A triangle of tariff treaties has been set up between the United States, Canada and the British countries with a purpose, and current movements looking to closer understandings amongst the countries of North and South America are also not without significance.

Geographically and commercially we occupy a pivotal position in the Anglo-American group. Our peculiar resources on the one hand, complement and supplement the natural wealth of the Empire; and on the other, they round out an almost perfect economic picture in North America. The commercial strategy of this situation is obvious, and furnishes in part, the reason for Canada's remarkable industrial growth since the beginning of the century.

Canada began to attract world attention as a producer of manufactured goods following the long depression which ended in 1897 and, concurrent with and largely a function of her industrial rise, has been the movement of American industry into the Canadian field. That movement was slow in its early stages, accelerated somewhat after 1910, interrupted by the war and resumed on an increasing scale after 1920. By 1930 one of our government departments had listed 957 Canadian operations of United States companies. In 1929 the Secretary of Commerce department of the United States Government, in an estimate of American investments abroad, had given a figure of 524 American branch plants, with an investment of American capital amounting to $541,000,000. This was exclusive of pulp and paper operations in which it was stated a further $279,000,000 American capital was invested, making a total of roughly, $820,000,000 at that time. It will be understood that this sum represented direct investment of American money in fixed assets, and does not include the many Canadian corporations, some of the capital stock of which may have been owned by Americans. It also makes no account of the numerous manufacturing arrangements by United States companies with existing Canadian manufacturers.

It is hard to offer any positive picture of the American branch plant movement. In 1933 we made a list, for the use of our local traffic officers, of over fifteen hundred American companies with manufacturing representation in Canada, which included many of the more important manufacturing arrangements. Some of these have since retired or consolidated. Another list I have seen, but not checked, runs over two thousand. We can conservatively add one hundred to our 1933 figures, bringing the current figure to 1,600 or thereabouts. This is probably low.

Estimates of this character are apt to vary a good deal because it is hard to draw the line between genuine manufacture and some types of assembly that may involve little more than packaging. In any event, conservative authorities agree that of the 156,000 manufacturing companies in the United States, upwards of 1,000 have established branch operations in Canada in the past 20 years or at an average rate of 50 per year, and that the investment of American capital in Canadian manufacturing might currently be placed at around $1,000,000,000. These may seem high figures to the small Canadian town that has been striving to secure even one of these industries.

The figures are impressive in that they reflect a movement almost unique in the economic history of countries. It is true that American industrialists have been active in other countries, but in 1929, for which we have the Secretary of Commerce estimate, their industrial investment in Canada was greater than in all the rest of the world combined. No such sustained and steady movement has, to the best of my knowledge, been recorded elsewhere.

The prime consideration that has led American industry into Canada has been the ability to serve directly, two additional markets, the Canadian domestic and the British Empire market, through the reduction of tariff, distribution cost and other handicaps. Their Canadian market has usually been fairly well established through previous penetration over the tariff, demand being stimulated in many cases through the penetration of American advertising and national proximity. Since the British market either has been previously established as an export market or is capable of promotion only through manufacturing in a British country, it follows that manufacture for British distribution represents sound business for Canada.

Other considerations are: the entry of a competitor who can thus undersell him; cutting of distribution cost by getting production closer to his customers; appeal to national sentiment through being able to offer a "made-in-Canada" product; domestic developments, such as the rise of the mining industry, stimulating demand for certain lines of producers goods; the protection of patent rights; necessity of establishing servicing facilities to hold or extend existing business; advantage in control and administration of having plant serving the British Empire as near as possible to the parent plant and, of course, for some industries, availability of materials, natural facilities, such as cheap power, and the adaptability of Canadian labour.

A recent development which is interesting is the establishment of Canadian plant by European interest as a hedge against possible unfavourable happenings abroad. A large plant is now being built in Canada in order to take up the slack should plants abroad have to suspend production through acts of war.

Similarity of business methods and the absence of unfamiliar conditions have been strong factors. Our trade practices are identical, corporation legislation has developed along parallel lines, income tax plans are similar, our currency is in the same denomination and normally interchangeable, advertising and distribution practices are identical, industrial technique and standards, equipment, labour all similar and our sales methods are one hundred per cent American. The transportation systems of the two countries cross and recross the border and enjoy interchange, and there are no rail tariff complications. The American manufacturer experiences little more difficulty in establishing and operating a factory at Montreal or Toronto then he would at Jersey City or Pittsburgh.

We have found consistently that firms who have never been able to sell in Canada have generally no interest in Canada—to them it has been and remains a closed market. It is only the man who has been able to develop some Canadian sales who starts to weigh its possibilities, combined with the British market, if the tariff differential were eliminated.

There is no doubt that the Canadian public and our commercial and financial institutions generally have welcomed this supplementing of our machinery of production. If the competition of chambers of commerce and civic officials to attract these industries to their towns express the desires of their citizenry then they most certainly are wanted.

On the question of any possible apprehension that Canadian enterprise might become dominated by these outside interests, I think we have only to regard some of our large industries of United States origin, note their personnel, their officers and directors, the part they play in the development of the community. Mark your own hesitation in deciding whether any one that comes to mind is, in fact, one hundred per cent American. We have a way of absorbing these industries—of making them a part of ourselves; we also have a way of acquiring them as the present list of stockholders of more than a few would indicate.

Canada wants these industries because they provide immediately the thing that we need and desire most, jobs for men and women. To the extent that their production replaces goods formerly imported or formerly shipped from the United States to British or other countries, there has been a corresponding transfer of man-labour-hours from the United States labour market to the Canadian labour market. The replacement, by these new Canadian goods, of goods formerly imported, swings our trade balance to the favourable side and the transfer to Canada of export business further adjusts it. Other advantages are obvious such as increased use of our raw mterials, power, transportation and the broadening of our export field through the introduction of new "made-in-Canada" lines in the markets of the world.

Canadians always wonder why American businessmen appear so little impressed with the fact that Canada is their largest export market. Perhaps the reason lies in their practice of handling Canadian business through the domestic rather than the export department. Our large exports to the United States, outside those items that have been the centre of tariff controversy, do not really give them much concern. They figure a large part of it is raw materials for their factories or bullion. They are largely right.

A thing that does give them concern is competition from Canada in the British Empire markets (substantially from Canadian branches of United States companies). They have a notion that Canada is difficult territory for distribution—they see the huge expanse and the small population, not realizing that two-thirds of our people live in a concentration similar to New England.

They have a high regard for the integrity of our business houses and a great admiration for our banking system. They sometimes tell us that they think our capital resources are concentrated in too few hands but commend our respect for capital which they couple with our reputed conservatism. They think our freedom from the capital gains tax is a wonderful idea. They admire some of our political leaders—they seldom remember their names—but feel that under such leadership radicalism will find the going rough.

In brief, they look on Canada as a stronghold of "free capitalism" and point to her "steady upward swing" while their own figures were nose-diving. They seldom have any figures, they just offer impressions, though they do see the figures for their own Canadian sales. Perhaps the thing that has impressed some of them most has been the activity of the Canadian Stock Exchanges when trading was slack in New York.

This praise of our institutions by the American businessman may have in it not a little of nostalgia for the good old days of what he would call the "free competitive economic system." I think he undervalues our weight in world commerce and world affairs generally and he doesn't worry much about our competition. He over-rates our conservatism. In moments of enthusiasm he points out sagely that Canada is in the same position to-day that the United States was 20 years ago and predicts a parallel rise in our population and wealth.

I have tried to give you a sort of impressionistic idea of the viewpoint of the average American businessman towards Canada, representing no single view but perhaps the sharper because it is impressionistic. But it is hardly necessary to add that these are as finely-trained, and in their lines of responsibility as able men as we will find in the world of business to-day. They may be unconcerned with matters not immediately touching them, but they know how to make goods and sell them. Also they are probably the most approachable businessmen in the world. This is partly natural friendliness and courtesy, partly the salesman instinct and partly the native instinct never to pass up a possibility. They are not sure what you have in the bag, but if it is anything, they do not want to miss it.

Basic Canadian data on which industrial analyses can be founded is not generally available in the United States, at least not through the channels through which their domestic data is developed. Some Canadian statistics and departmental reports, of course, are found in the public libraries and at New York City in the Trade Commissioner's office, but the marshalling and application of the underlying data to individual problems and its interpretation and amplification in the light of experience and knowledge gained on the ground represents the work of the Canadian development man in this field. It is unnecessary to outline the method of preparing an industrial report or to detail the numerous analyses, chartings and graphs through which it labours to draw its conclusions, or to suggest that the technique of factory location is as definite as structural design.

Home-made methods of plant location have been responsible for a good many industrial tragedies, and that this is being increasingly recognized in the United States is apparent from the expansion of government departmental activities in the field of industrial service, and the increasing demand for this service.

Fortunately for Canadian development men working abroad, our own federal and provincial government departments have set up some of the best servicing machinery that is supplied by any country I know. As example, I would say that our Dominion Bureau of Statistics offers better-arranged and more comprehensive statistical data than any corresponding service we have occasion to consult. The available data in our Bureau of Geology and Topography and the Bureau of Mines pretty well exhausts what is presently known, publicly, about our mineral resources, and I know of no service anywhere corresponding with the Foreign Tariffs Division of our Department of Trade and Commerce.

I would not say that all services, federal and provincial, are on a par with these highly organized bureaus, but our government services are generally good and highly cooperative.

But it is one thing to establish facts and another to interpret and apply them to the solution of a practical problem, particularly when your range of activity extends over a couple of thousand miles of foreign territory, and the result is that a good deal of possible contact work is sacrificed to the necessity of developing economic studies on the ground. Moreover, the contact programme is not a business of chasing prospects, as popularly supposed, but definitely developed through studies designed to uncover opportunity in the Canadian field. We call it "Uncovering bare spots in the Canadian picture." Our problem then is that we have to make our snowballs as well as throw them —correspondingly limiting our field effectiveness.

And so it has been the feeling of some of us that there is to-day something that might be accomplished nationally in the organization and correlation of Canadian development effort. The organizations promoting industrial development represent and are responsible to corporate or civic interests whose development aims, from their nature, are either regional or local. I am inclined—and I hope I am free from bias—to except the railways, to some extent, because both our leading Canadian roads have nation-wide interests and broad national policies, and while they do compete for added sources of traffic, their development efforts have been largely co-operative and directed to the broad interests of the Dominion they serve.

I offer the thought that the time may be ripe for Canadians generally to take a wider interest in the subject of our economic future. That now, while radical changes, political and economic, are sweeping almost the entire world, changes that are affecting our mother country, our neighbors to the south and that must affect us, we Canadians might do well to study how we may best adapt our economy to whatever world conditions emerge from to-day's turmoil; how we may turn to best account our natural gifts; how best overcome our deficiencies, that our arm may be strong on a day when a strong arm may be our salvation.

I have no definite proposals, and would not presume to offer any, but I have made bold to set down some thoughts in the hope that something would emerge that might suggest a possible line of concrete action.

Briefly, the thought is this: that some technically competent body with nation-wide affiliations might initiate the organization and administration of a nationally undertaken study of the natural wealth of Canada, the practical possibilities in the application or utilization of each of its many items, industrially or otherwise productively, and the market or field in which its resultant might find an outlet or be applied to the end that our people, our industrial, civic, commercial and financial organizations may gain a clearer knowledge of what we have and what might be done with it and that those interests promoting Canadian development may have an organized instrument ready to their hands. That the organizing body enlist in this undertaking every available fact-finding and research source in the Dominion right down to the individual; every educational institution, bureau, technical society, trades and business association, industrial corporation, public utility, railway—on to the college undergraduate, to the academy and high school, to labour and farmer organizations, boys' and girls' agricultural clubs, women's societies, to the man on the street.

The collectivists may have taught us something. Might we not show them what voluntary collective action can accomplish in a democracy?

A suggestion is that a broad syllabus or programme of national economic research or enquiry might be prepared under the direction of a central council and amplified into a series of annual or continuing working programmes distributed from coast to coast, possibly through local councils representing each section. The central council would control and correlate the work and examine and evaluate the findings to form the basis of a set of memorials or reports with exhibits, argument, and conclusions on each problem studied. These reports would be directed immediately to recommend channels of action and copies filed at a central point—logically the headquarters of the sponsoring organization—in conjunction with and as a part of a central library, which would carry every obtainable reference to the natural wealth of Canada. All work done, outside office help at headquarters, would be submitted free of cost to the council as a contribution to the national welfare.

The federal and provincial government departments, with their splendid facilities, would perhaps lend their weight, the National Research Council, the Canadian Manufacturers Association, the Canadian Chamber of Commerce, the banks and insurance companies, all of whom employ economists, and who have such a heavy stake in the Dominion, the railways who have departments of research and development, the power companies, chemical industries with research departments, the big metallurgical and mining interests with their fine laboratory facilities. Organized labour should have much to offer, social welfare groups, and so on.

I leave to the last what I suggest as the most important of all—the students pursuing undergraduate, post-graduate and other studies in our schools, and the thought was that these might furnish much of the primary fact-finding, fact-gathering and reporting machinery. That was what I meant by enlisting the best brains in the Dominion. Long ago, in reviewing a list of subjects proposed as theses for undergraduate and graduate work, it struck me, perhaps wrongly, that the aim must have been more to set up a requirement of wide reading and the development of mental discipline than to achieve creative work, and I rather thought the student might feel so too. And the thought occurred to me: "What if we could take these alert young minds, this youth-power, and apply it while fresh and untired, in the direction of some of the real problems that face our country and that they will come to face soon—if they stay here?"

I suggest, as random but perhaps typical projects, the following from the hundreds that offer:

An analysis of the British Empire market for chemical products, and parallel with this

An analysis of the British Empire market for electrochemical and electro-metallurgical products.

A report on the vacant farm situation in the Maritime Provinces, giving the physical picture by counties and working out the agronomy by zones.

A survey of the vacant factory situation throughout the Dominion by towns, filing, as exhibits, photographs, ground plans and structural data, with recommendations as to type of industry to which plant is adapted.

A report on the possible effect on Canadian enterprise of current policies of the United States government in the development and control of hydro-electric power.

A recompilation of all data bearing on the electric reduction of iron ore and its possible application to the direct production of specification steel to determine whether developments to date would warrant our re-study of its application to certain iron ore deposits in Canada.

A report on (a) the small wild fruit (blueberries and cranberries) resources of Eastern Canada, with charting of areas recommended for development.

(b) markets or outlets for wild fruit products.

A ground survey and charting of grazing and wild hay areas throughout the central plateau between the Rocky Mountains and the Coast Range.

A survey of the freshwater fisheries of Canada—

(a) present fishing waters.

(b) potential fishing waters.

(c) the United States market for fresh-water fish.

(d) analysis of United States channels of distribution, etc.

These rough suggestions cover a very wide range but will serve to indicate the range of opportunity.

It may be said that many of these things have been done. We know they have, we have done some of them ourselves. A good deal has been done in the Universities, McGill has done a lot of this work and published some of it, and one of the banks offered prizes for theses on some Canadian economic subjects and printed the winning papers. But there has been, so far as I know, no central organization of this fine effort and no clearing house for the results; also, all students are not in schools and it seems to me that if the student power of our country, wherever it might be found, could be marshalled, from the University right down to the village school, and its work organized in a broad comprehensive study with the collaboration and leadership of the established research machinery of the country, public and private, the personnel, technical equipment and cost factors in such a plan as I have visualized would be taken care of. As a prominent Canadian business-man said in a recent public address—"We have enough brains to give Canada the finest future of any country in the world, but we must use them."

With such a background of broad national effort and practical support, your development men selling Canadian opportunity in the capital markets abroad and at home may proceed, confident that they are armed with equipment that is weighted not only with fact but with the ambitions and hopes of our people.

So far I have only suggested the value in such a plan of supplying our national need for a continuing inventory of our natural wealth and for conclusions as to how we may best promote its development to the national advantage, but I am sure that it must have been apparent, if you have had patience to follow along, that underlying this there has been a deeper thought. The doing of a job may be worth more than the job. We have in this country upwards of 2,400,000 youngsters attending our schools and colleges. How many of this class of native-born Canadians have we lost in the past, how many of this *2,400,000* will leave us and what mind would dare to set a monetary valuation against this loss of our blood and brain?

These young men and women leave to seek opportunity. May they not stay to seize opportunity if they themselves find opportunity, like the bluebird in the tale, in the cherry tree at their door?

REPORT OF COUNCIL FOR THE YEAR 1938

Your Council has pleasure in reporting upon a year in which all activities of the Institute continued under generally favourable conditions. An examination of the technical papers and the records of branch activities published in the past year's issues of the "Engineering Journal" will show that the principal object of the Institute—the interchange of professional knowledge—has been well promoted. The year has, in fact, been notable for the quality of the papers contributed by our members.

At the last Annual General Meeting unanimous approval was given to a new enabling by-law sponsored by Council and designed to clothe Council with wide power to enter into co-operative agreements with the provincial professional associations. It was endorsed by the largest favourable vote ever recorded by an Institute ballot. This overwhelming support for a Council proposal is significant. It means that the membership of the Institute in every province desires closer relations with the provincial association, and, what is very important, the membership desires that the responsibility for effecting this closer relation, and for determining its character, shall rest squarely on Council. Realizing this, Council set up a special Committee on Professional Interests to take supervisory charge of all negotiations between the Institute and the associations. Council also arranged that the branches should be visited by the strongest possible delegation from Headquarters, with the President, the Chairman of the Committee on Professional Interests and the General Secretary as a nucleus. Each of the twenty-five branches has been so visited, and wherever possible, in addition to round table duscussions with branch executives and past councillors, there have been well attended open discussions on Institute affairs, during which the President emphasized the desire of the Council to proceed with the negotiations in each province just as soon, just as fast, as the provincial associations desired.

During the year the traditional close relations between the provincial professional associations and the Institute has grown more cordial. This is evidenced by the unique event at Regina in October when the first agreement between the Institute and an association under the provisions of the new enabling by-law was completed. Saskatchewan engineers have shown how the interests of the engineering profession in one province can be constructively served and with a concomitant strengthening of both the Institute and the Association.

Grateful acknowledgment is now made to the President and Council and Registrar of the Association of Professional Engineers of Saskatchewan for their courteous consideration of the interests of the Institute prior to, during, and since the memorable week-end at Regina last October during which the signing officers of the Institute and the Association completed the formal agreement between the two bodies. It is confidently believed that the nearly Dominion-wide broadcast of the addresses of the two presidents during the signing ceremony was a fitting conclusion for "another engineering triumph".

Due very largely to the initiative of the Committee on International Relations, the Institute's relations with the engineering organizations of Great Britain and of the United States have become very cordial. True, with certain of the Institutions, and also with some of the Founder Societies, the Institute has enjoyed all through its history very friendly relations. During 1938, however, these good relations have notably grown more general and much more intimate, to the great good fortune of the Institute. Very special mention should be made of the inspirational help derived from contact with the Engineers' Council for Professional Development. The Institute cannot do better than profit by the successful and often pioneering efforts of this unique professional organization to benefit in particular the young American engineer and in general the entire profession. The activities of the Institute in this regard, though creditable, can be and should be both improved and extended.

At the suggestion of Dr. Fairbairn, the Headquarters delegation conferred at Seattle with the officers of the local sections of certain of the Founder Societies, and en route home from his western trip the President spoke to three important groups of engineers at Chicago and Detroit. In every case a surprisingly friendly interest in the Institute and its aspirations was evidenced.

In connection with the Committee on International Relations, special mention should be made of the visit to Headquarters of the President of the Institution of Chemical Engineers, Dr. W. E. Cullen; the President-Elect of the Institution of Electrical Engineers, Dr. A. P. M. Fleming; a councillor of the Institution of Civil Engineers, Dr. R. E. Stradling, and Mr. Spencer G. Scoular, a member of the New Zealand Institution of Engineers.

The chairman of the Committee on International Relations, Past-President J. M. R. Fairbairn, visited London, England, early in the year to represent the Institute, as well as the American Society of Civil Engineers, in consultations regarding the programme for the conference of British, American and Canadian engineers in New York, September 4th to 9th next.

Another feature that has made weight for friendly attitude towards the Institute by the general public, and at the same time has contributed to the better understanding between members of the Institute, has been the receptions which the President, assisted by the past-presidents and the vice-presidents and their ladies, has held at London on January 30th, at Halifax on May 1st, and at Regina on October 30th.

As to matters of internal economy, brief mention should be made of the refurbishing and modernizing of Headquarters. All members of the Institute are urged, when in Montreal, to take time to visit their own Headquarters. They will be warmly welcomed by the Headquarters personnel and will be interested in the improved appearance and facilities.

The "going" of a tried and true official of the Institute, who served it well and worthily for almost fourteen years, and the "coming" of a new General Secretary was accomplished with a minimum of lost motion, and on a basis that has greatly pleased Council because of the cordial co-operation between the parties directly concerned. To meet a desire expressed to the President throughout his visits to the branches, Council has arranged appropriately to recognize at the Annual General Meeting in Ottawa the services of former General Secretary Richard John Durley, M.E.I.C.

The work of the Committee on Professional Interests cannot be too highly commended, nor can its importance to the profession be over-estimated. The chairman, Mr. Fred Newell, M.E.I.C., has been indefatigable in his efforts, first, to clarify the position of the Institute in respect of the provincial associations, and then to simplify their inter-relation, all leading, of course, to eventual co-operative agreements pursuant to the new enabling by-law 76. On the advice of this committee, an informal dinner, at the University Club of Montreal, was tendered in April to the President and members of the Dominion Council, when the attitude of the Institute to this potential body was declared. The timely enunciation of Institute policy then made was, by direction of Council, published in the May issue of the "Engineering Journal."

In an earnest effort to promote cordial relations with the Dominion Council, its President was invited to attend the Halifax regional meeting of Council and to accompany the Institute President upon his visit to the Western branches. Special invitations were issued to the representatives of provincial associations on the Dominion Council to participate freely in the regional meetings of Council and in the functions incidental to the visit of the Headquarters delegation to the Institute branches in their respective provinces. Acknowledgment is now made of the advice and assistance received from these Dominion Council members throughout the Dominion. Particular mention is made of the valuable help of Colonel F. W. W. Doane, M.E.I.C., of Halifax, H. Cimon, M.E.I.C., of Quebec, the late A. B. Crealock, M.E.I.C., of Toronto, D. A. R. McCannel, M.E.I.C., of Regina, and P. M. Sauder, M.E.I.C., of Lethbridge. When in Winnipeg the President urged the advisability of Manitoba being represented upon the Dominion Council. Word has recently been received that the Association of Professional Engineers of Manitoba will be represented by its President, Mr. P. Burke-Gaffney.

The work of the Committee on Membership and Management, under the able chairmanship of Professor R. A. Spencer, A.M.E.I.C., of Saskatoon, has been progressing satisfactorily. It is expected that this committee will shortly be in a position to submit to Council a final report on the seven questions remitted to its care early in 1937.

The work of the Publication Committee is best evidenced by the steady improvement in the Journal, which culminated in a substantially new publication in the month of January. Whether separate Transactions will be found feasible is still problematical.

During the year several innovations regarding Council proceedings have been tried out with satisfactory results. The routine minutes of Council are no longer marked "confidential." Minutes are now sent regularly to members of Council, to past-presidents, to ex-councillors for one year following their term of office, and to all chairmen of branches. This procedure, along with a brief précis of Council minutes inserted in the "Engineering Journal," broadcasts Council business to a much wider circle of Institute membership, and undoubtedly results in a greater interest in Institute affairs.

Several regional meetings of Council have been held; the first in London in February, the next in Halifax in May, when all Maritime councillors and the Maritime Branch chairmen met with the President and a Headquarters delegation. Senior, actively interested local members of the Institute and the executive committee of the local branch, were invited to sit in as observers and to participate in the discussions. Other regional meetings of Council were held in Toronto on April 22nd, following which was a joint dinner at the Royal York Hotel between the members of the Council of the Institute and the Council of the Ontario Provincial Professional Association, who sat at a round table discussion presided over by Eric Muntz, M.E.I.C., President of the Association, who undoubtedly paved the way for closer co-operation between organized engineering bodies centring in Toronto. A regional meeting of Council was held in Ottawa on June 24th, and in Peterborough on November 26th. The one in Regina on October 30th enabled all the councillors and the chairmen from the prairie provinces to meet with the President and his delegation from Headquarters. The Saskatchewan Branch executive committee and the members of the Council of the Association of Professional Engineers of Saskatchewan were invited to attend as observers and to participate in the discussions.

Invariably these enlarged Council meetings have awakened a renewed interest in Institute affairs by furnishing councillors with a better and wider cross-section of Institute opinion and activity. They have enabled Council to function more quickly and in greater accord with the general desires of the membership. It is earnestly believed that these practices should be continued. All the regional meetings of Council held this year have been much less expensive than would one Plenary Meeting at Headquarters, and in the opinion of many, more good was accomplished.

No report of Council work would be complete without a well deserved tribute to the outstanding services rendered without exception by the five vice-presidents. Vice-President McCrory, in his capacity as chairman of the Finance Committee, has been continuously assiduous in his efforts to keep expenditures well within anticipated income. His attendance at the regional meetings of Council at Halifax, Ottawa, Toronto and Peterborough, often at considerable inconvenience, has been greatly appreciated. Vice-President Dunsmore, of Halifax, has been present at several regional meetings of Council and has attended to important special duties in the Maritimes. Vice-President Keay has been a regular attendant at Council meetings throughout the year. His long experience in Institute affairs, his contribution to the profession while on the staff of McGill University and since, have made him a valuable member of Council. Vice-President Buchanan has been particularly helpful to the President, and has been present at most of his visits to the Ontario Branches. In addition, he represented the Institute at the International Engineering Congress in Glasgow. Vice-President Carpenter, one of the senior members of the Institute in the west, has rendered yeoman service to the profession, and in particular has guided the Council well in connection with the strategically important negotiations which have led to the compact between the Institute and the Saskatchewan Association.

Wherever possible throughout the year the Headquarters delegation when visiting the various branches, also addressed the undergraduate bodies in engineering of the local universities. Judging by the keen interest shown by the undergraduates in every case, there can be no doubt about the great importance of giving special attention to these groups of young men from which future members of the Institute are to be recruited.

Early in the year, the way opened for an entente with the Canadian Chamber of Commerce, a Dominion-wide organization for the promotion of the general economic welfare in all of the provinces. The Chamber has a splendid record of constructive contribution to national unity. It is brilliantly led and ably managed. A member of the Council selected by it is now permitted to sit on the governing body of the Chamber. Council is convinced that this affiliation affords the Institute an opportunity to participate, on behalf of the engineering profession, in the evolution of a movement which promises much for interprovincial accord and national progress.

The Fifty-second Annual General Meeting convened at Headquarters on January 20th, 1938, and was adjourned to the Hotel London, London, Ontario, on January 31st. This was followed by the General Professional Meeting where technical papers dealing with highways and flood control occupied the major portion of the programme.

Roll of the Institute

During the year 1938, three hundred and twenty candidates were elected to various grades in the Institute. These were classified as follows:—Twenty-nine Members; eighty-four Associate Members; fifty-six Juniors; one hundred and forty-eight Students, and three Affiliates. The elections during the year 1937 totalled three hundred and twenty.

Transfers from one grade to another were as follows:—Member to Honorary Member, one; Associate Member to Member, twenty-seven; Affiliate to Member, one; Junior to Associate Member, thirty-two; Student to Associate Member, thirty-three; Student to Junior, sixty-five—a total of one hundred and fifty-nine.

The names of those elected or transferred are published in the Journal each month immediately following the election.

Removals from the Roll

There has been removed from the roll during the year 1938, for non-payment of dues and by resignation, seventeen Members; fifty-six Associate Members; seventeen Juniors; one hundred and nine Students; and five Affiliates. A total number of two hundred and four. Twenty-eight reinstatements were effected, and twenty-one Life Memberships were granted.

Deceased Members

During the year 1938 the deaths of forty-nine members of the Institute have been reported as follows:

Honorary Member

His Grace the Duke of Devonshire, K.C., G.C.M.G.

Members

Barber, James Henry	Latham, Richard L.
Burke, John William	Mailhiot, Adhemar
Caldwell, Frederick William	McAll, Henry Wardlaw
Cartwright, Conway Edward	McMath, Francis C.
Crealock, Archie Burgess	Newell, Joseph Pettus
Craig, John Cormack	Robb, David Wentworth
Dennis, John Stoughton	Ross, Charles Cathmer
Duchastel de Montrouge, Jules Alexandre	Smith, J. Warren
	Strauss, Joseph Baermann
Dufresne, Alexander Ritchie	Sullivan, John G.
Ervine-Grim, Walter Atkyns	Swan, Hamilton Lindsay
Fleming, David Howard	Thompson, William Thomas
Forward, Edwin Albert	Thornton, Kenneth Buchanan
Harvey, David William	Trost, Paul Anthony
Haycock, Richard LaFontaine	Waddell, John Alexander Low
Hopkins, Marshall Willard	Wheatley, Edward Augustus
James, Edward Henry	Yorston, William Gardiner

Associate Members

Aldred, John James	Porter, Cecil George
Baily, Paul	Ritchie, Alan Bruce
Bridges, Fitz James	Ross, Othmar Wallace
Galea, Arthur Frederick	Stephen, Charles
Macaulay, Harry Donald	Thompson, John Henry
McDougall, Stewart Robertson	Turley, Edward James
McLaren, William Alfred	Wright, George R.

Affiliate

Burpee, Frederick Demille

Total Membership

The membership of the Institute as at December 31st, 1938, totals four thousand, six hundred and thirty. The corresponding number for the year 1937 was four thousand, five hundred and thirty-six.

1937	
Honorary Members	16
Members	1,041
Associate Members	2,152
Juniors	422
Students	860
Affiliates	45
	4,536

1938	
Honorary Members	16
Members	1,053
Associate Members	2,218
Juniors	496
Students	806
Affiliates	41
	4,630

Respectfully submitted on behalf of the Council,

J. B. Challies, M.E.I.C., *President.*
L. Austin Wright, A.M.E.I.C., *General Secretary.*

TREASURER'S REPORT

The President and Council:

The Auditor's Report shows your Surplus Account at the end of the year increased by $3,718.62 over last year; $2,453.58 of this sum represents the turning-over to the General Account of the excess of the War Memorial Fund and $915.04 is excess revenue over expenditures.

It is gratifying that there is a favourable balance at the end of a period of such activity and changes as the Institute has undergone.

The Institute's buildings have been renovated and are in a good condition, but their value is carried in the books at cost, without depreciation, so that their value as an asset is uncertain.

Apart from the value of the buildings, the assets amount to $32,547.99; the excess of the assets in the hands of the Institute over the current liabilities is $22,123.31 and the excess of the assets over the current liabilities and the liabilities of the Institute to its own Special Funds is $10,109.69.

Respectfully submitted,

de Gaspe Beaubien, M.E.I.C. *Treasurer.*

FINANCE COMMITTEE

The President and Council:

The Financial Statement for the year 1938, which is presented herewith, is encouraging in that the year's operations resulted in a balance of receipts over expenditures amounting to $1,674.70. From this amount $409.66 has been written off as depreciation on furniture, and $350.00 has been set aside as a building maintenance reserve, leaving a net surplus of $915.04. That this result was achieved in spite of a decrease in receipts from fees and the added expense of printing a membership list in the December issue of the Journal is due in no small part to the loyal co-operation of the General Secretary and of the Headquarters' staff.

Certain items in the Comparative Statement of Revenue and Expenditure for the two years 1937 and 1938 must be interpreted in the light of changes that were made at the beginning of the year. The receipts from Journal Advertising for instance, show an apparent decrease of some $3,000. During 1937, as in previous years, advertising for the Journal was procured by a staff at Headquarters and their salaries charged against the Journal. In 1938, however, this work was done by an outside organization on a commission basis so that the receipts shown in the statement for this year are net and represent a greater net return to the Institute than for the preceding year.

It will be noted that there is no item in this year's statement under the heading of "Catalogue." At the beginning of the year, on the recommendation of the Publication Committee, it was decided by Council to dispose of this publication. This action was taken after a thorough investigation and the receipt of an offer that would reimburse the Institute for the amount expended up to that time on the preparation of the 1938 issue.

Another item on which comment should be made is the large increase this year in Secretary's Travelling Expense. The benefit derived by the Institute in having the General Secretary accompany the President on his visits to the Branches indicates that this expenditure was well worth while and that future budgets should provide an amount sufficient to enable the General Secretary to keep in close personal touch with the Branches.

That the upward trend in membership fees remarked in last year's statement was not maintained is disappointing not only from a financial standpoint, but even more so as reflecting the business recession that developed toward the end of 1937 and that affected adversely so many of our fellow engineers. It is hoped that the improvement shown so far in 1939 marks the beginning of a long period of prosperity for the profession.

Respectfully submitted,

J. A. McCrory, M.E.I.C., *Chairman.*

LIBRARY AND HOUSE COMMITTEE

The President and Council:

During this year your committee has done considerable renovation and repair work to the Headquarters building. For the past twenty-five years only unavoidable repairs had been made, and consequently the building was in an unsatisfactory state. Early last spring, the committee was requested to draw up a list of the repairs and renovations most urgently required. Unfortunately, due to our limited financial resources, some things which badly need attention had to be curtailed, or left undone.

The chief items undertaken are:

A new roof surface on the front portion of the building.

Redecoration of the lecture hall, including new curtains at the rear of the platform, drapes for the windows, a new central hall carpet, and new light contact.

Reflooring the main hallway.

Redecorating the reading room, council room, secretary's office, and general office. The latter has been rearranged to give a more efficient and convenient layout. The secretary's office has been greatly improved by the addition of new drapes, lighting fixtures, and carpet.

Larger radiators have been installed in the secretary's office, council room, reading room, and lower hallway. Metal weather stripping has been placed around the windows, and the frames have been caulked with mastic.

All outside woodwork and iron work has been repainted.

In general, the building has been greatly improved, and it is now more in keeping with the handsome war memorial which it houses.

An amount of $250.00 was contributed by the Montreal Branch towards the cost of redecorating the Headquarters premises, and the committee is glad of this opportunity to acknowledge this donation, and to express appreciation of the action of the branch.

Library and Information Service

Tabulated below is a summary of the requests that have been made to the librarian for data and information during the last three years. It will be noted that, in general, there have been fewer inquiries this year than in 1936, but more than in 1937. It is possible that the renovation of the building, with the consequent inconveniences, was partly responsible for this.

	1938	1937	1936
Requests for information	727	516	861
Requests for textbooks, periodicals, etc.	285	360	577
Technical books borrowed	125	130	153
Bibliographies compiled (number of pages)	56	27	40
Photoprints furnished (number of pages)	129	158	119
Accessions to library (largely reports, etc.)	429	554	665
Books presented for review by publishers	35	19	32

COMPARATIVE STATEMENT OF REVENUE AND EXPENDITURE

For the Year Ended the 31st December

Revenue

	1937	1938
Membership Fees:		
Arrears	$ 3,427.20	$ 2,404.50
Current	25,210.39	25,766.28
Advance	512.65	545.15
Entrance	1,557.00	1,438.00
	$ 30,707.24	$ 30,153.93
Publications:		
Journal subscriptions and sales	$ 7,052.75	$ 7,041.60
Journal advertising	17,714.98	①14,710.43
Catalogue advertising (net)	1,331.69	—
	$ 26,099.42	$ 21,752.03
Income from Investments	$ 452.06	$ 448.21
Refund of Hall Expense	610.00	485.00
Sundry Revenue	10.80	26.69
Total Revenue	$ 57,879.52	$ 52,865.86

Expenditure

	1937	1938
Building Expense:		
Property and water taxes	$ 2,035.48	$ 2,031.73
Fuel	280.80	373.81
Insurance	165.45	189.32
Light, gas and power	277.78	314.90
Caretaker's wages and services	878.00	878.00
Maintenance and repairs	496.23	653.95
	$ 4,133.74	$ 4,441.71
Publications:		
Journal—Salaries	$ 5,821.65	$ 2,246.15
Expense	②20,217.18	16,028.85
Sundry Printing	452.75	769.61
	$ 26,491.58	$ 19,044.61
Office Expense:		
Salaries	$ 10,800.51	$ 11,453.64
Telephone, telegrams and postage	1,750.28	1,736.28
Office supplies and stationery	1,511.65	1,265.29
Audit and legal fees	300.00	315.00
Messenger and express	83.02	111.67
Miscellaneous	362.97	808.85
D preciation—Furniture and Fixtures	463.74	409.66
	$ 15,272.17	$ 16,100.39
General Expense		
Plenary Meeting of Council	$ 1,116.50	—
Annual and Professional Meetings (Net)	969.92	$ 1,873.77
Round Table Conference	755.46	—
Meetings of Council	155.10	432.88
Travelling	111.20	1,267.61
Branch Stationery	244.70	201.23
Students' Prizes	77.76	69.79
E.I.C. Prizes	288.75	288.45
Gzowski Medal	17.25	17.25
Library—Salary	666.55	600.00
Expense	378.18	401.95
Interest, discount and exchange	297.18	225.43
Examinations and Certificates	40.72	*11.66*
Committee expenses	732.68	445.83
National Construction Council	100.00	150.00
	$ 5,951.95	$ 5,962.53
Rebates to Branches	$ 6,270.22	$ 6,401.58
Total Expenditure	$ 58,119.66	$ 51,950.82
Surplus or *Deficit* for Year	*240.14*	915.04
	$ 57,879.52	$ 52,865.86

①*Journal advertising revenue in 1938 is net after deduction of commissions.*
②*Journal expense for 1937 included the sum of $5,836.60 for the cost of the Semicentennial number.*

All the additions made to the library were presentations. In recent years, few technical books have been purchased, and consequently the library is sadly deficient in up-to-date books on engineering subjects. We feel that a policy should be adopted whereby each year a certain number of well selected, up-to-date, technical books should be purchased.

On behalf of the committee, I wish to express to the General Secretary and his staff our appreciation of their collaboration and assistance.

Respectfully submitted,

J. B. D'Aeth, M.E.I.C., *Chairman.*

PAPERS COMMITTEE

The President and Council:

The Papers Committee, this year, is composed of the chairman and the three following vice-presidents: R. L. Dunsmore, M.E.I.C., Vice-President Maritime Provinces, Dartmouth, N.S., H.O.Keay, M.E.I.C., Vice-President for Quebec, Trois Rivières, Quebec, and H. S. Carpenter, M.E.I.C., Vice-President Western Provinces, Regina, Saskatchewan.

This Committee has carried on a large amount of correspondence and put forth some effort to assist smaller branches but with only partial success. It is not difficult for the larger branches to secure speakers, papers, or motion picture films for their meetings and they are frequently able to arrange the entire season's programme at the beginning of the year. Many of the smaller branches, however, are isolated and handicapped financially. Most of them have exhausted the supply of available speakers near at hand and it is more difficult to secure speakers from the larger places.

The chairman of this committee recommends that steps be taken by Headquarters to assist branches, particularly the smaller ones, in the following ways:

1. Arrange for prominent members of the Institute, when travelling to other parts of Canada, to visit and speak at one or more branches.
2. Arrange and pay expenses for a suitable speaker to address a group of branches on a pre-arranged schedule.
3. Secure a list and arrange for distribution of motion pictures on engineering subjects to the branches. (Manufacturers are often glad to supply a copy of their films to the Institute for exhibition at branch and other meetings.)
4. On every occasion encourage joint meetings of branches, inter-branch visiting, and generally more personal contacts among the membership.

Distance and lack of funds make it very difficult for any such committee as this to function effectively and be of much benefit, and your chairman regrets that the committee has been unable to accomplish more during the past year.

Respectfully submitted,

James A. Vance, A.M.E.I.C., *Chairman.*

COMPARATIVE STATEMENT OF ASSETS AND LIABILITIES

As at 31st December, 1938

Assets

Current:		
Cash on hand and in Savings Bank		$ 115.82
Accounts receivable	$ 3,172.56	
Less: Reserve for uncollectible accounts	273.67	2,898.89
Arrears of fees—estimated		2,500.00
Balance due on Catalogue contract		378.82
		$ 5,893.53
Special Funds—Per Statement attached:		
Investments ($3,000.00 pledged with Bank)	7,285.14	
Cash in Savings Bank	1,413.50	
Due by Current Funds	3,314.98	
		$ 12,013.62
Investments—At Cost:		
$100 Dominion of Canada 4½% 1946	96.50	
200 Dominion of Canada 4½% 1958	180.00	
4,000 Dominion of Canada 4½% 1959	4,090.71	
500 Prov. of Saskatchewan 5% 1959	502.50	
1,000 Montreal Tramways 5% 1941	950.30	
2,000 Montreal Tramways 5% 1955	2,199.00	
2 Shares Canada Permanent Mortgage Corporation	215.00	
40 Shares Montreal Light, Heat & Power, N.P.V.	324.50	8,558.51
(Approximate Market Value $9,100.00.)		
Advances to Branches		100.00
Advance—Travelling Expenses		100.00
Deposit—Postmaster		100.00
Prepaid and Deferred Charges—		
Stationery and Office Supplies	481.08	
Unexpired Insurance	121.10	602.18
Gold Medal		45.00
Library—at cost—less depreciation		1,448.13
Furniture—at cost—less depreciation		3,687.02
Land and Buildings—At Cost (Assessed value $57,200)		91,495.22
		$124,043.21

Liabilities

Current:		
Bank Overdraft—Secured		$ 3,210.94
Accounts payable		3,248.08
Rebates due to Branches		645.68
Library deposits		5.00
Amount due to Leonard Medal Fund	500.00	
Amount due to Past-Presidents' Fund	$2,814.98	3,314.98
		$10,424.68
Special Funds:		
Leonard Medal	$ 645.29	
Plummer Medal	657.27	
Fund in Aid of Members' Families	2,470.89	
Past-Presidents' and Prize Fund	5,683.48	
Duggan Medal and Prize Fund	2,556.69	
War Memorial Fund	—	
		$12,013.62
Reserve for Building Maintenance		350.00
Surplus:		
Balance as at 1st of January, 1938	$97,886.29	
Add: Excess of Revenue over Expenditure for year per Statement	915.04	
Transfer to Surplus of Balance of War Memorial Fund disposed with in accordance with Minute No. 8747	$2,453.58	$101,254.91
		$124,043.21

Audit Certificate

We have audited the books and vouchers of The Engineering Institute of Canada for the year ended 31st December, 1938, and have received all the information we required. In our opinion, the above Statement of Assets and Liabilities and attached Statement of Revenue and Expenditure for 1938 are properly drawn up so as to exhibit a true and correct view of the Institute's affairs as at 31st December, 1938, 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 shown by the books.

(Sgd.) Ritchie, Brown & Co.,
Chartered Accountants.

Montreal, 21st January, 1939.

PUBLICATION COMMITTEE

The President and Council:

In accordance with instructions of Council, the Publication Committee added to its duties as a standing committee, the function of the former Committee on Publications, which had been dealing with problems in connection with The Engineering Journal and the Engineering Catalogue. There was no change in the personnel of the committee, which consisted of the following councillors: R. W. Boyle, A. Duperron, R. H. Findlay, F. S. B. Heward, and J. L. Busfield (Chairman).

Early in the year, the committee had recommended to Council that the Institute should cease publishing the Engineering Catalogue, and transfer all rights therein to N. E. D. Sheppard, A.M.E.I.C., on the understanding that he would continue the publication with no connection with The Engineering Institute. At the same time it was recommended that a contract be made with Mr. Sheppard whereby his organization would be responsible for all Journal advertising on a commission basis. These recommendations were approved by Council, and the committee put them into effect.

Late in the year 1937, a questionnaire was issued to all members of the Institute, seeking information on various points pertinent to the publications of the Institute. The response to the questionnaire was very gratifying and brought to light the fact that the membership felt that there was room for improvement in the Journal. Under the system of publishing about 36 papers per annum, and taking into consideration the wide diversification of interests of the membership at large, it was perhaps only to be expected that the majority of members would point out that they were not getting very many papers in their own line of engineering. There was also a definite indication that the majority of members favoured short pithy articles, rather than long papers full of technical detail.

To meet this particular phase of the situation, the committee recommended that a reasonable proportion of the Journal be set aside for the publication of abstracts of articles appearing in other technical publications. In order to accomplish this, it was decided to ask a number of members to assist the committee by (a) giving advice on technical editorial matters, (b) by preparing abstracts of technical papers. The response to this request was very gratifying to the committee. Names of advisory members of the Publication Committee are now published on the contents page. These are the members who have undertaken to review technical literature and prepare abstracts of worth-while articles.

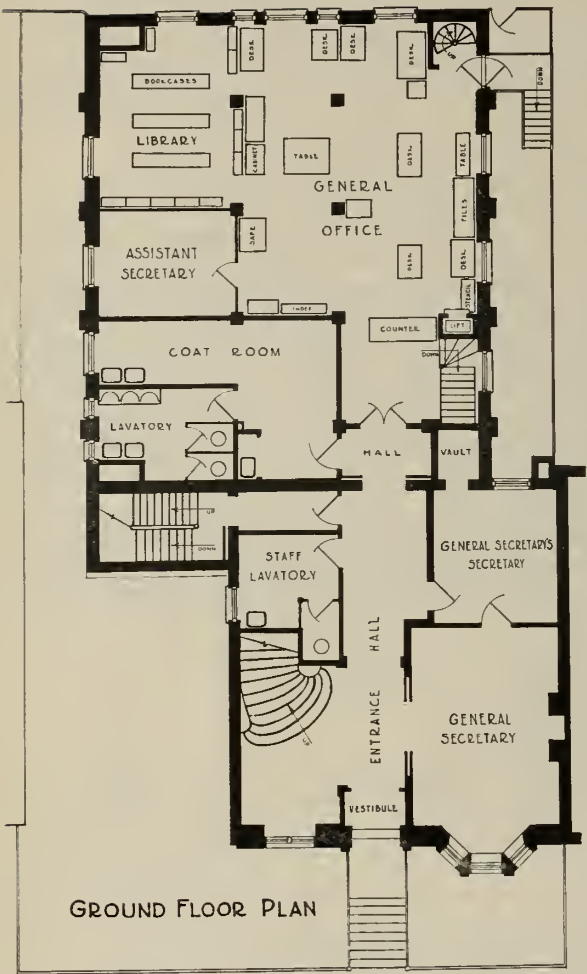
The committee submitted a report to Council during the early summer, indicative of the general lines along which it was working towards an improved Journal. However,

SPECIAL FUNDS

As at 31st December, 1938

Leonard Medal Fund:			*Represented by:*		
Balance as at 1st January, 1938	$ 654.34		Cash in Savings Bank	$ 145.29	
Add: Bank interest	.70		Amount due by Current funds	500.00	
Interest on amount loaned to Current Funds	7.50				
	$ 662.54				
Deduct: Cost of Medal	17.25				
		$645.29			$645.29
Plummer Medal Fund:					
Balance as at 1st January, 1938	656.30		$500.00 Dominion of Canada 4½% 1959 Bonds	500.00	
Add: Bond interest	22.50		Cash in Savings Bank	157.27	
Bank interest	.72				
	$ 679.52				
Deduct: Cost of Medal	22.25				
		657.27			657.27
War Memorial Fund:					
Balance as at 1st January, 1938	2,131.15				
Add: Bond interest	45.00				
Bank interest	.52				
Profit and Interest on Bonds Sold	276.91				
	$ 2,453.58				
Deduct: Amount realized on sale of bonds	2,276.91				
Balance taken from Savings Account	176.67				
Fund in Aid of Members' Families:					
Balance as at 1st January, 1938	2,379.02		$1,000 Province of Ontario 4½% 1964 Bonds	1,022.17	
Add: Bond interest	90.00		$1,000 Dominion of Canada 4½% 1959 Bonds	972.97	
Bank interest	1.87		Cash in Savings Bank	475.75	
		2,470.89			2,470.89
Past Presidents' Prize Fund:					
Balance as at 1st January, 1938	$ 5,684.45		$3,000 Montreal Tramways 5% 1955 Bonds	2,490.00	
Add: Donation	50.00		Cash in Savings Bank	378.50	
Bond Interest	150.00		Amount due by Current Funds	2,814.98	
Bank Interest	1.53				
Interest on amount loaned to Current Funds	34.50				
	$ 5,920.48				
Deduct: Cost of Prizes	237.00				
		5,683.48			5,683.48
Duggan Medal and Prize Fund:					
Balance as at 1st January, 1938	2,450.88		$2,300 Dominion of Canada 4½% 1959 Bonds	2,300.00	
Add: Bond interest	103.50		Cash in Savings Bank	256.69	
Bank interest	2.31	2,556.69			2,556.69
		$ 12,013.62			$ 12,013.62

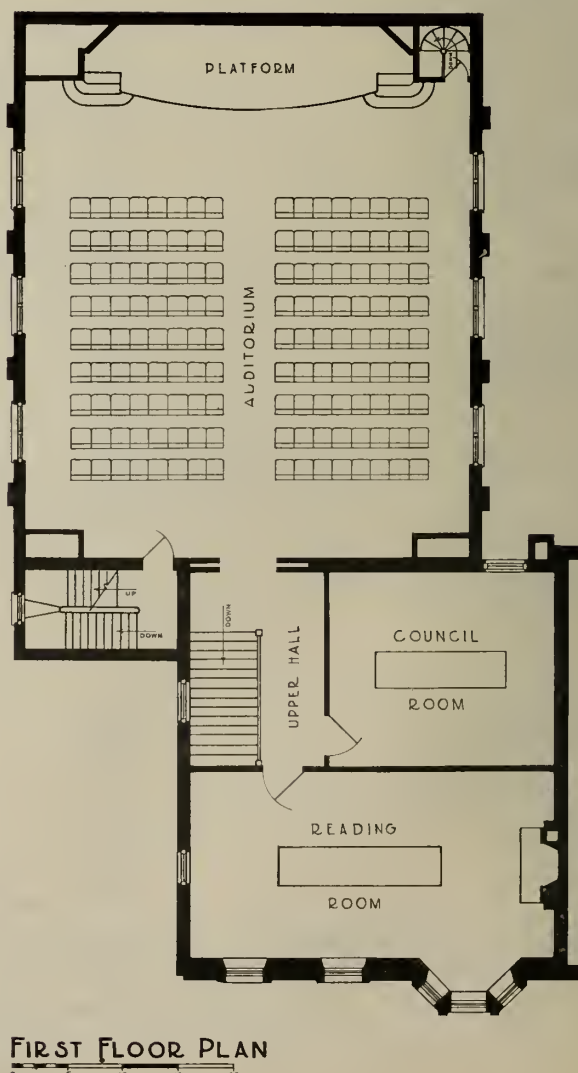
See Report of Library and House Committee on page 62



GROUND FLOOR PLAN

The General Office

Entrance Hall



FIRST FLOOR PLAN

changes could not be made over night, and it was not until the preparation of the January, 1939, issue (Volume 22, No. 1) that it was found possible to implement the previous recommendations.

During the early part of the year, two members of the committee visited New York, and spent some time with officials of the American Societies, from whom a great deal of most useful information was obtained. The committee has pleasure in recording its appreciation of the courtesies received, and of time so freely devoted by these officials to help a sister organization.

A competition was held for a new cover design, the results of which have already been reported through these columns.

To the membership at large, the January issue of the Journal may be looked upon as the visible expression of the work of the Publication Committee for the past year.

Respectfully submitted,

J. L. Busfield, m.e.i.c., *Chairman.*

LEGISLATION COMMITTEE

The President and Council:

Your Legislation Committee begs to submit the present report concerning its activities in 1938:

(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 Nova Scotia, a bill was presented to the Legislature in 1938 to amend "The Nova Scotia Engineering Profession Act" in order to allow the Association of Professional Engineers of Nova Scotia to enter into any agreement with The Engineering Institute of Canada for the purpose of securing greater co-operation between the two bodies. This bill was defeated.
2. In Quebec, no legislation was passed in 1938 affecting the interests of the Institute or of its members but notice was given recently in the Official Gazette that a bill will be presented to the Legislature at its next session by the Association of Architects for various purposes mentioned in the said notice. So long as the details of this bill remain unknown, it is impossible to determine up to what extent the interests of the engineering profession or of the engineers may be affected thereby.
3. In New Brunswick, Prince Edward Island, Ontario, Manitoba, Alberta, Saskatchewan and British Columbia, no legislation was enacted in 1938, to the knowledge of the committee, which might affect the profession or the engineers and no legislation is proposed for 1939 in said provinces with the exception of British Columbia where the committee has just been apprised that a bill will be presented to the Legislature by the Association of Professional Engineers of British Columbia.

   The purpose of this bill is as yet unknown to the committee.

Respectfully submitted,

A. Larivière, m.e.i.c., *Chairman.*

COMMITTEE ON WESTERN WATER PROBLEMS

The President and Council:—

During the past year your Committee has studied work that is being done under the Prairie Farm Rehabilitation Act, and has been actively engaged in obtaining the papers which are forming part of the programme of the General Professional Meeting being held in Ottawa in February, 1939, the subjects of which have already been announced.

Respectfully submitted,

G. A. Gaherty, m.e.i.c., *Chairman.*

COMMITTEE ON MEMBERSHIP AND MANAGEMENT

The President and Council:

This committee was appointed by the Plenary Meeting of Council on June 14, 1937. It is composed of a chairman and a representative from each of the provinces (two in the case of Ontario). The work assigned it was to examine into and report on the following questions:

1. Is more local autonomy in the provinces advisable ?
2. Would the setting up of provincial divisions be advisable ?
3. Can the present organization of Council be improved and is the conduct of Institute affairs efficient and economical ?
4. What are the standards of admission and fees in other engineering organizations ?
5. Ar the present qualifications for admission to the Institute best suited to existing conditions ?
6. Are the present classifications of membership in the Institute best suited to existing conditions ?
7. Can ways and means be provided under which better knowledge of Institute affairs will be disseminated throughout the membership and particularly with regard to conditions obtaining in the respective provinces ?

The committee has been working under considerable difficulty, particularly because of its scattered membership representing the various provinces, necessitating the carrying out of the work entirely by correspondence.

The investigation of the above questions has entailed a large amount of time and correspondence. As a result, however, we have gathered together and compiled much relevant and valuable information. To reach the desired finality has necessitated the consideration of many proposals. The scope of our investigations covering several subjects has required recommendations and opinions from the branches as well as individuals on several major questions.

It being our desire to report fully on all matters referred to us, we regret as yet we are unable to report on reclassification or reorganization of Council. In regard to reclassification necessary information requested by Council from the various branch executives has not yet come to hand but is expected at an early date. Regarding possible reorganization of Council opinions secured for our committee by Headquarters from branch executives have only recently come to hand and are now under consideration by the committee.

Due to the foregoing we regret the committee are unable to make the desired full report at this time. Anticipating that information now at Headquarters on reclassification can be studied by our committee at an early date, we feel assured a full report can be submitted in time for consideration at the Annual Meeting in February.

Respectfully submitted,

R. A. Spencer, a.m.e.i.c., *Chairman.*

COMMITTEE ON PROFESSIONAL INTERESTS

The President and Council:

At the beginning of 1937 Past-President Dr. F. A. Gaby, m.e.i.c., who was Chairman of the above Committee, resigned on account of ill health. Thereupon Councillor Fred Newell was appointed Chairman, the other two members being Dean H. W. McKiel, m.e.i.c., and Past-President Dr. O. O. Lefebvre, m.e.i.c.

The Provincial Sub-Committee chairmen are as follows:

P. H. Buchan, m.e.i.c.—British Columbia.
R. M. Dingwall, m.e.i.c.—Alberta.
R. A. Spencer, a.m.e.i.c.—Saskatchewan.
A. J. Taunton, m.e.i.c.—Manitoba.
J. A. Vance, a.m.e.i.c.—Ontario.
J. A. McCrory, m.e.i.c.—Quebec.
E. J. Owens, a.m.e.i.c.—New Brunswick.
H. S. Johnston, m.e.i.c.—Nova Scotia.

The Chairman of your Committee had the privilege of accompanying the President on both his Maritime and Western trips, visiting all the branches in the Maritimes, the Prairies and on the Pacific Coast, discussing with them their problems and explaining the willingness of Council, under By-law 76, to enter into negotiations and formulate agreements with the Professional Associations for the mutual benefit of the Institute and the Associations.

There was ample evidence of a strong desire among the members of all branches for a close co-operation between the Institute and the Associations. Conditions varied throughout the Dominion, causing special problems in each province, but it is believed that these problems can be solved by sympathetic discussion and a free exchange of views. The enthusiastic interest taken by Institute members in all of the branches in the problems of organized engineering speaks well for the future of the Institute and the profession.

The following brief summary of the situation in each of the provinces is submitted for general information.

Nova Scotia

It was expected in the early part of this year that the President would have the privilege, on behalf of the Institute, of signing an agreement with the Professional Association of Nova Scotia during his Maritime visit in the spring.

It is regretted that this was not possible, owing to certain misunderstandings which arose when the Association was seeking new legislation to enable it to sign a previously agreed upon co-operative agreement with the Institute.

The President and the Chairman of your Committee studied this question during their visit to Halifax, and, acting on the advice of a number of representative members of the profession in Nova Scotia, concluded that most difficulties would disappear if the Institute secured a new by-law which would obviate the necessity of the Association applying for new legislation. This solution has been decided upon and a new by-law will be submitted to the membership of the Institute for approval. This should be secured early in April.

In the meantime, active negotiations are taking place in the province and modifications in the proposed agreement have been suggested which are now being studied by your Committee. It is hoped that these negotiations will result in an agreement that will prove acceptable to both the Association and the Institute.

New Brunswick

Progress is being made towards an agreement in this province, so that it is quite possible that a conclusion will be reached during the coming year under the able guidance of the President-elect, Dean H. W. McKiel, and with the sympathetic co-operation of Mr. C. C. Kirby, President of the Dominion Council, who resides in Saint John, N.B.

Manitoba

The engineers of this province have for some years shown themselves to be leaders in the movement for a closer co-operation between the Professional Association and the Institute and it is regretted that local difficulties did not allow of a more speedy solution of the matter.

The whole of the engineering profession in the west has suffered very severely during the recent years of depression and far more so than their fellow-engineers in the east. This in itself presents a temporary barrier to any movement which might call for an increase in the financial obligations of many of the members of the profession.

Agreement in principle between the Manitoba Professional Association and the Institute is quite general in Winnipeg but there are a great many engineers in the outlying parts of the province who belong only to one of these bodies and can see little need for membership in both. This state of affairs can only be overcome by personal contact, which, of necessity, would take considerable time. Nevertheless the Winnipeg members of the Institute have undertaken to do what they can, with the assistance of the Headquarters staff, to inform the engineers in the outlying districts of the advantages to them of their support to both the Association and the Institute.

Saskatchewan

As is generally known, Saskatchewan has led the way so far as action under the new enabling By-law 76 is concerned. At Regina, on October 29th last, an agreement between the Institute and the Association of Professional Engineers of Saskatchewan was signed, sealed and delivered. This agreement guarantees that the resident members of the national body will gain the privileges and assume the responsibilities that go with the right to practise as a professional engineer in Saskatchewan. Reciprocally, the members of the Association will obtain the advantage of participating in all the social and technical activities of the national body, which enjoys great prestige, not only on both sides of the international boundary, but abroad as well. Following the completion of this agreement, the secretariats of both bodies have been busily engaged in the work involved in having the members of the Association properly classified as corporate members of the Institute. The President and General Secretary of the Institute have written personal letters to each member of the Institute resident in Saskatchewan who is not a member of the Association, urging that advantage be taken of the provision in the Saskatchewan agreement which permits corporate members of the Institute to be granted membership in the Association without the payment of an entrance fee. It is hoped that such members of the Institute will be prompt in taking advantage of this provision.

Alberta

Discussions with the officers and members of the Edmonton, Calgary and Lethbridge Branches indicated a strong desire for the opening of active negotiations with the Association of Professional Engineers of Alberta.

The interests of the large number of mining and geological engineers in the Province of Alberta, many of whom are not members of the Institute, and many of whom are members of the Association, will have to be very carefully considered in any negotiations respecting a co-operative agreement between the Institute and the Association. This situation, however, should not offer serious difficulty. It is hoped that during the year, the representatives of the three Alberta Branches, acting in consultation with the Committee on Professional Interests, may be in a position to initiate active negotiations with the Alberta Association.

British Columbia

In this province the profession is particularly favoured by having a strongly organized and well operated Professional Association admirably serving all grades of membership in the profession, including students and engineers in training. The position regarding Alberta mining members is very similar to that which exists in the Province of British Columbia.

During the Presidential visit to the coast, a meeting with the President and officers of the British Columbia Association was held, at which Past President Cleveland, Councillor Buchan, the General Secretary and the chairman of your Committee were present. A full discussion of the position of the Association and the Institute in this province took place. The President of the Institute explained the wide authority of council under the new enabling By-law 76, insofar as negotiations for co-operative agreements with Provincial Professional Associations. He made it plain that while the council was ready and willing to open negotiations with any association, it did not wish to go any faster nor any further in these matters than the associations themselves desire.

Ontario

Your provincial sub-committee under the guidance of Councillor J. A. Vance, has done excellent work during the year in promoting a spirit of co-operation among the several engineering bodies functioning in the province of Ontario, insofar as the Institute and the Association of Professional Engineers of Ontario are concerned.

In these efforts, the President of the Association, Mr. Eric Muntz, M.E.I.C., has rendered invaluable advice and assistance to the Institute.

In the early part of the year, when a meeting of the Council of the Institute and a meeting of the Council of the Association in Toronto were being held on the same day, President Muntz invited the Past Presidents, the President and Council of the Institute to a joint dinner with the same officers of the Association. On this occasion, the President of the Institute stated the position of the Institute with respect to the registration and licensing movement in the various provinces. He emphasized the earnest desire of the Council of the Institute for close co-operative agreements with the Associations which the Institute had been primarily responsible for bringing into being.

It is the opinion of the chairman of your committee that a definite and sympathetic understanding exists between the Institute and the Ontario Association, which should permit the present entente cordiale being translated into some sort of a co-operative agreement at least as regards those members of the Institute and the Association who reside outside of the capital city of Toronto. In Toronto, in addition to a branch of the Institute, there are several ably managed, strong, influential groups of engineers affiliated actively with certain of the Founder Societies of the United States. It is confidently believed that when these bodies understand fully the aspirations of the Institute and its record throughout the Dominion, they will be willing eventually to support a co-operative agreement between the Institute and the Ontario Association, that will cover the entire province of Ontario.

Quebec

The relationship between the Corporation of Professional Engineers of Quebec and the Engineering Institute has at all times been most cordial.

The Chairman of your Committee takes this opportunity publicly to express his sincere thanks to the President for his unremitting help and counsel in the work of your Committee.

In conclusion, your Committee desires to thank the Chairman of the Provincial Committees and all members of the Institute and the Professional Associations whose assistance has made possible such progress as your Committee has accomplished.

Respectfully submitted,

FRED NEWELL, M.E.I.C., *Chairman.*

COMMITTEE ON INTERNATIONAL RELATIONS

The President and Council:

The Committee on International Relations has had during the year 1938, and particularly during the latter part of the year, quite a busy time.

In the early part of the year one member of the Institute, Vice-President Buchanan of London, Ont., went overseas to attend the Engineering course at the Glasgow Exhibition.

Your Committee a little later in the year dealt with the question of a joint meeting of the Canadian Institute of Sewage and Sanitation, the American Water Works Association (Canadian Section) and the Engineering Institute of Canada, which meeting is to take place at Winnipeg in 1939, and the arrangements for which are not yet complete, but we have been advised by the Secretary-Treasurer of the Winnipeg Branch that he is in touch with the matter and will keep us advised of any matters that require attention.

In April last, our General Secretary, Mr. L. Austin Wright, accompanied the writer to New York, where the latter had the opportunity of introducing Mr. Wright to Mr. Geo. T. Seabury, Secretary of the A.S.C.E., Mr. Clarence E. Davies, Secretary of the A.S.M.E., Mr. H. H. Henline, Secretary of the Am. Inst. of Elec. Engrs., and Mr. A. B. Parsons, Secretary of the A.I.M.M.E., all of whom were kind enough to accord Mr. Wright every opportunity of discussing the affairs of our respective societies, and of looking over the plant and processes with which they carry on their work in the New York headquarters of the four societies. Particularly the publication procedures and policies were fully discussed with Mr. Wright and by the various secretaries. We were also introduced to Dr. Craver, librarian of the Engineering Societies Library, and to Mr. Otis Hovey, Treasurer of the A.S.C.E. and Director of the Engineering Foundation.

In August, the Council of our Institute accepted the invitation of the A.S.C.E. to participate with them and the Institution of Civil Engineers in a joint meeting to be held in New York in 1939, and as there was being planned by the A.S.M.E. a joint meeting with the Institution of Mechanical Engineers for the same time, in September, 1939, we have since, through the good offices of our President and Secretary, undertaken to join with the two American societies in helping to entertain their visitors from overseas, as well as to participate with them in the joint proceedings at New York during the World's Fair next September.

These arrangements were brought about as the result of a meeting in New York on October 21st, attended by President J. B. Challies; the Presidential nominee for 1939, Dean H. W. McKiel; General Secretary L. Austin Wright and the writer. At that time we discussed quite frankly and freely with the committee of the A.S.C.E. the arrangements which they were making, and agreed to meet them later to go into further particulars.

This we did, President Challies and the writer going to New York on the 5th December and meeting on the 6th the committee of the A.S.C.E. under Vice-President Malcolm Pirnie, where we discussed fully the general arrangements for the September gathering. Tentative suggestions were made as to some of the papers to be read, and also as to the various meetings and entertainments of one sort and another to be held in New York during the week of September 3rd. Then discussion was had as to the post-congress trips, it being generally agreed that it would be most desirable if, when the visiting delegates had concluded the Congress in New York and have done a little touring in the United States, they should come to Canada, arriving at Niagara Falls and proceeding to Ottawa, thence to Montreal, Shawinigan Falls, Grand'Mere, etc., ending up either at Montreal or Quebec to take steamer to Great Britain.

In the meantime, President Challies and the writer had an interview with the Hon. C. D. Howe, Minister of Transport at Ottawa, Dr. T. H. Hogg at Toronto, Mr. Gordon Gale at Ottawa and Dr. Julian C. Smith and Dr. Oliver Lefebvre at Montreal, with the result that we have been enabled to suggest a very interesting trip, with some delightful entertainment, for the visitors.

A meeting of your Committee on International Relations was held at Montreal on Friday, 16th December, at which, unfortunately, only three members of the Committee—Mr. P. L. Pratley, Mr. F. P. Shearwood and the writer—were able to attend, but Past-Presidents Lefebvre and Surveyer and President Challies were kind enough to sit in with the committee and listen to a report of recent events considerably more in detail than the present report, and all gave their unqualified approval to what has been done. Also letters were received from Messrs. Angus, Allcut and Murphy, generally concurring in the work of the committee.

At the moment there is nothing definite to report in regard to detailed arrangements for the meeting, other than to say that both the A.S.C.E. and the A.S.M.E. have advised their confreres on the other side not to make definite commitments until the writer has had an opportunity of discussing with them, when he reaches London about the 14th or 15th January, the tentative programmes which have been prepared.

Respectfully submitted,

J. M. R. FAIRBAIRN, M.E.I.C., *Chairman*

MEMBERSHIP COMMITTEE

The President and Council:

In order that a proper picture of the membership conditions over a number of years be known a comprehensive study has been prepared showing membership of the Institute from 1910 up to and including 1937. The statement also gives the membership of the various professional engineering associations of the provinces and other important engineering bodies operating throughout Canada.

With these data plotted in graphical form your committee noted the various fields from which we could hope to recruit new members. It indicated the need of the transfer of a great number of members to a higher grade and also the lack of membership in the class of students as compared to the great increase in engineering students in our colleges.

It was also apparent that there was a lack of enthusiasm amongst the present members, probably a marking of time during the period when reorganization has been so much to the fore and the outcome of negotiations with the professional bodies has been uncertain.

The activities of President Challies, the sending of the minutes to the Branch Chairmen, the agreement with the Professional Engineers of Saskatchewan and the coming agreement with Nova Scotia have all played a large part in alleviating this apathy.

President Challies has cemented the co-operation of the branches by his visits and brought the universities to see the benefits to be derived by, not only the faculty, but the students, from membership in the Institute. His interest in and co-operation with the Founder Societies of the States will in the near future have beneficial results to the membership at large.

We are happy to report an awakening interest by the student bodies, the formation of a student division of the Toronto Branch now being under way.

We feel that employment facilities play a most important part in the minds of prospective members especially the student group and that every effort should be made to arrange as soon as possible some Dominion-wide employment service possibly working through the Technical Service Bureau in Ontario and similar bodies in other provinces or the universities. This service should be capable of preparing information showing the long term demand for engineers of various types, such information to be available for students leaving high schools in order to help them select the best course to pursue. It should also prepare data concerning the spending of public funds for public works as a relief to unemployment; the placing of students in suitable employment during the summer months; education of employers to the advantages of using technically trained help and the advantages to be derived from technical research.

The following changes have taken place in the membership during the year 1938:

	1937	1938	Difference
Hon. Members	16	16	0
Members	1,041	1,052	12
Associate Members	2,152	2,218	66 increase
Juniors	422	496	74 increase
Students	860	806	54 decrease
Affiliates	45	41	4 decrease
Life Members	11	21	10 increase
Resignations	61	69	8 increase

The committee is especially grateful to H. Massue, A.M.E.I.C., for his work in preparing statistics dealing with membership studies and the graphical representation thereof. This work is of a comprehensive nature and wide in scope and it is recommended that it be maintained as a permanent record of the Institute's progress.

Respectfully submitted,

W. E. Bonn, M.E.I.C., *Chairman.*

BOARD OF EXAMINERS AND EDUCATION

The President and Council:

Your Board of Examiners and Education for the year 1938 has had prepared and read the following examination papers with the results as indicated:

	Number of Candidates	Number Passing
May Examination:		
Schedule B		
I. —Elementary Physics and Mechanics	1	1
IIA.—Strength and Elasticity of Materials	1	1
Schedule C		
II. —*Civil Engineering*		
A. —General Civil Engineering	1	0
B. 4—Railway Engineering	1	0
VI. —*Mining Engineering*		
A. —General Mining	1	1
B. 1—Metal Mining	1	1
VII.—*Structural Engineering*		
A. —General Structural Engineering	1	1
B. 2—Reinforced Concrete Design	1	1
November Examination:		
II. —*Civil Engineering*		
A. —General Civil Engineering	1	1
B. 1—Highway Engineering	1	1
III. —*Electrical Engineering*		
A. —General Electrical Engineering	1	1
B. 1—Electrical Machine Design	1	1

Respectfully submitted,

C. J. Mackenzie, M.E.I.C., *Chairman.*

THE CANADIAN CHAMBER OF COMMERCE

The President and Council:

I have the honour to submit the first Annual Report to Council under the arrangement whereby the Council of the Institute is represented on the Executive Committee of the Chamber.

The Chamber is basically a voluntary association of 117 Boards of Trade and Chambers of Commerce from coast to coast and also contains within its membership over 350 business enterprises in the Dominion, the activities of which are, for the most part, of a national character.

As an institution embracing a substantial part of all phases of Canadian commercial life in the nine provinces, the Chamber believes that the voice of sectionalism is not the voice of the Canadian people and that it is only by renewing and re-emphasizing the ideals expressed by the Fathers of Confederation that the people of Canada can continue to maintain their destined national existence.

In its Submission to the Royal Commission on Dominion-Provincial Relations the Chamber summarized its views on the current national problems, as follows:

1. Removing and preventing sectional barriers to business.
2. Balancing of governmental budgets by:
   (a) Solving the railroad problem;
   (b) Making relief entirely a federal matter;
   (c) Arresting the increase in public debt;
   (d) Co-ordinating public services;
   (e) Reducing the number of:
      (i) Elected representatives;
      (ii) Local administrations.
3. Collecting personal and corporation income taxes by the Dominion.
4. Abolishing corporation capital taxes.
5. Unifying and simplifying the collection of Succession Duties.

6. Reducing real estate taxes.
7. Unifying and simplifying government returns.
8. Giving the Dominion jurisdiction over:
   (a) Insurance;
   (b) Security Frauds Prevention;
   (c) Labour Regulations;
   (d) Old Age Pensions.
9. Making Provincial Companies' Acts uniform;
10. Supervising the borrowings of provinces obliged to lean on the Dominion for financial support by means of a Loan Council.
11. Determining subsidies by a Grants Commission.
12. Setting up uniform accounting systems and fiscal periods on the part of the provinces.
13. Making provincial control over municipal borrowing more strict.
14. Encouraging selected immigration.

The 1938 Convention of the Chamber was held at the Seigniory Club, P.Q., from 27th September to 1st October, and the Institute was represented by its President, Dr. J. B. Challies, its General Secretary, L. Austin Wright, and the undersigned.

The Executive Committee of the Chamber was convened on 47 occasions during the past year with an average attendance of 20.

The importance to the Institute of closer association with so prominent and outstanding a body as the Canadian Chamber of Commerce will readily be appreciated. It is only by maintaining a national unity without sectional discrimination that the prosperity of Canada may be expected to endure.

Respectfully submitted,

F. S. B. Heward, a.m.e.i.c.

GZOWSKI MEDAL COMMITTEE

The President and Council:

The Gzowski Medal Committee consisting of Messrs. A. O. Dufresne, C. V. Johnson, L. B. Kingston, J. A. Martineau, mm.e.i.c., and the chairman, beg to recommend that the Gzowski Medal be awarded to A. W. F. McQueen, a.m.e.i.c., and E. C. Molke, a.m.e.i.c., for their paper entitled "The 18-Foot Diameter Steel Pipe Line at Outardes Falls."

Respectfully submitted.

Hector Cimon, m.e.i.c., *Chairman.*

PAST-PRESIDENTS' PRIZE COMMITTEE

The President and Council:

The Past-Presidents' prize Committee for the year 1937-38 was comprised as follows:

O. O. Lefebvre, m.e.i.c., Montreal, P.Q.
G. A. Lindsay, a.m.e.i.c., Ottawa, Ont.
S. S. Scovil, m.e.i.c., Ottawa, Ont.
J. J. Traill, m.e.i.c., Toronto, Ont.
J. T. Johnston, m.e.i.c., (Chairman), Ottawa, Ont.

Only two papers were submitted on the subject of the competition, "Stream Control in Relation to Droughts and Floods"; one by Dr. A. E. Berry, m.e.i.c., Toronto, Ont., and the other by P. C. Perry, m.e.i.c., Regina, Sask.

After careful study of these papers the majority of your committee recommend the award of the Past-Presidents' prize to P. C. Perry, m.e.i.c., of Regina, Sask.

Respectfully submitted,

J. T. Johnston, m.e.i.c., *Chairman.*

LEONARD MEDAL COMMITTEE

The President and Council:

Your committee appointed to consider an award of the Leonard Medal for the current year have given careful thought to all papers eligible and have reached the unanimous conclusion that the medal should be awarded for the paper, "The Prevention of Silicosis by Metallic Aluminum," as published in the September, 1937, issue of The Canadian Mining and Metallurgical Bulletin, and by the following authors:

J. J. Denny, m.c.i.m.m.
Metallurgist, McIntyre Porcupine Mines Limited, Schumacher, Ont.
W. D. Robson,
Chief Surgeon, McIntyre Porcupine Mines Limited, Schumacher, Ont.
Dudley A. Irwin,
Associate Professor, Department of Mining Research, University of Toronto, Toronto, Ont.

Respectfully submitted,

Sydney C. Mifflen, m.e.i.c., *Chairman.*

PLUMMER MEDAL COMMITTEE

The President and Council:

Your committee has pleasure in recommending that the Plummer Medal for the year 1937-38 be awarded to H. I. Knowles, Chief Chemist, Atlantic Sugar Refineries, Saint John, N.B., for his paper, "Building Invisible Edifices," which was published in the August, 1938, issue of The Engineering Journal.

Respectfully submitted,

Alfred Stansfield, m.e.i.c., *Chairman.*

DUGGAN MEDAL AND PRIZE COMMITTEE

The President and Council:

For the year 1937-38 there were no papers submitted to the Institute for the Duggan Medal and Prize. Your Committee, however, has taken into consideration a number of papers published in The Engineering Journal and has reached the conclusion that no award should be made this year.

Respectfully submitted,

A. H. Harkness, 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 16th, 1939, and the following awards were made:

H. N. Ruttan Prize (Western Provinces)—To C. Neufeld, s.e.i.c., for his paper, "A Photo-Elastic Investigation of Stress Conditions in an End Block of the Borden Bridge, at Ceepee, Sask."

John Galbraith Prize (Province of Ontario)—To R. E. Edson, s.e.i.c., for his paper, "The Sandcasting of Crankshafts."

Phelps Johnson Prize (Province of Quebec, English)—to S. G. Lochhead, jr.e.i.c., for his paper, "The New Westmount Trunk Sewer, 1935."

Ernest Marceau Prize (Province of Quebec, French)—to J. G. Belle-Isle, s.e.i.c., for his paper, "Projet de Developpement Hydro-Electrique".

Martin Murphy Prize (Maritime Provinces)—No papers received.

EMPLOYMENT SERVICE

The President and Council:

The Employment Service Bureau of the Institute reports an active but less effective year than in 1937. This change is due largely to the absence of an assistant to the secretary, who normally gives the Bureau a large portion of his time. Although the staff has carried on with satisfactory results, it should be kept in mind that this activity is an extremely important phase of Institute work, and should not be neglected.

Toward the latter half of the year there was a decided falling off in the number of unemployed engineers registered with the Bureau. An increase in positions vacant also developed, so that at the end of the year most of the names still on the register represented members who were employed but desired better positions if any should develop. The list of members seeking positions now contains only 150 names, most of whom are already employed.

For many months there has been a shortage of electrical and mechanical engineers. Several openings of this kind have developed for which we were not able to find suitable applicants.

In reading the figures for the report it should be kept in mind that usually many positions are secured from leads given in this office, upon which no report is made by the applicant or the employer after the transaction is completed, although each is asked to keep the Bureau posted.

An endeavour has been made to enlarge the usefulness of the Bureau by means of affiliations or working agreements with similar organizations doing the same work in other parts of Canada. It is the desire to extend the field in such a way that equal benefits may be made available to members in districts far removed from Headquarters. These negotiations are still under way, and it is hoped that substantial progress will be made this year.

The following figures show the placements effected during the past six years:

1933	1934	1935	1936	1937	1938
50	70	77	110	181	61

The extent of the Bureau's work for 1938, as compared with 1937, is shown as follows:

	1938	1937
Registered members	71	132
Registered non-members	42	74
Number of members advertising for positions	79	68
Replies received from employers	25	40
Vacant positions registered	112	275
Vacancies advertised in The Journal	33	69
Replies received to advertised positions	146	380
Men's records forwarded to prospective employers	345	701
Men notified of vacancies	90	355
Placements definitely known	61	181

NOMINATING COMMITTEE, 1939

Chairman: A. L. Bishop, M.E.I.C.

Branch	Representative
Halifax Branch	C. A. Fowler, M.E.I.C.
Cape Breton Branch	J. R. Morrison, A.M.E.I.C.
Saint John Branch	J. H. McKinney, A.M.E.I.C.
Moncton Branch	E. B. Martin, A.M.E.I.C.
Saguenay Branch	G. F. Layne, A.M.E.I.C.
Quebec Branch	P. Methé, A.M.E.I.C.
St. Maurice Valley Branch	A. C. Abbott, A.M.E.I.C.
Montreal Branch	R. E. Jamieson, M.E.I.C.
Ottawa Branch	A. K. Hay, A.M.E.I.C.
Peterborough Branch	W. M. Cruthers, A.M.E.I.C.
Kingston Branch	D. S. Ellis, A.M.E.I.C.
Toronto Branch	W. E. P. Duncan, M.E.I.C.
Hamilton Branch	W. Hollingworth, M.E.I.C.
London Branch	D. S. Scrymgeour, A.M.E.I.C.
Niagara Peninsula Branch	W. Jackson, M.E.I.C.
Border Cities Branch	C. G. R. Armstrong, A.M.E.I.C.
Sault Ste. Marie Branch	A. M. Wilson, A.M.E.I.C.
Lakehead Branch	E. L. Goodall, A.M.E.I.C.
Winnipeg Branch	T. C. Main, A.M.E.I.C.
Saskatchewan Branch	S. Young, M.E.I.C.
Lethbridge Branch	J. M. Campbell, A.M.E.I.C.
Edmonton Branch	R. M. Dingwall, M.E.I.C.
Calgary Branch	F. J. Heuperman, A.M.E.I.C.
Vancouver Branch	G. L. Tooker, A.M.E.I.C.
Victoria Branch	F. C. Green, M.E.I.C.

Abstracts of Reports from Branches

Note—For personnel of Executive Committees see p. 52. For Membership and Financial Statements see pp. 76 and 77

BORDER CITIES BRANCH

The Executive Committee met eight times during the year for the transaction of Branch business.

Eight regular monthly meetings were held during the year 1938, as follows, attendance being given in brackets.

Jan. 14—**The Manufacture and Testing of Shot Gun Shells,** by Major J. W. Holden (31).

Feb. 18—**Some Improvements in Modern Turbine Practice,** by Chas. Hopper, of C. A. Parsons Company (40).

Mar. 18—**Meters and Combustion Control,** by W. L. Thompson (30).

Apr. 29—**The Mysteries of Electrical Science,** by Prof. H. O. Warner of the University of Detroit (22).

May 27—**Flying Technique of Commercial Aviation,** by J. W. Candless of American Airlines, Inc. (30).

May 28—The President of the Institute, Dr. J. B. Challies, was present and addressed the meeting on "Institute Affairs." A pipe was presented to W. H. Baltzell, a member of the Border Cities Branch, on his leaving to take up residence at Pittsburg, Pa. (18).

Sept. 24—A successful joint meeting with the London Branch was held at Sarnia. An inspection of the Imperial Oil Company plant was held in the morning and inspection of the new Blue Water highway bridge held in the afternoon, followed by a dinner. The President, Dr. J. B. Challies, was present with the Secretary, L. Austin Wright. The speaker of the evening was R. M. Smith, A.M.E.I.C, Deputy Minister of Highways of Ontario. (104).

Oct. 21—**Conveyor Economics,** by Jesse McBride, Vice-President of Palmer Bee Co. of Detroit (29).

Nov. 18—**Engineering among the Professions,** by Roy E. McFee of Grand Trunk Western in Detroit (28).

Dec. 9—Annual Meeting and election of officers for the year 1939. **Practical Experiences of an Engineer,** by Geo. McCubbin, M.E.I.C., of Chatham, a member of the Border Cities Branch. Mr. McCubbin was presented with a gold membership pin in recognition of his forty-three years of service to the engineering profession (14).

The Border Cities Branch was grieved by the passing of F. J. Bridges, A.M.E.I.C., in the last week of November. Mr. Bridges was an active member of the Border Cities Branch in 1919, and acted as Secretary-Treasurer during 1919, 1923 and 1924.

CALGARY BRANCH

Thirteen general and special meetings of the Branch were held during the year 1938. The following summary shows the dates, speakers, subjects, and attendances (in brackets) at these meetings:—

Jan. 17—**An Amateur Tries to Understand Our Weather,** by A. W. Haddow, A.M.E.I.C., city engineer, City of Edmonton (39).

Feb. 3—**Modernized Main Street,** by L. H. Hunt of the Calgary Power Co., and **Transmission Line Relays,** by A. W. Howard, S.E.I.C. (51).

Feb. 24—**Air Conditioning,** by D. G. Tapley, JR.E.I.C. (37).

Feb. 26—Annual joint dinner with the Association of Professional Engineers of Alberta and the Rocky Mountain Branch, Canadian Institute of Mining and Metallurgy. Guest Speaker—D. E. Cameron, Extension Dept. University of Alberta (86).

Mar. 12—Annual meeting, following luncheon. **Proceedings at the Round Table Conference, the Semicentennial Meetings, and a special meeting re consolidation, in Montreal, June 14-16, 1937,** by J. McMillan, A.M.E.I.C., Branch Secretary-Treasurer (30).

Mar. 17—Sound film—**The Golden Gate Bridge,** through courtesy of the Bethlehem Steel Co. (100).

Sept. 10—Annual Golf Tournament (50).

Oct. 7—Informal dinner and entertainment provided by The Canadian Western Natural Gas, Light, Heat & Power Company, Ltd. (58).
Oct. 20—**The Operation of Calgary's Natural Gas System**, by B. W. Snyder, A.M.E.I.C. (38).
Nov. 2—Luncheon meeting with President Challies and Headquarters party (25).
Nov. 2—Reception and dinner in honor of President Challies. Speakers—President Challies, General Secretary Wright, Councillor Newell and G. A. Gaherty (94 inc. ladies).
Nov. 18—**World Revolution by Science**, by Dean C. J. Mackenzie, M.E.I.C., School of Engineering University of Saskatchewan (64).
Dec. 8—**Problems of the City Engineers**, by J. R. Wood, M.E.I.C. (28).

During the year, the Branch Executive Committee met nine times for the purpose of conducting the business of the Branch, and the other committees held meetings as required for their work. We are pleased to report that interest in the activities of the Branch is being well maintained, the average attendance at regular functions showing an increase over the previous year. This, we believe, is due, at least in part, to the efforts of the executive and programme committees to secure speakers on topics of general interest in addition to talks on more technical subjects.

Obituary

On September 12th, 1938, the death occurred of the Hon. C. C. Ross, M.E.I.C., former Minister of Lands and Mines in the Government of the Province of Alberta, and an esteemed member of the Calgary Branch.

CAPE BRETON BRANCH

During the Year 1938 the Branch held five general meetings:

An American Engineer's Experience in Soviet Russia, by Wm.Von Meding.
Pre-Stressing and Erecting of the Isle of Orleans Suspension Bridge, by D. B. Armstrong, A.M.E.I.C.
Heat Control, by F. E. Hawker.
Inside Story of Lubrication and **Safari on Wheels**—Moving pictures. Presented by J. R. McLelland.
Reception to the President, General Secretary and Councillor Newell.

The average attendance at these meetings was 58.

EDMONTON BRANCH

The Executive Committee held six meetings during the year to transact the regular business of the Branch and one special luncheon meeting to discuss Institute affairs with President Challies and other members from headquarters.

The Branch held six general dinner meetings during the year as follows:—

Jan. 20—**Oil Sand Coring in Trinidad**, by Dr. K. A. Clark.
Feb. 25—**Expert Evidence**, by W. Dixon Craig, K.C.
Mar. 15—**The Building of the Golden Gate Bridge**, Sound motion picture.
Apr. 2—**An Amateur Tries to Understand the Weather**, by A. W. Haddow, A.M.E.I.C.
Nov. 1—Joint dinner, with members of the Canadian Institute of Mining and Metallurgy and the Association of Professional Engineers of Alberta and ladies present, in honour of President J. B. Challies and other members of a party from headquarters.
Dec. 15—**The Use of Models in Engineering**, by Prof. H. R. Webb, M.E.I.C.

HALIFAX BRANCH

The Branch has held six meetings during the Year 1938:

January —Joint dinner with Association of Professional Engineers.
February —**A Review of the Relationship Between the Institute and Professional Associations**, by Dean H. W. McKiel, M.E.I.C.
March —**Steam Electric Generating Plant at Sydney**, by W. S. Wilson, A.M.E.I.C.
April —Visit from President J. B. Challies, Vice-President J. A. McCrory, Councillor Fred Newell, and General Secretary L. Austin Wright.
November—**Rural Electrification**, by J. J. Doolan.
December—Annual meeting.

HAMILTON BRANCH

The Executive Committee held eleven business meetings during the year with an average attendance of seven.

Meetings and Papers, during 1938, with attendance figures in brackets.

Jan. 12—Annual general meeting and banquet. Guest speaker, Captain Rev. Norman Rawson. Entertainment (68).
Feb. 16—**The Practical Significance of Laboratory Tests of Lubricating Oils**, by Dr. R. K. Stratford, chief research chemist of the Imperial Oil Limited. Held at McMaster University (75).
Mar. 16—**The Uses of Aluminum in Industry**, by A. K. Jordon, sales engineer, the Aluminum Company of Canada. Held at McMaster University (33).
Apr. 8—Joint meeting of the Branch and the Toronto Section of the American Institute of Electrical Engineers. **Mercury Arc Rectifiers and Ignitrons**, by Dr. Joseph Slepian, associate director of research, The Westinghouse Electric and Manufacturing Company, East Pittsburgh. Held in the Canadian Westinghouse Auditorium (245).
Apr. 12—**Patent Laws for Engineers**, by Charles E. Church, A.M.E.I.C., patent engineer, Hamilton. Held at McMaster University (69).
May 10—**Why Bridges**, by R. K. Palmer, M.E.I.C, chief engineer, Hamilton Bridge Company Limited. This was followed by the sound motion picture **Erection of the Golden Gate Bridge**, arranged by the Bethlehem Steel Company. Held at McMaster University (97).
May 27—Annual joint meeting of the Hamilton Branch, E.I.C., Grand Valley Group of Registered Professional Engineers, London Branch, E.I.C., and Niagara Peninsular Branch, E.I.C., Golf and trap shooting in the afternoon and Dinner at Brantford, in the evening. Guest Speaker, President, J. B. Challies. Entertainer, George Leacock. (162).
Oct. 6—Joint meeting of the Hamilton Branch E.I.C., and the Hamilton Group of the American Institute of Electrical Engineers. **The Place of Research in the Evolution of the Automobile**, by T. A. Boyd of the research department, General Motors, Detroit. The meeting was held at McMaster University (218).
Oct. 14—Special meeting held in honour of President J. B. Challies. During the afternoon visits were made to the Steel Company of Canada, the Burlington Steel Company and the Dominion Foundries and Steel Limited. A reception was held for President Challies, followed by a dinner, which he addressed on **Affairs Relating to the Engineering Profession** (122).
Nov. 15—**The Story of Dynamite and Power in Industry**, by G. C. Grubb, B.Sc., manager of the explosives division of Canadian Industries Limited, Montreal. The lecture was illustrated and held at McMaster University (48).
Dec. 13—Joint meeting of the Hamilton Branch, E.I.C. and the Hamilton Group of the American Institute of Electrical Engineers. **Testing and Research in an Electrical Utility**, by W. P. Dobson, M.A.SC., M.E.I.C., chief testing engineer of the Hydro-Electric Power Commission of Ontario. Held at McMaster University (106).

A. B. Dove, A.M.E.I.C., Chairman of the Papers Committee moved to Montreal during the year and the duties were taken over by J. R. Dunbar, A.M.E.I.C. The Branch is indebted to these members for the valuable and interesting papers they arranged for presentation at our meetings.

We wish to express, through The Engineering Journal, our indebtedness to the management of McMaster University for the splendid assistance given to us throughout the year.

Publicity

The Executive wishes to record sincere appreciation for the courtesies extended by the Press, especially the Hamilton Spectator and the Daily Commercial News.

Obituary

We record with deep regret the passing away of R. L. Latham, M.E.I.C., chief engineer of the Toronto Hamilton and Buffalo Railway, on November 13th, 1938.

General

At this time the Executive Committee wishes to thank members of all grades of the Branch for their help in making the work of the year a success in spite of the difficulties faced by so many. We also thank the other engineering societies that have co-operated with us during the year. We close this report with an expression of most sincere appreciation for the active interest taken in the work of this Branch by the President and General Secretary.

KINGSTON BRANCH

The Branch held seven dinner meetings during 1937-1938.

Oct. 25—Annual meeting for reports and election of officers for 1937-38, followed by **Lochaber (Scotland) Water Scheme,** by R. F. Legget, A.M.E.I.C.

Nov. 12—First public lecture, given by Dean S. C. Hollister, Cornell University, on **Boulder Dam** in Convocation Hall, Queen's University. Over 300 students and cadets attended.

Jan. 25—**Post War Developments of the Royal Air Force,** by Squadron-Leader F. G. Wait, R.C.A.F.

Mar. 11—Inspection tour under Dr. W. L. Malcolm, M.E.I.C., of the new Sanitary Engineering Laboratory, Queen's University.

Mar. 17—Second public lecture, **Canadian Conservation Problems,** by Robson Black, in the Sir Arthur Currie Memorial Hall, Royal Military College. A large number of cadets were present.

Apr. 27—**The Problem of Russian Development,** by Dr. E. L. Bruce.

Oct. 22—A tribute dinner to Dr. W. L. Malcolm and to welcome the president, Dr. J. B. Challies, was held at the Kingston Badminton Club.

Membership—The Branch regrets the loss of two very active members, Dr. W. L. Malcolm, M.E.I.C., and R. F. Legget, A.M.E.I.C., through change of residence. Our student membership has fallen off somewhat and every effort should be made to increase it.

Council—Lt.-Col. L. F. Grant, M.E.I.C., replaced J. E. Goodman, M.E.I.C., resigned, while Professor D. S. Ellis, M.E.I.C., replaced Lt.-Col. Grant on the nominating committee.

LAKEHEAD BRANCH

The following meetings were held during the year 1938.

Jan. 26—Ladies night.

Feb. 16—Dinner meeting at Port Arthur. Moving picture, **Heat and its Control,** by A. Sinclair of the Canadian Johns-Manville Corporation.

Apr. 13—Dinner meeting at Fort William. Discussion of change in By-laws 44 and 51.

June 22—Annual meeting at Port Arthur. Election of officers.

Oct. 25—Luncheon meeting at Fort William. An informal discussion of Institute affairs between officers of the Institute and members of the Branch executive and prominent local members of the Institute. The guests were Dr. J. B. Challies, M.E.I.C., President of the Institute, F. Newell, M.E.I.C., Councillor, and L. Austin Wright, A.M.E.I.C., General Secretary.

Oct. 26—Dinner meeting at Port Arthur, in honour of the visiting President and Officers of the Institute and their ladies.

Dec. 21—Dinner meeting at Port Arthur. **Manual and Automatic Telephone Systems,** by R. B. Chandler, manager, Public Utilities Commission, Port Arthur.

LETHBRIDGE BRANCH

Since January 1st, 1938, 8 regular meetings with an average attendance of 35; 2 meetings of corporate members with an average attendance of 21; and 6 executive meetings with an average attendance of 7 have been held.

All regular meetings have been preceded by a dinner during which musical numbers were rendered, followed by community singing.

The list of meetings during 1938 with subjects and speakers follows, attendance being indicated by the figures in brackets.

Jan. 22—**Radio Aviation,** by A. K. Bayley, Esq., Department of Transport, Aviation Radio Branch, Lethbridge (31).

Feb. 5—**Generating Power by the Losses Method,** by W. E. Ross, Calgary Power Co., Lethbridge. **The Rise of Early Modern Civil Engineering,** by E. A. Lawrence, S.E.I.C., Irrigation Branch, C.P.R., D.N.R., Lethbridge. **Electrical Equipment of a Sugar Plant,** by R. W. Craig, Jr.E.I.C., Canadian Sugar Factories Ltd., Picture Butte, Alberta.

Feb. 19—**Art,** by Major F. G. Cross, M.E.I.C., supt. of operation and maintenance, Irrigation Branch, C.P.R., D.N.R., Lethbridge (36 inc. ladies).

Mar. 5—Annual meeting for corporate members only. No speaker. (11).

Mar. 12—**Training for the Royal Air Force,** by Pilot Officer Wilson Donaldson, R.A.F. (40 inc. ladies).

Mar. 19—Joint meeting with the Association of Professional Engineers of Alberta, and the Rocky Mountain Branch of the Canadian Institute of Mining and Metallurgy. **A Journey to the Arctic,** illustrated with motion pictures, by C. E. Garnett, M.E.I.C., President of the Association of Professional Engineers of Alberta (40).

Nov. 3—Corporate Members Meeting. **Institute Affairs,** by Dr. J. G. Challies, President of The Engineering Institute of Canada. Accompanying President Challies were L. Austin Wright, General Secretary, Fred Newell, Councillor for the Montreal District and Mr. G. A. Gaherty, general manager for the Calgary Power Co. Montreal (30).

Nov. 5—**My Trip through Europe,** by Miss Hazel Watson (43 inc. ladies).

Nov. 19—**World Revolution by Science,** by C. J. McKenzie, M.E.I.C., Dean of Engineering, University of Saskatchewan (28).

Dec. 3—**The Story of Rigid Airships,** by Dr. John P. Liebe, B.A., Ph.D., instructor, Lethbridge Technical School (25).

LONDON BRANCH

During the year 1938 the following meetings were held; attendance given in brackets.

Jan. 31, Feb. 1 & 2—Annual General Meeting of The Engineering Institute.

Feb. 23—Election of officers and regular meeting was held in the Council Chambers, County Building, London. **Babcock Integral Furnace Boiler,** by W. A. Osbourne, vice-president, Babcock-Wilcox & Goldie McCullough Ltd., Galt (53).

Mar. 30—Ladies night, Dinner (34).

Sept. 24—Joint meeting with Windsor Branch at Sarnia. Inspection of Imperial Oil Refineries plants, and International Blue Water bridge (114).

Oct. 26—Regular meeting held jointly with the Military Engineers Association in the National Defence Building, London, by kind permission of Lt.-Col. W. M. Veitch. Two sound pictures were shown and sponsored by the Bethlehem Steel Corporation represented by C. G. Lamb. The pictures were entitled: **The Production of Structural Steel; The Golden Gate Bridge.** (60).

Nov. 23—Regular meeting was held in the Public Utilities Commission board room, London. **Chemical Warfare,** by Lt. R. M. Crowe of the Royal Canadian Reg't. (34).

Dec. 14—Regular meeting was held in the Public Utilities Commission board room, London. Vice-President E. V. Buchanan, M.E.I.C., gave a description of his recent trip to Europe. The meeting was also honoured by the presence of Eric P. Muntz, M.E.I.C., President of the Association of Professional Engineers of Ontario (16).

Average attendance of all meetings excepting Annual Meeting—52.

In addition to the above 7 Executive meetings were held with an average attendance of 8.

MONCTON BRANCH

The Executive Committee held five meetings. Four meetings of the Branch were held during the year 1938, at which addresses were given and business transacted as follows:

Jan. 26—Supper meeting. **The Pre-stressing and Erection of Island of Orleans Bridge,** by D. B. Armstrong, A.M.E.I.C., chief designing engineer, Dominion Bridge Co. Ltd., Montreal.

May 4—Supper meeting. Dr. J. B. Challies, M.E.I.C., President, Engineering Institute of Canada, gave an address on Institute Affairs.

May 19—A meeting was held for the purpose of nominating Branch Officers for 1938-39.

May 31—The annual meeting was held on this date.

It is with regret that we record the death of William Alfred McLaren, A.M.E.I.C., which occurred on January 5th, 1938.

MONTREAL BRANCH

Papers and Meetings Committee

The Papers and Meetings Committee of the Branch had the following personnel:—

R. E. Jamieson, M.E.I.C., *Chairman* — I. S. Patterson, A.M.E.I.C., *Vice-Chairman*

Civil Section

L. H. Burpee, A.M.E.I.C., *Chairman* — J. A. Freeland, A.M.E.I.C., *Vice-Chairman*

Electrical Section

S. H. Cunha, A.M.E.I.C., *Chairman* — J. H. Wilson, A.M.E.I.C., *Vice-Chairman*

Industrial and Management Section

T. M. Moran, A.M.E.I.C., *Chairman* — C. A. Peachey, A.M.E.I.C., *Vice-Chairman*

J. E. Dion, A.M.E.I.C.

Mechanical Section

P. E. Poitras, M.E.I.C., *Chairman* — A. B. Dove, A.M.E.I.C., *Vice-Chairman*

Municipal Section

J. Comeau, A.M.E.I.C., *Chairman* — J. M. Breen, A.M.E.I.C., *Vice-Chairman*

Radio and Communications Sections

S. Sillitoe, Jr.E.I.C., *Chairman* — D. N. McLeod, S.E.I.C., *Vice-Chairman*

Junior Section

L. Jehu, A.M.E.I.C., *Chairman* — L. Trudel, A.M.E.I.C., *Vice-Chairman*

The question of adequate reporting of papers and discussions has not been settled to the satisfaction of the committee, although an attempt has been made to develop along the lines suggested in the last annual report. In this connection, C. E. Frost, A.M.E.I.C., is preparing a study of this subject and will report to the incoming executive committee.

Some expansion of activities took place in the Industrial and Management Section, and the Civil Section, each of which held meetings to discuss subjects of special interest.

Following is a list of the papers and meetings for the calendar year 1938, with attendance in brackets:

Jan. 6—Annual Meeting of the Branch (50).
Jan. 13—**The Network Analyzer,** by R. G. Lorraine (60).
Jan. 20—**Technical Men in Industry,** 2nd of Series (125).
Jan. 27—**Construction of Suspension Cable on Golden Gate Bridge.** (A moving picture from the J. H. Roebling Co.) (200).
Feb. 3—**The Willans Law in the Analysis of Steam Plant Performance,** by J. T. Farmer, M.E.I.C. (55).
Feb. 10—**Welded Steel Pipe, Centrifugally Cement Lined,** by C. R. Whittemore, A.M.E.I.C. (75).
Feb. 17—Branch Smoker.
Feb. 24—**Waves, Words, and Wires,** by Dr. J. O. Perrine (300).
Mar. 3—**Electro-Galvanizing,** by A. R. Weisselberg (70).
Mar. 10—**Heat and its Control.** (A moving picture from the Johns-Manville Co.) (60).
Mar. 17—**Housing Surveys for Montreal,** by R. Belanger (55).
Mar. 24—**Transmutation,** by Dr. K. K. Darrow (130).
Mar. 31—**Soil Mechanics,** by Prof. W. P. Kimbal (145).
Apr. 7—**The Design and Construction of Pie IX Bridge,** by Dr. S. A. Baulne, A.M.E.I.C. (170).
Apr. 14—**Technical Men in Industry,** 3rd of Series (80).
Apr. 21—**Railways Progressing towards Continuous Rails,** by H. G. Drake (100).
Oct. 6—Joint Meeting with American Society of Heating and Ventilating Engineers (160).
Oct. 13—**Psychological Aspects of Industrial Management,** by L. P. Alvin, of Paris, France (150).
Oct. 20—**Steel—Man's Servant.** (A moving picture from U.S. Steel Corporation) (250).
Oct. 26—Civil Section. **Some Practical Considerations of Concrete** (45).
Oct. 27—**Welding in Ship Construction,** by W. Bennett, Chief Surveyor of Lloyd's, New York (120).
Nov. 3—**Relativity, and the Experiment on which it is based,** by W. B. Cartmel (125).
Nov. 10—**The Baie Comeau Electrical Installation of the Quebec North Shore Paper Co.,** by D. Anderson, A.M.E.I.C (110).
Nov. 17—**Town Planning Achievement in Montreal,** by H. A. Terreault (80).
Nov. 21—Civil Section. **Structural Aluminum,** by E. C. Hartmann (80).
Nov. 24—**The Collapse of the Falls View Bridge,** by P. L. Pratley, M.E.I.C. (95).
Dec. 1—**A Permanent Cultural Plan to Combat Drought and Control Soil-Drifting, in the Agriculture of the Prairie Provinces,** by Dr. E. S. Archibald (50).
Dec. 7—Visit to New Rolling Mill, Steel Co. of Canada (200).
Dec. 8—**A Description of Merchant Mills,** by W. Worthington, of Pittsburgh, Pa. (95).
Dec. 15—**Power Line Carrier Communication,** by S. Sillitoe, Jr.E.I.C. (50).

Branch Sections

Early in the year the membership was canvassed to ascertain the numbers interested in the various sections of engineering. Forty-five per cent of the members replied, and this information has been tabulated and is available for the guidance of Branch section organizations. It is felt that there should be more specialized activity in these sections, which should function within themselves as far as possible. An attempt has been made to organize these sections where the demand was most evident, and some success has resulted. It is anticipated that this work will develop further during the next two or three years.

Membership Committee

The Membership Committee was organized under the chairmanship of K. O. Whyte, A.M.E.I.C., After some study by the committee, and at their request, the executive confirmed the appointment of this committee for two years, because it was felt that considerable time would be required to organize. The committee has prepared a detailed plan of organization for obtaining new members in which there will be an easy means for all members to assist. Results in the way of increased membership should be marked in 1939. In addition, twelve new members were obtained this fall, with six more names assured. Particular thanks are due to Mr. Whyte and his assistants for their work in the rather difficult task assigned to them.

It is with sincere regret that we record the names of the following members deceased during the year.

Jules Alexandre Duchastel de Montrouge, M.E.I.C.
Alexandre Ritchie Dufresne, M.E.I.C.
Edwin Albert Forward, M.E.I.C.
Adhemar Mailhiot, M.E.I.C.
Kenneth Buchanan Thornton, M.E.I.C
Paul Baily, A.M.E.I.C
Stuart Robertson McDougall, A.M.E.I.C
Cecil George Porter, A.M.E.I.C
John Henry Thompson, A.M.E.I.C.
Edward James Turley, A.M.E.I.C.

Reception Committee

A very active committee has co-operated with the chairman, R. E. Heartz, M.E.I.C., by an average attendance of over 80 per cent at all of their meetings.

The fall season was inaugurated on September 17th, with an interesting visit to Shawinigan Falls by 60 members of the Branch, who were joined by 30 members from the St. Maurice Valley Branch, at a luncheon, as guests of the Shawinigan Water and Power Company, represented by J. A. McCrory, M.E.I.C., Vice-President of the Institute. After luncheon, a visit was made to several of the important local industries; this inspection was made possible in the short time available by a particularly well organized and carefully scheduled plan for which thanks and credit must go to the officers of the St. Maurice Valley Branch.

On April 27th, the committee arranged a special meeting to welcome L. Austin Wright, A.M.E.I.C., the new general secretary of the Institute, and to make a presentation to R. J. Durley, M.E.I.C., Secretary Emeritus, as a token of appreciation of his services to the Montreal Branch during his fourteen years as general secretary.

Branches	Border Cities	Calgary	Cape Breton	Edmonton	Halifax	Hamilton	Kingston	Lakehead	Lethbridge	London
MEMBERSHIP										
Resident										
Hon. Members	..	..	..	..	..	..	1	..	..	..
Members	12	17	9	20	24	33	11	10	3	6
Assoc. Members	36	47	12	28	52	44	21	20	18	31
Juniors	5	14	3	10	10	17	5	3	2	5
Students	8	10	3	23	16	27	26	5	1	10
Affiliates	1	..	1	..	1	2	..	1	..	..
Total	62	88	28	81	103	123	64	39	24	52
Non-Resident										
Hon. Members	..	..	..	..	..	..	..	..	..	..
Members	4	4	4	1	8	5	..	4	1	3
Assoc. Members	7	11	12	5	19	12	4	8	5	3
Juniors	4	6	3	..	8	..	1	3	1	1
Students	7	1	9	2	11	3	3	1	5	1
Affiliates	..	..	..	..	..	..	..	..	..	..
Total	22	22	28	8	46	20	8	16	12	8
Grand Total December 31st, 1938	84	110	56	89	149	143	72	55	36	60
" December 31st, 1937	79	124	..	87	..	163	59	..	69	..
FINANCIAL STATEMENTS	$	$	$	$	$	$	$	$	$	$
Balance as of December 31, 1937	249.78	216.85	208.40	216.15	350.94	666.09	50.65	194.72	33.32	82.16
Revenue										
Rebates	153.90	208.50	111.55	161.70	275.75	276.00	120.75	100.00	100.00	104.70
Affiliate Dues	....	25.00	....	....	....	36.00	....	....	22.00	....
Interest	....	48.14	....	....	1.87	68.09	.49	.74	.14	....
Special Appeal	....	....	....	....	....	....	....	....	....	....
Miscellaneous	3.30	....	....	....	6.82	6.60	....	....	....	7.83
Total Revenue	157.20	281.64	111.55	161.70	284.39	386.69	121.24	100.74	122.14	112.53
Expenditure										
Printing, Notices, Postage①	98.72	31.13	33.13	7.10	68.49	125.82	13.92	16.70	1.55	34.70
General Meeting Expense②	40.80	92.82	13.50	41.01	15.00	98.60	54.83	104.62	89.81	4.00
Special Meeting Expense③	56.05	134.86	....	102.15	125.48	56.40	....	....	6.14	62.39
Honorarium for Secretary	....	16.35	....	50.00	50.00	50.00	25.00	....	....	....
Stenographic Services	....	10.00	....	....	10.00	....	....	....	2.50	5.00
Travelling Expenses④	....	....	26.35	41.78	10.03	....	....	....	13.95	....
Subscriptions to other organizations	....	....	....	....	....	....	⑤15.00	....	....	....
Subscriptions to The Journal	....	....	....	....	....	....	....	....	....	....
Special Expenses	....	....	....	....	....	....	⑥25.00	....	....	....
Miscellaneous	25.75	41.80	....	5.03	9.00	25.35	....	....	....	9.32
Total Expenditure	221.32	326.96	72.98	247.07	288.00	356.17	133.75	121.32	113.95	115.4
Surplus or *Deficit*	*64.13*	*45.32*	38.57	*85.37*	*3.61*	30.52	*12.51*	*20.58*	8.19	*2.8*
Balance as of December 31, 1938	185.65	171.53	246.97	130.78	347.33	696.61	38.14	174.14	41.51	79.2

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.
⑤Chamber of Commerce.
⑥Repayment of loan from Headquarters.

Moncton	Montreal	Niagara Peninsula	Ottawa	Peterborough	Quebec	Saguenay	Saint John	St. Maurice Valley	Saskatchewan	Sault Ste. Marie	Toronto	Vancouver	Victoria	Winnipeg
..	3	..	3	..	..	..	..	..	..	..	1	..	1	..
3	213	14	83	8	21	6	12	4	18	9	131	68	22	31
17	555	50	196	23	66	32	19	20	53	12	215	58	18	82
3	96	12	21	11	11	9	11	14	8	8	56	7	6	21
4	292	10	17	25	16	10	8	8	..	4	63	3	5	37
..	14	6	2	..	..	2	1	..	..	..	4	1	..	3
27	1,173	92	322	67	114	59	51	46	79	33	470	137	52	174
..	..	..	..	..	..	..	..	..	..	..	..	1	..	..
2	3	1	13	2	1	..	6	..	10	9	7	17	2	3
4	36	5	38	18	8	3	14	4	49	32	7	29	4	13
2	10	..	10	4	2	..	11	..	7	14	2	4	1	4
8	21	2	12	4	1	1	16	4	4	13	2	7	..	4
..	..	..	..	..	..	..	..	..	1	..	1	..	..	..
16	70	8	73	28	12	4	47	8	71	68	19	58	7	24
43	1,243*	100	395	95	126	63	98	54	150	101	489	195	59	198
58	1,163	119	418	105	126	..	..	46	104	102	460	204	64	205

*For voting purposes only there should be added to Montreal Branch, an additional 337 members, 189 being resident in the United States, 20 in British Possessions and 28 in foreign countries.

$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
149.61	1,445.70	299.41	1,781.33	121.45	53.48	230.89	231.75	71.06	58.87	482.51	482.80	199.45	71.66	633.64
105.40	1,754.30	190.80	569.10	151.20	228.90	120.00	141.60	108.10	219.50	149.70	644.20	387.50	125.50	302.00
30.00	94.85	18.00	57.00	35.00	......	......	......	......	......	28.25	......	......	3.00	11.00
.72	4.32	......	44.94	.24	......	1.08	......	......	......	1.02	10.61	.90	......	22.50
......	......	......	......	......	......	......	......	......	......	......	84.00	......	......	......
......	2.71	31.70	......	2.50	......	......	......	......	......	10.00	7.00	......	......	......
136.12	1,856.18	240.50	671.04	188.94	228.90	121.08	141.60	108.10	219.50	188.97	745.81	388.40	128.50	335.50
8.99	846.09	11.40	233.81	10.15	9.95	22.39	62.02	27.43	65.77	27.69	186.45	98.30	23.58	33.43
22.30	98.00	102.73	360.52	53.80	63.25	25.52	33.80	50.60	39.09	57.01	72.25	147.21	15.55	153.83
......	228.53	32.29	40.00	23.26	20.42	62.40	10.75	52.78	......	40.41	59.90	81.63	35.05	128.17
25.00	300.00	75.00	......	......	100.00	......	25.00	......	75.00	25.00	115.98	50.00	25.00	20.00
......	120.00	5.00	25.00	......	......	......	1.50	......	......	.35	40.00	20.00	8.25	......
......	141.90	15.50	......	......	......	......	......	4.80	......	......	28.60	......	......	36.50
......	......	......	......	......	......	......	......	......	......	......	10.00	......	......	......
......	30.00	......	6.00	19.30	......	......	......	......	......	10.00	......	......	......	......
......	⑦250.00	......	⑧102.40	......	......	......	......	......	......	......	⑨85.00	......	......	⑩20.00
27.51	58.19	......	19.49	4.00	......	10.00	......	......	......	5.60	34.30	11.00	12.35	5.00
83.80	2,072.71	241.92	787.23	110.51	193.62	120.31	133.07	135.61	179.86	166.06	632.48	408.14	119.78	396.93
52.32	*216.53*	*1.42*	*116.19*	78.43	35.28	.77	8.53	*27.51*	39.64	22.91	113.33	*19.74*	8.72	*61.43*
201.93	1,229.17	297.99	1,665.14	199.88	88.76	231.66	240.28	43.55	98.51	459.60	596.18	179.71	80.38	572.21

⑦Contribution to cost of rehabilitation of Headquarters building.
⑧Honorarium to R. J. Durley, Students' Prizes, Grant to Aeronautical Section.
⑨Students' Prizes, $25.00; Publicity, $60.00.
⑩Students' Prizes.

Arrangements have been completed by the committee for a smoker to be held on February 2nd, 1939.

Junior Section

The executive committee for the Junior Section consisted of L. Jehu, A.M.E.I.C., chairman; L. Trudel, A.M.E.I.C., vice-chairman; P. E. Savage, A.M.E.I.C., secretary; R. N. Warnock, A.M.E.I.C.; R. Boucher, Jr.E.I.C.; C. Craig, Jr.E.I.C.; G. N. Martin, Jr.E.I.C.; C. E. Frost, A.M.E.I.C.; J. F. Plow, A.M.E.I.C. The following thirteen meetings were held, including three visits to plants; the total attendance was 485, which is slightly below the average for last year.

Jan. 18—Annual Meeting. Address **Applying for an Engineering Job—The Interview** (65).
Jan. 31—**Westmount Trunk Sewer**, by S. G. Lochhead, Jr.E.I.C. (11).
Feb. 14—**Concrete in the Field**, by E. McKinstry (19).
Mar. 9—**Modern Treatment of Asbestos Ores**, by Guy Belanger, S.E.I.C. (18).
Mar. 28—**Oil Refining**, by G. Henderson (25).
Apr. 23—**Visit to Crane Company Ltd. Montreal** (80).
Oct. 17—**Scientific Property Management**, by A. J. Farrell, A.M.E.I.C., also a Sound Film on **Rolling Structural Steel Shapes** (38).
Oct. 31—**The Engineer in the Pulp and Paper Industry**, by H. Wyatt Johnston, Ph.D., A.M.E.I.C. (46).
Nov. 14—**The Manufacture of Cement**, by T. R. Durley, A.M.E.I.C (31).
Nov. 26—Visit to Canada Cement Co. Plant, Montreal (40).
Nov. 28—**New Uses for Rubber**, by H. H. Marcou (36).
Dec. 3—Visit to Dominion Rubber Co. Plant (45).
Dec. 12—**Theoretical Considerations of X-Rays, and their Uses**, by L. Cartier, S.E.I.C., and **Radiography as applied to Industry**, by F. Dugal (31).

Nominating Committees

At a special general meetings of the Branch on November 10th, E. V. Gage, A.M.E.I.C., P. E. Poitras, M.E.I.C and I. S. Patterson, A.M.E.I.C., were elected as members of the Branch nominating committee, to act with the chairman and secretary who were appointed by the executive, to nominate candidates for Branch officers.

The executive committee appointed R. E. Jamieson, M.E.I.C., as representative from the Montreal Branch on the Institute nominating committee for 1939.

Special Meetings

At the request of the necessary number of members of the Branch, a special general meeting was called on May 9th, to discuss the location and other considerations of the proposed Trans-Island Boulevard. Several engineers qualified to discuss this matter were especially invited to attend so that a complete presentation could be made. The Minister of Roads delegated a qualified assistant to outline the various aspects of the problem as it had been presented to the Department. After lengthy and interesting discussion, the meeting adopted resolutions expressing the sentiment of the majority in attendance, which were transmitted to the authorities in Quebec.

On October 6th, a regular meeting was held in conjunction with the American Society of Heating and Ventilating Engineers who were holding their general council meeting in Montreal. This sister society has made all arrangements for a group of speakers who covered various phases of heating and ventilating work suitable to their membership but also of great interest to a large number of members of the Institute. This marked the first time that the society has held such a meeting in Montreal, and it was a privilege to have the opportunity to co-operating with a sister organization on this occasion. Dr. J. B. Challies, President of the Institute, welcomed the American Society of Heating and Ventilating Engineers to Headquarters and expressed the congratulations of the Institute to Holt Gurney, their President, the first Canadian to occupy that position.

Special Lectures

A third series of lectures on economics by Dr. D. M. Marvin was completed in April. About 25 members participated in this series of 12 lectures, which will unfortunately not be continued, as Dr. Marvin has gone to the University of Illinois. Such study groups, either in economics, or in any branch of engineering or science, form a legitimate field for the activities of the Branch, but can be established only if there is a demand for them from the membership.

In general the Montreal Branch has completed a very satisfactory year. Some new ideas have been initiated which should eventually increase the activity in the Branch, and while results obtained to date have not been as great as was hoped for, they have provided a very good fund of experience for future operations. To obtain adequate support for such efforts on the part of your Executive, and the various groups to whom they delegate a great deal of work, it is essential that the membership should realize the great amount of time and effort that is expended by the various committee members. The Executive Committee is sincerely grateful for their help and constructive co-operation. It is also desired to thank the staff at Headquarters, the Institute officers, the Press, and those among our membership who have assisted in keeping the affairs of this Branch operating satisfactorily during the past year.

NIAGARA PENINSULA BRANCH

The Branch Executive held nine business meetings, and the Branch held the following dinner meetings during the year 1938, attendance being given in brackets.

Jan. 11—At Niagara Falls, Ont. **Hydraulic Power Development at Baie Comeau, Quebec**, by Dr. H. G. Acres, M.E.I.C., Consulting Engineer, Niagara Falls. Dr. T. H. Hogg, M.E.I.C., Chairman of the Hydro-Electric Power Commission of Ontario, was an honoured guest and delighted the members with a talk on reminiscences of his engineering activities. (90).
Feb. 9—At St. Catharines, Ont. **Manufacture of Steel Wire for Cables**, by A. B. Dove, A.M.E.I.C., chemical engineer, Steel Company of Canada (25).
Mar. 10—At Welland, Ont. R. L. Hearn, M.E.I.C., of the Dominion Construction Corporation presented a sound film on the **Abitibi Canyon Power Development** (80).
Apr. 5—Joint meeting with the Niagara District Chemical & Industrial Association at St. Catharines, Ont. **Earth Structure as Revealed by Seismology**, by Dr. E. A. Hodgson, M.E.I.C., Dominion Seismologist (90).
May 14—Annual meeting at Niagara Falls, Ont. Dr. J. B. Challies, the President, and L. Austin Wright, the General Secretary, favoured the branch with a visit and presented a discussion of **Institute affairs**. After the dinner A. E. Hay of the Pratt & Lambert Co., Buffalo, N.Y., gave a very interesting address (50).
Oct. 5—General business meeting at St. Catharines, Ont. Councillor W. R. Manock, M.E.I.C., introduced the subject of proposed changes in classification, followed by open discussion. Ex-councillor W. Jackson, M.E.I.C., outlined some principles of branch management (18).
Oct. 27—At Niagara Falls, Ont. Dr. Speakman of the Ontario Research Foundation gave an illustrated talk on the **Work of the Ontario Research Foundation** (42).
Nov. 18—Afternoon inspection trip through the Fleet Aircraft Plant, Fort Erie, Ontario, followed by dinner meeting, after which Mr. Young, chief engineer of Fleet Aircraft, gave a very interesting paper on **Problems in Aircraft Design and Manufacture** (95).
Dec. 8—Joint meeting with the Niagara District Chemical & Industrial Association at St. Catharines, Ont. Sound film on **Heat and Its Control**, by A. D. Hopkins of the Can. Johns-Manville Co. who explained many features of research work carried on by the Johns-Manville Co. on insulation and heat control.

OTTAWA BRANCH

During the year the Managing Committee held nine meetings for the transaction of general business.

The Proceedings Committee arranged 16 meetings, including the annual meeting of the Branch. Of these, 12 were luncheon meetings and 4 evening meetings. The luncheon meeting held on June 24th marked an outstanding event, namely, the meeting of Council of The Engineering Institute of Canada, which took place here on that date. The luncheon was attended by the President, members of Council, and several distinguished guests. It was addressed by the President, who also took occasion to introduce the new General Secretary, L. Austin Wright, A.M.E.I.C., successor to R. J. Durley, M.E.I.C. Mr. Wright made a short and apt address to the assembled members and guests.

It is with deep regret that we report the deaths of two of our members: R. L. Haycock, M.E.I.C., and Charles Stephen, A.M.E.I.C.

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 1938, with attendance figures in brackets. Unless otherwise stated meetings were luncheon meetings.

Jan. 13—Evening meeting, National Research Council Bldg. annual meeting, Ottawa Branch. Also display of illuminated addresses sent to the Institute on the occasion of its Semicentennial, by sister institutions throughout the world. Maj.-Gen. McNaughton, M.E.I.C., president of the National Research Council, had the Museums of Aeronautics and Surveys thrown open for the benefit of members of the Branch, and he with members of the staff very kindly explained features of the exhibits (69).

Jan. 27—**Sanitary Engineering Laboratory at Queen's University,** by Professor W. L. Malcolm, M.E.I.C., Queen's University (83).

Feb. 10—**Turner Valley—A Major Oil Field,** by George S. Hume, Ph.D., Geological Survey, Dept. of Mines & Resources (96).

Feb. 24—**Pax Nipponica,** by C. A. Bowman, M.E.I.C., Editor, Citizen, Ottawa, also presentation of Gzowski medal to Dr. J. H. Parkin, M.E.I.C., by the President, Dr. J. B. Challies. (122).

Mar. 10—**What Canada is doing with the aid of Camera and Airplane,** by A. C. T. Sheppard, B.A.Sc., D.L.S., Bureau of Geology & Topography, Dept. Mines & Resources (100).

Mar. 24—**Trans-Canada Air Lines,** by P. G. Johnston, vice-president, Trans-Canada Air Lines (121).

Apr. 7—**Electronic Devices,** by Jos. T. Thwaites, B.Sc., Westinghouse Company, Hamilton (56).

Apr. 12—Evening Address, National Research Council Bldg. **Automobile Parking in Ottawa,** by R. M. Simpson, Engineer, Citizens' Parking Committee, Ottawa (15).

Apr. 21—**Seismology,** by Dr. E. A. Hodgson, M.E.I.C., Dominion Observatory, Ottawa (50).

May 5—**Sun Spots,** by Dr. R. E. DeLury, Dominion Observatory, Ottawa (76).

May 19—**Roads in the Sky,** by Professor R. DeL. French, M.E.I.C., McGill University (60).

June 24—Meeting of the Council of the E.I.C. (See opening paragraph) (97).

Oct. 12—Evening Address, National Research Council Bldg. **Commercial Speed: A Common Problem for Rail, Road, and Water,** by L. P. Alvin, Paris, France (40).

Nov. 17—Evening Meeting, Can. Govt. Motion Picture Bureau. **Steel—Man's Servant,** by A. W. Allyn of United States Steel Products Company, Montreal (150).

Dec. 1—**Impressions of Japan,** by E. Haanel Cassidy, Toronto. (95).

Dec. 15—**Recent Mineral Developments in the Northwest Territories,** by Dr. Chas. Camsell, C.M.G., M.E.I.C., Deputy Minister, Dept. Mines & Resources (115).

Membership

With several adjustments during the year the membership roll now shows an increase of 7 during the year, the total now being 339 resident and 86 non-resident members.

Aeronautical Section

Six evening meetings were held, when technical papers dealing with aeronautical or related subjects were read and discussions held. The average attendance was 34.

Officers for 1939

The Annual Meeting of the Branch will be held on the 12th of January when the officers and members of the Managing Committee for 1939 will be elected.

PETERBOROUGH BRANCH

The following meetings were held during the year 1938, with attendance in brackets.

Jan. 20—**Manufacture of Carborundum Abrasive and Refractory Material,** by F. D. Bowman, Canadian Carborundum Co (54).

Feb. 24—**Air Conditioning,** by J. H. Daynes, Canadian General Electric Co., Toronto (59).

Mar. 10—Annual Student and Junior night. **Sand Casting of Crank Shafts for the Automobile Industry** by R. E. Edson, S.E.I.C.; **Water Purification,** by J. R. Desmarais, S.E.I.C.; **Metallic Arc Welding,** by M. F. Carriere, S.E.I.C. (38).

Mar. 24—**The Long Road,** (Sound Film), by P. B. MacEwan, Ethyl Gasoline Corporation (57).

Apr. 14—**The Inside Story of Lubrication** (Sound Film), by A. G. Scott, chief lubrication engineer, Imperial Oil Co. Ltd. (48).

May 5—Annual meeting and election of Executive (41).

May 19—**The Building of the Golden Gate Bridge and The Manufacture of Structural Shapes and Related Products** (sound films), by Bethlehem Steel Corporation. (400).

May 27—Visit to the new Globe and Mail Bldg., Toronto (100).

Sept. 29—Supper and social gathering (49).

Oct. 13—**Manufacture of High Voltage Wet Process Insulators,** by J. M. Somerville, Canadian Porcelain Co. (35).

Oct. 27—**Color Photography,** by J. W. McFarlane, Eastman Kodak Co., Rochester (650).

Nov. 10—**Canada's Contribution to Aerial Photographic Mapping,** by A. C. T. Sheppard, D.L.S., Bureau of Geology and Topography, Dept. of Mines and Resources, Ottawa. (33).

Nov. 26—Annual Dinner, attended by the President, Dr. J. B. Challies, L. Austin Wright, and Councillors (85).

Dec. 8—**New Developments in Lighting,** by J. W. Bateman, Canadian General Electric Co., Toronto (25).

Number of Executive Committee meetings held during the year—11.

Special Sub Committees:—

Meetings and Papers Committee—B. I. Burgess, A.M.E.I.C.; S. O. Shields, A.M.E.I.C.

Branch News Editor—J. L. McKeever, Jr.E.I.C.

Membership and Attendance Committee—H. R. Sills, A.M.E.I.C.; E. Prete, Branch Affiliate.

Social and Entertainment Committee—R. L. Dobbin, M.E.I.C.; A. L. Killaly, A.M.E.I.C.; B. Ottewell, A.M.E.I.C., E. R. Shirley, M.E.I.C.

QUEBEC BRANCH

Five meetings of the Branch Executive Committee were held during the year. The last meeting, held on December 19th, 1938, was the occasion of the President's and General Secretary's visit to the Branch. The Executive were hosts at a luncheon given to President Challies. At this meeting the affairs of main import to the Institute such as the co-ordination of the Institute and the Associations were discussed.

Six Branch meetings were held during the year 1938, as follows:—

Jan. 21—**Gasoline for Today's Automobile,** by Gordon M. Connor, B.Sc., field representative of the Ethyl Gasoline Corporation.

Feb. 17—Luncheon meeting. **The Two New 50-Kilowatt Stations of the C.B.C.,** by John C. Stadler, A.M.E.I.C., executive assistant, Canadian Broadcasting Corporation.

May 2—Luncheon Meeting. **Life Saving with Light,** by E. D. Gray-Donald, A.M.E.I.C., assistant general superintendent, Quebec Power Company.

June 17—Annual meeting and election of officers.

Nov. 14—**Le chauffage électrique dans l'industrie,** by Leo Roy, Jr.E.I.C., power sales engineer, Quebec Power Co.; **Le chauffage à l'air climatisé,** by Jean Marie Paquet, Jr.E.I.C., engineer, J. A. Y. Bouchard.

Dec. 19—Dinner Meeting. **The Status of the Engineer in Canada,** by President J. B. Challies. Councillor Fred Newell also spoke on the position of the movement for closer relations between the Institute and provincial professional associations. General Secretary L. Austin Wright reported on proposals for a conclave of British, Canadian and American engineers at the World's Fair in New York.

Committees

The Branch Committees are as follows:—

Nominating	*Membership*
A. Gratton, M.E.I.C.	H. Cimon, M.E.I.C.
G. W. Cartwright, A.M.E.I.C.	T. M. Dechêne, A.M.E.I.C.
A. O. Dufresne, M.E.I.C.	Jean Saint-Jacques, A.M.E.I.C.
Legislation	*Excursions*
J. O. Martineau, M.E.I.C.	T. M. Dechêne, A.M.E.I.C.
O. Desjardins, A.M.E.I.C.	E. D. Gray-Donald, A.M.E.I.C.
J. G. O'Donnell, A.M.E.I.C.	W. R. Caron, A.M.E.I.C.
Library	
P. Methé, A.M.E.I.C.	J. O. Martineau, M.E.I.C
R. Dupuis, A.M.E.I.C.	B. Pelletier, A.M.E.I.C.
T. M. Dechêne, A.M.E.I.C.	

SAGUENAY BRANCH

The Executive Committee held nine meetings during the year for the transaction of Branch business.

In addition to the above, twelve general meetings were held during the year 1938 as follows:—

Feb. 11—**Technical Men in Industry,** by T. M. Moran, A.M.E.I.C., factory manager Dominion Rubber Company, Ltd., Montreal; Chairman Industrial Management Section of the Montreal Branch.

Feb. 25—**Paper Unloading Facilities at Port Alfred,** by Frank Calder, Aluminum Company of Canada, Ltd., Arvida.

Mar. 25—**Operating Experience with Wood Pole Transmission Lines in the Saguenay District,** by N. D. Paine, A.M.E.I.C., general electrical supt. Price Bros. Company, Kenogami, Que.; **Operating Experience with Steel Tower Transmission Lines in the Saguenay District,** by F. L. Lawton, M.E.I.C., chief engineer, Saguenay Power Company, Arvida, Que.

May 4—**Wood Preservation,** by G. E. LaMothe, A.M.E.I.C., logging division Engineer, Price Brothers Company, Chicoutimi, Que. Also sound pictures **Structural Shapes** and **Golden Gate Bridge.**

May 13—**Latest Applications of Grid Controlled Mutators,** by A. Leuthold, engineer for Brown Boveri Company, Switzerland.

June 22—**Manufacture of Electric Furnace Abrasive,** by R. H. White, vice-president and general manager of Canadian Abrasives Company, Ltd., Arvida, Que.

July 13—Dinner and annual meeting held at Arvida, Que.

Aug. 5—**Operating Experience with Rotary Converters,** by William Fraser, Aluminum Company of Canada, Ltd., Arvida, Que.

Sept. 7—Sound pictures, **The Inside Story** and **Design for Power,** supplied by Imperial Oil Company.

Oct. 14—Sound picture **Flow** supplied by Crane Limited.

Nov. 25—**Modern Electric Arc Welding,** by Gordon Cape, Dominion Bridge Company, Montreal, Que.

Dec. 18—Visit of Dr. J. B. Challies, President, Mr. L. Austin Wright, General Secretary, and Mr. F. Newell, Councillor, who were also the speakers.

SAINT JOHN BRANCH

Seven meetings of the Executive Committee were held during the year 1938 and eight meetings of the Branch as follows:

Jan. 27—Annual joint dinner with the Association of Professional Engineers of New Brunswick. **Pre-stressing and Erection of the Isle of Orleans Bridge,** by D. B. Armstrong, A.M.E.I.C., chief designing engineer of the Dominion Bridge Company.

Feb. 17—**Heat and its Control,** illustrated by motion pictures, by a representative of the Canadian Johns-Manville Co.

Mar. 24—**Building Invisible Edifices,** by H. I. Knowles, chief chemist of the Atlantic Sugar Refineries.

Apr. 12—Joint meeting with the Engineering Society of the University of New Brunswick at Fredericton. **The Manufacture and Uses of Nickel and its Alloys,** illustrated by motion pictures, by Wm. J. Brown, foundry engineer of the Robt. W. Bartram Company.

May 5—Annual dinner meeting and election of officers of the Branch. President J. B. Challies, General Secretary L. Austin Wright and Councillor F. Newell were guests of the Branch.

Oct. 13—Supper meeting. **Research in Manufacturing,** by L. W. Simms, president of the T. S. Simms Brush factory.

Nov. 16—**Engineering in Broadcasting,** by H. M. Smith, design and construction engineer of the Canadian Broadcasting Corporation.

Dec. 8—Supper meeting. **The September Crisis in Britain,** by T. C. McNabb, M.E.I.C., superintendent of the Atlantic division of the Canadian Pacific Railway.

ST. MAURICE VALLEY BRANCH

It is with pleasure that we welcome to the Branch those members resident in LaTuque and Rapide Blanc, who were formerly attached to the Quebec Branch.

Six general meetings were held during the year 1938, four at Shawinigan Falls and two at Three Rivers. Four of these were dinners. A summary of the meetings with attendance in brackets is as follows:—

Feb. 23—At Three Rivers, a dinner in honor of H. O. Keay, M.E.I.C., newly elected Vice-president of The Engineering Institute of Canada (32).

Mar. 29—At Shawinigan Falls, in conjunction with the Shawinigan Falls Chemical Association. **Cellite, the Story of the Diatom,** a talking picture supplied by Canadian Johns-Manville Co. (85).

Apr. 12—At Shawinigan Falls. **Observations on the Probable Causes of Disintegration of Concrete Structures,** by T. C. Creaghan, Western Waterproofing Co., Montreal (54).

May 20—At Shawinigan Falls, a dinner meeting, **The Development of Design and Construction of Guns,** by Lieut.-Col. Norman C. Sherman, M.E.I.C., ordnance mechanical engineer, Royal Canadian Ordnance Corps (48).

Oct. 8—At Shawinigan Falls, a dinner to welcome the presidential party, including President J. B. Challies, the General Secretary, L. Austin Wright, and the chairman of the Committee on Professional Interests, Fred Newell (32).

Dec. 10—At Three Rivers, **Steel—Man's Servant,** the United States Steel Corp.'s talking picture (400); and a dinner meeting, **The Use of Rigid Frames in Building Construction,** by E. R. Jacobsen, A.M.E.I.C., Dominion Bridge Co., Lachine, P.Q. (64).

SASKATCHEWAN BRANCH

Meetings

There were five regular meetings of the Branch, each being preceded by a dinner, at which the average attendance was sixty-one. In addition, general meetings were held during the months of February and October, under the auspices of The Association of Professional Engineers of Saskatchewan.

The new system which was inaugurated late in 1937 with regard to the monthly meetings which are now being held jointly by the Saskatchewan Branch of The Engineering Institute of Canada, The Association of Professional Engineers of Saskatchewan and the Saskatchewan Section of the American Institute of Electrical Engineers has again proved to be of general interest. 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. Elections for the Branch have been dispensed with due to the new co-operative agreement recently signed.

The Standing Committees of the Branch are as follows—

Papers and Meetings—H. A. Jones, A.M.E.I.C., Convener.

Nominating—H. R. Mackenzie, A.M.E.I.C., Convener.

Membership—J. J. White, A.M.E.I.C., Convener.

The programme for the year 1938 was as follows:—

Jan. 21—**The Mining Industry in Manitoba and Western Ontario,** by M. C. Lowe.

Feb. 18—Branch members met with The Association of Professional Engineers of Saskatchewan in annual meeting.

Mar. 18—Annual meeting of Branch, election of officers. Animated pictures of **Boulder Dam.**

Apr. 22—**Photographic Registration of Lightning Discharges,** by L. M. Howe.

Oct. 29—Meeting under the auspices of The Association of Professional Engineers of Saskatchewan in semi-annual meeting. Signing of co-operative agreement between The Saskatchewan Branch of The Engineering Institute of Canada and The Association of Professional Engineers of Saskatchewan.

Nov. 25—**Irrigation in Saskatchewan,** by E. E. Eisenhauer, A.M.E.I.C.

Dec. 19—**Scientific Crime Detection.** by R.C.M.P. Surgeon Maurice Powers.

SAULT STE. MARIE BRANCH

The Executive Committee met on Jan. 14, 1938, and appointed standing committees. The committees and the chairmen are as follows:—

Papers and Publicity—Hugh J. Leitch, A.M.E.I.C.
Entertainment—John L. Lang, M.E.I.C.
Membership—A. H. Russell, A.M.E.I.C.
Legislation and Remuneration—F. A. Smallwood, M.E.I.C.

The Executive Committee met seven times during the year to discuss and promote the activities of the Branch and the Institute.

Seven dinner meetings were held during the year. The average attendance at the meetings was 31 members and guests. As customary 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 President J. B. Challies, and the General Secretary L. Austin Wright. Mr. Challies was in Sault Ste. Marie in July and Mr. Wright in November.

Programmes of the meetings held were as follows:—

Mar. 4—**Development of Helen Mine,** by E. M. MacQuarrie, M.E.I.C., O.L.S., Sault Ste. Marie, Ont.
Apr. 29—**The Oxy-Acetylene Process in Industry,** by R. J. Anderson, Dominion Oxygen Company, Montreal, P.Q.
May 27—Visit to the Sault Structural Steel Co. under the direction of the general manager, Hugh J. Leitch, A.M.E.I.C.
July 20—Visit of the President of the Institute, J. B. Challies, M.E.I.C.
Sep. 30—**Montreal River Lower Falls Power Development,** by K. G. Ross, M.E.I.C., Lang and Ross, Construction Engineers.
Nov. 18—Visit of the General Secretary of the Institute, L. Austin, Wright, A.M.E.I.C.
Dec. 16—Annual meeting for 1938.

A feature of the current year which might be mentioned is the pleasing increase in the resident membership from 33 to 41 during the year. One Associate Member, 5 Juniors, one Student and one Branch Affiliate made up the increase.

The movement of members during 1938 is summarized as follows:—

	In	Out	Transfer
Elected to membership	8		
Moved out of Branch		17	
Moved into Branch	20		
Resignations, suspensions		2	
Transfer to higher grade			5
Total	28	19	

TORONTO BRANCH

The Annual Meeting of the Branch was held at the Canadian Military Institute on Thursday, May 12th, 1938, at which the officers for 1938-39 were elected. The meeting was preceded by a dinner at which the President of the Institute, Dr. J. B. Challies; L. Austin Wright, General Secretary; E. V. Buchanan, Vice-President, Zone B.; J. Vance, Woodstock; W. J. W. Reid, Hamilton; R. L. Dobbin, Peterborough; Prof. R. W. Angus; Prof. C. R. Young; Dr. F. A. Gaby; Dr. A. H. Harkness and some sixty others were present. Willson Woodside was the speaker of the evening. Dr. J. B. Challies and L. Austin Wright added a few words and expressed their pleasure at being present.

The undermentioned were named as chairmen of the Standing Committees:

Papers—A. E. Berry, M.E.I.C.
Meetings—W. E. P. Duncan, M.E.I.C.
Finance—C. E. Sisson, M.E.I.C.
Social—H. E. Brandon, A.M.E.I.C.
Membership—W. E. P. Duncan, M.E.I.C.
Branch Editor—D. D. Whitson, A.M.E.I.C.
Student Relations—M. Barry Watson, A.M.E.I.C.

During the year the executive committee has held fourteen meetings with an average attendance of about ten at each meeting.

The following regular meetings were held during the year 1938, attendance figures being given in brackets.

Jan. 10—**Heat Insulating Materials,** by Prof. E. A. Allcut, M.E.I.C. This was a joint meeting held in conjunction with the American Society of Heating and Ventilating Engineers (Toronto Chapter) and the American Society of Mechanical Engineers (Ontario Section). The paper was preceded by a dinner attended by members and friends. (168).
Jan. 20—**Application of the New Science of Seeing to Lighting,** by W. J. Bateman, Canadian General Electric Co. Limited, and chairman of Toronto Chapter, Illuminating Engineering Society (25).
Jan. 22—Social evening held at the Engineer's Club for members and ladies. Preceded by dinner and followed by entertainment, music, cards and billiards (92).
Feb. 24—Annual students night at which the following took part: **Development and Role of Aviation in Mining,** by M. R. Brown; **Flying in the Stratosphere,** by K. R. Busby; **Advantages of the Trolley Bus in Municipal Transportation,** by T. L. Cooke; **The Engineer in Society,** by B. Etkin; **High Temperature Steam,** by J. L. Hemphill; **Arc Welding of Cast Iron,** by I. W. Smith. The papers were preceded by a talking picture loaned by the Bethlehem Steel Co. and showing the Golden Gate Bridge, San Francisco (275).
Mar. 17—**Outardes Falls Power Development,** by A. W. F. McQueen, M.E.I.C. (40).
May 12—Annual Branch meeting. **Germany Would Lose,** by Willson Woodside (68).
Sept. 20—Golf Tournament, followed by dinner (45).
Oct. 13—**Technical Aspects of Attack and Defence in Modern Warfare,** by Lieut.-Col. E. J. C. Schmidlin, M.C., director of Engineering Services, Dept. of National Defence, Ottawa (150).
Nov. 3—**Recent Developments in Synthetic Rubber,** by B. K. Read, Canadian Industries Limited, Montreal (80).
Nov. 17—**The Regulation of Traffic in a City,** by Tracy D. LeMay, Town Planning Commissioner, Toronto (100).
Dec. 1—**Some Problems of a Research Laboratory,** by Dr. Saul Dushman, B.A.Sc., Ph.D., assistant director of the Research Laboratory, General Electric Company, Schnectady, N.Y. (170).

Previous to each regular meeting well attended dinners have been held at Hart House and enjoyed by all who availed themselves of the opportunity to attend.

The branch loan fund established some six years ago has a balance of $300.00. No applications for loans have been received during the past year.

It is with deep regret that we record the death of the following members of the Branch during the year: Victor Topping, A.M.E.I.C.; A. T. C. McMaster, M.E.I.C.; H. W. McAll, M.E.I.C.; J. H. Barber, M.E.I.C.; D. W. Harvey, M.E.I.C.; A. B. Crealock, M.E.I.C. Our sincere sympathy is extended to their families in their loss.

VANCOUVER BRANCH

We have just passed through a very successful and interesting year. Two large projects were carried out in Vancouver and Victoria which stimulated a great interest in the engineering profession: the Lions' Gate Bridge and the National Defence programme. Both of these projects were very fine examples of engineering and our Branch is very fortunate in having these works so close that frequent visits could be made to the different projects.

One of the most interesting and important things that happened this year, as far as the Institute was concerned, was the visit of the President, Dr. Challies, and the Chairman of the Committee on Professional Interests, Fred Newell, also the General Secretary, L. Austin Wright, to Vancouver in November. The visit of these gentlemen to this Branch will go a long way towards bringing the Association of Professional Engineers and the E.I.C. into closer relationship.

During the year the Branch held 10 meetings and two luncheons, as follows:

Jan. 5—Farewell Luncheon to Percy Sandwell, M.E.I.C.
Jan. 20—**The Grand Coulee Dam,** by Major S. E. Hutton, Engineering Staff of the U.S. Bureau of Reclamation.

Mar. 16—**Modern Manufacture of Lubricating Oils,** by Dr. W. F. Seyer, Department of Chemistry, University of British Columbia.

Apr. 13—**Mining in B.C. and the Function of the Department of Mines,** by Dr. John F. Walker, Deputy Minister of Mines.

May 5—**The Steel Industry in Canada,** by Lt. Col. J. P. Mackenzie, M.E.I.C.

June 1—**The Cables of the Lion's Gate Bridge,** by S. R. Banks,

June 13—Complimentary Luncheon to Sir Godfrey Rhodes.

Sep. 13—Joint Meeting—Board of Trade Engineering Bureau and Engineering Institute. **The Collapse of the Niagara Arch Bridge,** by P. L. Pratley, M.E.I.C.

Oct. 26—**Why the Weather,** by A. R. McCauley, Chief Meteorologist, Sea Island Airport.

Nov. 8—Public Meeting. **The Status of the Engineer,** by Dr. J. B. Challies. Meeting also addressed by Fred Newell and L. Austin Wright, Representatives of the Association, A.I.E.E., Architects, C.I.M.M., and construction industries present.

Nov. 10—Meeting with student body (Applied Science) University of B.C. Speakers—Dr. Challies, Mr. Newell and Mr. Wright.

Nov. 21—Annual dinner and meeting. **Some Principles of British Government Finance,** by Dr. Ivor Jennings.

The Executive held nine meetings during the same period.

The Executive Meetings have been quite important, matters of great interest to the Profession being discussed, the result of deliberations being sent to the Institute in Montreal. Some of the more important discussions were:

Membership Classifications—This matter is now before Council and in due course we shall be notified of their position in the matter.

Representation on Council—This appeared to your Executive to be a very important matter and we strongly recommend that this Branch be permitted to retain its present representation on Council.

The proposed new section 76 which gives Council authority to proceed with negotiations and enter into an agreement between the Institute and any Provincial Association for the furtherance of their mutual interests.

In addition to the Executive Meetings the Committee on Professional Interests held three meetings during the year.

The members of this committee are as follows:

P. H. Buchan, M.E.I.C., *Chairman*	E. A. Cleveland, M.E.I.C.
H. N. McPherson, M.E.I.C.	J. P. Mackenzie, M.E.I.C.

The deliberations of this committee were sent direct to Institute Headquarters in Montreal.

The Membership Committee of the Branch has not been particularly active. This was due to the unsettled state of affairs in connection with co-operation and co-ordination between the Institute and The Professional Association. This matter is now on an improved basis and the Membership committee for next year will have a better opportunity of making headway.

We are sorry to report the death of four of our members: H. L. Swan, M.E.I.C., C. E. Cartwright, M.E.I.C., George Wright, M.E.I.C., and Capt. E. A. Wheatley, M.E.I.C.

Our relations with the student body in engineering at the University of British Columbia are very much closer than they have been for which thanks are due to Dean Finlayson and Archie Peebles. It is important that attention is paid to the problems of the young engineer and the time to start is during his college days. At one meeting which we held at the University while the President was here, the student body turned out in force and we should lose no opportunity of encouraging these young men to become Institute-minded.

The Papers committee have done excellent work as is shown by the number and calibre of the meetings, and the Secretary has been untiring in his efforts on behalf of the Branch.

VICTORIA BRANCH

During the year four general meetings of the Branch were held, two being dinner meetings and one a luncheon meeting with an average attendance of 23. The outstanding of these was on November 5th when the Branch entertained President Challies and Mrs. Challies, Councillor Fred Newell and Mrs. Newell, L. Austin Wright, general secretary, and some 45 members and friends of the Branch and their families at a formal dinner. Following the dinner many of the distinguished guests addressed the meeting, including C. A. Magrath, the recipient of honorary membership announced by President Challies on this occasion. At noon on the same day President Challies made the presentation of the Sir John Kennedy medal to Col. J. S. Dennis at the Jubilee Hospital. It was much regretted that Col. Dennis, who has since deceased, was too ill to permit his being present at the dinner held that evening.

Three meetings of the Executive Committee were held during the year, much of the business of the Branch being left in the hands of the chairman and the secretary for attention.

Membership

The membership of the Branch stands at 62, a reduction of two over the preceding year. One new member was received and one was transferred to this Branch, also one Junior member was transferred to this Branch membership. Resignations were received from one Member and one Associate Member. One Junior was transferred to other parts of Canada. The Branch had the misfortune to lose by death during the year one of its life members, namely, Col. J. S. Dennis, also H. L. Swan, who died shortly after his transfer to the Vancouver Branch.

Annual Meeting

The annual meeting of the Branch was held on December 16th, and took the form of a dinner meeting followed by the election of officers for the year 1939.

In conclusion the Executive Committee of the Branch wishes to sincerely thank the General Secretary and the staff at Headquarters for their generous assistance and unfailing courtesy throughout the year.

WINNIPEG BRANCH

Meetings

Acting upon a resolution passed at the Annual Meeting, Feb. 3, 1938, an agreement with the Association of Professional Engineers of Manitoba whereby all general meetings are held under the joint auspices of the Branch and the Association, was consummated. All meetings of the fall season have been held in accordance with this agreement.

There were 12 general meetings throughout the year 1938, the average attendance being 61. (Attendance given in brackets). In addition there were 11 meetings of the Executive Committee.

Jan. 6—**Air Conditioning,** by D. C. Brooking (77).

Feb. 3—Annual Meeting.

Feb. 17—**Modern Methods of Sludge Treatment,** by A. L. Genter (59).

Mar. 3—**Polar Exploration,** by Capt. Innes-Taylor (58).

Mar. 17—**The Handling of Grain in Large Elevators,** by P. C. Watt (38).

Apr. 7—**The Effect of Boundary Layer Control on the Efficiency of the Draft Tube,** by J. W. McBride, S.E.I.C. **Features of the Design of a Power Unit,** by R. T. Harland (31).

Apr. 21—**Air Transportation in Canada,** by V. H. Patriarche, A.M.E.I.C. (47).

Oct. 13—**Keeping the Lines Alive,** by H. L. Briggs, A.M.E.I.C. (70).

Oct. 27—Luncheon. Delegation from Headquarters (76).

Oct. 27—Dinner. Delegation from Headquarters (43).

Oct. 27—President Challies, Councillor F. Newell, L. Austin Wright General Secretary, **Institute Affairs** (66).

Nov. 1—**Electric Precipitators,** by Prof. J. W. Dorsey (53).

Dec. 1—**Weeds to Waterfowl,** by G. R. Fanset (43).

Abstracts of Current Literature

Contributed abstracts of articles appearing in the current technical periodicals

FUEL TRENDS IN THE UNITED STATES

The Engineer, December 2nd, 1938

Abstracted by A. A. Swinnerton, A.M.E.I.C.

An investigation in the United States by the National Bituminous Coal Commission has shown that anthracite production has declined 48 per cent since 1918 and bituminous coal production has declined 25 per cent. In the same period there was a 186 per cent increase in water power, a 224 per cent increase in natural gas, and a 230 per cent increase in petroleum. It was also found that anthracite coal furnished only 5.4 per cent of the energy produced in the country in 1937, as compared with 22.1 per cent in 1899, and bituminous coal furnished only 45.3 per cent of the energy output in 1937, as compared with 68.2 per cent in 1899—a total decline in the coal energy from 90.3 per cent in 1899 to 50.7 per cent in 1937. During the same thirty-eight years the energy contributed by water power increased from 1.8 to 9.4 per cent, the energy from natural gas increased from 3.3 to 9.5 per cent, and that from petroleum from 4.6 to 30.4 per cent—a gain in the relative position of water power, natural gas, and petroleum from 9.7 per cent in 1899 to 49.3 per cent in 1937.

EXHAUST STEAM HEATS MOTOR CAR PLANT

By F. O. Jordan, in the Heating and Ventilating Journal, November, 1938.

Abstracted by L. M. Ashley, M.E.I.C.

This heating plant is unique in that while the unit heater has become standard equipment for heating large structures of this kind here is a system of hot water heating that has been operating with great satisfaction for ten years. The author claims inexpensive operation of the plant because of the use of exhaust steam from trip hammers; this steam is so foul with oil and grease that it is usually wasted, but by the design of special water heaters with short tubes of large diameter so arranged that the oil and dirt are blown through quickly, water has been heated satisfactorily for this job. The building is heated entirely by means of pipe coils through which the hot water is circulated by means of motor driven centrifugal pumps. The roof and all monitors are blanketed with heating coils many of them 1,000 feet long; coils are also installed on the walls and under the windows. Coils are hooked up with 90 deg. turns and are supported on roll hangers. There is separate heater and pump room and the usual expansion tank to keep the system full of water. Over-sized mains with plugged outlets have made it easy to supply heat for building changes and additions, and the upkeep required for maintaining the system in good condition has been very small. When it has been necessary to supply outside air for ventilation, air supply systems have been installed on the roof. These systems are made up of air circulating fans, blast heaters for heating the outside air to be introduced, ductwork and registers for delivery into the building.

In designing the system conventional methods were used. For example the usual overall transmission coefficients were used in estimating the heat loss from the building, the heat for heating the outside air entering the building by natural leakage or infiltration was estimated by assuming one change of air per hour in outside bays and one half of this for inside bays. The hot water distribution systems were designed so that the pressure drop through all parallel circuits or water paths was the same. Pipe coils were based on delivering 240 B.t.u.'s per hour per square ft. of heating surface.

The author has one paragraph headed "A 30-Day Wonder" in which he writes of the building for which this heating system was designed. "In the late '20's Walter P. Chrysler thought he saw a market for a large number of low priced high performance cars, but realized the need for quick action. Orders were given to start work immediately on an automotive plant of mammoth dimensions as this plant was to be ready to start production within sixty days. He visited architect Albert Kohn's place of business and asked when footing drawings could be delivered on the site of his proposed factory. The answer was that they would be delivered in the morning. The next morning saw footing drawings delivered and waiting steam shovels begin action, and thirty days later a Plymouth's horn tooted and the first car rolled from the assembly line under its own power, followed by an endless procession which has never been stopped."

DUAL PARSHALL FLUMES MEASURE WIDE RANGE OF FLOWS

By H. S. Riesbol, Jr., Am. Soc. C.E., in Civil Engineering, January, 1939

Abstracted by A. C. D. Blanchard, M.E.I.C.

The use of Parshall (Venturi) flumes for the measurement of flow of water has been greatly extended during the past few years, and this type of measuring device has now been developed to cover, with a single installation, the complete range in discharge between zero and 800 sec. feet.

The Parshall flume, originally devised for the measurement of silt-laden water in irrigation canals, is now being utilized by the Soil Conservation Service of the U.S. Government for run-off determinations of relatively small watersheds.

It is pointed out that no practicable hydraulic device will measure accurately the extreme ranges of discharge which occur on small watersheds, the immediate conclusion in order to secure accurate results being to pass the flow through a series of measuring units, each having a range such that the error will remain within the desired limits. It is inferred, however, that the dual Parshall flume will obviate the necessity of installing more than one measuring unit for ranges in discharge within the limits previously mentioned.

Any device for this purpose should have a minimum susceptibility to velocities of approach and must be capable of handling flows that carry silt and debris. These requirements preclude the use of measuring weirs, either sharp or broad-crested.

The flume is adapted to handling debris-laden water better than most other hydraulic measuring devices because the velocities through the flume are accelerated until the critical velocity is reached. This is ordinarily sufficient to maintain the flume in a clean and unobstructed condition.

The most recent development introduces an installation of two flumes side by side, the smaller of which is intended to measure base flows of from zero to eight second feet, while the other, of much greater dimensions, will measure all higher flows.

A drawing showing a typical dual installation appears with the text and shows, in addition to the plan and profiles of the two flumes, the location of the recording device. The general arrangement is simple, as only one head measurement is required for each flume.

The theory of design is not discussed in this paper, nor are any definite statements made as to the degree of accuracy to be expected by this form of measuring device. For the theoretical hydraulic principles involved and the results of tests carried out with Venturi flumes as applied to measurements of sewage, reference may, however, be made to a paper by H. K. Palmer and F. D. Bowlus in the 1936 Transactions of the American Society of Civil Engineers, which deals with the adaptation of Venturi flumes to flow measurements in conduits.

CRACK DETECTIVE

By T. C. Rathbone, in Power, November 1938

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

Examination of turbine blades for fatigue cracks (1) by the "whiting" test, (2) by change in vibration frequency, (3) by change in the sound or "ring", (4) by visual inspection with the aid of mirrors and lights have proved unreliable. Where the blades are of alloy-steel magnetic methods of testing for cracks has proved itself in determining fatigue cracks. The Magnaflux process depends on the tendency of fine magnetic powder to adhere to the line of an apparently invisible crack when properly magnetized. Flux lines are forced into the air and the magnetic powder tends to bridge the path. Magnaflux powder is finely divided iron particles coated with an inert oxide to prevent cohesion and increase their mobility.

The surface under examination need not be cleaned of thin light scale or oxide. Thick, loose deposits should be removed by wire brushing or sand blasting. Oily deposits should be cleaned with a solvent. The surface under test must be dry for the dusting method. The powder is dusted on by a salt shaker or by a spray bulb with a non-ferrous nozzle. Tapping the blades lightly assists the powder to collect at a crack.

Ferrous parts may be magnetized (1) by passing current directly through the part, (2) by applying permanent magnets or electromagnets and (3) by winding energized cables around the object.

Blades and buckets assembled in the rotor are magnetized by wrapping the rotor body with cables carrying current from a portable welding set, using 500 to 2,000 or more ampere-turns. Segments of one or more rows may be magnetized by means of magnets or external solenoids applied at the periphery of the rows. From 300 to 600 ampere-turns is sufficient. Feeble magnetization in the proper direction is more effective than heavy magnetization.

The bulk of the powder drops off when the magnetizing current is broken and with the normal blowing out and cleaning there should be no harm from residual powder. Journals and bearings should be reasonably protected.

PRESSURE CHARGING HIGH SPEED FOUR-STROKE ENGINES

By J. H. Pitchford in The Oil Engine of December 1938

Abstracted by J. L. Busfield, M.E.I.C.

This article directs attention to an original paper read before the Institution of Automobile Engineers.

The article deals entirely with the application of pressure charging to four cycle engines only, and points out that as a means for temporarily increasing the power, pressure charging is of unquestioned value, but for obtaining permanently higher outputs it has to compete with a number of other methods of obtaining the same result. Different forms of pressure charging blower and their advantages and disadvantages are discussed, such as the mechanically driven centrifugal type, which is best adapted to marine and industrial work, while the exhaust turbo driven centrifugal blower is best from the point of view of overall thermal efficiency. The Roots positive displacement type has a high mechanical efficiency and may be run at high speed, and has simple lubrication. The vane type blower has a relatively high compressing efficiency, but mechanical losses rise rather rapidly as speeds rise.

For high altitude sites a larger unblown engine is needed, and users are reluctant to pay for it, but the small extra cost of a blower is much more readily faced. Reduced weight, which affects transport installation and maintance costs, will also be in favour of a forced induction engine.

The article has a number of diagrams indicating the response to pressure charging under a number of various conditions, and also tables giving comparative data on 10-litre six-cylinder engines for automotive and industrial purposes with and without super charging.

NEW PRODUCT FROM PICKLING LIQUOR

Chemical and Metallurgical Engineering, August, 1938

Abstracted by F. G. Green, A.M.E.I.C.

Disposal of some 2,000 tons per day of pickling liquor has long been a problem of the steel industry.

This liquor contains for the most part a saturated solution of ferrous sulphate together with, in most cases, several per cent of free acid. It cannot be pumped into streams. It corrodes metals. Neutralization with lime is only a temporary palliative as subsequent hydrolysis slowly returns it to the corrosive stage. It can be converted to copperas but the demand for this material falls far short of its potential production.

A recent development, however, now produces with little equipment and at small cost a building material said to have remarkable insulating properties. A plant to produce 25 tons per day of this new material is being built at Sharon, Pa.

This material is largely a precipitated iron oxide and calcium sulphate. It is tan in colour and extremely porous.

In one stage of its manufacture it is plastic and can be moulded into any desired shape. Later it sets to a hard rigid mass by a combined process of drying and oxidation.

It resembles wood in many ways but is fireproof, termite-proof and warp-proof. It is like plaster but has over five times its insulating value and can stand higher temperatures. It resembles brick but weighs only one third as much. It can be made into wallboard and used as a pipe covering, will insulate at temperatures up to 900 deg. F. It will remove hydrogen sulphide from gases and liquids; may be used as a filter medium and, according to tests now in progress, shows promise as a soil conditioner and a secondary fertilizer.

MACHINE CRISIS

By Garet Garrett, in the Saturday Evening Post, November 12, 1938

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

Mr. Garrett recently wrote an anti-New Deal article for the "Post" which should be of particular interest to engineers. He developed the thesis that the crisis in western civilization is not due to the machine but rather to the suspension by human agencies of the laws which regulate a machine age.

The modern pessimists, he says, claim that the machine throws people out of work—this is called technological unemployment. Those who remain employed must support the unemployed and there is not enough money left to purchase the goods produced. The result is called overproduction. The solution, says the pessimists, lies in shorter working hours, a planned and managed economy and in a sort of "birth control" of the machine.

Mr. Garrett claims that the history of the last hundred and fifty years gives the lie to this static view of our productive system. He says emphatically that there is no such thing as absolute overproduction. There is only relative overproduction because the machine does not increase the production of all goods equally. This has always resulted in a temporary crisis. A further cause of crisis in the past lies in the fact that the machine destroys old capital. This is in its very nature. The steamship destroyed the capital in the sailing ships; the railroads destroyed the capital in canals; the Bessemer steel process destroyed the capital of the old iron industry. Then, too, machines destroy one another—a new machine rendering an old one obsolete long before it is worn out. Such is the law of the machine. But so long as it operated—so long as the creative genius of mankind was allowed free rein—the curve of production, the standard of living, the population, and the number of gainfully employed all rose steadily. And this happened in spite of, or perhaps because of, temporary crises and the destruction of old capital.

But now that we have glimpsed the more abundant life, we have grown soft. We are afraid to trust the inventive genius of man—afraid of the future—afraid to face the destruction of old capital which machine progress involves. So, in the interests of present privilege, monopoly, obsolete capital, and even immediate profit, we propose to suspend the law of the machine and invent a new social system to control our present productive capacity as though it were a static thing. And for the first time the curves of production, standards of living, wages and employment have been dropping steadily.

But this is not all. The machine is loose in the world. The white peoples have complacently offered to all the world the technical knowledge which constituted their greatest asset. And the new lords of the machine are willing to accept its law. They know that it means more work, not less work. They are willing that it should destroy capital, custom and usage. The author quotes Spengler—"The privilege of the white race has been thrown away, squandered, betrayed. The centre of gravity of production is shifting away from them. This is the real and final basis of unemployment in white countries. It is no mere crisis, but the beginning of catastrophe."

Mr. Garrett concludes—"With the earth flattening under the weight of armaments . . . a nation which will limit its work, limit its machine power, limit its production, under the delusion that it may arrive thereby at the more abundant life, must be walking in its sleep."

THE ENGINEER AND THE COMMUNITY

By Robert F. Legget, A.M.E.I.C., in the Dalhousie Review

At the celebrations of the fiftieth anniversary of The Engineering Institute of Canada, the late Harrison P. Eddy of Boston, a distinguished American engineer, commented upon the social and economic changes due to the activities of the engineer and inquired as to the use which the community will make of the increased leisure which will be available in the future. He also considered that definite educational development, leading to a greater interest in social, economic and governmental progress, would be needed.

The question thus arises, whether the social conscience of the engineering profession is being aroused, or are engineers still concerned solely with their own technical affairs? Such an awakening might well affect profoundly the future trend of social developments.

In Great Britain the engineering institutions have done little towards this end, either singly or collectively. The Engineering Public Relations Committee, which they have established, is rather intended to bring to the attention of the public the achievements of engineers in the modern world. But an Engineers' Study Group on Economics has been formed under the presidency of Sir Richard Gregory, which proposes to study and discuss such matters as the relations between the actual standards of living and leisure and the advances in these directions which science has made possible. It is a non-political body of engineers and associated technical workers.

In the United States the leading engineering societies have confined their own activities almost entirely to technical work, but several co-ordinating bodies, notably the American Engineering Council and the Engineers' Council for Professional Development, have been instituted under their auspices. The principal functions of the former body are the unification of the engineering profession as regards social and economic questions, the dissemination of information, and the promotion of clear thinking amongst engineers about public matters. Some of the major engineering societies have commenced to give some publicity in their journals to social questions of importance to engineers and at their meetings some discussions have taken place on technical subjects which have a political background.

In our own country the Canadian Society of Civil Engineers did something towards submitting briefs to the Dominion Government on national matters. Of recent years, however, The Institute has been concerned largely with internal problems of the profession and has done little in matters of national social concern. So far engineers in Canada have not been prominent in public administration. Only two members in recent federal cabinets have been engineers; the engineering profession is represented by only three members in the House of Commons as contrasted with seventy lawyers.

Two important questions at issue are, how can the technical qualifications of engineers who are fitted for public life be utilized for valuable public service of an administrative character, and how can the active interest of the general body of engineers in social questions be awakened? The answer of these questions must be based on a proper development of engineering education, so that the young engineer will fully realize the social implications of his work.

In 1936 the President of the United States addressed a message to the American engineering colleges, recommending that the training of young engineers should be such as to prepare them more effectively to meet social responsibilities, particularly those arising from the effect of technological advances upon the daily life of the community. The need for this becomes more vital in view of the misuse of scientific progress. Sir James Ewing, in his James Forrest Lecture in 1928, "saw that the wealth of products and ideas with which the engineer has enriched mankind might be prostituted to ignoble use" and continued "surely it is for the engineer as much as any man to pray for a spiritual awakening, to strive after such a growth of sanity as will prevent the gross misuse of his good gifts. For it is the engineer who, in the course of his labours to promote the comfort and convenience of man, has put into man's unchecked and careless hand a monstrous potentiality for ruin."

POSITION DETERMINATION OF ARCTIC COAST LINES

By C. H. Ney, in Canadian Surveyor, October, 1938

Abstracted by R. H. Field, A.M.E.I.C.

Mr. C. H. Ney, of the Geodetic Service of Canada, gives an interesting account of the work of the geodetic engineer in determining the astronomical latitude and longitude of points in the Arctic. Such operations are the sole means open to the surveyor in fixing positions on the earth's surface pending the extension of a geodetic triangulation net to the area in question. Mr. Ney's paper reveals yet one more branch of our profession in which adventure is to be found, and also contains several interesting facts regarding Frobisher Bay—now unknown to many, but in the 16th century the centre of keen financial speculation in which even Queen Elizabeth participated.

Mr. Ney has done important work in fixing astronomical positions in Canada, e.g. the point where the Ontario-Manitoba boundary meets Hudson Bay, and the northerly boundary of Saskatchewan. A result of the work described was to show that Hudson Bay is some 46 miles wider than indicated on exisiting maps.

Apparently after three or four hours, work with a Wild type precision theodolite the astronomical position can be fixed to a precision of 100 ft. while with more elaborate (and of course, heavier) astronomic equipment, the figure is reduced to 20 ft. after three nights' observations. Radio is used to receive standard time signals, and Mr. Ney also employed two-way communication with the aid of a small portable transmitter. At one time the *Nascopie* was "worked" when 700 miles away.

The paper is full of interest. Among other items it is recorded that the Eskimo engineer of a motor-schooner, faced with the replacement of a broken cylinder-head bolt, proceeded to cut a thread in a piece of iron with the help of a file—and actually produced a very satisfactory and good-looking job.

THE DEWATERING AND DRYING OF COAL

By J. R. Cudworth and E. S. Hertzog, U. S. Bureau of Mines Information Circular No. 7009.

Abstracted by A. A. Swinnerton, A.M.E.I.C.

The problem of drying and dewatering coal is important for the coal industry, and the U.S. Bureau of Mines has prepared a report on the subject, with information on current American and European practice.

Excessive moisture is undesirable on account of extra freight charges and difficulty in unloading and storage. For gas and coke manufacturing, the control of moisture content is necessary to maintain standard conditions of coking and quality of products. The proper practice depends chiefly upon the size of coal and the moisture reduction required. For dewatering coarse sizes, say over ½ inch, ordinary drainage suffices, but for fine sizes, mechanical equipment is necessary.

Compared with other drying devices, the capacity of centrifugal dryers is large and the space occupied small. They produce a dryer product than any other method not employing heat. In the United States the machines most used are the Carpenter, Elmore and Wendell. The first named consists of a truncated cone made up of a series of sieve bands on a vertical shaft. These are of increasing diameter from top to bottom, so that the centrifugal force applied to the coal increases as the coal descends. The average capacity of a Carpenter centrifuge is 100 tons per hour per unit, the power required being 75 H.P. In one case, the reduction is from 19.9 to 5.5 per cent moisture content. The Elmore centrifuge is also cone shaped. The basket has smooth sides, and scrapers are provided to keep the coal moving down the sieve. This unit has a capacity of 80 tons of coal per hour, with a power requirement of about 30 H.P.

The Reinefeld and Wedag centrifuges are much used in Germany, the former somewhat resembling the Elmore, but using perforated steel plates instead of screens. The latter is somewhat similar in design, but more attention is paid to interchangeability and replacement of worn parts. The Altpeter centrifuge is designed for dewatering slurry and fine coal. The coal is thrown against the walls of a drum rotor, and the water flows out through orifices projecting into the coal, the main advantages of this type being the reduction of the amount of coal in the effluent, and the absence of screens which require periodical replacement.

Filters are used for dewatering fine coal sludge and froth flotation products. Among the best known are the Oliver, Dorco, American vacuum, etc., in America, and the Wolf, Groppel, and Bloomco, in Europe. Froth-flotation of coal has been carried farther in Europe than in America.

Heat dryers are usually of the rotary type heated by steam or hot flue gases. In America, the Ruggles-Cole, Christie, and Rotary Louvre are of this kind; in Europe there are the Büttner, Rheinland, and Pherson. The chief difference between these types is in the method of bringing the drying medium into contact with the moist coal. In the D.L.O. drier, also used in the United States, the coal is moved on a conveyor through a hot oven (counter current). The vertical type of dryer is used largely in Europe, the H.H., Lopulco, and Universal being examples. Generally, they have horizontal shelves over which the hot air passes, with rabble arms to stir up the coal and cause it to pass from top to bottom.

Lastly there is the pneumatic type which includes the Buhler, Koon, Büttner Rapid, and Rema Rosin driers. These consist of long steel tubes through which the coal is blown by the hot gases. They are used largely in Europe in briquetting plants and for drying coal sludge, but suffer from the difficulty of ensuring a uniform feed and low drying efficiency in the discharge section of the tube.

ULTRA-SHORT-WAVE TRANSMISSION AND ATMOSPHERIC IRREGULARITIES

By C. R. Englund, A.B. Crawford, and W. W. Mumford, in The Bell System Technical Journal, October, 1938

Abstracted by J. L. Clarke, M.E.I.C.

Results of an ultra-short-wave fading study are here reported. Transmission was carried out in the range of 1.6 to 5.0 meters, over a 70 mile (112.6 kilometer) ocean path, on 106 days during a period of two years. Both horizontal and vertical polarizations were used and during part of the time a 6-megacycle amplitude, 120 cycle, frequency modulated transmission was added, for the cathode-ray tube observation of the frequency characteristics of the radio path. On 45 mornings records were taken, on vertically polarized radiations, during the flight period of the Mitchel Field Weather Bureau plane.

Fading was found present practically all of the time. Amplitude changes up to 40 db. and fading rates up to 5 fades per minute were found. Simultaneous transmission of the same wave in two polarizations, and of two waves of different wave-length in the same polarization showed that the horizontally polarized component was practically always, and the shorter wave-length one was usually the worse fader of the pair. The greater part of the time there was no correlation between the fading of these radiation pairs; occasionally, however, and for the slow, smooth amplitude, undulating type of fading, coincidence was observed. The frequency sweep patterns showed multiple signal components to be present, with various degrees of relative phase retardation.

A tentative explanation is proposed for these phenomena. This theory assumes the presence of a refracted-diffracted signal component, transmitted along the earth's surface and calculable in the manner of Wwedensky, Van der Pol and Gray, and one or more signal components reflected from air mass boundaries. The air-plane results are shown to be in reasonable agreement with the frequency sweep observations. Boundary heights from 5.5 kilometers down to 1.9 kilometers are measured; below 1.9 kilometers other boundaries are indicated. The receiver band, flat over two megacycles, sets the low height limit of resolution of reflecting boundaries at 1.9 kilometers.

A discussion is given of some observations of signal fading at various wave-lengths which have been reported by other observers, and which are apparently referable to the same mechanism as is here proposed.

SEVEN-FREQUENCY RADIO PRINTER

By. L. Devaux and F. Smets in Electrical Communication, July, 1938

Abstracted by J. L. Clarke, M.E.I.C.

Printing telegraph systems on wire lines use a telegraph code signal consisting of combination of (usually five) "marking" or "spacing" elements of equal duration. Such systems are not well adapted for radio use owing to the distorting effects of superimposed atmospherics.

The system described in this article employs a method of "scanning" or analyzing the printed character into a number of elementary lines consisting of dashes and spaces of varying length. The "lines" are differentiated by the frequencies of the currents used for their transmission. The system is thus not unlike facsimile transmission and is well suited to radio circuits since interference cannot change one letter into another which is totally dissimilar. The only effect of interference is to print small extra elements or to suppress small elements of the transmitted letters but as is well known a large amount of "bad" printing is possible without any impairment of intelligibility. The characters are more or less accurately reproduced depending on the strength of the interfering static. The system may be arranged to operate on the "start-stop" principle and is suitable for unattended operation.

SULPHATE OF AMMONIA IN 1937-38

The Colliery Guardian, December 30, 1938

Abstracted by A. A. Swinnerton, A.M.E.I.C.

The eighteenth annual report of the British Sulphate of Ammonia Federation, Ltd., for the year ended June 30, 1938, states that the world production of pure nitrogen for the fertilizer year ended June 30, 1938, was 2,880,000 metric tons, and the consumption was 2,872,000 metric tons. Both these figures were the highest ever reached, and represented increases of 6.8 per cent and 5.2 per cent respectively over the previous year. The production in Chile increased by 18,000 tons, or 9 per cent, and output in other countries increased by 165,000 tons, or 7 per cent. As in the previous year, the most marked increases in the output of manufactured nitrogen have been in Germany and the Japanese Empire, but in the U.S.A. there was a decrease. Synthetic nitrogen plants have on an average operated at only about 53 per cent of capacity during the year: the world production capacity for synthetic nitrogen, including cyanamide, is estimated at roughly 4,100,000 tons of nitrogen. The increase in fertilizer nitrogen consumption was 123,000 metric tons, or 5.2 per cent, as compared with 12.5 per cent in the previous year. Each main class of fertilizer showed an increase; ammonium sulphate (including ammonia for mixed fertilizers) increased by 59,421 tons of nitrogen, or 5.1 per cent over the 1936-37 figure. In individual countries the largest tonnage changes in fertilizer nitrogen consumption have been increases in Germany, the Japanese Empire, Spain and Italy, and decreases in the U.S.A. and China.

THE PETROLEUM PRODUCTS INDUSTRY IN CANADA, 1937

Dominion Bureau of Statistics

Abstracted by A. A. Swinnerton, A.M.E.I.C.

Forty-four petroleum refineries were in operation in 1937, seventeen in Saskatchewan, eight in Alberta, five each in Ontario and Quebec, three each in Manitoba and British Columbia, and one each in Nova Scotia, New Brunswick, and the Northwest Territories. These refineries had an operating capacity of 168,220 barrels per day, of which Quebec accounted for 41% and Ontario 24%. Fifteen establishments reported cracking units in use, with an aggregate capacity of 80,450 barrels per day.

In 1937, these refineries used 1,344 million gallons of imported crude oil and 90 million gallons of Canadian oil, a total of 1,434 million gallons, which was equal to about ⅔ of refinery capacity. About 70% of the crude oil refined came from the United States, 24% from other countries, and 6% from Canadian sources. The total cost of crude oil and naphtha charged to the stills was 75 million dollars.

Gasoline production in 1937 amounted to 640 million gallons, of which about 57% was straight run and 43% cracked. This production was the highest on record, being 13% greater than that in 1936, and was valued at the refinery at 59 million dollars. In addition, some 72 million gallons of gasoline were imported. Exports were negligible.

The production of gas and fuel oils amounted to 544 million gallons (almost equal to the gasoline production). In addition some 49 million gallons were imported and 11 million exported. Production of lubricating oils amounted to 24 million gallons, and imports to about 15 million gallons.

The capital employed in the refining industry was reported at 64 million dollars, the average number of employees at 5,047, and the total wages and salaries at 8 million dollars. The cost of raw materials and fuels was 84 million dollars, and the value of the products was 98 million dollars at the works.

The average wholesale tank-wagon price of medium grade gasoline varied from 14 cents per gallon in Montreal to 22.4 cents in Regina.

Over 38 million dollars were collected in gasoline taxes in 1937, of which 17.5 million dollars came from Ontario and 7 million dollars from Quebec. The gasoline tax was 10 cents a gallon in the three maritime provinces, 6 cents in Ontario and Quebec, and 7 cents in the other provinces.

The total of all motor vehicles registered in Canada was approximately 1,300,000 in 1937.

INDUSTRIAL RESEARCH AS A CAREER

In the course of an address on "Industrial Research as a Career," which he delivered recently before the Birmingham University Engineering Society, Mr. H. Warren, Director of Research, British Thomson-Houston Company, Limited, said that manufacturing and designing engineers had clearly defined aims upon the materialization of which the assessment of their success depended. The industrial research worker was largely engaged in discovering, trying out and establishing the practical feasibility of novel objectives suitable for the processes of development and production; or in working out better processes or overcoming difficulties concerned with existing objectives. Thus he, too, to a degree, had definite aims and not only the roving commission to prospect among the forces and elements of nature with which the profession of research was traditionally endowed. Nevertheless, the head of an industrial research laboratory knew well that future progress would be served most effectively by scientific discovery and was personally proud of his staff, who now and then had new knowledge to impart to scientific and technical men. Proof that a young man could execute specific jobs effectively and with initiative would best qualify him to follow a line of original research which might arise out of his work or to assist other more experienced men already engaged in such research. There was hardly a field of science or technology that was not included in the activities of a large industrial electrical research laboratory, and hardly a cultured realm to which its staff had not ready access or a class of scientific worker not represented among its visitors.

The practical commencement of a research job was a mental marshalling of what was already known about the subject. The beginner would probably have some relatively straightforward job of construction, observation or measurement to do for a senior man, who would explain what was required and help with the work. He would thus become interested in the main problem and would find much to learn. He should read, ask questions, and enter into the general objective, thus gradually becoming more useful. He should make contacts with the various technical departments of the company, attend and contribute to meetings of learned societies, and exchange visits with men in other laboratories. He should cultivate the arts of discussing and of expressing his thoughts clearly and briefly in writing; and should master the presentation of clear and informative reports. One of the most appreciated attributes of an assistant was the ability to get things done. At best, the efficiency of a research laboratory was bound to be low because only a small percentage of its ventures could be successful and even those that were rarely yielded the precise results that were sought. However, they provided information for future reference and were generally amply justified in time by the practically successful work.

As regards conditions of employment, a review of the salaries of average engineering, manufacturing, commercial and research men, of one to ten years' service, showed that there was no financial sacrifice attached to research work. In a concern with a long-sighted research policy, there was a prospect of continuous employment, special opportunities to acquire the latest scientific and technical knowledge, relative freedom of activity, and chances to develop originality, to make contact with a varied panorama of new ventures and to travel frequently.—*Engineering.*

Editorial Comment...

ON TO OTTAWA

About the time this issue of the Journal is delivered the Annual Meeting of the Institute will be in session at Ottawa.

It is going to be an unusual meeting in many ways. The Governor General and the Lady Tweedsmuir are to grace the occasion, and to take part in certain presentations. One of Canada's senior engineering statesmen will be awarded an Honorary Membership. The presidents and secretaries of four leading engineering bodies from across the border are to be our guests. One of the finest speakers—if not the finest—in our entire profession in North America is the speaker at the banquet. The Journal joins with the entire membership in welcoming these visitors to Canada and to the annual meeting.

The principal papers make up a symposium on one of Canada's greatest problems—drought on western farm lands. The problem is of more than western interest. It affects every citizen of Canada, and its solution in whole or in part will contribute untold millions to all parts of the country from coast to coast. It is hoped that the study sponsored by the Institute will result in a real contribution towards a solution.

The old proverb about "all work and no play" has not been forgotten. Many functions of a lighter nature have been arranged, as well as an elaborate programme which will be placed before the ladies. The Ottawa Branch is living up to its reputation as host and has prepared a two days programme which will establish a record that may not be equalled for a long time.

THE IMPORTANCE OF BASIC WATER RESOURCE DATA

The securing of dependable and systematic stream-flow and river run-off records is a matter of cardinal importance in the studying of the control of water for all the uses to which it can be put. This was recently emphasized by the drought problem in the west which forcibly brought home to those in authority in the service of the governments of the United States and Canada the tremendous importance of accurate, reliable and complete information regarding available water resources. It is fortunate that the methods adopted by the Water Resources Division of the United States Geological Survey and by the Dominion Water and Power Bureau of the Canadian Department of Mines and Resources are identical—the instruments of measurement are standardized; the same field and office systems are in use; and the same procedure is adopted for publication and distribution of the results. For this reason anyone interested in studying water resource problems is in the fortunate position of being able to depend on data that are reliable and uniform throughout all the provinces of the Dominion and all the states of the Union.

It is impossible to over-emphasize the value of the available information regarding the run-off and the capacities of the rivers of Canada and, in particular, those which flow through the area where precipitation has been temporarily low during the past few years. There is at least one fortunate phase of the drought problem which will form the subject of a symposium of papers before the 53rd Annual Meeting of the Institute, namely, the fact that the governments on both sides of the boundary have established similar basic systems of water analysis and measurement. It is of outstanding importance to the solution of some of the most vital problems in Canada, that the securing of this indespensable record of the character and extent of her water resources be aggressively carried on without any interruption whatever.

THE ENGINEER AND THE COMMISSION

Much has been written about the various phases of public service in which engineers may or should participate. "Their name is legion," and fortunately more and more engineers are contributing substantially to the welfare of society by active participation in public business.

One way in which the engineer may contribute effectively to the solution of public problems is through service on Royal Commissions. His training and outlook, involving, as they do, the habitual, systematic and unprejudiced weighing of formidable masses of apparently unrelated and conflicting facts and opinions and his uncompromising attitude where the truth is concerned are qualifications that should not be set aside lightly by governments. It is not too much to say that in the public interests any commission appointed to deal with a situation having a technological aspect, or one tinged with both technology and economics, should include in its membership an engineer.

The attitude has often been taken that the most valuable equipment for service of this kind is a knowledge of law. While this may be true where the matters in question are predominantly legal in character, many investigations by commissions require that the commissioners have a knowledge of technology or economics much more than that of law. This is apparent from the fact that Royal Commissions are not required to adhere strictly to court procedure and are privileged to obtain information from any source and in any manner that they see fit.

A recent instance of an important service of this type is afforded by the work of the Royal Commission on Transportation of the Province of Ontario. One member of the Institute sat as a member of the three-man commission and another member served as its engineer-economist.

The nature of the reference in this instance made it imperative that engineers should have an important part in dealing with the questions at issue. The commission was required to investigate and report upon all matters pertaining to the transportation of freight by motor vehicles, whether for gain, or not, and passengers by motor vehicle for gain, and to compare such operations with those of all competing forms of transport. This involved considerations for all forms of transport, of the magnitude of the tolls and rates charged and the manner of fixing them; taxes, licence fees or other imposts; wages and hours of labour; subsidies and grants.

Moreover, the commission was required to report upon the provisions that appeared necessary in order to ensure that just and reasonable service should be furnished to the people of the province and that there should be no unfair competition within the motor transport industry or with other forms of passenger and freight transportation. In addition, it was charged with determining the annual cost of constructing, maintaining and administering all public roads in Ontario, the part of such cost contributed by the municipalities and the extent to which the cost of such public roads should be met by the owners and operators of commercial motor vehicles.

In undertakings of this kind engineers of judicial temperament who possess a sound knowledge of the technical and financial matters involved may take part with definite advantage to the state. It is the earnest desire of all thinking citizens, that the recent example of the Province of Ontario may be followed in all similar investigations that may be decided upon from time to time in the future.

ROY—THE ENGINEERS' FRIEND

Members of the Institute who have had occasion while in Paris to call at the Canadian Legation will recall many kindly courteous considerations extended them by the retiring Canadian Minister to France. Following the First World Power Conference in London in 1924, the Hon. Mr. Philippe Roy entertained at a notable luncheon at the Cercle Interallie, many members of the Institute and their professional friends from the Continent. This perhaps was the first occasion on which the Institute participated in an important official function in Europe proper. As a result of this function, the Hon.Mr. Roy became a warm, interested friend of the Institute, and ever since he has been ready to advise and assist its members in either their professional or personal pursuits while in France.

The Journal therefore gladly voices the congratulations of the Institute to the retiring Minister to France upon the bestowal by the Municipal Council of the French Capital of the rarely-given distinction: "An Honorary Citizen of Paris." The bestowal of this distinction was one of the last of many functions given on the occasion of the departure of M. Roy from Paris. It was handed to him at a dinner in the historic Lauzon Residence of the City of Paris, in the presence of some 30 guests, representative of all aspects of the Capital's government, including Gaston le Provost de Launay, president of the municipal council, who presided; Foreign Minister Georges Bonnet; the Prefect of the Seine, Achille Villey-Desmesarets; Maurice Loze, Chief of Protocol at the Foreign Ministry; Senator Andre Honnorat and Professor Emile Sergent.

COUNCIL MEETING

A meeting of the Council was held at Headquarters on Monday, January 16th, at 8.00 o'clock.

There were present: President J. B. Challies, in the Chair; Vice-President J. A. McCrory (Montreal); Councillors R. W. Boyle (Ottawa), J. L. Busfield (Montreal), J. B. D'Aeth (Montreal), A. Duperron (Montreal), R. H. Findlay (Montreal), F. S. B. Heward (Montreal), W. A. Manock (Niagara Peninsula), F. Newell (Montreal), E. Viens (Ottawa); Treasurer de Gaspe Beaubien; Secretary Emeritus R. J. Durley, and the General Secretary. Dr. F. W. Gray, M.E.I.C., of Sydney, N.S., Past-President of the Association of Professional Engineers of Nova Scotia was present by invitation and was welcomed by the President.

The President made a report of progress being made for the joint engineering conference in New York in September, and a tentative programme for a three-day visit by the members of the British Engineering Institutions and their ladies, to points of engineering interest in Central Canada was discussed. While the general programme as submitted was approved it was decided to point out to the Committee on International Relations that consideration might be given to the possibility of the Institute acting as host to the visitors at some function while they are in Canada.

Mr. Newell, chairman of the Committee on Professional Interests, submitted a revised draft of the proposed agreement with the Association of Professional Engineers of Nova Scotia. Some minor modifications had been introduced since the last discussion and Council unanimously approved of the agreement with these modifications.

Vice-President McCrory submitted a draft of the report of the Finance Committee, and Treasurer de Gaspe Beaubien a draft of the Treasurer's report, both of which were approved for presentation to the annual meeting.

Reports of the various standing and Institute committees and of the Prize and Medal committees were submitted and accepted by the Council for presentation at the annual meeting. The President drew attention to the desirability of the student prizes being presented by Dean McKiel during his visits to the branches in such cases as had not been presented at the annual meeting. Mr. Newell expressed regret that it had been found impossible to recommend an award for the Duggan Medal and Prize, and thought something should be done to stimulate the presentation of papers by members of the Institute. Messrs. McCrory, Newell and the General Secretary were appointed a committee for this purpose.

The General Secretary made a report on progress regarding the registration of technically trained men for the Department of National Defence, the preliminary work in connection with which was being done by The Canadian Institute of Mining and Metallurgy, The Canadian Institute of Chemistry, and The Engineering Institute of Canada.

A communication was received from the National Construction Council advocating some plan of action for creating public opinion favourable to a reduction of taxation on real estate, and it was decided that the question was one which might well be taken up with the Canadian Chamber of Commerce, and the matter was therefore referred to F. S. B. Heward, A.M.E.I.C., our liason director with that organization.

The General Secretary was appointed The Institute's representative upon the National Canadian Committee of the World Power Conference.

The General Secretary reported a discussion with the publisher of the Financial Post regarding a special supplement entitled "Builders of Canada" which would be published without cost to the Institute, about the time of the International Engineering Congress in September. The Council approved of the proposal.

In accordance with provisions of the agreement with the Association of Professional Engineers of Saskatchewan, Council classified a number of members of the Association who had now become corporate members of the Institute. Twelve were placed in the class of Member, and thirty-four in the class of Associate Member. In addition there were three engineers "in training" who were classed as Juniors.

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

Elections

Members	3
Associate Members	9
Juniors	4
Students	11
Affiliates	1

Transfers

Associate Member to Member	3
Junior to Associate Member	4
Student to Junior	1

PRESIDENTIAL ACTIVITIES

The presidential visits to the twenty-five branches of the Institute were completed on January 10th, when Dr. Challies, Councillor Newell and the General Secretary addressed the members of the Headquarters' Branch following the installation of its 1939 Chairman, Mr. Kirkland McLeod, a son of a greatly esteemed former general secretary of the Institute, the late Professor C. H. McLeod of McGill University.

The President and Mrs. Challies were guests of the Toronto Branch at its annual Ladies' Night reception, dinner and dance at the Engineer's Club on Saturday evening, January 14th.

All forenoon at Headquarters, and through luncheon at the University Club, on January 15th, the President and President-elect, Dean McKiel, who came up from Sackville for the purpose, conferred with the committee in charge of arrangements for the 53rd Annual General Meeting. During the afternoon, they conferred at length with the Committee on Professional Interests regarding certain new proposals for a co-operative agreement with the Association of Professional Engineers of Nova Scotia.

On Monday evening, January 16th, the President presided at the regular meeting of Council, when the report of Council for 1938, and the reports of the Standing and Special Committees were prepared for presentation at Ottawa.

On Wednesday, January 18th, he attended the 86th Annual Meeting in New York of the American Society of Civil Engineers, when he was accorded a seat on the platform among the past presidents during the honorary membership ceremony, at the conclusion of which, President Riggs, M.E.I.C., formally presented him to the meeting, when Dr. Challies took advantage of the opportunity briefly to express the satisfaction and appreciation of the Council for the very cordial relations which exist between the Institute and the Society. During the evening of the same day, the President was the guest of Vice-President Malcolm Pirnie and of Director Carleton Proctor at the dinner and reception to the Society's new president and honorary members.

On Friday, January 27th, the President presided at a luncheon at the University Club when Past-President H. H. Vaughan and a few resident members of Council had an opportunity to meet Mr. F. Gill, of London, England. An account of Mr. Gill's purpose in visiting Headquarters is reported elsewhere.

At the Annual Smoker of the Montreal Branch on February 2nd, the President was afforded an opportunity to call attention to the special preparations that are being made to welcome at the Annual Meeting of the Institute at the Chateau Laurier, in Ottawa, on Tuesday afternoon, February 14th, a distinguished engineering delegation from the United States, including the President, the Past President and the General Secretary of the American Society of Civil Engineers; the President and General Secretary of the American Society of Mechanical Engineers; the President and General Secretary of the American Institute of Electrical Engineers, also the Chairman and the Assistant Secretary of the Engineers' Council for Professional Development.

On February 4th, in Toronto, the President was privileged to respond to the toast to the engineering profession at the annual banquet of the Association of Professional Engineers of Ontario. It is fitting that this was one of his last important official outside duties inasmuch as President Challies had much to do with the establishment of the Ontario Association.

ENGINEERING CO-OPERATION OVERSEAS

The Institute has received a communication from the Joint Committee on Engineering Co-operation Overseas, on which is represented—

The Institution of Civil Engineers.
The Institution of Mechanical Engineers.
The Institution of Naval Architects.
The Institution of Electrical Engineers.
The Institution of Municipal and County Engineers.
The Institute of Marine Engineers.
The Royal Aeronautical Society.
The Institution of Structural Engineers.

And reading as follows:—

"Consideration has been given recently by the British Engineering Institutions mentioned at the head of this letter, to the question as to whether there were any means whereby they could render greater service to those of their members who were resident abroad, and it is felt that something could be achieved in this direction by fostering co-operation between the overseas members of these institutions and where there is a local Engineering Institution in existence, between these members and that Institution.

"As a result a special joint committee, known as the Joint Committee on Engineering Co-operation Overseas, has been set up by these British Engineering Institutions charged with the duty of exploring the position in the various countries and promoting co-operation on the lines indicated wherever possible.

"At the last meeting of this joint committee consideration was given to the question as to whether anything could be done to foster such co-operation with the Engineering Institute of Canada. The committee realize that any such co-operation in Canada could only be attained through the kind assistance of your Institute and the committee will therefore be very grateful if your Council could, in the first instance, consider this matter with a view to suggesting what means, if any, they feel could be adopted to bring about some measure of co-operation between your Institute and the members of the British Engineering Institutions resident in your country.

"The chairman of the committee (Mr. F. Gill, who met the members of your Council some years ago) asks me to say that he expects to be in New York during February next and if it would be agreeable to your Council he would try to make it convenient to visit Montreal to discuss the matter."

(*Ed. note: The President, Vice-President Vaughan and some of the officers of the Institute met Mr. Gill at lunch on January 27th, and a very interesting discussion took place. The President assured Mr. Gill that the Institute would enthusiastically support any movement towards co-operation with the British Institutes*).

LETTER TO THE EDITOR

Sir:

As a Branch Non-Resident who has been employed for some time in the rural sections of Canada and consequently not in a position to take part in the discussions of the various branches, the writer finds the Engineering Journal to be very interesting. It has done much to further the interests of the young graduate engineer not only in the employment section but also through the discussions of papers relating to various branches of the profession.

A scheme has been in the writer's mind for some years, and unless released may turn into an obsession. The writer would therefore like to bring forward the suggestion now and would ask some one active in one of the branches who agrees, to present it in the form of a motion.

The idea is the introduction of an "Apprenticeship in Engineering Trades" for young Canadians somewhat on the lines of the training of artisans in the British Isles. Probably this has been discussed already in Montreal.

To-day the skilled artisan from the Old Country is not coming to Canada possibly due to better conditions prevailing in his own country.

At any small wayside station there are gathered youths watching the daily train, who have gone as far educationally as local schooling will allow them and who at present are being demoralized through lack of employment.

To gainfully employ these young men after a period of qualifying training, to rescue them from parents accepting gratuitous relief, would make useful citizens of them, and also fill in a gap in our industries. Engineering in Canada is rapidly approaching the state of a certain country the writer has in mind—too many generals and an insufficient number of sergeants.

The writer has discussed the situation with a resident engineer of Consolidated Mining and Smelting, which company has a praiseworthy scheme of apprenticeships, and also with old country artisans. The scheme would require some modification in Canada, but the discipline enforced in the English indentures is a fine feature.

In the writer's opinion the Institute as the foremost power in Canadian engineering is the logical body to sponsor the training of skilled mechanics. The Institute with its contact with Government and with industry is in a position to set the standard for skilled workmen to their mutual advantage, individually and collectively.

There is no doubt several members have given thought to this problem. In our country the great grandfather was behind the plough. The grandfather was a professional man, the father was a soldier, and the son is standing on the street corners. The son should be taught a trade.

Your very truly,

W. S. E. Morrison, A.M.E.I.C.

DISTINGUISHED VISITORS AT THE ANNUAL MEETING

DONALD H. SAWYER
President
American Society of Civil Engineers

A. G. CHRISTIE
President
American Society of Mechanical Engineers

JOHN C. PARKER
President
American Institute of Electrical Engineers

J. P. H. PERRY
Chairman
Engineers' Council for Professional Development

COL. WILLARD CHEVALIER
Vice-President
McGraw Hill Publishing Company

H. H. HENLINE
National Secretary
American Institute of Electrical Engineers

C. E. DAVIES
Secretary
American Society of Mechanical Engineers

GEORGE T. SEABURY
National Secretary
American Society of Civil Engineers

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

I. C. Barltrop, A.M.E.I.C., who has been assistant engineer with the Department of Public Works, British Columbia since 1935 has been transferred to the Highway Transport Branch of the Department and is now located in Vancouver.

H. J. Vennes, A.M.E.I.C., development engineer of the Northern Electric Company Limited, Montreal, has collaborated with Professor E. Godfrey Burr of the Engineering Department of McGill on the construction of the apparatus now being used in connection with research on deafness. This research work is being carried on at the Montreal General Hospital.

R. W. Dobridge, A.M.E.I.C., has recently been appointed district engineer for Alberta and British Columbia of the Canadian Pacific Telegraphs with headquarters at Calgary, Alta. Prior to accepting this position Mr. Dobridge was transformer engineer with the Canadian Marconi Company in the Town of Mount Royal, Que.

Reginald Mudge, A.M.E.I.C., for a long time assistant engineer in the chief engineer's office, Canadian Pacific Railway, has been appointed assistant engineer of track. Mr. Mudge has been with the Canadian Pacific Railway since 1910 when he entered the construction department as instrumentman. He was promoted to the positions of resident engineer and assistant engineer successively, and later to the position from which he is now promoted.

R. B. Jones, A.M.E.I.C., is the newly appointed engineer of track of the Canadian Pacific Railway. He has been with the company since 1910 when he entered as draftsman and transitman under J. E. Armstrong, A.M.E.I.C. He was promoted to the position of assistant engineer in 1919, which position he has ably filled to the time of his recent promotion.

C. R. Young, M.E.I.C., Professor of Civil Engineering at the University of Toronto, and **Norman D. Wilson,** M.E.I.C., consulting engineer, Toronto, have been engaged in the work of the Royal Commission on Transportation of the Province of Ontario, which has recently reported upon basically important problems of commercial highway transportation in the province. The former sat as one of the three commissioners; the latter rendered valuable service as the commission's engineer-economist.

Brian T. O'Grady, M.E.I.C., has received the appointment of superintendent of Brokers' Office, Department of Mines, British Columbia, and will be located at Victoria. He has been with the British Columbia Government since 1919 in the positions of highway locating engineer, assistant resident mining engineer, resident mining engineer and on the Coast District Mineral Survey.

Dr. F. D. Adams, Hon.M.E.I.C., emeritus vice-principal of McGill University, former dean of the Faculty of Applied Science and Graduate Studies and Logan Professor of Geology, has been awarded the Wollaston Gold Medal by the Geological Society of Great Britain. This is the highest distinction which the society can award for geological work and is in recognition of the work of Dr. Adams over a long series of years, which has just culminated in the writing of an exhaustive history of geology.

The Honorable Michael Dwyer, A.M.E.I.C., has recently accepted the presidency of the Nova Scotia Steel and Coal Company. Throughout his professional career, Mr. Dwyer has been associated with Nova Scotia's coal and steel industry, having been for many years with the Nova Scotia Steel and Coal Company previous to his becoming a member of the Provincial Legislature. He occupied the positions of mechanical superintendent, manager of the Princess colliery, manager of the wash plant and coke ovens, assistant works superintendent and general superintendent. In 1924 Mr. Dwyer was appointed president of the Indian Cove Coal Company at Sydney Mines, N.S., which office he held until 1932 when he entered on his political career.

W. E. MacLennan, A.M.E.I.C., has been appointed building inspector and inspector of weights and measures by the City of Fort William, Ont. Mr. MacLennan was formerly assistant resident engineer of Lake Sulphite Pulp Company at Red Rock, Ont.

Past Presidents **J. M. R. Fairbairn** and **H. H. Vaughan,** Secretary Emeritus **R. J. Durley** and **Dr. J. B. Porter,** MM.E.I.C., have been accorded Honorary Life Memberships in the Canadian Engineering Standards Association in recognition of valuable services which have been given by them during the past twenty years.

VISITORS TO HEADQUARTERS

We were pleased to see **G. R. Duncan,** A.M.E.I.C., Past Chairman of the Lakehead Branch, and also to note that the Montreal Star gave prominence to an interview with him dealing with the shipment of grain on the Great Lakes.

On two occasions recently **C. C. Kirby,** M.E.I.C., President of the Dominion Council of Professional Engineers, visited headquarters and we had the opportunity of discussing many matters of mutual interest, especially on his second visit when the Registrar of the Corporation of Professional Engineers of Quebec, C. L. Dufort, was also present.

Dean H. W. McKiel, M.E.I.C., President-Elect, spent the week-end of January 14th in Montreal meeting a number of officers and generally discussing matters of importance to the Institute, such as the negotiations with the Association of Professional Engineers of Nova Scotia, arrangements for the annual meeting, and so forth.

Reginald W. McColough, M.E.I.C., chief engineer, Department of Highways for Nova Scotia, was in Montreal on January 28th and found time to visit Headquarters to discuss Institute affairs in his province.

H. J. A. Chambers, A.M.E.I.C., Councillor from the Border Cities Branch, visited headquarters and also had a conference with the President.

L. McK. Arkley, M.E.I.C., Professor of Mechanical Engineering of Queen's University, Kingston, visited us during the holiday season and as Professor Arkley is one of the advisory members of the Publication Committee we had many matters of mutual interest to discuss.

Among other recent visitors who have taken the opportunity of looking over the redecorated headquarters have been **W. E. Cooper,** S.E.I.C., **J. M. McCarey,** Jr.E.I.C., **F. L. Lawton,** M.E.I.C., **K. R. Chestnut,** M.E.I.C, **Allan R. Crookshank,** M.E.I.C., and **Col. W. C. Sherman,** M.E.I.C.

Obituaries

It is with deep regret and sympathy to relatives that the following deaths are recorded:

Senator Joseph Philippe Baby Casgrain, A.M.E.I.C., at his home in Montreal on January 6th. He was born at Quebec on March 1st, 1856, and educated at the Seminary of Quebec from which he graduated in civil engineering. In 1874 he entered the employment of the Canadian Pacific Railway on survey work, and after a year on location and construction he went to Philadelphia as assistant secretary of the Canadian Department of the Philadelphia Centennial Exposition. When he returned to Canada he began work on the design of the St. Lawrence and Pacific viaduct and railroad ferry from Ile Ronde to Longueuil for connection with the railways on the south shore of the Island of Montreal.

In 1879 he was engaged on extensive surveys for the Quebec Government and later in Newfoundland for the government railway there. He had already received his commission as Quebec Land Surveyor in 1878 and in 1881 he qualified as a Dominion Land Surveyor and later was admitted to the practice of land surveying in Ontario and Manitoba, where he was engaged in work for the Dominion Government.

On the completion of this work he became chief engineer of the Montreal Turnpike Trust Company and for four years he was in charge of bridge building and other works on the Island of Montreal.

In 1892, he became chief engineer of the Montreal and Pacific Junction Railroad which position he retained for some years.

In 1900 Senator Casgrain was summoned to the Senate representing the district of deLanaudiere, Quebec, and two years later was appointed a member of the Ottawa Improvement Commission. He had the distinction of being one of the representatives of the Canadian Senate at the coronation of Their Majesties King George V and Queen Mary in June, 1911.

The late Senator was well-known for his interest in various aspects of modern transportation, and in 1910 he wrote a book entitled, "The Problems of Transportation in Canada." He frequently contributed to the debate in the Senate when the subject of transportation matters was under consideration.

Senator Casgrain was on the board of a number of transport and industrial concerns. He was president of the Northern Montreal Land Company, the Northern Montreal Centre Company and the Birnham Realty Company, of the Montreal Herald Publishing Company, and a director of the following concerns: Montreal Light, Heat & Power Consolidated; Canada Steamship Lines; Dominion Steel & Coal Company; Canada Cement Company; Montreal Tramways & Power Company; Quebec Power Company, and the Montreal Life Insurance Company.

Senator Casgrain joined the Canadian Society of Civil Engineers in 1895 as Associate Member, and was made a Life Member of The Engineering Institute of Canada in 1936.

William Gardiner Yorston, M.E.I.C., at Nevada, Mo., on October 5th, 1938. Born at Truro, N.S., on February 7th, 1867, he received his early education at Pictou Academy. Upon graduating from the Royal Military College in 1886, he was the recipient of the Governor-General's Gold Medal and the Sword of Honour. During his career as an active engineer from 1887 to 1918, Mr. Yorston remained in Nova Scotia where he built up an enviable reputation as an engineer of high attainment.

He spent the first three years after graduation in railway work, being employed by the Gatineau Valley Railway, the Springhill and Oxford Railway and the Newfoundland Government Railways successively. He then became engaged in various municipal work and surveys for water supply. In 1892 he was placed in charge of construction of water and sewer systems in the town of Dartmouth, and later those in the Town of Parrsborough. In 1899 he went to Sydney, having been assigned to the construction of a water supply for the Dominion Steel Company, which had commenced operations in that city. Upon the completion of this work he became city engineer of Sydney, N.S., which position he retained until 1908 when he became engaged in general engineering practice, principally hydraulic work in the design and construction of water power plants. By 1913 he was generally acknowledged as the leading hydraulic engineer in the province and received the appointment of chief engineer of the Public Works Department of the Province of Nova Scotia. In 1918 he was transferred to the newly created Highway Board as chief engineer, but he was compelled to resign shortly after owing to ill health.

Mr. Yorston joined the Canadian Society of Civil Engineers as a Member in 1914.

ELECTIONS AND TRANSFERS

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

Members

Bird, William Lister, vice-president and general manager, Kaministiquia Power Co. Ltd., Fort William, Ont.

German, Horace Henry, (Royal Naval College, Greenwich), consltg. naval architect, Lambert, German & Milne, Montreal, Que.

Hull, Arthur Harvey, B.A.Sc., (Univ. of Toronto), acting chief elect'l. engr., H. E. P. C. of Ontario, Toronto, Ont.

Associate Members

Bird, William Henry Stephenson, Bach. Aero. Engrg., (Univ. of Minnesota), chief dftsman., aviation divn., Canadian Car & Foundry Co., Fort William, Ont.

Carriere, Jean P., asst. engr., Public Works of Canada, London, Ont.

Kay, William, (Bury Municipal Technical School), master mechanic, Price Bros. & Co. Ltd., Riverbend, Que.

***Kemsley,** Sydney Hyde, surveyor, Public Works Department, Hamilton, Bermuda.

Morrison, Robert Laurance, B.A.Sc., (Univ. of B.C.), mech. designer, Consolidated Mining and Smelting Co. of Canada Ltd., Trail, B.C.

Proudfoot, W. Bradley, B.A.Sc., (Univ. of Toronto), engr., Railway and Power Engineering Corpn. Ltd., Montreal, Que.

Spencer, Brian Roff, Lieut.-Commander(E), R.C.N., (Royal Naval Engrg. Coll., Devonport), Engineer Officer, H.M.C.S. "Saguenay," c/o Dept. of National Defence, Naval Service, Ottawa, Ont.

Taylor, Willard Davidson, B.Sc., (McGill Univ.), engr., Railway and Power Engineering Corpn. Ltd., Montreal, Que.

Young, Loyola Currie, B.Sc., (N.S. Tech. Coll.), elect'l. engr., Nova Scotia Light & Power Company, Halifax, N.S.

Juniors

Ball, Elmer Langdon, B.Eng. (Civil), (N.S. Tech. Coll.), junior engr., Engineering Service Company, Halifax, N.S.

Inglis, William Leishman, B.A.Sc., (Civil), (Univ. of B.C.), struct'l. steel detailer, Western Bridge Company, Vancouver, B.C.

Russell, Earl Albert, B.A.Sc. (Civil), (Univ. of Toronto), demonstrator in surveying, University of Toronto, Toronto, Ont.

Taylor, Thomas Franklin, B.A.Sc., (Univ. of Toronto), dftsman., Richards-Wilcox Canadian Company, London, Ont.

Affiliate

Beckett, Russell MacDonald, electrician in charge at Port of Churchill, National Harbours Board, (Home), 327 So. Mark St., Fort William, Ont.

*Has passed the Institute's examinations.

Transferred from the class of Associate Member to that of Member

Dunsmore, Robert Lionel, B.Sc. (Civil), (Queen's Univ.), supt., Halifax Refinery, Imperial Oil Limited, Dartmouth, N.S.

Pitts, Gordon MacLeod, B.Sc., M.Sc., B.Arch., (McGill Univ.), partner of firm, Maxwell & Pitts, Montreal, Que.

Wilson, Harry Alton, (Grad. S. P. S., Univ. of Toronto), charge of engrg. sales, Canada Foundries & Forgings Ltd., Welland, Ont.

Transferred from the class of Junior to that of Associate Member

Duchastel de Montrouge, Leon Alexandre, B.A.Sc., C.E., (Ecole Polytechnique, Montreal), power sales engr., Shawinigan Water & Power Company, Montreal, Que.

Regan, Francis Edward, (Associate, Royal Salford Tech. Coll.), Ontario Manager, Bepco Canada Limited, Toronto, Ont.

Timleck, Curtis James, B.A.Sc., (Univ. of B.C.), sales engr., Canadian Ingersoll Rand Co. Ltd., Winnipeg, Man.

Yeomans, Richard Henry, B.Sc., (McGill Univ.), asst. dial apparatus engr., Northern Electric Co. Ltd., Montreal, Que.

Transferred from the class of Student to that of Junior

Hart, Herbert Trench, B.Eng. (Elec.), (McGill Univ.), asst. mgr., Jamaica Theatres Ltd., Kingston, Jamaica, B.W.I.

Students Admitted

Campbell, John Graham, (Queen's Univ.), 1841 Chilver Rd., Windsor, Ont.

Davis, Harold Arthur, B.Sc., (Queen's Univ.), laboratory instructor, Queen's University, Kingston, Ont.

Dixon, Howard Henry, (Univ. of Man.), 246 Dromore Ave., Winnipeg, Man.

Duncan, Frederick Robert, (McGill Univ.), 3653 University St., Montreal, Que.

Furanna, Anthony L., (Queen's Univ.), 732 Wellington St., London, Ont.

Gregory, Arthur Herbert, (Univ. of Man.), 451 Dominion St., Winnipeg, Man.

Gusen, Aaron, (Univ. of Man.), 432 Aikins St., Winnipeg, Man.

Hunt, George Robinson Myers, (R.M.C.), Royal Military College, Kingston, Ont.

Mitchell, Earl Roe, (Queen's Univ.), 161 Connaught Ave. No., Hamilton, Ont.

Porter, Earle Fredrick, B.Eng. (E.E.), (N.S. Tech. Coll.), student ap'tice., Canadian Westinghouse Company, Hamilton, Ont.

Swan, Andrew M., (Univ. of Man.), 728 Warsaw Ave., Winnipeg, Man.

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*

The Annual Meeting and election of officers of the Branch was held on December 9th, following a dinner in the Prince Edward Hotel.

Following branch custom at annual meetings, the chairman then presented Geo. A. McCubbin, m.e.i.c., with a Member's gold button. Mr. Krebser paid tribute to Mr. McCubbin's contributions to the profession—Forty-three years a surveyor, engineer, expert in drainage, irrigation, and hydraulics, Mr. McCubbin had given of his time and his thought to his profession—the highest exemplification of professional engineer.

Mr. Newman introduced Mr. McCubbin, his friend of many years' standing, referring to the scope of Mr. McCubbin's practice, and described him as an outstanding authority in the Province of Ontario in his specialty of drainage engineer and in the law of municipal engineering.

Mr. McCubbin then spoke, giving many reminiscences on his years of practice. He recalled his first trip to Windsor by stage-coach to try his entrance examinations, his apprenticeship to land surveying and the early years of his practice. He commented on the prejudice of the older engineers to acceptance of theory and mathematics and the gradual break from empirical methods of hydraulic design to the present accepted methods of rational mathematical design. There followed descriptions of survey expeditions to Lake Abitibi in the early days of the century illustrated by lantern slides. The development of land drainage under the two Ontario Statutes, the Ditches and Watercourses Act and the Municipal Drainage Act was explained and illustrated by his work for the Canada Company's drain at Grand Bend on the Au Sable River, the Raleigh Plains Drain, the Vespra Swamps Drain on the Nottawasaga River, and the evolution of the various methods for land drainage projects on large scale, gravity schemes, dyking and pumping, together with the advance of mechanical equipment for prosecuting the work, dredges, drag lines and steam shovels.

He concluded his sketch of his experiences by showing a number of very beautifully executed coloured slides illustrating some of the many lectures he has given on literary subjects. These slides depicted many scenes from the English classics, of Milton, Tennyson, Mallory, the Scottish Poet Burns, and his own researches into the classical mythology of Homer and the ancient Greeks—revealing the scholar and philosopher and humanist in addition to his role of civil engineer.

EDMONTON BRANCH

F. A. Brownie, a.m.e.i.c. - *Secretary-Treasurer*
J. W. Porteous, Jr.e.i.c. - *Branch News Editor*

A dinner meeting of the Edmonton Branch was held in the Macdonald Hotel on Thursday, December 15, at 7.00 p.m. There were about 24 members present. W. E. Cornish, a.m.e.i.c., the branch chairman, introduced the speaker, Professor H. R. Webb, m.e.i.c., who gave a very interesting paper on **"Engineering Models."**

The first part of the paper was taken up with the consideration of the mathematical background necessary for the proper scaling of models. Following this, pictures of a great number of models were shown and discussed. These included Boulder Dam, Grand Coulee Dam and the particularly interesting model of the Rangoon Harbour.

This model, constructed in London, covers the territory surrounding Rangoon, Burma, which is located at the mouth of the Rangoon river. The most interesting point to most of those present seemed to be the fact that this model was used to predict how deposit and erosion would affect the harbour in future years. Corrective measures could then be adopted.

HALIFAX BRANCH

At the annual meeting of the Halifax Branch which was held in December, 1938, the retiring chairman, I. P. Macnab, m.e.i.c., reviewed the activities of the branch during the year 1938. He made a special reference to the visit of G. J. Desbarats, hon. m.e.i.c., as this was the first occasion on which the President of the Institute had been present at the annual meeting of the branch.

Mr. Macnab also referred to visits to the branch by Dean H. W. McKiel, m.e.i.c., Vice-President; President and Mrs. J. B. Challies, Vice-President J. A. McCrory, Mr. F. Newell, and Mr. L. Austin Wright, and expressed his appreciation of the good accomplished by such visits.

HAMILTON BRANCH

A. R. Hannaford, a.m.e.i.c. - *Secretary-Treasurer*
W. E. Brown, Jr.e.i.c. - *Branch News Editor*

The annual meeting and dinner of the branch was held at the Rock Garden Lodge on Friday, January 13th. There were 61 members and guests present and the visitors included C. E. Sisson, m.e.i.c., chairman of the Toronto Branch; C. G. Moon, a.m.e.i.c., and G. E. Griffiths, a.m.e.i.c., Chairman and Secretary of the Niagara Peninsula Branch; W. P. Dobson, m.e.i.c., President, and E. P. Muntz, m.e.i.c., Past President of the Association of Professional Engineers of Ontario. The dinner was presided over by the retiring chairman, W. J. W. Reid, m.e.i.c.

An address on **The Buttress of Humour** was given by Frank Dowsett, advertising manager of the Gutta Percha and Rubber Company. The many prolonged laughs were a tribute to the humourous side of the subject, but the author also had a serious message to deliver. He defined humour as the ability "to laugh with people rather than at people." Humour, like gold, has an intrinsic value; in times of adversity, happy the man with a sense of humour, which was the backbone of the ranks in the front lines during the Great War. With the aid of many clever and often amusing stories the speaker proved that a keen sense of humour was a necessary asset to our business, family and national life, and as food for thought closed his talk with this equation, "Enthusiasm minus Humour equals Fanaticism."

Following this address a delightful entertainment was given by eight little girls, the bell ringers of West Hamilton Public School. Bell ringing is an old English village custom and this recital proved that the art is by no means lost. L. L. Merrill, Branch Affiliate, also gave an amusing reading on "The Art of Golf."

At the subsequent business session the election of officers for the Year 1939 took place and J. R. Dunbar, a.m.e.i.c., was elected Chairman. (*Ed. Note: For other officers of the Branch* *see Page 51.*)

A vote of thanks was moved by Mr. Muntz to McMaster University for their work in the community and for the courtesies extended to the Hamilton Branch of The Institute. Mr. Dobson expressed his appreciation to the branch for the work being done to further the usefulness of the engineering profession.

LAKEHEAD BRANCH

H. Os, a.m.e.i.c. - *Secretary-Treasurer*

The regular monthly dinner meeting of the branch was held at the Prince Arthur Hotel, Port Arthur, December 21st, 1938.

The speaker of the evening was R. B. Chandler, m.e.i.c., manager of the Public Utilities Commission, City of Port Arthur, giving an address on **"Manual and Automatic**

Telephone Systems." Mr. Chandler briefly outlined the history of the telephone since its invention by Alexander Graham Bell in 1876, to the present day. "There are two types of central telephone equipment available to-day," he said, "manual and dial or automatic telephone. The automatic system is the progressive system of to-day and where conditions are such that it can be proved in for any community, the installation of any other system would be retrogressive and not in trend with the times," he contended. Mr. Chandler further mentioned that several cities in Canada with a population of only around 1,000 stations had automatic telephone installations.

A short discussion followed, various members asking questions and voicing their opinion of the relative merits of the two systems.

E. L. Goodall, A.M.E.I.C., chairman of the Branch, presided.

LONDON BRANCH

D. S. Scrymgeour, A.M.E.I.C. - *Secretary-Treasurer*
Jno. R. Rostron, A.M.E.I.C. - *Branch News Editor*

The regular monthly meeting was held on the 14th December in the board room of the Public Utilities Commission at the City Hall. The speaker of the evening was Vice-President E. V. Buchanan, M.E.I.C., who gave a descriptive talk on his trip to England and Scotland while attending the International Engineering Congress at the Glasgow Exhibition and at Torquay and London in 1938. The Chair was taken by J. Ferguson, A.M.E.I.C.

Mr. Buchanan pointed out that his talk would be a personal and social one as the main matters in connection with his visit to the International Engineering Congress had already been embraced in his report to Council, and which was published in the October number of the Engineering Journal.

Speaking of the exhibition itself he described it as a very fine show and well managed. It was situated in a park just outside Glasgow and covered 225 acres. The grounds were well laid out and made beautiful by a profusion of flowers; at many points fountains had been installed throwing jets of aerated water many feet into the air and adjusted to give various geometrical curves of fine spray which when illuminated at night with different colours gave a wonderful show. The exhibition buildings were coloured and illuminated also, the whole presenting a beautiful and entrancing spectacle.

The engineering pavilion was the largest and full of machinery of all kinds. An amusing feature was the installation of a number of models without attendants to explain them—however, the mystery was solved when he found that by inserting a penny in the slot the model worked and a gramophone described it.

In Colonial Avenue the largest pavilion was the Canadian.

Regarding Glasgow itself, he described some of the slum areas which were terrible in their squalor; however, great progress had been made in the clearance of many of these areas and in a re-housing scheme of which almost full advantage was being taken by the former slum dwellers. He also spoke of the return of the Kilt which is now being extensively used for sports wear.

His visit to the Electrotechnical Session at Torquay is fully described in his report in the October number of the Journal. Outside of this he recounted a conversation he had with one of the Germans who was present and this man spoke in high praise of the efficiency of his own country and advised a visit to see it, but, he explained, Germans were not allowed to visit other countries in their holidays. When business—such as the present—necessitated a visit to another country they were not allowed to bring their wives and were limited to very meagre expenses.

At London, Mr. Buchanan gave a humourous account of the officialdom which prevailed and seriously hampered him in doing what he had to do in a short time. However, he said there was no doubt that they did things well.

He and his wife and daughter greatly enjoyed their visit to Buckingham Palace in response to the King's invitation to the Colonial visitors. They were presented to His Majesty and had a short chat with both the King and Queen Mary, who was entertaining in Queen Elizabeth's absence, enforced by the death of her mother. The reception was held in the Gardens of the Palace and was enlivened by the music of the Scots Guards. The King addressed the visitors in a short speech.

He also attended the British Standards Institution dinner at the Guild Hall where the delegates were received by the Lord Mayor and Sheriffs. The guest of honour at the head table was H.R.H. the Duke of Kent. It gave one a thrill to take part in a function of this kind within the walls of London's historic Guild Hall some 700 years old.

Mr. Buchanan related many incidents, some of them against himself, in his customary humourous style and his talk was much enjoyed.

A conversational discussion followed the speaker's address and one of the points brought out was the high taxation levied in the Old Country on real estate as well as income.

A vote of thanks to the speaker was proposed by J. R. Rostron, A.M.E.I.C., seconded by W. R. Smith, A.M.E.I.C., and unanimously carried.

Sixteen members and guests were present, amongst the latter being E. P. Muntz, M.E.I.C., President of the Ontario Association of Professional Engineers.

The annual meeting of the branch was held on Wednesday evening, January 25th, and was preceded by a dinner at the Glen Allen Restaurant, Glendale, attended by over fifty members of the branch and their friends, including His Worship Mayor Johnston of London. Owing to his unfortunate indisposition the retiring chairman of the branch, A. O. Wolff, M.E.I.C., was unable to be present and the chair was ably filled by H. F. Bennett, M.E.I.C., who was subsequently elected to the office of Branch Chairman.

Following the dinner the Mayor welcomed the gathering in a few well chosen words. Vice-President E. V. Buchanan, M.E.I.C., presented the valedictory of the retiring chairman Mr. Wolff (and incidentally joined in a little repartee with the chairman over the quality of the street lighting of the City of London) and received from the Branch Secretary a gold membership badge for presentation to Mr. Wolff in recognition of his services to the branch.

Mr. Bennett expressed the sense of loss that the branch sustained through the transfer of Mr. Wolff to Toronto, and referred in particular to the able way in which the annual general meeting of the Institute held in London in February, 1938, had been organized.

The gathering was addressed by J. L. Busfield, M.E.I.C., managing director, Gardner Engines (Eastern Canada) Limited, of Montreal, on the subject **Diesel Engines and Their Modern Applications.** The speaker first of all explained that in general the use of the diesel engine was an economic problem, rather than mechanical or engineering, and gave some examples to show that both capital and operating costs had to be taken into proper consideration. Mr. Busfield then presented a number of lantern slides illustrating applications of the diesel engine in stationary installations, in boats, in automotive vehicles, locomotives and railcars, following which there was a general discussion in which many of the members and visitors present took part.

At the subsequent Annual Meeting of the branch, H. F. Bennett, M.E.I.C., was elected Chairman, W. E. Andrewes, A.M.E.I.C., Vice-Chairman. (Ed. Note: *For other officers elected, see page 52.*)

Mr. Busfield in his capacity as Chairman of the Publication Committee of the Institute was asked to say a few words about the changes in The Engineering Journal. The meeting passed a resolution expressing its appreciation of the improvements which have been made.

MONTREAL BRANCH

E. R. Smallhorn, a.m.e.i.c. - *Secretary-Treasurer*

On Thursday, January 5th, H. F. Lambart, m.e.i.c., addressed the branch on "**Exploration and mapping of the hitherto little known mountains of the South Nahanni River, N.W.T., by the Harry Snyder Canadian Expedition of 1937.**" He explained the difficulties involved in sending a survey expedition to the rugged and little known sections of Canada. Having been attached to the Department of the Interior, Ottawa, as one of the surveyors of the Alaska-Yukon boundary, and having accompanied the Harry Snyder Canadian Expedition of 1937, Mr. Lambart was fully qualified to speak on this subject and to make it a most interesting one to the audience. Lantern slides and moving pictures illustrated the lecture.

C. C. Lindsay, m.e.i.c., presided at this meeting which was preceded by a courtesy dinner at the Windsor Hotel.

The annual general meeting of the branch was held January 12th, at which the general business of the branch was discussed, the report of the retiring executive and the financial statement presented and the new officers installed. C. K. McLeod, a.m.e.i.c., was elected chairman for 1939 and Ernest Gohier, m.e.i.c., vice-chairman. Vacancies on the committee were filled by R. S. Eadie, m.e.i.c., J. G. Chenevert, m.e.i.c., and Gordon McL. Pitts, m.e.i.c.

At this meeting President Challies made his official visit to the branch and in a most interesting manner, outlined the trend of organized engineering in Canada, as indicated by his recently completed visits to the 25 branches of the Institute and his discussions with the Founder Societies of the United States. Councillor Fred Newell also addressed the branch, explaining the progress towards a closer relationship between the Institute and the eight provincial associations.

Through the courtesy of Imperial Oil Limited a motion picture, "**Safari on wheels,**" was shown to the branch. Refreshments were served at the close of the meeting.

On January 19th the Montreal Branch was addressed by James McIsaac on the subject of "**Fire Prevention in Montreal.**" Mr. McIsaac has been chief of the Fire Prevention Bureau of the City of Montreal since 1921. This organization reports that the number of fires per 100,000 population has decreased from 476 to 240 per year, during the years since 1913 when the Bureau was organized. The lecture covered fire hazards found in Montreal, and particularly those arising due to cold weather. Special references to fire prevention during construction, for various types of heating systems, and in public buildings, etc., were made. A. J. Farrell, a.m.e.i.c., presided.

NIAGARA PENINSULA BRANCH

G. E. Griffiths, a.m.e.i.c. - *Secretary-Treasurer*
J. G. Welsh, s.e.i.c. - - *Branch News Editor*

On December 8, 1938, the Niagara Peninsula Branch met with the Niagara District Chemical and Industrial Association for the annual joint meeting at the Leonard Hotel, St. Catharines.

C. G. Moon, a.m.e.i.c., chairman of the branch, presided. Paul Buss, a.m.e.i.c., introduced the speaker of the evening, A. D. Hopkins of the Canadian Johns-Manville Company. Mr. Hopkins presented a sound film on the subject, **Heat and Its Control.**

Heat is transferred in three ways. In the first place, by radiation. This was exemplified by the open fire. Heat was accompanied by the acceleration of the molecules of which the substance was composed. As the molecules near the fire were accelerated, they bombarded those in contact, thus imparting energy, and thus radiating the energy, heat. It was shown that heat followed the laws of light.

The second manner of heat transfer was by convection. A box with one side cold and the other side heated portrayed the fact that warm air flows up and cold down, and that still air is set in motion by differences in temperature in different regions.

The third manner of heat transfer was by conduction. This is motion of heat similar to radiation but in the substance itself. There was a great variation in the thermal conductivity of substances. Thus some lent themselves to use as conductors while others as insulators.

A heat insulator must have resistance to shock, that is, it must not be injured by sudden changes in temperature; it must not have excessive expansion or contraction. In some cases it must be resistant to weathering, vermin, vibration, water absorption, or mechanical abrasion. But in all cases it must be a poor conductor, and be very porous and the cell walls thin. The smaller the pores the better. This reduced the convection and radiation losses and offered greater resistance to conduction by reducing the area. As a result four basic materials make up practically all insulators. These are asbestos, magnesium carbonate, diatomaceous silica (celite), and rock or mineral wool.

Rock wool is the most widely used for low temperature work. It may be formed into batts for application in new construction or into nodules for blowing under pressure into the normally hollow walls of existing structures. Four inches of this rock wool are as effective an insulator as eleven feet of solid stone. Tests have shown that a home thus insulated will be up to 15% cooler on the hottest summer days, and savings on fuel bills up to 30%. In railroad passenger and refrigerator cars another inherently water-repellant insulator in the form of chemically cleaned cattle hair, felted between fabrics of various types is used. Its high insulating efficiency is due to the interlacing of the hair to form minute air pockets.

The standard insulation for steam lines, and general work up to about 600°F. has been a combination of asbestos fibre and magnesium carbonate. This 85% magnesia insulation can be molded or in slab form to suit requirements.

Another insulating material with an asbestos base is available for temperatures up to 700 F., where immunity to the effects of vibration and rough handling, sustained high insulating effectiveness in service, and unusually high salvage value is desirable. Known as asbesto-sponge felted, and produced in sheet, block or pipe insulation form, this material is built up of felts composed of asbestos and small particles of spongy cellular material. It owes its remarkable insulating efficiency to the great amount of entrapped dead air and the many surfaces interposed in the path of heat flow.

For temperatures up to 1,900°F. a carefully selected and calcined celite is blended and bonded with asbestos fibres, whose inherent strength and permanence due to their mineral composition, gives the celite and asbestos the qualities necessary to allow its molding into blocks and pipe insulators of any desired size and thickness.

For temperatures up to 2,500°F. the pure celite is ground, pugged, pressed and fitted in kilns, and then molded as desired.

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 12, 1939, at the auditorium of the National Research Laboratories. Reports for the past year were presented and officers elected for the ensuing year. W. F. M. Bryce, a.m.e.i.c., retiring chairman, presided.

The secretary-treasurer's report, presented by R. K. Odell, stated that the branch was in a sound financial condition, and that the total membership is now 339 resident and 86 non-resident members. Feeling reference was made to the loss suffered through the death during the year of R. L. Haycock, m.e.i.c., and Lieutenant Commander Charles Stephen, a.m.e.i.c.

In accordance with the motion passed at the last Annual Meeting the branch as usual donated two sets of draughting instruments to the Ottawa Technical School for presentation as prizes for proficiency in draughting. F. H. Peters, M.E.I.C., personally presented the prizes to the successful students. A copy of "Standard Handbook for Electrical Engineers" was also sent to the Hull Technical School to be awarded to one of its students.

Thanks were expressed to B. H. Segre, A.M.E.I.C., for his work as auditor.

P. Sherrin, A.M.E.I.C., reported for the membership committee and Squadron Leader A. L. Ferrier, A.M.E.I.C., outlined the work of the Aeronautical Section. J. L. Rannie, M.E.I.C., also reported in connection with the work of his special committee on arrangements for the forthcoming Annual General Meeting of the Institute to be held in Ottawa.

The report of the Proceedings Committee, by W. H. Munro, M.E.I.C., stated that 16 meetings, including the annual meeting of the branch, were held during the year. Of these, twelve were luncheon meetings and four were evening meetings. The luncheon meeting held June 24, 1938, marked the first meeting of the Council of The Institute to be held in Ottawa apart from any that may have been held during Institute annual meetings.

As a result of the elections, officers for the ensuing year are: chairman, J. H. Parkin, M.E.I.C.; secretary-treasurer, R. K. Odell, A.M.E.I.C., re-elected; members of Managing Committee: N. Marr, M.E.I.C., H. V. Anderson, M.E.I.C., and W. L. Saunders, A.M.E.I.C., newly-elected to serve two years; and R. A. Strong, A.M.E.I.C., and Dr. R. M. Stewart, M.E.I.C., who were elected at the 1938 annual meeting and have one remaining year to serve.

After the business part of the meeting was over, Mr. Munro read an interesting paper prepared by Sydney March, one of the sculptors of the National War Memorial. The paper explained the various technicalities of construction of the memorial. Sydney March and his brother, Walter, were at the meeting as honoured guests and the former answered many questions from the floor after his paper was read.

PETERBOROUGH BRANCH

A. L. Malby, Jr.E.I.C. - - - *Secretary-Treasurer*
D. R. McGregor, Jr.E.I.C. - - *Branch News Editor*

The sixth meeting of the Branch during the current season was held on December 8th, when J. W. Bateman, of Toronto, manager of the Lighting Service Department of the Canadian General Electric Company, gave an address on **New Developments in Lighting.**

Mr. Bateman opened his address by pointing out that electric lighting as we know it today has been in existence only a relatively short time—less than sixty years.

For the first half of this period, the carbon lamp of the same general form as the first electrical incandescent lamp invented by Edison, was the standard light source. In this time, lamps improved in efficiency and in quality from the early lamps, which had efficiencies of the order of 1.4 lumens per watt and lives of about 40 hours, to lamps of three times this efficiency and many times the life.

The tungsten lamp has held sway for the second half of this period. Likewise, improvements have been made; efficiencies have doubled, quality has improved, and prices have been lowered. Electrical distribution systems have improved and rates have decreased until today we get about twelve times as much electric light for one dollar as could be had just thirty years ago.

In the early nineteen-thirties, things were fairly stable as regards electric lamps. However along about 1932, practical sodium gaseous conductor lamps were developed, which were found to have efficiencies about 2½ times those of the equivalent tungsten lamps. Then followed the high intensity mercury vapour lamp, another electric discharge lamp having about double the efficiency of the incandescent lamp. Just recently the fluorescent Mazda lamp has been developed; this lamp in some colours is as much as 120 times as efficient as the equivalent coloured tungsten lamp, and it appears to open up a new field in lighting practice.

One of the outstanding developments in electric discharge lamps is the new 1000 watt capillary mercury vapour lamp. The light source itself, which is in a quartz bulb which must be water-cooled, is about the diameter of a lead pencil and about one inch in length. This 1000 watt lamp has a light output of 65,000 lumens—three times that of a 1000 watt incandescent lamp. The intrinsic brilliancy of the source is almost equal to that of the sun itself. It is expected that this new lamp will meet with quite a wide application in the projection and photo-engraving fields.

The standard tungsten lamp is now appearing in a new type of bulb; this bulb is shaped not unlike a small spotlight, and has a reflecting surface hermetically sealed inside it. The lamp provides a powerful floodlight beam without the use of auxiliary reflectors; and can be obtained made of ordinary glass, for indoor use, or of a special glass for outdoor use. It is probable that this lamp will find a wide use for amateur theatricals, store window lighting, garden lighting, and many other applications.

The recently developed Mazda fluorescent lamps are revolutionary light sources. These lamps are primarily mercury arcs of low pressure. The ultraviolet rays given by the mercury arc are converted into visible light by means of powders, known as phosphors, applied in the form of a coating on the inside of the glass tubes of the lamps. These lamps are similar in appearance to the tungsten 'Lumiline' lamps; however they run at only 10 watts per foot of tube length, with efficiencies ranging from 3 to 70 lumens per watt. These are at present available in seven colours—green, blue, gold, red, pink, daylight, and white. The green lamp burns with an efficiency of from 60 to 70 lumens per watt, providing green light at an efficiency from 100 to 200 times that of the tungsten lamp. The white and daylight lamps give about 30 to 35 lumens per watt, about double that of the ordinary 200 watt tungsten lamp.

Mr. Bateman closed his address by stating that years of research had proved the desirability of high levels of lighting of the proper quality to provide easy seeing conditions and to minimize eye strain and nervous tension. The development of new light sources and new methods of lighting will continue to make possible in the future, better light for seeing.

SASKATCHEWAN BRANCH

J. J. White, M.E.I.C. - *Secretary-Treasurer*

On November 25th the Saskatchewan Branch held its monthly meeting when 57 members and friends had dinner at the King's Hotel, Regina. R. W. Jickling, A.M.E.I.C. chairman of the Saskatchewan Section of the A.I.E.E. occupied the chair.

After dinner Mr. Jickling introduced E. E. Eisenhauer, A.M.E.I.C., irrigation specialist with the Provincial Government, who spoke to the gathering on **Irrigation in Saskatchewan.**

The speaker traced the development of irrigation in the world from Biblical times up to the present. In the Biblical days the Martians were supposed to have built a dam on the Arabian Desert. This dam was supposed to have failed, the result being the flooding of the old world. He mentioned that in many instances on present sites of devlopment, relics of old drainage ditches and other evidences of irrigation were found.

The reason for The Prairie Farm Rehabilitation Act coming into the picture was to better spread the cost over

Canada, for everybody benefits by irrigation. The Government buys the land from the farmer at a nominal price, develops it and resells it to him at a slightly higher figure guaranteed free from speculative prices. At the present time in Saskatchewan the Prairie Farm Rehabilitation has 60,000 acres under ditch and it is possible to irrigate about a maximum of 250,000 acres. In Alberta there are more than a million acres. Due to the drought only, in Saskatchewan, the large schemes may make money, otherwise they do not pay.

He suggested that proper development of irrigation in Saskatchewan will take care of a larger population due to the reason that projects in Saskatchewan are scattered over dry lands where the small farmer has a security of income due to his ability thus to provide for lean years. Irrigation is a profitable affair in dry years and he stated several cases where $300.00 or $400.00 expenditure for a dam saved a cost of $3000 or $4000 for feed.

The Prairie Farm Rehabilitation Act helps to the extent of $350.00 and if possible, every farmer should take advantage of this opportunity to develop his own farm. It is the duty of every engineer to give this work all the publicity possible. The farmer is not tied down to any restrictions and can sell the land immediately if he wishes to do so.

In the sugar beet industry, at least a parcel of 20,000 acres is needed for a factory, that is, there would be 10,000 acres under crop and 10,000 under cultivation the same year. Due to the restrictions in the production of sugar, the comparative cost of raw sugar processed elsewhere, freight and insufficient demand, another factory in the west would not be economical. The crop for Saskatchewan is the small grain such as alfalfa.

The question period was inaugurated by Mr. Linton and Mr. Norman McLeod, while several others joined in asking questions.

The last half of the programme was taken up by a sound picture produced by the Ford Motor Company of Canada Limited, at Windsor. This was a very interesting picture and followed the making of a car from raw product to shipment. About sixty per cent of the cars manufactured in Canada were sold in other parts of the Empire.

TORONTO BRANCH

J. J. Spence, a.m.e.i.c. - *Secretary-Treasurer*
D. D. Whitson, a.m.e.i.c. - *Branch News Editor*

Regulation of Traffic in a City

Offences against traffic laws will have to be made anti-social before the ultimate in traffic safety can be reached, Tracey D. LeMay, Commissioner of City Planning, City of Toronto, told the Toronto Branch at Hart House on Thursday, November 17th. Observation of traffic rules, he said, must cease to be a matter of convenience, and be regarded as a social duty and matter of conscience.

Commenting on the beneficial changes in living conditions brought about by the automobile, he stated that "at the same time it has created a death toll and caused personal injury and suffering and an economic loss that in its magnitude vies with the horrors of war and of pestilence." One person in every 160, he said, would be killed or injured by a motor car on Toronto's streets within the next twelve months. He cited carelessness, inattention and even wilful disregard as major factors in the accident record.

Mr. LeMay deplored the fact that "the driver who breaks a traffic law does not feel that he has committed a crime against society or that in doing so he has been guilty of depriving some other driver of his fair share of the use of a public highway. A man who pilfers a pair of socks from a departmental store is looked upon as a criminal, but the motorist who drives from here to Barrie in sixty minutes, endangering his own and scores of other lives, is considered a hero, or at worst a crazy fool," he observed.

There should be some form of international tie-up that would make for continent-wide uniformity in traffic rules, he said. It was reasonable, he pointed out, that matters of this kind should be placed under the jurisdiction of the Federal authorities both in Canada and the United States.

An overall speed of twelve miles per hour was as fast as safety would allow in city driving, the speaker stated. Such a speed on main-travelled streets, however, seemed to be generally unattainable because of street car interference with steady and continuous progress. In the congested section of the Toronto downtown area tests had shown that a little more than nine miles was the average overall speed to be expected on a continuous run on car line thoroughfares. The average speed in the outer parts of the business section was higher. The condition was not ideal, but it was not sufficiently acute to cause concern.

"Intersections are the greatest single cause of traffic delay," the planning commissioner continued. Nothing much could be done except to provide expensive traffic circles or grade separations, he pointed out. Mid-block prohibition of parking, with prohibition of all stopping in the vicinity of an intersection, appeared to him to offer the best chance of improvement. Referring to opposition of merchants to a general prohibition of parking on business streets, he declared that "it seems physically impossible that the disastrous effects which they predict would materialize." He cited results of surveys on Yonge Street which indicated that fewer than one per cent of customers who entered fifteen leading retail stores came from cars parked in the same block.

Synchronizing or retaining of traffic signals could only speed up traffic in one direction due to the unequal length of city blocks, he said. "No automatic traffic signal, even those embodying the latest traffic actuated developments, can fully take the place of an efficient police officer who is able to utilize every second of intersection time," he added.

The speaker doubted the wisdom of too general prohibition of left turns. Every left turn prohibited meant two left turns and a right turn elsewhere, he said, pointing out that such prohibition added to congestion and defeated its own purpose if it increased the vehicle-miles travelled on the streets.

He urged citizens to store their cars in driveways or garages when not in use. Automobiles parked on residential streets were a definite hazard, especially at night. Parking on both sides of a pavement less than thirty feet wide, he said, left insufficient room for moving vehicles to pass.

Pointing out that an era of a few years, prosperity might add 50 per cent to Toronto's 140,000 automobiles, Mr. LeMay declared that it was inevitable that municipal action must be taken to meet the need for parking accommodation. Parking on vacant lots was, he added, not an economic use of land. "The time will come, sooner or later, when these properties will be required for building operations, leaving the streets still less able to provide accommodation, he predicted.

There was, he said, no golden rule in traffic regulation. Each individual case had to be separately studied and planned for. "Any solution must maintain the relative traffic fluidity over the whole route or area. A very careful analysis of the possible effect of proposed regulations should be made, based on engineering data obtained by engineering methods," he asserted.

On December 1st, 1938, the branch held its semi-monthly regular meeting at Hart House. C. E. Sisson, m.e.i.c., occupied the chair and made the important announcement that a committee had been formed to consider the advisability of forming a junior section of the branch, and that some progress had already been made. The action had been taken on the request of a number of the junior members.

The speaker of the evening was Dr. Saul Dushman, assistant director of the Research Laboratory, General Electric Company, Schenectady, New York, and a graduate of '04, University of Toronto. Dr. Dushman spoke on the **Problems and Organization of a Research Laboratory**, and succeeded remarkably in presenting to the members in an interesting way how the really tough problems in physical, chemical and electrical research had been tackled and solved. He pointed out that from the time of the formation of the Research Laboratory in 1900 the results obtained have been of such a nature that they not only continued to justify the existence of the laboratory from the point of view of scientific achievement but also from that of actual benefits to the company as a manufacturing organization. Naturally the efforts of the Research Laboratory have been directed largely from the point of view of the practical activities of the company. However, the laboratory did not hesitate to carry on a certain amount of purely scientific research, where it was felt that an increased knowledge of fundamentals in a given field might be of value towards future practical developments.

The G.E. Research Laboratory at Schenectady is only one of sixteen laboratories maintained by the Company, and after the Schenectady laboratory has evolved the fundamental principle, and possibly the initial device or mechanism resulting from the application of the principle, it usually hands over the results to the particular laboratory connected with the division of the company that will be manufacturing the device for further development. It has been found best to carry on all research of a fundamental character at Schenectady rather than in the separate Works' laboratories, whose staffs do not have the advantage of association and discussion of problems with other research workers in widely different fields, and whose overlapping experience has often been of greatest value. The laboratory staff consists of about 100 technically trained men, 40 of whom have Ph.D. degrees, and their assistants, machinists and glass blowers, etc., and since the inception of the laboratory have carried on innumerable investigations.

From 1900 to 1934, the laboratory was directed by Dr. Willis R. Whitney, and since then by Dr. Coolidge. The method of selection of new men for the staff has been evolved over a period of years and recently has consisted of inviting men who are studying for Ph.D. degrees to work on a temporary basis in the laboratory, and to move them around among the senior researchers who make recommendations concerning their aptitudes. In this manner it is hoped that fewer mistakes will be made in selecting men who will fit satisfactorily into the organization.

Dr. Dushman then proceeded to take his audience on a tour of the laboratory. Research group number one were engaged on investigating what is known as monomolecular film. The film was produced on a glass slide by thrusting the slide into a vessel of clean water, on whose surface had been placed a drop of the material being studied. The first layer of film was deposited on the glass slide on its first up-journey through the water, second layer on the next down-journey and so on. It was found that the molecules deposited themselves in opposite orientation in the different layers, and one practical application was the fact that reflection was eliminated from glass surfaces treated with the films.

Research group number two were investigating the magnetic properties of silicon steel. It was discovered that there are directions of easiest magnetization which are oriented in definite directions with respect to the orientation of the crystals. Through learning to control the grain size in the steel structure of silicon steel transformer sheets, reducing magnetostriction by increase in silicon, and by orientation by cold reduction, transformer sheets have been produced in which the power loss has decreased over a period of years from 0.7 watts per lb. in 1918 to 0.4 watts per lb. at the present time. The estimated saving to North American power users due to the above increase in efficiency is estimated in millions annually.

Research group number three discovered that a heat resistant alloy of nickel, aluminum, cobalt and iron, could by heat treatment be made into excellent material for small permanent magnets which would lift 60-80 times its own weight. Research group number four were working on special glasses to seal electrodes into metal radio and power control tubes, and high-voltage multi-sectional x-ray tubes. Research group number five were studying arcs, with mercury switches being the ultimate object in mind. Research group number six were studying vapor discharge lamps, fluorescent materials and lamps and the mechanism of fluorescence, and also phosphorescence, and cathode-luminescence used in television.

Dr. Dushman said television had not yet reached the practical stage for home use but appeared to be definitely on the way to successful solution, but did not care to say how soon. Another group were working on x-ray tubes up to 800,000 volt rating in several sections, and still another on chemical and metallurgical problems such as compounds for use in plastics, mercury vapor detectors in connection with mercury boilers, and plastic flow in metals at high temperatures, with the practical application being the life of blades in high temperature steam turbines.

It is no exaggeration to say that Dr. Dushman gave one of the most interesting addresses the branch has heard in recent years, and it is also a fact that the members were all left with a new appreciation of the increasing difficulties encountered by those who would open new doors of knowledge to mankind, and a new conception of the extent of the knowledge, training and keenness necessary for an individual to have any success at this type of work.

On January 14th the branch held its annual social evening at the Engineers' Club, when over 125 of the members, wives and friends enjoyed dinner, singing, billiards, dancing and cards. This year's attendance was higher than on any previous occasion, and it appears that in future years larger accommodations may be necessary. The guests were received by C. E. Sisson, M.E.I.C., Branch Chairman, and Mrs. Sisson, and Dr. J. B. Challies, President of the Institute, and Mrs. Challies. Mr. Sisson and Dr. Challies spoke briefly at the conclusion of the dinner. The social committee handled their duties in excellent style and was headed by Mrs. C. E. Sisson, Mr. Harry Brandon and Mr. Nicol MacNicol.

On January 19th the Toronto Branch held its regular semi-monthly meeting at Hart House, University of Toronto, with C. E. Sisson, M.E.I.C., in the chair. This was the opening meeting for 1939, and it was devoted to a speaking competition for Engineering Students on engineering subjects.

There were six contestants and the winning talk was on "Cavitation" by A. D. Smith, fourth year student at the Faculty of Applied Science. The second prize went to M. D. Stewart for his talk on "Geared Turbine Drives for Marine Propulsion." The third prize was taken by G. T. Perry, who spoke on the "Future of Pulp in Northern Ontario," and fourth prize went to R. N. Boyd for the subject, "Diesel Electric Buses." Interesting talks were also given by W. M. Walkinshaw on "Soil Stabilization" and by F. C. Read on "The Engineer in the Plant." The judges were Col. C. S. L. Hertzberg, M.E.I.C., R. B. Young, M.E.I.C., and A. O. Wolff, M.E.I.C. All the winners received a student membership in the Institute, and a year's subscription to The Engineering Journal, with cash prizes added of $10.00, $7.50, $5.00 and $2.50. The speakers made use of large diagrams, models, and slides to illustrate their addresses and all had obviously prepared their addresses with great care, and the style of their presentation reflected great credit on both themselves and their instructors.

Films on western Canadian scenery were also shown through the courtesy of the Canadian National Railways.

News of Other Societies

Items of interest regarding activities of other engineering societies or associations

THE NATIONAL CONSTRUCTION COUNCIL OF CANADA

The revival of prosperity in the Canadian construction industry which did nearly $600 millions of business in 1929—the amount falling of recent years to less than 40 per cent of that figure—cannot be a matter of indifference to the general public and is of special interest to members of the engineering profession.

In the opinion of the National Construction Council, if the existing position of the industry is to be improved, it is absolutely "necessary to relieve real estate of a portion of the present heavy burden of municipal taxation." It is felt that the impending publication of the Rowell Commission's report, and the holding of the announced Dominion-Provincial conference, will furnish an opportunity to impress the urgency of the situation upon the various municipal, provincial, federal and private interests whose unco-ordinated actions are believed to have contributed materially to the present state of affairs.

It is hoped that the Construction Council's recent representation to the Royal Commission on Dominion-Provincial Relations will result in a recommendation for constructive action, but this will not necessarily follow unless the "powers that be" are shown that a body of public opinion is in favour of the change in policy.

In a letter presented to the Institute Council at its last meeting, the executive of the N.C.C. asked for the fullest co-operation of the Engineering Institute in bringing this about; the Council was entirely in sympathy with the suggestion, and directed that the present reference should be made to the matter in the columns of the Journal.

Institute members will realize that in giving their support to the policy of reduction in taxation on real estate (basing such reduced taxation on income, not on assessed capital value) and in endeavouring to form public opinion along such lines, they will be acting in accordance with the views of their own Council, and helping to rehabilitate the construction industry in this country.

THE AMERICAN SOCIETY OF CIVIL ENGINEERS

At the annual meeting of the society held at the Engineering Societies' Building, New York, on Wednesday, January 18th, Donald Hubbard Sawyer, of Washington, D.C., was elected President. Since 1935 Colonel Sawyer has been a special assistant to the Director of Procurement, and Chief of the Section of Space Control with the U.S. Federal Government, involving the preparation of an inventory of all Federal real estate and improvements, as well as the presidency of the U.S. Housing Corporation.

One of the features of the meeting was the presentation of Honorary Memberships to five members of the Society, namely, C. Frank Allen, long associated with engineering works in Boston and New England; Anson Marston, a Past-President of the Society, and Dean Emeritus of Iowa State College; Arthur S. Tuttle, Past-President of the Society, with 48 years of continuous engineering service to the City of New York; Edward E. Wall, with 50 years of engineering service to the City of St. Louis; and Frank E. Weymouth, General Manager and Chief Engineer of the Metropolitan Water District of Southern California.

Following the ceremony of conferring the Honorary Memberships, the President of The Engineering Institute of Canada, Dr. J. B. Challies, was formally introduced to the meeting by the President of the Society, Dr. H. E. Riggs. Dr. Challies spoke as follows:

"This dignified ceremony of conferring honorary memberships upon five engineer statesmen of America, which I have been privileged to witness from a seat of honour among the distinguished Past-Presidents of this great Society, is easily the most impressive and the most inspiring event of a very busy presidential year.

"Canadian engineers will greatly appreciate this courtesy to The Engineering Institute of Canada—a strictly professional engineering body that embraces all branches of our profession and which earnestly endeavours to maintain the splendid traditions of its mother society, the Institution of Civil Engineers of Great Britain, and may I say, also of its mother-in-law society, the American Society of Civil Engineers.

"It has been a matter of great satisfaction to the Council of the Institute that its relations with the Founder Societies of the United States, and, in particular, with the American Society of Civil Engineers, each year grow more cordial. As President of the Institute, I am glad to acknowledge the priceless privilege which it has enjoyed in being permitted to lean heavily upon the advice and assistance of the officers and the secretariat of this Society.

"It is perhaps a happy circumstance that while the President of the Institute should be permitted today to participate in the 86th Annual Meeting of the American Society of Civil Enginerrs, only a few weeks hence the President of this Society will honour the Institute by attending its 53rd Annual Meeting in the capital city of the Dominion.

"To this Institute meeting at Ottawa, all members of the American Society of Civil Engineers will be as welcome as the flowers in May."

THE INSTITUTION OF ELECTRICAL ENGINEERS

A. P. M. Fleming, C.B.E., D.Eng., M.Sc., has recently been elected President of the Institution. Dr. Fleming was a visitor to Canada during 1938 and met many members of the Engineering Institute.

The following is an extract from the annual report of the Council of the Institution:

"With reference to overseas members of the various institutions the Engineering Joint Council have recently, at the request of this Institution, considered what steps can be taken further to bring these members together, the suggestion being that the schemes of co-operation already in existence in China and the Argentine might be the basis of similar co-operation elsewhere overseas. A report of a special committee set up by the Joint Council to discuss this matter is now available giving details of a suggested scheme for carrying out the object in view."

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF BRITISH COLUMBIA

The following is the constitution of the Council of this Association for the year 1939: President, C. E. Webb, M.E.I.C., Civil Engineer; Vice-President, E. Redpath, Mechanical Engineer; Past-President, C. V. Brennan, Mining Engineer.

Council, elected by the Profession: J. N. Finlayson, M.E.I.C., Civil Engineer; P. B. Freeland, Mining Engineer; F. W. MacNeill, Electrical Engineer; H. R. Younger, A.M.E.I.C., Civil Engineer.

Appointed by the Lieutenant-Governor in Council: S. J. Crocker, Mechanical Engineer; W. H. Hill, Chemical Engineer; P. L. Lyford, Forest Engineer; H. J. MacLeod, M.E.I.C., Electrical Engineer.

President C. E. Webb is the representative of the Association on the Dominion Council.

Library Notes

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

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.C. MOTORS OF FRACTIONAL HORSE-POWER

By H. H. Jones. New York, Chemical Publishing Co., 1938. 189 pp., illus., diagrs., charts, tables, 8 x 5 in., cloth, $3.00.

The working principles of fractional horsepower A.C. motors are described and information is given for the construction, coil winding, testing and repair of such motors. A special chapter is included on silencing and the suppression of radiated interference.

A.M. FUEL SYSTEMS FOR AIRCRAFT

By B. Demtchenko, with an introduction by P. Dumanois; translated from the French by M. E. Boname. Paris, Gauthier-Villars, 1938. Illus., diagrs., charts, tables, 10 x 6 in., cloth, 90 frs.

A translation from the French, this book discusses the general technique of feeding an engine, the layout of a fuel system including installation rules, the factors influencing the flow of fuel, mechanical and gravity feed systems, and the calculation of the efficiency of a fuel system. Several chapters are devoted to diagrams of fuel systems for various hypothetical cases.

A.S.T.M. STANDARDS ON COAL AND COKE

Prepared by Committee D-5 on Coal and Coke, Oct., 1938. Phila., American Society for Testing Materials. 152 pp., illus., diagrs., charts, tables, 9 x 6 in., paper, $1.25.

Standards and specifications, as developed by the special committee on coal and coke, covering sampling methods, chemical analysis, methods of testing, coal classification, and definitions of terms, are here brought together in convenient form.

CHEMICAL STUDIES OF P. J. MACQUER

By L. J. M. Coleby. London, George Allen & Unwin; New York, Nordemann Publishing Co., 1938. 132 pp., tables, 9 x 6 in., cloth, $1.75.

Macquer (1718-1784), occupied a commanding position in French chemistry. He wrote the first "*Dictionary* of Chemistry," which was translated into many languages. He carried out important researches, especially on technical questions, and was Director of the Dyeing Industries and Superintendent of the Sevres porcelain factory. This book gives a sketch of his life and an account of his researches and writings, with a bibliography.

DIFFERENTIAL UND INTEGRALRECHNUNG, 3 Vol., (Göschens Lehrbücherei, Bd. 24, 25 and 26)

By O. Haupt and G. Aumann. Berlin, Walter de Gruyter & Co., 1938. diagrs., tables, 9 x 6 in., cloth, Vol. 1, 196 pp., 11.20 rm.; Vol. 2, 168 pp., 9.80 rm.; Vol. 3, 183 pp., 10.60 rm.

Of the three volumes in this set, the first provides an introductory discussion of series and real functions of one or more variables. The second covers the differential calculus of functions of one or more variables, including both theoretical discussion and applications. In the third, the major portion, on the theory and applications of integrals, is preceded by an introduction to the theory of measurement.

DIE DISPERSION ELASTISCHER WELLEN IM BODEN

By A. Ramspeck and G. A. Schulze. Berlin, Julius Springer, 1938. 27 pp., diagrs., charts, tables, 12 x 9 in., paper, 4.80 rm.

In soil mechanics and foundation research much attention is now being paid to elastic waves. Examples and interpretations of data are presented in this publication with reference to dispersion and interference phenomena, and practical applications are given.

DIE ELEKTROLYTISCHE OXYDATION DES ALUMINIUMS UND SEINER LEGIERUNGEN, Grundlagen und Richtlinien für die praktische Durchführung der Eloxalverfehren. (Technische Fortschrittsberichte, Bd. 42, 1938)

By A. Jenny. Dresden and Leipzig, Verlag von Theodor Steinkopff, 1938. 224 pp., illus., diagrs., charts, tables, 9 x 6 in., paper, 10.50 rm.

The purpose of this work is to give a general account of current methods of protecting aluminum and its alloys from corrosion. The text is divided into two sections. The first surveys the electrochemical reactions involved, the reactions of aluminum when exposed to gases, and the anodic phenomena at metal electrodes. The second section is concerned with the protective film, the chemical reactions at the electrodes and in the bath, bath control and the technique of the eloxal process. A chapter is devoted to chemical processes of protection.

ELEMENTS OF YACHT DESIGN

By N. L. Skene, New York, Kennedy Bros., rev. ed. 1938. 252 pp., illus., diagrs., charts, tables, 10 x 6 in., cloth, $3.50.

The fundamental considerations in yacht design are discussed and the practical operations involved are carefully presented, with many descriptive illustrations. Attention is given to the problems of power equipment, and various rules and regulations are included.

ENGINEERING APPLICATIONS OF AERIAL AND TERRESTRIAL PHOTOGRAMMETRY

By B. B. Talley. New York and Chicago, Pitman Publishing Corp., 1938. 612 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $10.00.

Photogrammetry, the science of measurements from photographs, is treated with the full detail merited by its increasing importance. Photographic fundamentals, types of equipment, serial photography, stereoscopy, and map projections are discussed. The various methods of photographic mapping, their uses, and the special instruments required are fully described with a wealth of useful illustrations.

ENGINEER'S MISCELLANY

By G. Bathe. Philadelphia, Patterson & White Co., 1938. 136 pp., illus., diagrs., maps, tables, 11 x 9 in., cloth, $4.50.

In this very attractive volume Mr. Bathe has collected ten contributions to engineering history: The early artisan as depicted in art; The commercial toy steam engine of fifty years ago; The decorative era in machinery design; A Digest of Fitch's Steamboats, 1786-1792; The first high pressure steam engine in America; The old Cornwall furnace; The antiquity of the inclined plane on canals; Three Cornish engineers; The lift wheel pumping plant of the Chesapeake and Delaware canal; Christopher Colles and the steam engine. These pleasantly written essays show the results of careful study and are illustrated by many reproductions of photographs and contemporary prints.

FOUNDRY WORK

By W. C. Stimpson and B. L. Gray, rev. by J. Grennan. Chicago, American Technical Society, 1939. 216 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $2.00.

A practical handbook on standard foundry practice, including hand and machine molding with typical problems, tools and equipment, casting operations, melting and pouring equipment, and the metallurgy of cast metals.

FUNDAMENTAL ELECTRONICS AND VACUUM TUBES

By A. L. Albert. New York, Macmillan Co., 1938. 422 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.50.

The material contained in this textbook is primarily for beginning study and can be described briefly as covering the following subjects: Fundamental principles of electronics and related phenomena; the electronic principles of vacuum (including gas) tubes; the use of vacuum tubes as circuit elements; photoelectric devices, cathode-ray tubes, and measurements. References and suggested assignments are given.

DIE GLEICHRICHTERSCHALTUNGEN, ihre Berechnung und Arbeitsweise

By W. Schilling. Munich and Berlin, R. Oldenbourg, 1938. 279 pp., diagrs., charts, tables, 10 x 7 in., cloth, 17.50 rm.

Rectifier connections are discussed comprehensively, both from the mathematical and the graphical viewpoints. Both single and polyphase connections are considered under varying conditions of control, inductance, and counter-current loading. Practical examples are included, and numerous useful tables and graphs are combined in the last section.

GREAT BRITAIN. Dept. of Scientific and Industrial Research. Fuel Research Technical Paper No. 48. The Hydrogenation-Cracking of Tars. Part IV, by H. E. Newall

London, His Majesty's Stationery Office, 1938. 55 pp., illus., diagrs., charts, tables, 10 x 6 in., paper, (obtainable from British Library of Information, 270 Madison Ave., New York, $.40).

Part IV of a series on the hydrogenation-cracking of tars, this publication describes experiments on the conversion of low temperature tar acids into aromatic hydrocarbons by treatment with hydrogen at atmospheric pressure. The design and operation of a small-scale plant are included.

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, 1938

London, His Majesty's Stationery Office, 1938. 191 pp., illus., diagrs., charts, tables, 10 x 6 in., paper, (obtainable from British Library of Information, 270 Madison Ave., New York, $1.20).

This report gives the results of the researches upon road problems carried on during the year. Particular attention has been given to the study of bituminous surfacing materials, of concrete road materials, to skidding and to the forces between vehicle and road surface.

GREAT BRITAIN, Mines Dept. Fire at Dumbreck Colliery, Stirlingshire, Reports by T. Ashley and J. A. B. Horsley.

London, His Majesty's Stationery Office, 1938. 27 pp., illus., diagrs., charts, tables, 10 x 6 in., paper, (obtainable from British Library of Information, 270 Madison Ave., New York, $.45).

This official publication comprises two special reports concerning the causes of and the circumstances attending a colliery fire. The colliery is briefly described and the electrical system discussed with reference to the event. Plans and diagrams are included.

GREAT BRITAIN. Mines Dept. Safety in Mines Research Board Paper No. 101. The Analysis of Mine Dusts, by A. L. Godbert

London, His Majesty's Stationery Office, 1938. 20 pp., illus., diagrs., charts, tables, 10 x 6 in., paper, (obtainable from British Library of Information, 270 Madison Ave., New York, $.30).

The methods and procedure are given for two analyses: I. Determination of carbon dioxide in mine dusts containing carbonates; II. Determination of free and combined water in mine dusts containing gypsum. A nomogram is included for the carbon dioxide calculation.

GRUNDZUGE DER SCHWEISSTECHNIK, Kurzgefasster Leitfaden

By T. Ricken. Berlin, J. Springer, 1938. 63 pp., illus., diagrs., charts, tables, 9 x 6 in., paper, 3.90 rm.

The various methods of welding by gas, thermite and electricity are described in this brief treatise, including auxiliary equipment. The plans, calculations and procedures for welding construction members are covered, as well as other special applications. The two final chapters discuss the distinctive and non-distinctive testing of welded seams, with a brief note on seam welding cost estimates.

HOT-DIP GALVANIZING PRACTICE

By W. H. Spowers, Jr. Cleveland, Ohio, Penton Publishing Co., 1938. 194 pp., illus., diagrs., tables, 9 x 6 in., lea., 7 drawings in pocket, $4.00.

Principles, methods, mechanical equipment, pyrometers, and fluxes and other necessary chemicals are discussed. Descriptions of various types of galvanizing jobs, wire, pipe, sheet metal, etc., increase its practical value.

DIE HUTTENWERKSANLAGEN, Bd. 1. Anlagen zur Gewinnung und Erzeugung der Werkstoffe

By H. Hoff and H. Netz. Berlin, Julius Springer, 1938. 468 pp.. illus., diagrs., charts, tables, 11 x 8 in., cloth, 66 rm.

This is a useful book, which gives a comprehensive account, with considerable detail, of the methods and equipment used in metallurgical works and the other industrial plants, such as glassworks and brickworks, where the problem is essentially that of converting raw materials into useful products through large amounts of heat. A great deal of space is given to furnaces and methods of heating. The preparation of fuels and ores, iron smelting and steel making, the smelting of non-ferrous metals, foundry equipment, lime and cement burning, ceramic factories and glassworks are discussed. Metallurgists and mechanical engineers will find the book of interest. There is a bibliography, confined almost exclusively to German publications.

J. & P. SWITCHGEAR BOOK

By R. T. Lythall. 3 ed. London, Johnson & Phillips, Ltd., Oct. 1938. 431 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, 10s. 6d.

This handbook for the user and operator is intended as an outline of modern switchgear practice. Subjects covered include descriptions of apparatus and instruments for both indoor and outdoor switchgear, busbars and connections, protective gear, and various problems connected with the selection, operation and maintenance of switchgear installations.

MAKING AND MOULDING OF PLASTICS

By L. M. T. Bell, rev. ed. 1938. New York, Chemical Publishing Co., 1938. 242 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $5.00.

The fundamental materials and the important processes of plastic molding are briefly and simply discussed, together with hydraulic plant and equipment, mold design and construction, inspection and testing. Probable future developments are suggested.

MINERAL INDUSTRY, Vol. 46, 1937, ed. by G. A. Roush

New York and London, McGraw-Hill Book Co., 1938. 778 pp., tables, 10 x 6 in., cloth, $12.00.

This annual summary of statistical and technical progress in the mineral industries covers both metals and non-metallic minerals. Production, prices, trade, uses and markets are given for the important items, and technological and bibliographical information is also given in some cases.

PROBLEMS IN PUBLIC UTILITY ECONOMICS AND MANAGEMENT

By C. O. Ruggles. 2 ed. New York and London, McGraw-Hill Book Co., 1938. 772 pp., diagrs., charts, tables, 9½ x 6 in., cloth, $6.00.

Important problems that arise in public utility management are presented for analysis and illustrated by actual cases. The questions considered include the economic characteristics of public utilities; their production problems; management, organization and finance; wholesale marketing of service; retail marketing; valuation, rate making and fair return; and regulation and management.

LA REPARATION DES PUITS DE MINE

By P. Baudart. Paris, Dunod, 1938. 192 pp., illus., diagrs., tables, 8 x 5 in., paper, 45 frs.

A concise practical manual, based largely upon French experience in rehabilitating the mines of northern France after the World War. The first chapter discusses various methods of shaft repair. Chapter two describes in detail a number of notable examples. Chapter three discusses methods for unwatering mines and for repairing flooded shafts. A final chapter gives the author's conclusions.

TECHNOLOGY OF SOLVENTS

By O. Jordan, translated by A. D. Whitehead for Technical Service Library, London; distributed by Chemical Publishing Co., New York, 1938. 351 pp., diagrs., charts, tables, 10 x 6 in., cloth, $10.00.

The general section of this translated German work discusses fundamental definitions and classification, physical properties, solvents for various kinds of materials, solvents for extraction, platicisers, solvent recovery, and the analysis, manufacture and physiological action of solvents. The special section describes individual solvents and plasticisers. There are many useful tables, a key to proprietary names, and a patent index.

SERVICE CHARGES IN GAS AND ELECTRIC RATES

By H. F. Havlik. New York Columbia University Press, 1938. 234 pp., tables, 9 x 6 in., cloth, $2.75.

A study of the theory and practice of gas and electric rate making, specifically concerned with the problem of service charges. Consideration is given to the case for and against the service charge, to the costs on which charges are and should be based, and to alternatives to the service charge, as well as the history of the development of these charges.

STEEL and Its Heat Treatment. Vol. 1 Principles, Processes, Control

By D. K. Bullens. 4 ed. rewritten. New York, John Wiley & Sons, 1938. 445 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.50.

This edition represents a thorough revision and an extension of this well-known text, carried out by the staff of the Battelle Memorial Institute. The work now appears in two volumes, of which the first discusses the metallurgical principles that underlie the heat treatment of steel, the surface-reaction processes in use and the control of heat-treating operations. The work aims to give a broad, practical picture of the heat treatment of steel and the principles involved. Each chapter has a bibliography.

STREET CLEANING PRACTICE, by the Committee on Street Cleaning of the American Public Works Association

Chicago, Amer. Pub. Works Assoc., 1938. 407 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

The street cleaning problem is considered in all its aspects. Subjects covered include methods and equipment, planning and organization, local conditions, catch-basin and inlet cleaning, snow and ice removal, personnel, and records. Anti-litter ordinances of particular cities are appended, together with a bibliography.

RESTORATION AND PROTECTION OF FIRE ISLAND, Suffolk County, Long Island

By W. E. Andrews. New York, W. E. Andrews, 30 Rockefeller Plaza, 1938. illus., maps, charts, diagrs., tables, 11 x 8 in., paper, apply.

A plan to restore and protect the Fire Island barrier reef is presented in this report, including construction of a parkway over the fill section and a boat channel through a dredged section behind the reef. There are many illustrations.

PATTERN MAKING

By J. Ritchey; rev. by W. W. Monroe, C. W. Beese and P. R. Hall. Chicago, American Technical Society, 1939. 233 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $2.00.

The essentials of pattern making are fully considered, covering tools and equipment, simple and complicated patterns for typical cases, the use of green and dry sand cores, and metal pattern making. Certain special problems of design are treated.

THEORETICAL MECHANICS, a Vectorial Treatment

By C. J. Coe, New York, Macmillan Co., 1938. 555 pp., diagrs., tables, 9 x 6 in., cloth, $5.00.

The basic principles of vector analysis are explained and applied to classical mechanics, and through it to mathematical physics, the simple postulates on which these are based having first been made clear. Starting with simple geometry the subject matter carries through concepts of increasing difficulty up through potential theory.

THEORY OF EQUATIONS

By J. M. Thomas. New York and London, McGraw-Hill Book Co., 1938. 211 pp., diagrs., tables, 8 x 6 in., cloth, $2.00.

A textbook for a course in the theory of algebraic equations for advanced undergraduate and graduate students. The treatment, though elementary, is in accord with "modern algebra". It covers certain topics seldom found in texts on the subject, and forms an approach to the Galois theory and other more advanced phases of algebra.

THORPE'S DICTIONARY OF APPLIED CHEMISTRY, Vol. 2

By J. F. Thorpe and M. A. Whiteley. 4 ed. New York and London, Longmans, Green & Co., 1938. 711 pp., illus., diagrs., tables 9 x 6 in., lea., $25.00.

A continuation of the fourth edition of this valuable work, covering the section" Bl-Chemical Analysis." Although the subject matter is arranged in dictionary style, the more important subjects are treated in monograph form with bibliographic references. The intention is to give a concise and readable account of the condition of modern chemistry which will be of use to both expert and layman.

WELDING ENCYCLOPEDIA, 1938

Compiled and edited by L. B. Mackenzie and H. S. Card. 9 ed. Chicago, Welding Engineer Publishing Co., 696 pp., illus., diagrs., charts, tables, 9 x 6 in., lea., $5.00.

In this new revised edition the subject matter is arranged alphabetically with cross references. The principal topics covered include the main types of welding, the most important fields of use, metals and alloys, metal spraying, rules, codes and specifications, tables and charts of engineering data, testing methods, and operator training. Company names are included with a listing of the trade names of their products.

WOOD PULP

By J. Grant. Leiden, Holland; Chronica Botanica Co.; New York, G. E. Stechert & Co., 1938. 209 pp., diagrs., tables, 10 x 6 in., paper, 7 guilders (about $4.50).

A work on wood pulp and the uses to which it is put, which affords an accurate, comprehensive view of the subject, without attempting to be exhaustive. The properties of cellulose, methods of identifying and evaluating pulping woods, the preparation of wood, pulping processes, pulp bleaching and purifying, by-products, testing and uses are discussed. There is a bibliography.

Notice: The membership list of the Institute, as published in the December, 1938, issue of The Engineering Journal, may be obtained in bound copies at the price of $2.00

ADDITIONS TO THE LIBRARY

PROCEEDINGS, TRANSACTIONS, ETC.

American Society of Civil Engineers:
Transactions, Vol. 103, 1938.

Royal Society of Canada:
Transactions, Section II, May, 1938.

REPORTS, Etc.

Canada Department of Labour:
Report for the Fiscal Year ending March 31, 1938.

Canada Department of Mines and Resources Division of Economics:
Metallurgical Works in Canada, Part II, Non-Ferrous and Precious Metals, 1938.

Canada Department of Mines and Resources Geological Survey: Rice Lake-Gold Lake Area, Southeastern Manitoba; Geology and Mineral Deposits of Freegold Mountain, Carmacks District, Yukon; Laberge Map-Area, Yukon. (*Memoirs 210, 214, 217*).

Canada Department of Public Works:
Report of the Minister . . . for the year ending March 31, 1938.

Canada Department of Trade and Commerce Construction Branch:
Report on the Construction Industry in Canada, 1937.

Canadian Broadcasting Corporation:
Annual Report, 1938.

Cooper Union for the Advancement of Science and Art: The Non-Technical Aspects of Engineering Education (a bibliography).

Edison Electric Institute: Combustion, 1938: A Report of the Combustion Subcommittee of the Prime Movers Committee, Edison Electric Institute.

Electrochemical Society: The Electrodeposition of Silver Alloys from Aqueous Solutions; Preparation of Polyvinyl Chloride Plastics for Electrical Measurements; Fabricated Porous Carbon; The Adherence of Thick Silver Plate on Steel; A Study of the Viscosity and Dielectric Dispersion of Methacrylate Resins in Benzene Solutions; Cold Welding of Silver; Effect of Solution Concentration in Electrodeposition of Manganese; Beneficiating Ferruginous Bauxites Through Chlorination; The Classification and Chemical Genetics of Organic Plastics; Ethyl Cellulose Films and Plastics; The Binary Alloys of Indium and Tin; The Dezincification of Alpha Brass with Special Reference to Arsenic; (Preprints Nos. 74-27 to 74-36, 75-1 to 75-3).

Institution of Civil Engineers: Papers set for the Preliminary and Associate Membership Examinations, October, 1938.

Institution of Structural Engineers: Report on Reinforced Concrete for Buildings and Structures, Pt. I, Loads. 1938.

Massachusetts Institute of Technology: Structural Analysis Laboratory Research 1937-38.

McGill University:
Annual Report, 1937-38.

Ohio State University: Physical Theory in Engineering Language; Measuring the Growth and Scale Resistance of Cast Iron (the Engineering Experiment Station Circular No. 35, Bulletin No. 100).

Panama Canal, Governor of the:
Annual Report, 1938.

Purdue University: Making Barium Chloride from Barium Sulfate; Methods and Equipment for Testing Safety Glass; Adhesion of Bituminous Films to Aggregates; Report of the Research and Extension Activities (Research Series Nos. 60-63).

U.S. Department of the Interior Bureau of Mines: Metallurgical Developments at Mercur, Utah (Technical Paper 588).

U.S. Geological Survey: Lexicon of Geologic Names of the United States, Pt. 1, A-L, Pt. 2, M-Z; Spirit Leveling in Missouri, Pts. 2, 3 and 4; The Brown Iron Ores of Eastern Texas; Geology of the Slana-Tok District, Alaska; Geophysical Abstracts 92, January-March, 1938 (Bulletins 896, 898-B, 898-C, 898-D, 902, 904, 909-A).

The San Junan Country: A New Upper Cretaceous Rudistid from the Kemp Clay of Texas (Professional Paper 188, 193-A). Surface Water Supply of the United States 1936, Pts. 1, 3, 4, 10, 12, 13, 14; Inventory of Unpublished Hydrologic Data; Quality of Water of the Rio Grande Basin Above Fort Quintman, Texas (Water-Supply Paper 801, 803, 824, 830, 832, 833, 834, 837, 839).

TECHNICAL BOOKS, Etc.

ABRÉGÉ DE MINÉRALOGIE (extrait de La Minéralogie du Prospecteur)
By J. M. A. Bleau. Montreal, DeLasalle, 1938, 67 pp. 7½ x 5 in., cloth.

AUTOGRAPHIC INDICATORS FOR INTERNAL COMBUSTION ENGINES
By J. Okill. London, Arnold, 1938. 88 pp. illus. figs. diagrs. 7½ x 5 in. cloth $1.50.

THE CANADIAN RAILWAY PROBLEM
By Lesslie R. Thomson, M.E.I.C. Toronto, Ont., MacMillan, 1938. 1080 pp. tab. charts, 10½ x 7 in. cloth, $12.00.

ECONOMIC TRENDS IN MANUFACTURING AND SALES
By William M. Vermilye. Reprinted from the Journal of The Franklin Institute of Pennsylvania, 1938. 32 pp., 9½ x 6¼ in., paper.

FAILURES OF LOCOMOTIVE PARTS
By Fred H. Williams. Montreal, 1938. 10½ x 9 in. leather binder, $5.00.

These articles (reprinted from the *Railway Mechanical Engineer*), describe in some detail the results of some years experience in the examination of locomotive parts which have failed in service or which on periodic inspection have had to be condemned.

The importance of fatigue cracks, the proper use of fillets, the necessity for fine and smooth finish, the effect of stress and corrosion are among the points dealt with. Half tone illustrations of over fifty broken parts are given in sixteen plates.

THE INTERNAL COMBUSTION ENGINE
By C. Fayette Taylor and Edward S. Taylor. Scranton, Pa., International Textbook Company, 1938. 322 pp. illus. charts diagrs. plates, 9¼ x 6 in., $3.50.

STRUCTURAL ALUMINUM HANDBOOK
Pittsburgh, Pa., Aluminum Co. of America, 1938. 196 pp., illus. tab. diagrs. 8½ x 5½ in. leather.

NEW AND REVISED SPECIFICATIONS

American Society of Testing Materials:
Tentative Standards, 1938.

Canadian Engineering Standards Association: C10-1938 Standard Specification for General Service and Street Series Tungsten Incandescent Lamps (2nd ed.); C50T-1938 Tentative Specification for Insulating Oils.

Canadian Government Purchasing Standards Committee: Specification for Varnish Vehicle for Aluminum Paint (Type 1, for Exterior and Marine Use on Metal); Varnish Vehicle for Aluminum Paint (Type 2, for Exterior Use on Wood); Varnish Vehicle for Aluminum Paint (Type 3, for High Temperature Use); Aluminum Pigment for Paint (Type 1, Dry Powder); Aluminum Pigment for Paint (Type 2, Paste); Interior Paint, Flat, White and Tinted (Tentative); Graphite Paint, Black (Tentative); Interior Varnish (Tentative); Exterior Paint, Flat, Dark Grey (Tentative); Enamel Undercoating, Interior, White and Grey (Tentative); Enamel Undercoating, Exterior, White Lead, Zinc Oxide Type, White and Grey (Tentative); Scouring Compounds; Methods of Sampling and Analysis of Soaps; Liquid Metal Polish.

U.S. Department of Commerce National Bureau of Standards: Building Materials and Structures Report BMS4 Accelerated Aging of Fiber Building Boards; Report BMS5 Structural Properties of Six Masonry Wall Constructions; Report BMS8 Methods of Investigation of Surface Treatment for Corrosion Protection of Steel; Report BMS9 Structural Properties of the Insulated Steel Construction Company's "Frameless-Steel" Constructions for Walls, Partitions, Floors, and Roofs.

Industrial News

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

ENGINEERING PROPERTIES OF NICKEL

Bulletin No. T-15, "Engineering Properties of Nickel," of the series of Technical Information regarding Monel, Nickel and Nickel Alloys, has been released by the Development and Research Division of The International Nickel Company. The bulletin contains eighteen pages of tables and other useful data under the main headings of composition, physical constants, mechanical properties, corrosion resistance, working instructions, mill products, castings and special nickel-alloys.

ELECTROSTATIC VOLTMETER

A sturdy and accurate portable electrostatic voltmeter has been announced by Canadian General Electric Co. Ltd. for measurements of a/c or d/c voltage on systems where one line is grounded. Available in ratings of 3, 5, 10, 15 and 20 kilovolts, the new instrument is designed for fast response and ability to hold its calibration. Further features include the light-beam pointer, magnetic damping, and a specially designed high-voltage terminal with a current-limiting resistor for increased safety. Typical applications are: measurement of applied voltage in di-electric tests; study of electrostatic phenomena such as the generation of charges by moving belts or other objects; determination of peak voltage by the vacuum-tube method; and measurement of exceptionally high voltages, when used in conjunction with a voltage divider.

INTAKE AND EXHAUST QUIETING

A new type of noise-quieting device which is non-acoustic and can be placed at any point in the intake or exhaust system of an engine or compressor, has recently been developed by the Acoustic Division of the Burgess Battery Company, 500 W. Huron Street, Chicago. Since it eliminates the cause of noise produced by the pulsating gases by snubbing the peak velocities and pressures and thereby produces a smooth flow of gas, this new device is called the Burgess Snubber.

The effect of the Burgess Exhaust Snubber is to prevent the sudden impact of the slug of vented gas with the atmosphere and also to stop the usual inrush of air into the exhaust pipe, after the discharge of the slug. Therefore, the sharp noise of the slug impact and the rumbling noise of the vibrating air column in the exhaust pipe are eliminated.

The same type of unit is applicable to intake and output lines of reciprocating and rotary compressors. Burgess Snubbers are available in a wide range of sizes for standard, heavy duty, and spark arresting service.

PORTABLE MEDIUM-PRESSURE ACETYLENE GENERATOR

Dominion Oxygen Company Limited has announced a new, portable acetylene generator, developed for the user of small quantities of acetylene for oxy-acetylene welding and cutting. This new generator, the Carbic Medium-Pressure Acetylene Generator (Type CMP-2), utilizes the advantages of Carbic processed calcium carbide. Like all Carbic generators it makes available a dependable supply of acetylene, generated as required.

TEMPERATURE-COMPENSATED INSTRUMENTS

Reducing temperature errors over a wide range of conditions, General Electric has developed two specially compensated Type AP-9 voltmeters as additions to the standard line. Using the same terminal arrangement as the standard instruments, the new units differ in ohms-per-volt sensitivity, temperature coefficient, and accuracy. They are listed in ratings of 150 and 150-300 volts and are expected to find their major applications in voltage-survey work.

DOSCO APPOINTMENTS

Arthur A. Cross, president of the Dominion Steel and Coal Corporation Limited, announces that A. M. Irvine, vice-president in charge of coal sales, is retiring from the corporation at the end of January. Effective immediately, O. P. Stensrud, at present assistant to vice-president, is appointed general manager of steel sales, and T. S. McLanders, superintendent of terminals, is appointed general manager of coal sales, both reporting to C. B. Lang, vice-president.

Mr. Stensrud and Mr. McLanders have been connected with the organization over a term of years, filling several important positions and have acquired a wide knowledge of the company's business. Mr. Stensrud entered the service of the corporation as cost clerk and timekeeper at the Halifax Shipyards, after his return from overseas in January, 1920. He was transferred to the Sydney office in September, 1924, taking the position of superintendent of yards, and was later promoted to the positions of manager of the order department and district supervisor of steel sales. In May, 1932, he was transferred to Montreal, taking over the duties of superintendent of terminals. In September of 1937 he was appointed assistant to vice-president of steel sales.

Mr. McLanders, who now takes the position of general manager of coal sales, also entered the service of the corporation through the Halifax Shipyards, as clerk in the purchasing department, on his return from overseas. In 1927 he was appointed purchasing agent of that company and served in that capacity until transferred to the Sydney office as assistant purchasing agent of the corporation. On January 1, 1938, he was transferred to Montreal as superintendent of terminals, which duties required full supervision over the distribution and transportation of coal.

15,000-VOLT RECLOSER

A new 15,000-volt oil circuit recloser for maintaining service on suburban and rural lines is now available from Canadian General Electric Company Limited. Designated Type FP-119, the device reduces outages and gives low-revenue lines the protection previously afforded only by large automatic reclosing circuit breakers. It is low in cost, easily and inexpensively installed and maintained.

The FP-119 is enclosed within a wet-process porcelain housing providing 15-kv insulation and protection. It is suitable for cross-arm mounting and is provided with an operation counter and an oil gage which can be easily read from the pole without touching the recloser.

In operation the new recloser is instantaneous on over-current, provides a three-second time-interval before reclosing, and operates through a cycle of three reclosures before lockout.

READY-RULED SHEATHING

A pamphlet, BCP-59, issued by British Columbia Plywoods Limited, Vancouver, B.C., describes and illustrates the Company's "Sylvaply Ready-Ruled Sheathing" for use in wall sheathing, sub-flooring, roof decking and as a base for interior panelling. The pamphlet gives tables of roof decking loads, nail sizes and labour costs.

COLOURING CONCRETE FLOORS

A four-page illustrated folder has been issued by The Masterbuilders Co. Ltd., Toronto, Ont., describing the new Colormix Method of laying and finishing coloured concrete. This entails the treatment of the fresh floor with KuroKrome, which is a coloured penetrating surface-sealer.

MULTIBREAK INTERRUPTER

A faster operating time for many conventional tank-type oil circuit breakers now in use can be achieved through application of a new multibreak interrupter developed by Canadian General Electric Co. Limited. Recently subjected to interrupting tests on 138 kv and 230 kv systems, the new devices consistently cleared short circuits as high as 2,000,000 kva in less than 5 cycles. In each series, carbonizing of the oil and erosion of the contacts were very moderate.

The new multibreak interrupter utilizes the oil blast principle. Pressure created by the arc forces oil across the arc and out through ports in the cylindrical housing. This principle is responsible for the new interrupter's ability to obtain performance, on circuit breakers of the conventional type, that approaches the impulse designs for voltages of 115 kv and above.

The interrupter is contained in a thick-walled, cylindrical housing of insulating material of high dielectric and mechanical strength. As the housing is easily removed, contact parts may be readily exposed for inspection.

TRACTOR DESIGN

A 35-page booklet, entitled "Digest of Features of Design," showing the design features of Cletrac Crawler Tractors, has been issued by the Cleveland Tractor Co. of Cleveland, Ohio. Each component part of the tractor has been indicated by an arrow and marginal note on a series of illustrations covering all the major parts of the tractor.

TRAFFIC COUNTING RECORDER

A portable automatic traffic counter and recorder is described in a four-page folder issued by the Paver-Sills Co., 4101 Ravenswood Ave., Chicago, Ill. The instrument is known as the "Traficounter" and is said to provide automatic continuous counting for seven days without attention and to provide printed hourly records of traffic on both paved and unpaved thoroughfares.

CAR-PULLERS, HOISTS AND WINCHES

Stephens-Adamson Mfg. Co. of Aurora, Ill., and Belleville, Ont., have just released a new eight-page catalogue illustrating and describing their car-pullers, hoists and winches which gives specifications, dimensions and other necessary engineering information on how to select. the proper car-puller. Copies of this catalogue may be obtained by applying to any of the Company's offices.

ALCOHOL IN INDUSTRY

An interesting story of the production of industrial alcohol and its utilization in industry is contained in a 26-page book recently issued by Gooderham & Worts Limited, of Toronto, Ont. The story is well illustrated and is prefaced by a history of the development of the company.

TEN-INCH SENSITIVE PRECISION LATHE

The Monarch Machine Tool Company, of Sidney, Ohio, has just introduced a new and entirely different 10-inch by 20-inch sensitive precision lathe which was developed as a result of research conducted over a period of years among large users of tool room lathes, making clear the fact that a large part of the work being done on 12-inch, 14-inch, and 16-inch geared head tool room lathes could be effectively handled on a small 10-inch lathe of a maximum 2 h.p. capacity

PRELIMINARY NOTICE

of Applications for Admission and for Transfer

January 20th, 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 March, 1939.

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

BARRIE—ALEXANDER OGILVY, of Kumasi, Ashanti, British West Africa. Born at Dumfries, Scotland, May 6th, 1910; Educ.: B.Sc. (Civil), Queen's Univ., 1934; 1931 (5 mos.), Beauharnois Construction Co.; 1933, Canadian Relief Camp, Dept. of National Defence; 1934-38, executive engr., E. H. Engineering Ltd., London, England; at present, executive engr., Public Works Department, Gold Coast, Africa.

References: W. P. Wilgar, D. S. Ellis, D. M. Jemmett, C. E. Pigot, R. O. Sweezey.

BISHOP—EDGAR RICHARD, of 24 Fairleigh Crescent, Hamilton, Ont. Born at Barry, Glamorgan, England, Sept. 12th, 1898; Educ.: 1920-24, Univ. of South Wales & Monmouth, Cardiff, England. Diplomas in elect'l. and mech'l. engrg., 1924; Associate Inst. E.E.; 1913-17, elect'l. ap'tice, Guest, Keen, & Nettlefolds Ltd., Cardiff; 1917-19, electrical improver, elect'l. dept., of Admiralty Dockyard, Devonport; 1919-20, erection engr., McWhirter & Sons Ltd., Cardiff, erection of elect'l. equipment in industrial concerns; 1927-29, engr. officer i/c of main engines and boilers on regular watch, W. E. Hinde Steamship Co. Ltd., Cardiff; 1929-31, teacher to bldg. trade apprentices evening class courses, in elect'l. installn., under Ont. Dept. of Labour, Hamilton Technical Institute; 1929 to date, dftsman., Canadian Westinghouse Company, Ltd., Hamilton, Ont., mech'l. design of transformers and heating equipment.

References: D. W. Callander, J. R. Dunbar, W. L. Millar, J. C. Nash, G. M. Bayne.

COOCH—HAROLD AUSTIN, of Hamilton, Ont. Born at Toronto, Ont., July 19th, 1888; Educ.: B.A.Sc., Univ. of Toronto, 1910. R.P.E. of Ont.; 1909-10-11 (summers), Westinghouse Electric & Mfg. Co.; 2 years, demonstrator, elect'l. engrg., Univ. of Toronto; 1916-19, overseas, Capt., Can. Engrs.; with the Canadian Westinghouse Co. Ltd., Hamilton, Ont., as follows: 1912-16 and 1919-23, sales engr., 1923 to date, sales executive, and at present, vice-president.

References: J. B. Challies, L. A. Wright, T. H. Hogg, W. D. Black, J. B. Carswell.

FOOTE—SAMUEL DAVID, of Toronto, Ont. Born at Stouffville, Ont., Oct. 7th, 1914; Educ.: B.A.Sc., Univ. of Toronto, 1937; 1937 to date, rodman, constrn. dept. C.N.R., Toronto, Ont.

References: W. B. Redman, A. A. Baldwin, C. R. Young, W. J. Smither.

GREBER—JACQUES, of 10 rue Pergolèse, Paris, France. Born in Paris. Mr. Greber is the well-known town planning expert. His most important works and assignments include the following: At present city planning consultant for the Federal Government of Canada for the plan of Ottawa; technical consultant of the High Commission for the Regional Plan of Paris; official consultant for the City Planning Commission to prepare the comprehensive plan of the City of Philadelphia; consultant city planning architect of St. Joseph, Missouri; town planner for many cities and garden-cities in France; also private and public parks in Paris, in the Nord dept., on the French Riviera, in Italy, Holland, Portugal, the New York region, near Philadelphia, Detroit, Florida and California; associated with various architects for the execution of memorials and chapels in the battlefields and war cemeteries of France; winner of many prizes incl. first prize in the competition for the general plan of the City of Paris, Section III, concerning the planning of the grounds for the fortified zone; 1937, architect in chief of the International Exhibition held in Paris; at present, consultant for the New York World's Fair, 1939.

References: A. Surveyer, J. B. Challies, A. Cousineau, O. O. Lefebvre, H. Massue.

HELLSTROM—CARL AXEL, of 140 Banning St., Port Arthur, Ont. Born at Ljusdal, Helsingland, Sweden, June 2nd, 1899; Educ.: 1917-22, Orebro Tekniska Gymnasium (Tech. High School), diploma in mech. engrg.; 1916-17 and 1922-25, ap'ticeship in sawmills, pulp and paper mills and steel mills in Sweden, incl. dfting.; 1925 (July-Dec.), tech. asst. in groundwood mill and sawmill, Hellesfor Bruks A.-B.; 1925-26, designing 6-gang sawmill, A.-B. Otto Hellstrom; 1926-27, Kippawa mill, International Pulp & Paper Co.; 1927-30, dfting and design, and field work, C. D. Howe & Co.; 1932, designing gang-sawmills, planning mill, log sorter and lumber yard, and 1933-34, i/c constrn. work, Pigeon Timber Co. Ltd., Port Arthur, Ont.; 1935-36, divn. dftsman., Dept. Northern Development; 1937-38, dfting and designing, Provincial Paper Limited; Aug. 1938 to date, supervision of constrn. work and special dfting work, Public Utilities Commission, Port Arthur, Ont.

References: C. D. Howe, R. B. Chandler, E. L. Goodall, J. M. Fleming, G. R. Duncan, H.Os., S. E. Flook.

JEFFREYS—CHARLES JOHN, of Westmount, Que. Born at Harrow, England, Mar. 18th, 1902; Educ.: 1919-23, London Polytechnic (England); scholarship to Willesden Poly. Junior Institute Engrs., London, England; 5 years, gentleman ap'tice., British Thomson Houston Co., Rugby & Willesden; 1924-26, dftsman., Charles Walmsley Co.; 1926-27, mtce. engr., Canadian International Paper Co.; 1927-28, designing mill extension, Abitibi Pulp & Paper Co. Ltd.; 1928-29, i-c Minton dryer, Charles Walmsley Co.; 1929, chief dftsman., Riley Engrg. Co.; 1929-30, designing, hydraulic dept., Dominion Engrg. Works Ltd.; 1930-32, estimating and dfting., Fraser Paper Companies; 1933-35, production mgr., Beatty Bros. Ltd.; 1935-36, chief designer, Canadian International Paper Co.; 1936-37, estimating, designing (i-c process), Ontario Paper Co.; 1937-38, estimating, designing and process, i/c dfting. office, mech'l. equipment and layout, John Stadler, M.E.I.C., consltg. engr., Montreal; at present, asst. res. engr., Powell River Company, Powell River, B.C.

References: J. Stadler, J. A. Freeland, H. Anvik, W. H. Cook, E. L. Goodall, K. O. Elderkin.

KERR—JAMES WINSLOW, of 118 Melrose Ave. South, Hamilton, Ont. Born at Hamilton, March 11th, 1914; Educ.: B.A.Sc., Univ. of Toronto, 1937; 1931-37 (summers), in various depts., 1937-38, engrg. ap'tice. course, and from August, 1938 to date, correspondent apparatus divn., Canadian Westinghouse Company, Hamilton, Ont.

References: J. R. Dunbar, D. W. Callander, E. M. Coles, G. W. Arnold, W. L. Miller.

LINNELL—VINCENT A., of 504 Grosvenor Ave., Westmount, Que. Born at Montreal, Aug. 20th, 1898; Educ.: High School, Dublin, Ireland, 1906-16; group study of steel manufacture in 1936, and lectures on steel at McGill, 1938; 1916-17, apprenticed in office of R. Sharpe, consltg. engr., Dublin; with the Grand Trunk Western Rly. as follows: 1917-18, chainman and rodman; 1918-19, levelman and dftsman., 1919-20, track and bldg. estimator, all on valuation and location; 1926 to present, estimator for Kendall Bros. Inc., also, 1927-29, for Verochio Constrn. Co., Wilson Excavation Co., Ott & Co., Poupore Constrn. Co., covering office bldgs., stores, residences, grain elevators, reservoirs, collector sewers, general grading, etc.; with the Montreal Tramways Company as follows: 1921-24, instrumentman; 1924-28, trackwork designing; 1928 to date, engr. of special trackwork, responsible for trackwork layouts and design. Annual inspection of track to recommend renewals. General design and alterations to castings. Specifications for all track materials, concrete in track structures, and welding technique. Special reports regarding trackwork, etc. Inspection of track layouts and materials. Reports and inspection of rails. Insurance values of all bldgs.

References—P. H. Buchan, A. Duperron, J. M. R. Fairbairn, W. McG. Gardner, B. R. Perry, W. M. Reid.

MARSHALL—JAMES LAWRENCE, of 4812 Grosvenor Ave., Montreal, Que. Born at Winnipeg, Man., July 13th, 1913; Educ.: B.Sc. (E.E.), Univ. of Man., 1935. Graduate Member, Inst. E.E. (Britain); 1929-33 (summers), rodman, etc., on land surveys; 1934-35 (8 mos.), gen. service, hydrographic survey, Lake Winnipeg; 1935-36 (7 mos.), student ap'tice., English Electric Company, Stafford, England; 1936-38, mtce., engr., British Broadcasting Corporation, London; at present, engr., transmitter dept., R.C.A. Victor Co. Ltd., Montreal.

References: E. P. Fetherstonhaugh, G. H. Herriot, N. M. Hall, A. E. Macdonald.

McCAFFREY—WALTER RAYMER, of Ottawa, Ont. Born at Markham, Ont., June 23rd, 1894; Educ.: B.A.Sc., Univ. of Toronto, 1915; 1915-16, hydrometric engr., irrigation office, Dom. Govt., Calgary; 1919-27, sales mgr. & engr., National Fireproofing Co. of Canada, Toronto; 1927-31, sales mgr., Don Valley Brick Works, Toronto; 1931-32, engr., Toronto Brick Co. Ltd., Toronto; 1932-36, mgr.-engr., Brick Mfrs. Assn., Toronto; 1936-37, asst. regional mgr. (Eastern Canada), West Disinfecting Co.; 1937 to date, secretary, Canadian Engineering Standards Association, Ottawa, Ont.

References: T. R. Loudon, C. S. L. Hertzberg, J. M. R. Fairbairn, A. H. Cowie, B. S. McKenzie.

NICKLE—HUGH DICKSON, of the Town of Mount Royal, Que. Born at Kingston, Ont., Nov. 14th, 1900; Educ.: S.B., Mass. Inst. Tech., 1924; 1924-26, cadet engr., Public Service Corpn. of N.J.; 1926-28, shop practice and test engr., Wheeler Condenser & Engrg. Co., Carteret, N.J.; with the Foster Wheeler Corpn., New York, as follows: 1928-29, asst. to mgr., steam generator dept.; 1929-33, mgr. i/c prelim. design and estimating, incl. responsibility for all prelim. layouts and proposals for complete steam generating units; 1933-36, engr., asst. to vice-president i/c sales; 1936-37, sales engr., American Flange & Manufacturing Co.; 1937 to date, mgr., service and erection dept., Combustion Engineering Corporation Ltd., Montreal, Que.

References: J. S. Misener, R. L. Weldon, H. C. Karn, I. R. Tait, F. A. Combe, P. Poitras, J. G. Hall, J. A. Kearns.

OLIVER—JOHN CRAIG, of 5897 McDonald St., Vancouver, B.C. Born at Edinburgh, Scotland, Nov. 25th, 1904; Educ.: B.A.Sc., Univ. of B.C., 1927; R.P.E. of B.C.; 1922-25 (summers), dftsman. and instr'man. on constrn., Municipality of Point Grey; 1926 (summer), dftsman. and surveyor, i/c control work, B.C. Forest Survey; 1927-28, designing dftsman., city engr's. office, Vancouver; 1928-30, instructor in civil engrg., Univ. of B.C.; 1930-38, asst. city engr., city engr's. office, sewer and water works divn., City of Vancouver; at present, registrar, Association of Professional Engineers of the Province of British Columbia.

References: C. E. Webb, C. Brakenridge, E. A. Cleveland, R. Rome, J. M. Begg, W. H. Powell.

ROWE—HUGH MILLER, of 43 Inglewood Place, Ottawa, Ont. Born at Kitchener, Ont., March 11th, 1891; Educ.: B.A.Sc., Univ. of Toronto, 1915; 1912-13, divn. clerk, Can. Nor. Ont. Rly.; 1914 (summer), instr'man., Welland Ship Canal; 1916-19, Overseas, Major, Can. Rly. Troops; with the Bell Telephone Company of Canada as follows: 1925-26, district engr., plant, Montreal; 1927-29, gen. engrg. dept., Montreal, design of equipment, plant, etc.; 1930-33, engrg. dept., Toronto, i/c future plant extensions and budget; May, 1937 to date, inspecting engr., on mining and tourist roads, Ontario, for Dept. of Mines and Resources, Ottawa.

References: A. M. Reid, W. H. Norrish, F. C. C. Lynch, W. B. Hutcheson, W. L. Saunders.

SCROGGIE—GEORGE NELSON, of London, Ont. Born at Guelph, Ont., March 31st, 1910; Educ.: B.Sc. (Civil), Queen's Univ., 1935; summer work as gen. asst., office and field work, to city engr., Guelph; 1935, inspecting engr., on roads, 1936, bridge inspecting engr., County of Waterloo, Ont.; 1937-38, instr'man., Dept. of Highways Ontario; Jan. 1st, 1939 to date, junior engr., Dept. Public Works of Canada, London, Ont.

References: H. S. Nicklin, D. J. Emrey, C. K. S. Macdonell, W. P. Wilgar, W. L. Malcolm.

SELF—ROBERT HARVEY, of 299 Sumach St., Toronto, Ont. Born at Vancouver, B.C., Oct. 23rd, 1911; Educ.: B.A.Sc., 1938; Univ. of Toronto; summer work: instr'man., etc., Joseph Wilde, Gen. Contractor; cost accountant and timekpr., Wm. Breithaupt & Son; instr'man., for Mr. Sewell, O.L.S., Toronto; 1936 (4 mos.), asst engr., Bickle-Seagrave Co. Ltd., Woodstock, Ont., designing and layout work: 1937-38, plant engr., Canada Packers Ltd., designed and supervised erection of various plants in Toronto and Montreal and across Canada; Dec. 1st, 1938, to date. estimating and junior supt., for Bennett Pratt, General Contractors, Toronto, Ont.

References: W. E. Bonn, F. G. Engholm, D. D. Whitson, D. C. Beam, E. A. Allcut.

WALLENDER—LOUIS, of 397 Spadina Ave., Toronto, Ont. Born at Toronto, July 14th, 1911; Educ.: B.A.Sc., Univ. of Toronto, 1935; 1936 (3 mos.), Burlec Limited (Electrical), Scarboro Jct., Ont.; 1938 (3 mos.), Appliance Sales Company (Electrical), Toronto; at present, postal employee, Terminal "A", Toronto, Ont.

References: E. A. Allcut, R. W. Angus, T. R. Loudon, C. H. Mitchell, J. J. Spence

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

COUSINEAU—AIME, of Montreal, Que. Born at St. Genevieve, Que., Nov. 20th, 1885; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1909. B.S. (Sanitary Engrg.), Harvard Univ., 1916; R. P. E. of Que.; 1914 to date, city sanitary engr., and technical advisor to the Medical Officer of Health, City of Montreal, at present, also supt. of the Divn. of Sanitation of the Dept. of Health. Member of several investigating commns., town planning, housing, sewage treatment, etc.; 1928-33, lecturer on heating and ventilation, and 1933 to date, lecturer on town planning, Ecole Polytechnique, Montreal. (*St. 1908, A.M. 1915*).

References: A. Surveyer, O. O. Lefebvre, A. Frigon, J. L. Busfield, T. J. Lafreniere, A. Duperron, E. A. Ryan, W. S. Lea, H. Massue.

HOLDEN—OTTO, of Toronto, Ont. Born at Toronto, Oct. 30th, 1891; Educ. B.A.Sc., Univ. of Toronto, 1913; R.P.E. of Ont., 1913, dftsman., London Public Utilities Commission; with the Hydro-Electric Power Commission of Ontario (Hydraulic Dept.), as follows: 1913-18, designing dftsman., 1918-22, designing engr., 1922-23, hydraulic engr., 1923-37, asst. chief hydraulic engr., and 1937 to date, chief hydraulic engr. i/c administration of all affairs of the department. (*A.M. 1921*).

References: T. H. Hogg, G. A. Gaherty, C. H. Mitchell, M. V. Sauer, H. G. Acres, J. T. Johnston, R. L. Hearn.

NASH—JAMES CUNDIFF, of 147 Mountain Park Ave., Hamilton, Ont. Born at St. Joseph, Mo., U.S.A., Dec. 14th, 1886; Educ.: B.A.Sc., Univ. of Toronto, 1912; 1913-15, layout, overhead system, Hamilton Hydro; 1929-30, teaching dfting., night classes, Hamilton Technical Institute; with the Canadian Westinghouse Company, Hamilton, Ont., as follows: 1908-09 and 1912-13, dfting., generators; 1919-28, dfting. transformers; 1928-38, responsible for mech.'l. design of transformers, and at present dftsman., transformer engrg. dept. (*A.M. 1922*).

References: H. A. Ricker, D. W. Callander, J. R. Dunbar, W. L. Miller, G. W. Arnold.

FOR TRANSFER FROM THE CLASS OF JUNIOR

ANDERSEN—VIGGO, of 4987 Earnscliffe Ave., Montreal, Que. Born at Roskilde, Denmark, Nov. 23rd, 1898; Educ.: B.Sc. (Civil), The Royal Technical College, Copenhagen, 1923; 1923-24, with the municipal engr., Roskilde, Denmark; 1924-25, Chicago Rapid Transit Co., Chicago, and George Jerome, consltg. engr., Detroit; 1926-27, reinforced concrete designer, municipal gasworks, Copenhagen; 1927-28, struct'l. steel detailer, Dominion Bridge Co. Ltd., Lachine; 1928-30, dftsman. and designer on hydro-electric developments, Power Corpn. of Canada, Montreal; 1931, 1933-34, 1937-38, dftsman and designer, Canadian Copper Refiners Ltd., Montreal East; 1931-32, reinforced concrete designer, J. A. Forgues, Ltd., consltg. engrs., Montreal; 1932-33, designer of industrial bldgs. and foundations, W. H. Wardwell, Consltg. Engr., Montreal; 1934-37, designing engr. on struct'l. steel and reinforced concrete (in charge of office work), Dominion Reinforcing Steel Co. Ltd., Montreal; at present, reinforced concrete designer, J. M. Eugene Guay Inc., Consltg. Engrs., Montreal, Que. (*Jr. 1928*).

References: N. Cageorge, H. S. Grove, C. N. Mitchell, A. Desserud, L. B. McCurdy.

BENJAMIN—ARCHIE, of Montreal, Que. Born at Glace Bay, N.S., Sept. 22nd, 1905; Educ.: B.Sc.. (Elec.), McGill Univ., 1928; with the Montreal Light, Heat & Power Cons., as follows: 1928-29, misc. work in Cedars power house (operating, survey work, etc.), 1929 (6 mos.), asst. operator in city sub-stations, 1929-30, asst. in underground divn., elec. distribution dept.; 1930-34, junior engr., in dist. engrg. divn.; 1934 to date, distribution engrg. divn., circuit layouts, inventories, duct lines, 66 kv. cable operation and engrg., misc. distribution engrg. problems. (*St. 1926, Jr. 1933*).

References: S. H. Cunha, L. A. Kenyon, R. N. Coke, L. L. O'Sullivan, G. E. Templeman, H. Milliken.

BERESKIN—ABRAHAM ISAAC, of 1307 Portage Ave., Winnipeg, Man. Born at City of Propoisk, Russia, April 28th, 1903; Educ.: B.Sc. (Civil), Univ. of Man., 1929; D.L.S.; R.P.E. of Man.; 1926-28, instr'man., on surveys, Topog'l. Survey of Canada; 1929-31, asst. to chief of survey party preparing engrg. plan of Rousseau River, Man., for drainage study and flood control, summer of 1929. 1930, asst. chief of party, legal subdivision of Peace River block; during period between surveys was employed by Topog'l. Surveys, Ottawa, as surveys engr. engaged principally in preparation of aero photographs for mapping; 1932 (3 mos.), private constrn. work; since 1932 engaged in retail business, and during last four years as accounts clerk with the Dept. of National Defence, Winnipeg. Occasional survey work, but recently more actively engaged in surveys qualifying for commission of Man. Land Surveyor; 2nd Lieut., Royal Can. Engrs., engaged in military engrg. at local hdqrs. and at Dundurn Camp, Sask. (*St. 1925, Jr. 1931*).

References: J. H. Edgar, J. N. Finlayson, A. E. Macdonald.

HAY—EDWARD CAMPBELL, of Regina, Sask. Born at Peebles, Scotland, Dec. 7th, 1906; Educ.: B.A.Sc., Univ. of B.C., 1930; 1925-26, dftsman., Canadian Westinghouse Co. Ltd., Hamilton; 1929 (4 mos.), helper, B.C. Electric Rly. Co., Vancouver; 1930-31, student, Westinghouse Electric & Mfg. Co., East Pittsburgh; with the Canadian Westinghouse Co. Ltd., as follows: 1933-36, student sales correspondent, Hamilton, and 1936-38, at Toronto; Sept. 1938 to date, sales engr., with territory comprising province of Sask. (*St. 1928, Jr. 1936*).

References: D. W. Callander, J. R. Dunbar, W. J. W. Reid, H. B. Stuart.

HOLGATE—WILLIAM THOMAS, of 85 Thompson Ave., Toronto 9, Ont. Born at Innisfail, Alta., Feb. 18th, 1904; Educ.: B.Sc. (E.E.), Univ. of Alta., 1930; R.P.E. of Ont.; 1927-29 (summers), mtce. and surveying, rodman, instr'man., C.N.R., Edmonton; with the Can. Gen. Elec. Co. Ltd. as follows: 1930-31, testing apparatus, Toronto and Peterborough; 1931, gen. engrg. dept., wire design, insulation, testing methods, etc., small radio transformer design; 1931-32, at Erie Works of General Electric Company, on rly. transportation work, also gen. engrg. in relation to Diesel electric locomotives; 1932-34, i/c refrigeration production at Peterborough; 1934-35, retd. to gen. engrg. dept.; 1935-36, handling orders and quotations at Toronto; 1936 to date, sales engr., Toronto district office, handling all types of elect'l. apparatus, incl. motors, control, transformers, capacitors, switching, breakers, etc. (*Jr. 1931*).

References: A. B. Gates, W. E. Ross, C. E. Sisson, E. C. Williams, W. M. Cruthers, W. T. Fanjoy, V. S. Foster, H. R. Webb.

JOHNS—CHARLES FREDERICK, of Sackville, N.B. Born at Portsmouth, England, Nov. 24th, 1903; Educ.: 1919-24, H. M. Dockyard School, Bermuda, B.Sc., Mount Allison Univ., 1928; 1919-24, ap'tice. and junior engr., H. M. Dockyard, Bermuda, elect'l. dept.; 1926-28, instructor in physics, Mount Allison Univ.; 1928 to date, i/c engrg. dept., heating and air conditioning divn., Enterprise Foundry Co. Ltd., Sackville, N.B. (*St. 1924, Jr. 1930*).

References: H. W. McKiel, F. L. West, H. W. Read, F. Binns, G. T. Medforth.

MILLS—WILSON STUART, of 350 Sorauren Ave., Toronto, Ont. Born at London, Ont., May 10th, 1895; Educ.: B.Sc., Queen's Univ., 1921; R.P.E. of Ont.; summer work, property resurvey, C.P.R., Geol. Surveys, Topog'l. Surveys; 1921-22, office engr., Queenston development, H.E.P.C. of Ont.; 1922-23, reports and supervision on drainage schemes under Municipal Drainage Act and Ditches and Watercourses Act; 1923 to date, district mgr., Wallace & Tiernan Ltd., manufacturers of chlorine and ammonia control apparatus, Toronto, Ont. (*Jr. 1921*).

References: A. E. Berry, W. L. Malcolm, W. S. Lea, C. K. McLeod, H. S. Van Patter, H. W. Lea, R. R. Murray, W. P. Wilgar.

MILNE—JAMES RAMSAY BURT, of 10 Mundy Ave., Kapuskasing, Ont. Born at Edinburgh, Scotland, January 10th, 1905; Educ.: 1920-24, H. M. Dockyard College, Rosyth. 4th year upper college pass; 1920-25, indentured ap'tice., H. M. Dockyard, Rosyth, incl. 1½ years design office; with Price Bros. & Co. Ltd., Kenogami, as follows: 1925-29, mech. engr., 1930-33, asst. to mech. supt., design and constrn. mill bldgs., paper mill equipment; 1934-35, mech. supt., i/c design, constrn. and mtce. paper mill, and responsible for same; 1936 to date, supt., mtce., Spruce Falls Power and Paper Co., Kapuskasing, Ont., i/c and responsible for mtce. and constrn. in field. (*Jr. 1932*).

References: G. F. Layne, N. D. Paine, C. H. McL. Burns, W. L. Yack, A. B. Sinclair.

MUNRO—DAVID JOHN BEST, of 36 Dobie Ave., Town of Mount Royal, Que. Born at Inverness, Scotland, March 9th, 1900; Educ.: B.Sc., McGill Univ., 1923; 1919-20 (summers), dftsman., elec. helper, C.P.R.; 1921 (summer) and 1923, records man, underground conduits constrn., G. M. Gest Ltd.; 1923-24, graduate students' course, 1924-26 and 1930-34, locomotive design, Westinghouse Elec. & Mfg. Co.; 1926-30, asst. supt., equipment and shops, Quebec Railway Light and Power Company; 1934 to date, supt. of equipment, Montreal Tramways Company, respons. for mtce. of all company car barns, for all rolling stock other than gas busses. Also engr. of all rolling stock design and modification as above. (*St. 1921, Jr. 1927*).

References: D. E. Blair, C. V. Christie, P. S. Gregory.

RIVA—RONALD HERRICK, of Wethersfield, Conn. Born at Buffalo, N.Y., Sept. 3rd, 1901; Educ.: B.Sc. (Civil), McGill Univ., 1925. R.P.E. of Que.; 1925-26, chief demonstrator, dept. of descriptive drawing, McGill Univ.; 1926-28, designing and layout of trackwork, dept. of mtce. and structure, Montreal Tramways Co.; 1928, chief of party, Rye extension of New York, Worcester & Boston Rly. for United Engineers and Constructors Inc.; 1928-29, job engr., for same company on constrn. of 22 story apt. bldg. and hotel; 1929-30, chief of party, Port Chester extension, New York, Westchester & Boston Rly., and 1930-31, asst. job engr. on constrn. of continuous plate mill, Chicago, Ill., all for same company; 1935, asst. town engr., Town of Hampstead, Que., i/c engrg. for new constrn. also bldg. inspection; 1936-37, field engr., on constrn. of townsite at Baie Comeau, Que., for the Ontario Paper Company; 1937, job engr., constrn. of plant for Austin Co.; 1938, asst. job engr., on constrn. of two bldgs., Fairfield State Hospital, Newtown, Conn., i/c engrg. for one bldg., and at present, job engr. on constrn. of 14 bldgs. for Connecticut State Home for Veterans, Rocky Hill, Conn., i/c of all engrg., for F. H. McGraw & Co., Inc. (*St. 1923, Jr. 1928*).

References: P. G. Gauthier, J. W. March, A. I. Cunningham, E. Cryer, W. McG. Gardner, W. M. Reid.

THWAITES—JOSEPH TAYLOR, of 144 Stirton St., Hamilton, Ont. Born at Bolton, Lancs., England, Mar. 2nd, 1901; Educ.: B.Sc., Queen's Univ., 1925; R.P.E. of Ont.; 1927-28, sales engr., Smart Turner Machine Co.; 1928-29, service engr., Wentworth Radio & Auto Supply Co.; 1929-30, asst. radio engr., 1930 to date, engr. on switchgear, Canadian Westinghouse Company, Hamilton, Ont. (*St. 1924, Jr.* 1928).

References: J. R. Dunbar, D. W. Callander, G. M. Bayne, E. M. Coles, G. W. Arnold.

WEST—THOMAS MACDONALD, of Kingston Rd., Toronto, Ont. Born at Toronto, Aug. 27th, 1899; Educ.: B.A.Sc., Univ. of Toronto, 1921; R.P.E. of Ont.; 1918, engine repair park, R.A.F., shop work, Polson Iron Works; 1921-22, demonstrator, thermodynamics, Univ. of Toronto; with J. & J. Taylor Safe Works Ltd. as follows: 1922-25, shop practice, 1925-39, i/c plant and research (1925, junior member of firm, 1935, secretary-treasurer). (*St. 1921, Jr. 1924*).

References: A. H. Harkness, C. S. L. Hertzberg, E. A. Allcut, R. W. Angus, E. A. H. Menges.

FOR TRANSFER FROM THE CLASS OF STUDENT

BRUMELL—ORBY RICHARD, of 1455 Drummond St., Montreal, Que. Born at Buckingham, Que., Nov. 29th, 1911; Educ.: B.Eng. (Mech.), 1934; R.P.E. of Que.; 1933 (summer), jr. engr., Dept. of Highways of Quebec; 1934-35, instructor, mech. lab., McGill Univ.; 1935-37, asst. chief engr., design, plant mtce. and development work, Dominion Rubber Co.; 1937, plant engr., Jenkins Bros.; at present, asst. engr., Dominion Oilcloth & Linoleum Co., Montreal, Que. (*St. 1930*).

References: J. L. Bicker, R. Ford, T. M. Moran, C. U. Vessot, C. M. McKergow.

CUNNINGHAM—HAROLD EMBERSON, of Montreal, Que. Born at Westmount, Que., Dec. 9th, 1907; Educ.: B.Sc. (Civil), McGill Univ., 1931; 1926-28 (summers), woods dept., St. Lawrence Paper Mills Co. Ltd.; 1930 (summer), on Sun Life Bldg., for Cook and Leitch; 1931-32 (8 mos.), C.N.R. Terminal, Montreal, Monsarrat & Pratley; 1934 to date, gear engr., Dominion Engineering Works, Montreal, Que. (*St. 1929*).

References: H. G. Welsford, F. P. Shearwood, H. A. Crombie, R. DeL. French, A. I. Cunningham.

ROSS—ARTHUR LEBRETON, of 484 Duplex Ave., Toronto, Ont. Born at Sault Ste. Marie, Ont., Oct. 7th, 1910; Educ.: B.Eng. (Elec.), McGill Univ., 1932; 1930-31 (summers), ap'tice., Southern Canada Power Co.; 1932-33, dftsman., 1933-34, electrn., 1934 (Feb.-Nov.), tech. asst. to plant engr., Noranda Mines Ltd.; 1934 to date, i/c production and sales engrg., control apparatus divn., Railway & Power Engineering Corpn., Toronto, Ont. (*St. 1930*).

References: H. M. Black, G. H. Kohl, R. N. Austin, D. S. Lloyd, C. V. Christie, J. S. H. Wurtele.

HOLDER—ALLAN SCOTT, of 61 Maple Ave., Shawinigan Falls, Que. Born at Saint John, N.B., Aug. 1st, 1911; Educ.: B.Sc., N.S. Tech. Coll., 1934; 1934-37, misc. mtce. and engrg. work, and 1937 to date, designing engr., Canadian Industries Limited, Shawinigan Falls, Que. (*St. 1931*).

References: H. J. Ward, H. W. McKiel, F. L. West, M. Eaton, A. H. Heatley, H. K. Wyman.

ROSS—HENRY URQUHART, of 137 Upton Road, Sault Ste. Marie, Ont. Born at Sault Ste. Marie, Ont., Oct. 6th, 1912; Educ.: B.Eng., 1936, M.Sc., 1938, McGill Univ.; 1931, 1934, 1935 (summers), dfting., Algoma Steel Corpn., smelter, Noranda Mines, mill work, Dome Mines Ltd.; 1936-37, Canadian Furnace Co., Port Colborne, (6 mos.), chemist, (5 mos.), constrn. work, (2 mos.), foreman, (3 mos.), office staff; June, 1938 to date, metallurgical dept., Algoma Steel Corporation, Sault Ste. Marie, Ont. (*St. 1936*).

References: F. Smallwood, J. W. LeB. Ross, K. G. Ross, J. L. Lang, J. S. Macleod.

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CIVIL ENGINEER, B.A.Sc. (Toronto '35), Jr.E.I.C. Age 26. Experience in highway layout and construction, concrete bridge construction, draughting, office work, and surveying. Further details on request. Good references. Available immediately. Location immaterial. Apply to Box 1832-W.

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CIVIL ENGINEER, B.Sc. '37, S.E.I.C. Age 22. At present employed, desires position with construction firm. Experience includes field instructing of transit and chain survey crews, draughting for geologist, instrument work and general supervision on highway construction work, purchasing in paper mill. Available on few weeks' notice. References and details on request. Willing to locate anywhere that offers required class of work. Apply to Box No. 1840-W.

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TROLLEY BUSES REPLACING TRAMS

In the East Midland Traffic Area only one municipality—Leicester—is still operating tramcars, and even this will probably cease to be true before long. Similarly, the only remaining tramway service in the Eastern Traffic Area is that at Southend-on-Sea, and that is being partially replaced. In the Metropolitan Traffic Area, there was a decrease of 286 in the number of the trams licensed, this being accompanied by an increase of 375 in the number of trolley 'buses. In this connection the Commissioners for the Yorkshire Traffic Area call attention to the desirability of trolley vehicles being brought under their jurisdiction, mainly because of the effects which the introduction of such vehicles have had on co-ordination schemes designed to avoid wasteful competition. They note that, for this reason, the use of trolley vehicles has been discontinued at Chesterfield, their place having been taken by Diesel-engined omnibuses. It would be interesting to know whether a similar change has taken place elsewhere. The Chesterfield Corporation, it is understood, are of the opinion that Diesel-engined omnibuses are capable of performances equal to those of trolley vehicles, and that their introduction on routes previously served by the latter will eventually admit of a more complete co-ordination of all the passenger-transport facilities in their district.—*Engineering.*

HYDRO-ELECTRIC PROGRESS IN CANADA

The annual review of hydro-electric progress in Canada, which has been issued by the Dominion Water and Power Bureau, Department of Mines and Resources, Ottawa, shows that during 1938 there was not only a substantial increase in new generating capacity, but also widespread activity in the extension of transmission and distribution facilities, particularly in rural areas and in the mining industry. The amount of hydro-electric generating plant added during the year was 135,459 h.p., bringing the total for the Dominion up to 8,190,772 h.p. In British Columbia a second 47,000-h.p. unit was added to the Ruskin station of the British Columbia Power Corporation on Stave River, while smaller additions were made to the stations of Messrs. Fraser River Golds, Limited, at Wahleach (Jones) Creek and of the Denver Light and Power Company, on Carpenter Creek. In Ontario a new generating station with a capacity of 10,400 h.p. was completed at Ragged Rapids, on the Musquash River, while a station of about the same capacity was brought into operation at Lower Falls, on the Montreal River. In Quebec the Gatineau Power Company added a 34,000-h.p. unit to its Chelsea plant on the Gatineau River, thus increasing the capacity of this station to 170,000 h.p., and the Shawinigan Water and Power Company added 8,000 h.p. to its La Gabelle station by changing the runners of two of the units. Important works under construction in this province include a 243,000-h.p. station at La Tuque, on the St. Maurice River, by the St. Maurice Power Corporation. To begin with, four 40,500-h.p. units will be installed and the delivery of these will start next year. The gravity dam will be 1,100 ft. long and will provide a normal head of 104 ft. The Beauharnois Light, Heat and Power Company is also adding a ninth 53,000-h.p. unit to its station at Beauharnois, on the St. Lawrence River. It is stated that while the output during the first ten months of 1938 was less than during the corresponding period in 1937, this is almost entirely accounted for by a falling off in the demand on the electric boilers used in the paper and pulp industry. At the end of the year this load showed signs of recovery.—*Engineering.*

THE RAILWAYS AND RATE CONTROL

The Committee of the Transport Advisory Council announce that, as a result of discussions between the railway companies and interests representing traders, the original proposals of the former regarding rate control have been amplified. The first proposal was for the entire abolition of control pending the establishment of a complete system of co-ordination of the various forms of transport, and it is now stated that the railways do not seek any alteration in the law relating to their obligation to provide reasonable facilities, through rates, or standard conditions of carriage. It is proposed that regular meetings should be established between the companies and the various trading associations for the discussion of matters of common interest. In the event of agreement proving unattainable, a procedure would be provided for appeal to a body such as the Railway Rates Tribunal, which would have the power of deciding on the reasonableness of the charge under dispute. Legislation would be required to place this procedure on an established footing. Such legislation would take the form of a provision entitling the railways to make such reasonable charges as they thought fit, subject to a proviso that in case of disagreement, the responsibility should rest with a body such as the Railway Rates Tribunal to fix the charge. Every trader, or body of traders, would have the right of appeal on the question of reasonableness, although it is hoped that normally all such cases would be amicably settled at one or other of the periodical meetings between the appropriate trading association and the companies. The railway repreesntatives have not yet had the opportunity of laying these proposals before the general body of traders, and they therefore wish to emphasize the main features of the scheme, namely, that all rates must be reasonable, that the trader will have a right of appeal to a body such as the Railway Rates Tribunal, and that where he is a member of any recognized trading association, he can bring his complaint before the regular joint meeting of that association and the railways before appeal. It is suggested that under safeguards of this description, the trader will have ample protection against injustice or excessive charges under existing conditions of competition.—*Engineering.*

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THE ENGINEERING JOURNAL

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"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 FORWARD

Another annual meeting has come and gone and the presidential mantle has fallen upon my shoulders. As I review the wearers of this mantle in the past I appreciate the great honour done me but even more do I appreciate the great responsibility I have accepted. To maintain the Institute at the level to which it has been raised is a great task; to raise it to a still higher level seems a very formidable one indeed. It can only be done with the active assistance of every member; I, therefore, bespeak for myself the same energetic support you have given your presidents in the past. To my immediate predecessor, I think the entire Institute owes a great debt of gratitude for his inspired leadership and great accomplishment.

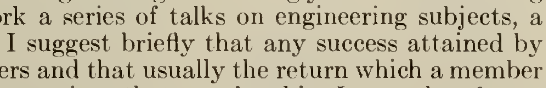
Our annual meeting was wonderfully successful, thanks to the Ottawa branch and the capable committee in charge. For the second time in two years we were honoured by the presence of His Excellency the Governor-General and this time we were still further honoured by the presence of the Lady Tweedsmuir as well. The honour which they have done the Institute shows the prominent place it occupies in the life of Canada today. But we must not forget that this prominence entails a great responsibility. The key-note of the meeting was "Service"; service not only to the profession but to the nation as well. This was the theme dealt with in the addresses of Dr. Wallace and Colonel Chevalier. It was further developed, in practice, by our sessions on western Canada's drought problem and by the address of the Honourable Mr. Gardiner.

The editor of the Journal has asked me to say something about the Institute's policy for the coming year. I believe the annual meeting indicated clearly what our policy should be—that is, service to the nation at all times. To effectually accomplish anything in this line engineers should act as a body, not only nationally but as far as possible internationally. Hence our efforts to bring about a spirit of co-operation among all engineering groups in Canada will be actively continued. Also the good-will existing between ourselves and our cousins to the south, shown so splendidly by the attendance at our meeting of the strong delegation from the American engineering societies, shall be zealously maintained and fostered. This friendliness we believe will be greatly amplified by the joint meeting in New York next September, at which the American Societies are acting as hosts to a visiting delegation from the British Institutions, and to The Engineering Institute of Canada. May I digress for a moment to urge that all Canadian engineers make an attempt to be present at this meeting.

Reverting to a consideration of policy I am sure that the members will be glad to learn that the Committee on Western Water Problems is to be continued under its present able leader, Mr. G. A. Gaherty, and a progress report crystallizing its findings to date is to be issued shortly.

These policies all depend for their ultimate success, however, on the young engineer of to-day. He is the trustee of the future. Hence he becomes our major interest. With this in mind the Council has set up a strong committee consisting of older engineers, younger men in the profession, practising engineers and engineering teachers to consider the welfare of these younger men. It will be the work of this committee to deal with such matters as engineering education; the apprenticeship period following their formal education, the period during which the young man attains professional status; and his subsequent career in the profession. This committee will be representative not only of the groups mentioned but also of geographic divisions of the Institute, and will be directed by H. F. Bennett, Chairman of the London branch, a choice upon which I feel the Institute is to be congratulated.

Finally, The Engineering Institute is to have the privilege during the coming year of broadcasting over the Canadian Broadcasting Corporation network a series of talks on engineering subjects, a favour which we greatly appreciate. In closing may I suggest briefly that any success attained by the Institute is due entirely to the efforts of its members and that usually the return which a member gets from his membership is in direct ratio to what he puts into that membership. Let us then forget all personal and regional differences and in working for the welfare of our profession and of The Engineering Institute of Canada ensure the service of the profession to the nation.



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SOIL MECHANICS IN FOUNDATION ENGINEERING

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Paper presented before the Montreal Branch of The Engineering Institute of Canada, March 31, 1938

SUMMARY—A review of advances in foundation practice based on soil mechanics, with comment on the misuse of precedent and the limitations of field tests. Notes the application of soil mechanics principles in proposals to state allowable bearing values for various types of soil.

Soil mechanics has been defined as the science which treats of the properties, behaviour and treatment of soil for engineering purposes. It has found applications in three major fields, dams, highways and foundations. In limiting this paper to its applications in foundation engineering it is not intended to minimize its importance in the construction of dams and highways. Very extensive research resulting in practical applications has been carried on in these fields by consulting engineers, engineering schools, U.S. Army engineers and other branches of the federal and state governments. The soil analyses made by the Army engineers on earth dams for the Muskingum flood control projects in Ohio and by the Experiment Station in Vicksburg, Mississippi, on the design of levees have been outstanding in the development of the science of soil mechanics. So also have the activities of the Federal Bureau of Public Roads and of several of the state highway departments in soil stabilization and drainage and in the elimination of frost heaves. A recent example of the application of soil mechanics to dam analysis is found in the investigation of the failure of the Marshall Creek earth dam in Kansas. The committee appointed to investigate the causes of failure, conducted laboratory tests and applied the theory of circular failure path developed by the Swedish Geotechnical Commission. As a result of this analysis, which could just as well have been made before the inadequate structure was built, the committee found a factor of safety for the dam of 0.86, an indication of the failure which actually occurred.

As a teacher of a college course in foundation engineering, the author has the opportunity as well as the obligation to review each year the developments in foundation practice and in soil mechanics and to evaluate the progress made in terms of its actual value as a contribution to the science of foundations. A teacher who includes in his course any material, the actual value of which he cannot clearly see, is not serving the profession or the students fairly. In soil mechanics the problem of what to teach is especially difficult because nobody knows the extent to which much of our soil mechanics may or may not be of value. Each year new contributions of significance are made and must be taught. Each year some of our beliefs, hypotheses, methods need to be revised and sometimes discarded in the light of newly acquired knowledge. Nevertheless the need for some scientific analysis of soil conditions has been confirmed in recent years by the warm reception which foundation engineers have given to this embryo science. The inconsistency of building structures whose every part is subjected to rigid mathematical analysis and laboratory tests on a material of such unknown properties as soil has become recognized more and more strongly by engineers. They are no longer willing to accept this inconsistency and they welcome studies which aim to eliminate the unknowns of foundation work.

Hypotheses and beliefs and wishful thinking alone do not keep structures from settling or cracking, or highways from acquiring washboard surfaces or dams from being washed out. Many a structure has stood the test of time when built on these things—and good luck. Many have failed when built on these things—and bad luck. While there are many beliefs and hypotheses in soil mechanics, there are also plenty of facts and plenty of sound basic principles.

It is proposed to outline in this paper how precedents, interpreted in the light of soil mechanics analysis, may be applied to the design of foundations; to present the soil mechanics of pile foundations; to outline desirable methods of soil exploration; to discuss the interpretation of field loading tests and the application of allowable bearing values to various types of soil; to show how the contributions of soil mechanics may be incorporated into building codes; and to outline very briefly the methods of making settlement analyses of structures.

There is one never-failing criterion for foundation design, one panacea for all soil problems, one "yardstick" for which soil mechanicians can claim little credit, for which they have to thank those who have been engineers and builders for many years. This panacea is precedent; unfortunately, precedent can only be safely applied to a very small proportion of foundation problems. But the principles of soil mechanics may help a good deal to establish the extent of the similarity which is often apparent between existing and proposed structures. Apparently, soil technicians in general are prone to disregard valuable precedents which may be available to them, but the practical foundation engineers are also guilty of disregard, in their case the disregard of factors which may cause apparently identical structures to behave very differently.

As an example of the misuse of precedent, a large and heavy double-deck bridge was recently constructed which for some distance runs parallel to a trestle supported on timber pile bents. The soil profile along the line of the bridge indicated that no useful purpose could be served by bearing piles under the heavy piers. In fact, according to soil mechanics developments it appeared that piles would be detrimental rather than helpful. The recommendation was therefore made that the timber piles tentatively scheduled to be driven be omitted. The engineers in charge of the design, however, pointed to the precedent of the pile bent trestle which had served its purpose satisfactorily for many years. They said the piles had worked there, so they should work under the piers of the new bridge. The piles were driven. No settlement records of the bridge are yet available, nor perhaps ever will be. But where is the fallacy in this precedent ? It lies in the vast difference between the types of structures under consideration. The first is a light timber trestle supported at intervals by pile bents. The loads on these bents are largely live, intermittent loads; the dead loads are very light. There is no concentration of loads; they are pretty uniformly spread over the length of the trestle. And, finally, there is no record to show what the behaviour of the trestle has actually been. It may have settled many inches without any serious effect on the structure. Or it may not have settled at all, of course. No one knows. The new bridge, in contrast, is heavily constructed to carry both automobile and interurban trolley traffic. The loads are not spread over the length of the bridge; they are concentrated at piers almost 300 feet apart. Pile groups do not consist of a few lightly loaded piles; they consist of several hundred, closely-spaced, heavily-loaded piles. Most of the load carried by these piles is not intermittent; it is dead, continuously applied. And finally, settlements, if they occur, will not only be unsightly to the contour of the structure, but will cause considerable disturbance to trolley track alignment and to the rigid concrete pavement of the bridge. The engineers did make one concession to the soil analysis. They provided the end connections of the trusses with jacking plates, "just in case" the settlements predicted might occur. Anyway, they drove piles; and what more could they do than that ?

As an example of the proper use of precedent, there is a heavy office building in one of our eastern cities. It was constructed on timber piles because the underlying soil consisted of soft clay, and the engineers were concerned over the possibility of settlement. They had reason to be. The records to date show an average of about nine inches settlement, and it keeps on going. The differential settlements have been serious enough to necessitate heavy maintenance expenditures. Not long after the construction of this building a similar building was planned to be erected on the same kind of soft clay. The engineers who designed this building were concerned about settlements, too. They looked at the first building, and they saw the similarity between the types of structures and the types of soil profiles, and they believed in precedent. So they didn't drive piles. Soil mechanics told them not to anyway, and so did their precedent. Instead they excavated about twenty feet of overburden, poured a concrete mat and Vierendeel truss foundation over the whole area and erected their building on that. The last observed settlement to date was about two inches, and the differential settlement has been negligible. Of course this matter of precedent can be carried to extremes, as it is in Mexico City, where the precedent of existing structures seems to suggest that the only sure way to get a three-story building is to build one three-and-a-half stories high.

The foregoing examples suggest that there are soil conditions in which piles may be not only useless but actually detrimental. That this statement is true has recently come to our attention both through settlement observations and through the scientific analysis of the structure of various types of soil. That the fact remained obscured so long is attributable to over-reliance on the results of driving observations and pile-loading tests, and to the feeling that, "It's a good thing we drove piles. The settlement has been bad enough. Think what it would have been without the piles." The unreliability of bearing capacities based on pile-driving records is universally recognized by engineers who have intelligently observed the driving of piles. That the resistance of piles to redriving, following a period of rest after driving, is likely to be very different from their resistance to the original driving has been demonstrated innumerable times. Generally the resistance to redriving is greater. Occasionally it is less, occasionally the same. Last summer the author had the opportunity to record the driving records of long timber piles for the foundation of a bridge on the site of the New York World's Fair. After a rest period of one to two minutes the driving resistance would increase from, say, 12 blows of a Vulcan No. 1 hammer per ft. of penetration to fifty blows. Sometimes the increase was less, sometimes greater. In other types of soil the rest period required is much longer, overnight perhaps. Such observations are substantiated by theoretical considerations of the soil types and establish beyond doubt the fact that in all but dry, cohesionless soils, a type seldom encountered, the resistance to driving bears no definite relation to its resistance to loading, which after all is what we are interested in. Furthermore, it can be shown that a short-time load-test on a pile—a test is seldom continued longer than a week—while it may be an indication of the ultimate bearing capacity of that pile, does not necessarily give any information regarding the bearing capacity of a group of piles or, more important, regarding the settlement which may be expected under long-continued load. Thus it becomes apparent that the sufficiency of a pile foundation cannot necessarily be determined by driving records or even load tests. The only true criterion is scientific analysis of the soil profile. Hard and fast rules are dangerous in this field, but here is one for pile driving: If the compaction of the soil which must carry the load of the building overbalances the injury to the structure of the soil, or if the load can be transmitted through weaker materials to better load-carrying strata below, piles should be driven. Otherwise they should not. Considering the two extreme types of soil through which piles are most generally driven, cohesive clay and granular sand, and realizing that there are all gradations of soils between the extremes, we can make the following statements which are generally true: Clay is displaced more than it is compacted by the driving of piles, and the geologic structure is seriously impaired. Sand is compacted or displaced depending upon its original density, and its geologic structure is not appreciably injured. Figure 1 shows several generalized cases where piles should be driven or should not be driven in accordance with these rules.

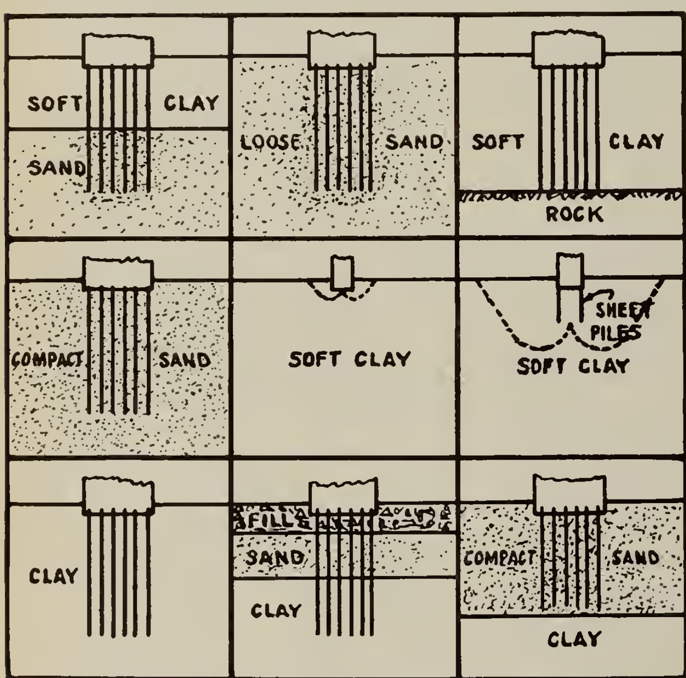

Fig. 1—Instances of beneficial and detrimental use of piling.

In the upper row three cases are illustrated where piles are decidedly beneficial. In the first case the piles carry the building load through a soft layer of clay to a firm underlying stratum of sand; in the second case the loose sand deposit is compacted, thereby increasing its load resistance; and in the third case the load is carried to unyielding rock through bearing piles. In the middle row the first case illustrates an all too common use of piles where no beneficial result can be expected. The sand is already compact and the driving of piles cannot further compact or solidify the deposit. No harm is done except in the useless expenditure of money. In such a deposit if jetting is required it is a pretty good indication that no beneficial compacting can be expected. The second case illustrates a narrow footing on soft clay where there is a danger of failure by lateral flow of the underlying material along the lines indicated. In such cases timber piles are often driven to add stability to the footing. This practice, however, may damage the structure of the clay so as to induce excessive settlements. An alternative remedy is suggested in the third picture. This consists of steel sheet piling driven around the footing. This treatment should produce the desired stability of the footing, since the flow path is greatly increased, as shown, without inducing the excessive settlement which would be caused by disturbance of the underlying the clay by bearing piles. The lower row illustrates cases in which the driving of piles may be detrimental. In the first case no compaction can be expected, and the breakdown of the geologic structure of the clay may result in excessive settlement. The same is true of the second case in which the clay, which must ultimately carry the load of the building, is weakened by the penetration of the piles. A better solution of this problem would be a mat foundation at the top of the sand stratum. In the third case the piles can effect no beneficial compaction of the already compact sand and merely tend to intensify the stresses which must be carried by the underlying compressible clay deposit.

A comparison with existing structures should undoubtedly begin with a careful study of the soil profile, and this means borings reliably made and reported and samples taken and preserved with an understanding of and a regard for the purposes and tests of the samples. The boring and sampling procedure is the backbone of all soil analysis. It is a simple matter to obtain satisfactory soil samples, and the expense involved in even the most elaborate sampling programme is almost negligible. Yet surprisingly few foundation soil profiles are adequately explored. Preliminary borings should generally be made by the combined wash-boring and drive-sampling method. In this method the casing is advanced by the familiar wash method, but samples are taken by means of a drive sampling spoon. The old-fashioned wash samples scooped out of the bottom of a tub of wash water are worse than useless. They are definitely misleading. The coarse material never reaches the tub and the fine material remains suspended in the water. The drive samples, though not undisturbed, are accurate and are suitable for some tests. They are used for classification—as sand, silt, clay—and for estimating their compactness, cementation, and structure and perhaps for rough determinations of moisture content. The soil analysis may end with the immediate visual inspection of these samples, for there is no doubt that an experienced engineer is able to determine merely by inspection that certain soils are satisfactory for the loads anticipated. Or the inspection of the samples may leave the engineer in doubt as to their load-resisting properties. In this case simple routine laboratory tests such as moisture content, mechanical analysis, density, liquid limit, plastic limit and shrinkage limit determinations may be made on the drive samples for the purpose of more exact identification. If the results of these tests indicate that the load-resisting properties of the soil can be determined only by more elaborate tests such as shear, permeability and consolidation tests it will become necessary to obtain undisturbed samples. The term "undisturbed" is used loosely and means merely a sample taken and transferred to the laboratory in as nearly its original state as the best methods so far developed make possible. There has been great development in sampling spoons during the past ten years. The importance of testing undisturbed samples was first recognized about 1930, at which time improvements were begun on the open end pipe which until that time was the most scientific sampling spoon in general use. Through the various stages of development since 1930 the improved sampling spoon shown in Fig. 2 has been evolved. The essential features of this device are: the removable liner tube in which the sample is preserved for shipment to the laboratory; the inset cutting edge which relieves side friction and drag on the sample as the spoon is jacked into the ground; the piano-wire loop which cuts the sample near the bottom of the cutting edge; and the tubes for drawing a vacuum above the sample and applying pressure below it as the spoon is withdrawn from the ground. The author has gone into this detail in the description of sampling devices because he feels that perhaps ninety per cent of foundation problems can be solved merely by an adequate sampling programme and intelligent inspection of the samples. For the other ten per cent, and this minority includes many major projects, more elaborate soil mechanics procedure is advisable.

Probably the outstanding example of the application of soil mechanics principles to general foundation problems is the proposed Code on Excavations and Foundations of the Boston Building Code. The Code specifies in connection with borings, for example, that "Washed or bucket samples shall not be accepted."

Field loading tests, long used to supplement borings, have found more definite but less broad application in the light of soil mechanics knowledge, for scientific studies indicate both theoretically and by actual comparison the limitations of field tests in predicting the behaviour of full-sized structures. The Boston Code, by differentiating with regard to both soil types and footing types, aims to do away with the indiscriminate application of loading tests to foundation design. In recognition of the fact that the bearing capacity and settlement of a foundation vary with the ratio of its width to its depth below the ground surface the Code

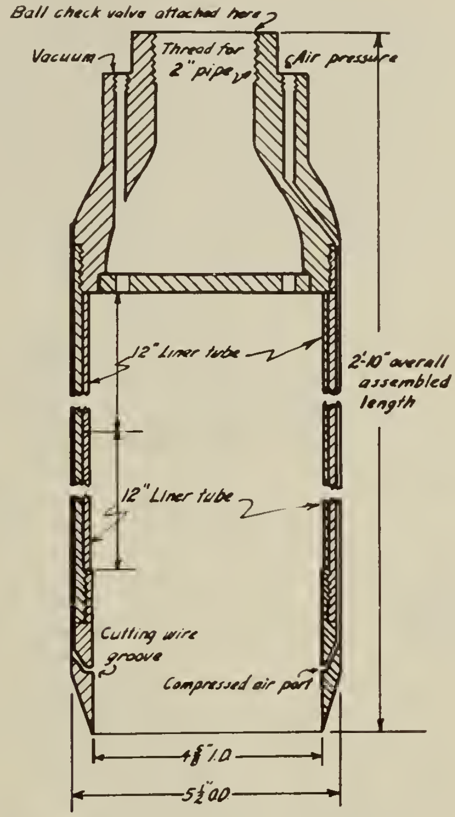

Fig. 2—Improved form of sampling spoon

specifies that this ratio be the same for test and structure. The occurrence of progressive, long-time settlement in clay is recognized in the Code by a paragraph requiring further investigations of clay subsoils at the discretion of the commissioner. Thus test-load settlements of three-eighths inch under design load, or one inch under twice the design load, are accepted in the case of rock or granular soils, such as gravel or sand. But when clay or rock flour soils are involved there is no such definitely established criterion of satisfactory behaviour; and where the proposed foundation is to be underlaid by a thick stratum of clay or by a stratum of clay varying considerably in thickness "the commissioner may require an analysis to be made of the probable magnitude, rate and distribution of settlement of the proposed structure. Such analysis may be based upon: (1) A study of settlement records of nearby structures having essentially the same foundation conditions; (2) Consolidation tests and other investigations of undisturbed samples of the compressible materials."

Building codes traditionally include a list of allowable bearing values for various types of soil. They specify that these values may not be exceeded in the absence of satisfactory tests. Some codes are actually indiscreet enough to name them "safe bearing values." Soil mechanics, settlement observations, and logic all emphasize the fallacies of assigning definite bearing values to vaguely defined soil types. In a particular location the practice is unwise enough. If the locality is not specified, as in the 1934 Building Code of the National Board of Fire Underwriters, the practice is entirely unjustifiable. For example this code states: "In the absence of satisfactory tests, the sustaining power per sq. ft. of soils shall be deemed as follows: soft clay, one ton; wet sand, two tons; coarse sand, four tons," etc. No further description of the soils listed is given anywhere in the code. An architect or engineer designing a structure is led to believe that the worst soil may be safely loaded to one ton per sq. ft. no matter what size, shape or type of structure is being designed; or that coarse sand may be safely loaded to four tons per sq. ft. regardless of the type of structure, the compactness or thickness of the coarse sand stratum, or the type of soil underlying it. Properly interpreted these values may be helpful to a designing engineer, but blind acceptance of them has been responsible for many foundation inadequacies and failures. In the January, 1938, issue of Civil Engineering (American Society of Civil Engineers), Jacob Feld, who has been a consulting engineer on foundations in New York City for many years, says, "The total money loss caused by necessary repairs from unequal settlement is probably greater than that caused by fire loss."

Referring specifically to the sustaining powers quoted from the Underwriters' Code, it may be mentioned that disastrous settlements have been recorded for buildings imposing loads of considerably less than one ton per sq. ft. on soft clay; and of course wet sand can be found which will safely sustain not two but six tons per sq. ft., whereas in its worst form, as quicksand, it may be entirely incapable of supporting any load at all.

As a sensible working compromise between the only safe method of prescribing allowable bearing values—that is, not to prescribe them—and the other extreme as we have found it in the Fire Underwriters' Code, the proposed Boston Code states: "The maximum pressure on soils under foundations shall not exceed the allowable bearing values set forth . . . subject to the modifications of subsequent paragraphs of this section: . . . soft clay (a clay which, when freshly sampled, can be moulded under relatively slight pressure of the fingers): one ton per sq. ft. . . . coarse loose sand (a sand consisting chiefly of grains which will be retained on a 65-mesh sieve and is readily removable by shoveling only): three tons per sq. ft.", etc. Note first of all that the materials are quite closely defined, and note particularly the modifications which are essentially as follows:

If the loaded area on rock is more than two feet below the lowest adjacent surface of sound rock, the tabulated allowable bearing value may be increased by 20 per cent for each foot of additional depth up to twice the tabulated values. Similarly, for granular materials such as sand or gravel the tabulated values may be increased by 2½ per cent for each foot of depth up to twice the tabulated values. See Fig. 3.

For very small footings on granular materials, if the least lateral dimension is less than three feet, the allowable value is limited to one-third the tabulated value multiplied by the least lateral dimension.

The values tabulated for cohesive materials such as clay or rock flour—sometimes called inorganic silt or just plain silt—apply to pressures directly under individual footings, walls and piers. The total load of any major portion of a building on these soils, minus the weight of excavated material, divided by the area of the bay is limited to one-half the tabulated value.

Furthermore, the Code considers the occurrence of weaker soils at a depth below a foundation area by limiting the

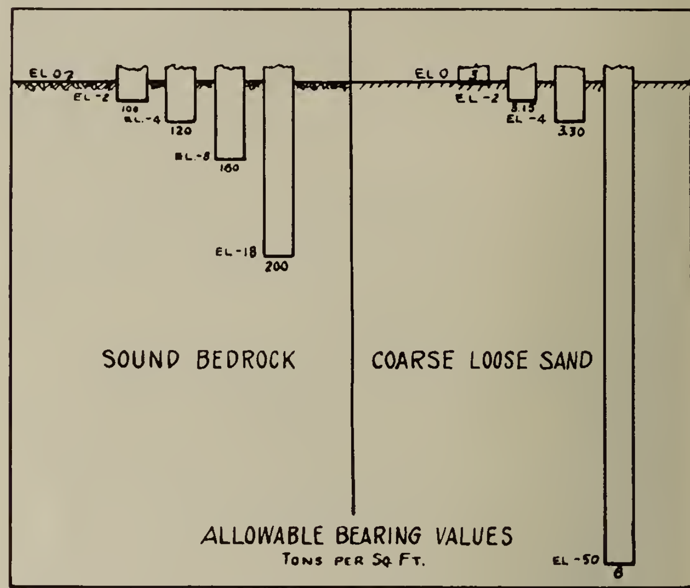

Fig. 3—Proposed scheme of allowable bearing values for Boston Building Code.

allowable pressure at that depth to the tabulated value for the soil type existing there. The calculation of pressure at a point below a loaded area is a complicated problem in elasticity and is one of the major concerns of mathematical technicians in the soil field; but the Boston Code, recognizing the approximate nature of allowable bearing values, recommends that these pressures be computed by the practical approximate method of considering the foundation load as spread uniformly at an angle of 60 deg. with the horizontal but not into areas within the 60 deg. lines of adjacent foundations.

And, finally, the code imposes the restriction that the tabulated values may not be applied at all to buildings which rest partially on soft clay or rock flour and partially on other materials. In such cases the commissioner may require a settlement analysis based on settlement observations of existing structures and on soil mechanics tests.

SETTLEMENT ANALYSIS OF ENGINEERING STRUCTURES*

A. W. SKEMPTON, M.Sc., A.C.G.I., D.I.C.

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SUMMARY—Describes the methods of ascertaining settlement in structures, sampling substrata, making laboratory tests on the samples, and analyzing the results, which have been adopted in Britain by the Building Research Station of the Department of Scientific and Industrial Research.

A knowledge of the settlements which a proposed engineering structure will undergo, both during and after construction, is of importance in design from two main points of view. In the first place, owing to differential settlement and the resulting secondary stresses, there will be a lowering of the true factor of safety with time, this being of particular importance in the case of modern rigid-frame buildings or arch bridges. Secondly, with such structures as chemical plant or the roadway of a bridge, it may be desirable to eliminate the effects of settlement by making provision so that such movements as occur will do so without causing any harm. In the past, foundation design has been considered rather from the point of view of safe bearing pressure of the soil than from that of settlement of the structure, although as some settlement must necessarily occur, the correct procedure is obviously to calculate what the movements will be and modify the design, should they be too great. Settlements can be reasonably estimated by the scientific methods developed during the last twelve years, largely by Terzaghi[1] and his followers. These replace the traditional bearing test, which yields little information on this point, owing to its empirical nature. A great deal of research has still to be carried out, but modern methods of analysis have achieved considerable success and are generally recognized as constituting an increasingly important factor in structural design.

Fig. 1.

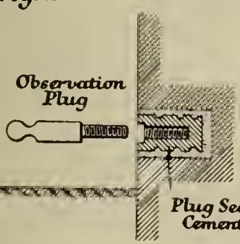


Fig. 2.

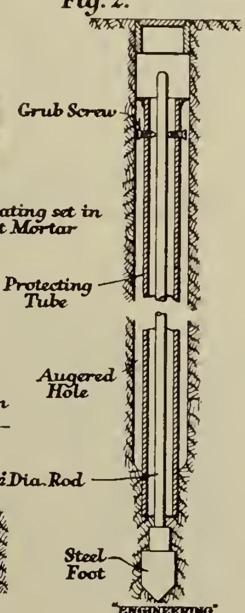
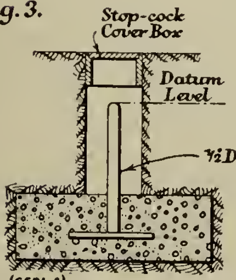


Fig. 3.



At the present time an essential part of research on the subject is to obtain settlement records, as they enable correlation with theory to be made and the types of settlement to be classified. Observations are made by taking levels from a datum point to various points on the building. The method used by the Building Research Station, with which the author is connected, is to have a brass plug which can be temporarily screwed into a socket cemented into the wall at ground level, as shown in Fig. 1. The plug is spherically ended and a special staff is held vertically on this end. The datum is established at a sufficient distance to remain unaffected by stresses due to the foundation load, and consists of a long rod sunk in the ground and protected from earth movements by a surrounding tube, as shown in Fig. 2. In hard ground a simpler type is used, and this is illustrated in Fig. 3. So far as it is possible to generalize, it has been found[2] that there are three main types of settlement, depending on the nature of the sub-stratum, responsible for settlement, and these are shown in Fig. 4. In the case of sand the movements do not continue for any appreciable time after construction, whereas for clay, the settlement continues long after construction, approaching a horizontal asymptote. With plastic clays and materials of high organic content a similar gradual settlement is observed, but here the asymptote is inclined. Table I has been prepared[3] from the records of 72 bridges built in connection with the *Reichsautobahnen*, and shows very clearly the importance of settlement of structures on clay or soft alluvial deposits.

Fig. 4.

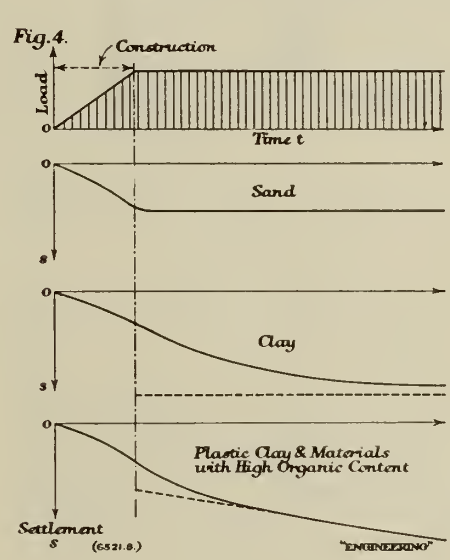
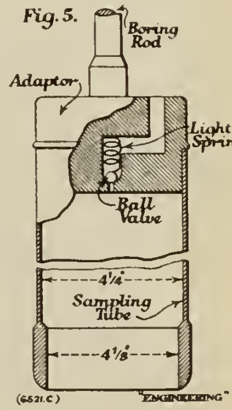


Fig. 5.



The settlement of a building with clay as the most important sub-stratum may be quite small at the end of construction, smaller, for example, than if it were on sand, yet the final or total settlement may be many times greater, reaching the figures quoted below.

The procedure adopted for settlement analysis in the case of a clay substratum may now be considered: (1) A visit is paid to the site and with the usual well-boring kit and special sampling tube, cores of the various substrata are obtained in an undisturbed state. The depth to which such sampling is taken depends on the individual conditions, but depths of 50 ft. are common and for large structures this must be greater. (2) Laboratory tests are carried out on the samples to determine their consolidation characteristics. (3) A mathematical analysis of the stresses set up in the sub-strata by the foundation load is carried out, and from the laboratory tests the rate of, and final value of, the com-

* Paper read before Section G of the British Association, at Cambridge, on August 24, 1938.

[1] von Terzaghi, K., *Erdbaumechanik.* Franz Deuticke, Vienna, 1925.

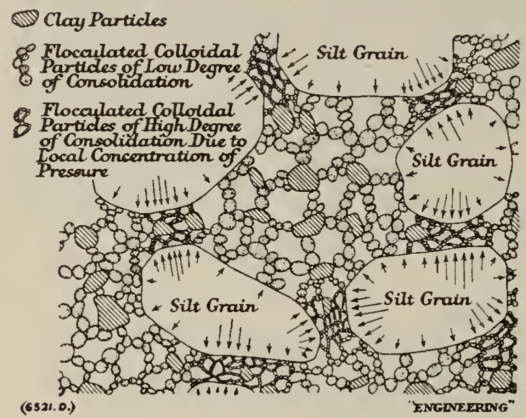
[2] von Terzaghi, K., "The Actual Factor of Safety in Foundations." *Structural Engineer*, Vol. 13 (No. 3), pages 126-160 (1935).

[3] Casagrande, A., "Subsidence in Bridge Constructions on the German State Arterial Roads." International Association for Bridge and Structural Engineering, 2nd Congress, Berlin, 1936.

pression which the clay will undergo as a result of these stresses is estimated.

Cores are obtained by drilling to a certain depth, withdrawing the auger and substituting a sampling tube. The sampling tube used by the Building Research Station for obtaining undisturbed cores consists of a steel cylinder of $4\frac{1}{4}$ in. internal diameter with a cutting nose which has a slightly smaller diameter and is proud on the outer face. This tube is fixed on to the rods by an adaptor with a ball-

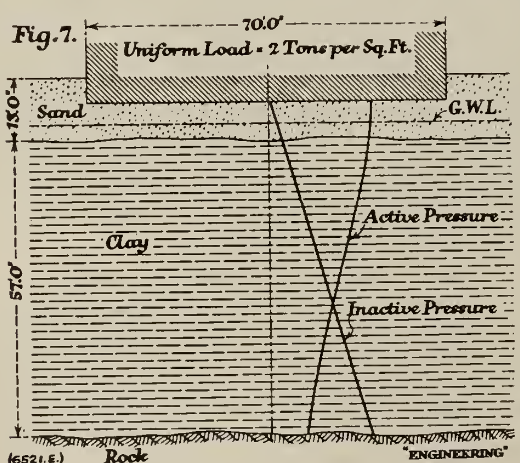
Fig. 6.
STRUCTURE OF UNDISTURBED MARINE CLAY X10[4]



valve air exit, as shown in Fig. 5. The tube is driven into the clay, and when full, a twist shears the clay and the apparatus is withdrawn. The core is retained owing to the ball-valve action and by the slight expansion of the clay after it has passed the cutting nose. The hole is then deepened and another core taken, until a complete record is obtained. In their natural state, clays have a complex cellular micro-structure, illustrated in Fig. 6, and if this is in any way broken down, the properties of the clay will be changed[4]. The importance of this effect will be realized, for London clay is nearly twice as compressible when remoulded as in its natural state. It is not possible to obtain cores from a bore-hole in a completely natural state, but the relief of the cutting nose minimizes disturbance by preventing frictional drag between the core and the tube, and examination of the samples shows distortion for only a very short distance (about $\frac{1}{8}$ in. for London clay) from the circumference.

To illustrate the method of analysis, let it be assumed

Fig. 7.



that the strata beneath the proposed building are as shown in Fig. 7. During the construction period, settlements due to the elastic compression of the sand, and to a lesser extent of the clay, will occur. Experience has shown[5] that in many

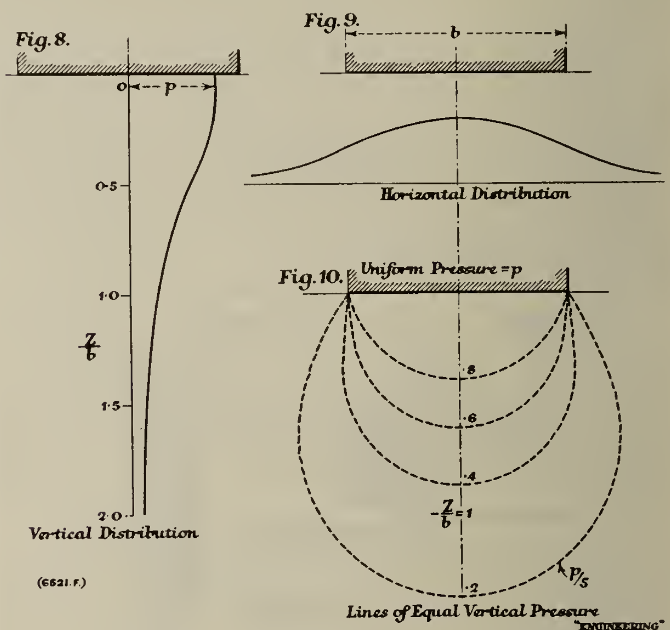
[4] Casagrande, A., "The Structure of Clay and its Importance in Foundation Engineering." *Journ. Boston Soc. C.E.*, Vol. 19 (No. 4), pages 168-221 (1932).

[5] von Terzaghi, K., and Fröhlich, O. K., *Theorie der Setzung von Tonschichten.* Franz Deuticke, Vienna, 1936.

Table I

Soil Type	Loading	Total Settlement
	Tons per square foot	In.
Sand, gravel	1.5—3.0	0—$\frac{1}{2}$
Sandy or gravelly clays	2.5—4.0	0—1
Clay loam	1—2.5	2—8
Alluvial silt, etc	1—2.0	8—40

cases this instantaneous settlement is small in comparison with the subsequent gradual settlement due to consolidation of the clay, and it will, therefore, be neglected. In those cases, however, where the foundation rests on a deep homogeneous clay stratum, the settlement due to elastic compression is of importance, and may be calculated from elastic theory and a knowledge of the compression modulus of the clay. A paper on the method of calculation is being prepared at the Building Research Station for publication. Now the clay at any depth has been subject for many centuries to a pressure equal to the over burden (with due allowance for hydrostatic uplift) and will not consolidate any further under this load, which is called the "inactive



pressure" for this reason. The structural load, however, increases the pressure by the amount shown as the "active pressure" and this increment will cause consolidation of the clay and hence settlement of the foundation.

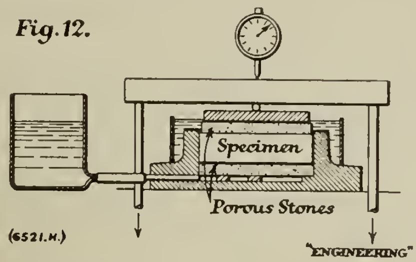
It is the vertical consolidation of the clay under the building which causes settlement and, consequently, it is the vertical component of stress at any depth which is referred to as the active pressure. By assuming that the clay stratum behaves as an elastic solid the problem is reduced to one of calculating the vertical stress at any point in a semi-infinite elastic solid due to a load on its surface. The general stress equations for this problem were derived by Boussinesq[6] in 1885, and the vertical component at a point $(r.\psi)$, taking the point of application of the load P as origin, is

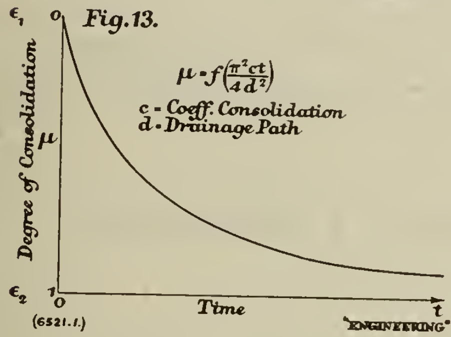
$$\sigma z = \frac{3\,P}{2\,\pi\,r} \cos^3 \psi \qquad (1)$$

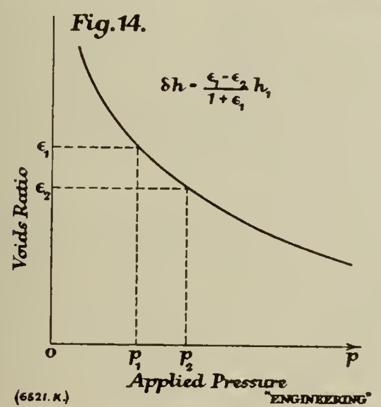
Integration of this expression will give the distribution for any particular case of loading, and many important

[6] Boussinesq, J., *Application des Potentiels.* Paris, 1885.

cases have been solved,[7] and conveniently tabulated. The distribution of vertical stress under a uniformly loaded square area is shown in Figs. 8, 9 and 10, and is seen to diminish both with depth and distance from the centre line. The lines of equal stress show that it is necessary to consider a depth of at least $1\frac{1}{2}$ times the width of the loaded area, for at this depth the stress has fallen only to one-fifth of its maximum value and 80 per cent. of the settlement takes place above this point. The absence of elastic constants from equation (1) does not imply that the question of the validity







of applying elastic theory to a clay stratum does not arise in deriving the expression. The question, in fact, is of the greatest importance, and is one which has received little attention owing to experimental difficulties. The present position, however, may be summarized by the statement that comparisons of calculations with full-scale observations[8] show promising results.

Turning now to laboratory tests, the behaviour of clay under changing stress was first studied by Terzaghi[9] in the oedometer, a modern form of which is shown in Fig. 12. A specimen, 3 in. in diameter and about 1 in. thick, is cut from a core and placed in a brass cylinder between two porous stones which are in contact with water. The conditions of saturation and lateral restraint are thus simulated in the laboratory, and it will also be noticed that as the core was 4 in. in diameter, the outer $\frac{1}{2}$ in., which includes the zone of disturbance due to sampling, is discarded.

[7] Jürgenson, L., "The Application of Theories of Elasticity and Plasticity to Foundation Problems." *Journ. Boston Soc. C.E.*, Vol. 21 (No. 3), pages 206-241 (1934). Newmark, N. M., "Simplified Computation of Vertical Pressures in Elastic Foundations." University of Illinois, 1934. *Circular No. 24 Eng. Expt. Station.* Report of the Special Committee on Earths and Foundations, *Proc. Am. Soc. C.E.*, Vol. 59 (No. 5), pages 777-820 (1933).

[8] See, for example, Casagrande, L., *loc. cit.*

[9] *Loc. cit.* (1925).

Now clay has an open cellular microstructure,[10] but the dimensions of the pores are very small and the resistance to flow is correspondingly high. Water has a negligible compressibility in comparison with the clay structure, and, therefore, the clay as a whole can suffer volume decrease mainly by the escape of some pore water. On the application of a load in the oedometer the increase in pressure in the (virtually restrained) water equals the applied stress increment. Flow will take place at the surface in contact with the stones, and a hydraulic gradient will be set up through the specimen, resulting in the extrusion of pore water, which will continue at a decreasing rate until an equilibrium density is reached. This change of volume with time is shown in Fig. 13. Theoretically, an infinite time is required for equilibrium to be established, but for the thickness of specimen used in the laboratory two days is sufficient for a close approximation. The load is now increased, a similar consolidation process takes place and a new equilibrium density is reached; a number of such points gives the relation between density, usually expressed as the voids ratio $= \dfrac{\text{vol. voids}}{\text{vol. solids}}$ and effective pressure. This is shown in Fig. 14.

Returning now to the conditions under the building, if at any depth beneath a certain point we have an elementary layer of thickness Δz and the inactive pressure is p_1, then this element will have a voids ratio ϵ_1, Fig. 14. The building now increases the pressure to p_2 and there will be a consolidation of the clay equal to $(\epsilon_1 - \epsilon_2)$. It is easily shown that this equals a change in length of

$$\delta s = \frac{\epsilon_1 - \epsilon_2}{1 + \epsilon_1}\Delta z \quad . \quad . \quad . \quad (2)$$

and clearly, the total settlement of this point of the building will be

$$s_\infty = \Sigma \delta s \quad . \quad . \quad . \quad . \quad (3)$$

the summation being carried out numerically. By choosing typical points, it is possible to gain a clear idea of the variation of settlement over the plan of the building.

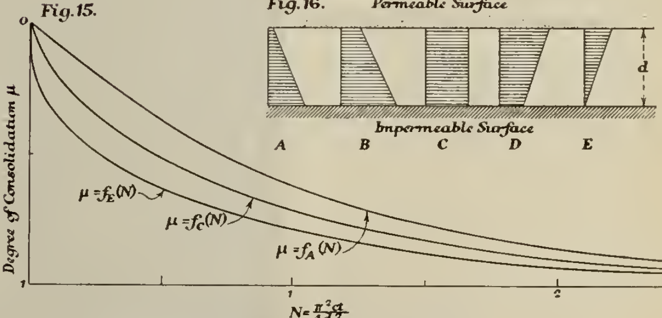
The settlement just calculated is the final value due to the attainment of equilibrium by the clay under the active pressure. This requires, as we have seen, a theoretically infinite time, and we have, therefore, to calculate the rate at which this consolidation occurs. From the mechanism of consolidation it is possible[11] to derive the fundamental equation

$$c\frac{\partial^2 \omega}{\partial z_2} = \frac{\partial \omega}{\partial t} \quad . \quad . \quad . \quad . \quad . \quad (4)$$

where

c = the coefficient of consolidation (a constant for any particular clay), and

ω = the hydrodynamic excess pressure in the pore water causing flow at a distance z from the drainage surface at a time t after the application of the load.



Case 1. Double Drainage. For all Pressure Distributions $\mu = f_c(N)$ (d = ½ Thickness of Layer)
Case 2. Single Drainage. $\mu = f(N)$ given for A, C & E. Types B & D by Interpolation
(6521 L)

[10] Casagrande, A., *loc. cit.*

[11] von Terzaghi and Fröhlich, *loc. cit.*

If μ = degree of consolidation = $\frac{s_t}{s_\infty}$

$$= \frac{\text{compression at time } t}{\text{total compression}} \quad . \quad . \quad . \quad (5)$$

then equation (4) may be solved in the form

$$\mu = f\left(\frac{n^2 c t}{4 d^2}\right) = f(N) \quad . \quad . \quad (6)$$

where d is the maximum length of drainage path.

The relation between μ and N has been evaluated[12] for a number of special cases, three of which are shown in Fig. 15. For uniform distribution of pressure the relation is

$$\mu = 1 - \frac{8}{\pi^2} \sum_{m=1}^{m=\infty} \frac{1}{(2m-1)^2} e^{-(2m-1)^2 \frac{\pi^2 c t}{4 d^2}} \quad . \quad . \quad . \quad (7)$$

and the other cases may be expressed by similar series.

In the oedometer the pressure distribution is uniform with double drainage, and thus for any value of μ we know f (N); but we have determined experimentally the value of t corresponding to this value of μ, and hence we know c (as the only other unknown is d, which is half the thickness of the specimen). Certain secondary effects[13] complicate this direct comparison, but the above description is essentially correct.

Let us assume that the distribution of active pressure under the building, Fig. 7, is trapezoidal, type B, Fig. 16. Now, for any value of t we know N, having determined c in the laboratory and d from the boring records, and, therefore, from the $\mu = f$ (N) relation we can find the corresponding value of μ. But $\mu = \frac{s_t}{s_\infty}$, and s_∞ has been previously calculated; thus we know s_t and can draw the time-settlement curve for any particular point of the building.

By the application of scientific method, it is, therefore, possible to estimate the settlements which any proposed structure will undergo and, therefore, to design a foundation with a measure of certainty impossible with the older empirical methods.

The author wishes to thank the Director of Building Research for permission to read this paper.

[12] von Terzaghi and Fröhlich, *loc. cit.*

[13] von Terzaghi, K., "Principles of Final Soil Classification." *Public Roads*, Vol. 8 (No. 3), pages 41-53 (1927-28).

THE GOLDEN GATE INTERNATIONAL EXPOSITION 1939

Notable Engineering and Artistic Features

In the centre of San Francisco Bay, twenty million cubic yards of sand have been dredged and deposited upon a shoal to make a new island, over a mile long and covering about 400 acres, which now forms a fitting location for a great international exposition, and will later be the site of a vast airport whose runways are to be constructed when the temporary exposition buildings have been cleared away.

This new land has been christened "Treasure Island." It has been built upon a shoal near Yerba Buena, the island which forms the mid point of the great Bay Bridge connecting Oakland with San Francisco. A causeway, 900 feet long, leads from Treasure Island to Yerba Buena and has been built for six traffic lanes. Three of these are of permanent construction for airport use; three others, of timber trestle work, will take care of the exposition crowds. Motorists to or from Treasure Island can leave or join the Bay Bridge at Yerba Buena on over-passes without any left turns across traffic streams. Parking space is provided for 12,000 cars.

Four ferry slips, three on the San Francisco side of Treasure Island, and one on the Oakland shore, are designed for an estimated peak ferry traffic of 65,000 passengers per hour.

Three of the buildings which are now practically completed on Treasure Island are intended to endure as airport facilities. One, a $900,000 reinforced concrete air terminal, now serves the Fair as administrative headquarters. The two others, each 287 by 335 feet, of steel and concrete, are being used as the Palace of Fine and Liberal Arts and the Hall of Air Transportation respectively; later, as hangars, their 200 by 40 foot doors will admit great aeroplanes—the doors being heightened at centres to 65 feet if found desirable.

The Court of Reflections
Golden Gate International Exposition, San Francisco, 1939

All the other buildings are of temporary construction, almost entirely timber and stucco. There is a main group of six blocks of exhibit halls, radiating from a central court; nearly seven million dollars have gone into their construction and embellishment.

A 400 foot "Tower of the Sun" in that central "Court of Honour" mounts a 44-bell carillon, and dominates the whole architectural group. The exposition buildings are largely windowless. Their new "Pacific" style of architecture is stated to have been devised "to exalt the visitor spiritually into a Never-Never land where romance is in the air." This effect will be aided by "ancient mystic oriental forms" and by a decorative scheme in which "flaming banners . . . will confer pungency to accentuate the simplicity of basic form."

The arrangement of the buildings is such that no exhibitor finds himself on a back street, and (to quote further from the somewhat flowery official descriptions) "a planned system of visitor-circulation is achieved ...so that the island will be saturated uniformly by strolling crowds." These crowds will be fed by "a number of prepared-food concessions that will embrace the international range of cookery."

Indirect illumination is provided throughout the Fair, using ten million kilowatt hours per week. Fluorescent paint, glowing under ultra-violet rays, underwater lamps, and nine thousand floodlights are among the novel features of the lighting scheme.

Tree planting is not usually considered a job for the

(CONTINUED ON PAGE 158)

Abstracts of Current Literature

Contributed abstracts of articles appearing in the current technical periodicals

THE DEVELOPMENT OF HIGH-SPEED CRAFT

The eleventh Thomas Lowe Gray Lecture delivered before The Institution of Mechanical Engineers, London, January 6th, 1939

By H. Scott-Paine

A condensation prepared by R. J. Durley, M.E.I.C., from the report in *The Engineer* January 13th and 20th, 1938.

As a result of the lecturer's experience since 1906 in racing boats and aircraft, and in handling fast motor boats in bad weather, he has found it possible to produce high-speed small craft of novel type, which can be driven at over 40 knots in a heavy sea and have been adopted by the Royal Navy as picket boats and motor torpedo boats. The prewar types of small high-speed boats were unsuitable and dangerous in bad weather, although by 1924 designers in the United States had developed the "hard-chine" boat and improved its seaworthiness. The type, however, then, had the following disadvantages:

1. Pounding of the forebody in a head sea.
2. A high angle of attack and considerable change of trim at high speed, so that much of the under surface of the hull was pushed out of the water.
3. Pitching or diving if the throttle was closed, so that in bad weather the boat's bow might dive into a head sea.

These conditions not only strained the hull and made the riding uncomfortable, but affected the steering, so that in bad weather or at slow speeds directional control was poor.

At that time no suitable lightweight marine engine had been developed in Europe, while in the United States several automobile engines had been successfully modified for marine work. An American engine averaging about 8 lb. per hp. could be obtained for about half the cost of the much heavier engines available in Britain. American engines were therefore used in the earlier experimental boats.

In flying boats, lateral stability and control at all speeds depend on the variation of dihedral angle along the length of the hull. The underwater form of the hard-chine boat was therefore rearranged so that the forefoot always remained in contact with the water, and the alteration of trim as the speed increased was reduced to about 3 degrees. In this way a directionally stable hull was obtained in which a small unbalanced rudder could be used, thus lessening resistance.

Propellers of high speeds of revolution were worked out and proved satisfactory with "Miss Britain III" (with which the salt-water speed record was made). The slip at 100 knots and 7,000 r.p.m. was only 20 per cent and the efficiency was remarkably high. In 1930 a twin engine 200 hp. boat was built for work with the flying boats of the Royal Air Force and proved beyond all doubt the superiority of the hard-chine type; this encouraged further development along the same lines with prospects of commercial success.

In order to obtain a suitable British engine, a 4½ litre car engine which gave a good 100 hp. was selected but nearly all parts had to be modified to meet the exacting conditions of boat service. In their final form the engines proved to be a little over ¾ lb. per hp. lighter than the American engine with a lower centre of gravity and a better petrol consumption.

There was now a 37 ft. 6 in. boat with two 100 hp. engines (the two propellers turning the same way), having excellent sea-keeping qualities, a greater load-carrying capacity, comparable petrol consumption in mi. per gal., twice the speed, and no greater cost than with its predecessors of round-bilge form. Hundreds of these boats have now been built with no instance of failure of structure in service. A 45 ft. boat of similar characteristics was the next step and met with success. Its small diameter propeller was found to give excellent propulsion when towing a mine-sweep.

Rolling:

The round-bilge hull, even if fitted with bilge keels, allows more free rolling than the hard-chine hull, which is extremely stable of itself and can carry its load at the lowest possible vertical distance from its bottom. When such a hull tends to slide down the side of a hill of water the action of the V bottom brings it upright.

Pitching:

With the round bilge form of hull, speed must be reduced in rough weather, as in meeting a wave the hull is in a diving position until the head wave has found sufficient area to lift the weight of the ship. The hard-chine motor torpedo boats can be driven up to 40 knots in a 45 m.p.h. wind and an 8 ft. sea. During official trials off the southeast of the Isle of Wight, with an average sea up to 12 ft. and occasional 20 ft. seas, the motor torpedo boat maintained a speed of 30 knots or more and easily outran the destroyer of 1,350 tons which carried the official observers.

Turning:

Ordinary forms of hull lean outward when turning. The new form may be designed to bank inward to any degree required. The motor torpedo boat can be turned at right angles to her course at any speed in seven or eight seconds and is directionally stable.

Construction:

The results stated have only been obtained by a constant effort for lightness of construction and of machinery. The 1935-37 motor torpedo boat, light, weighed about 12 tons, increased to 21-22 tons with fuel oil and armament. Under these conditions its speed only decreased from 40 to 38 knots.

The hull has a strength-weight ratio unapproached before except in aeroplane construction. Special high tensile material is used for all fastenings. Tanks have been reduced in weight to one lb. per gal. The weight of the latest type of boat complete with engines, but unloaded, is 10 lb. per hp.

Machinery.

The first motor torpedo boats had 500 hp. converted Napier "Lion" water-cooled aero-engines, later an engine of the same general type was specially built for the job. The fresh-water cooling circuit is closed, with a circulating pump and a cooler. Great care is necessary to avoid any possibility of salt-water entering the fresh-water system. The total weight of the whole engine and its gear is under 3 lb. per hp. Each boat has three of these engines; they can all be removed in four hours by six men, and replaced in a similar time. Much experimenting was needed to obtain a trouble-free salt-water pump; finally a pump was devised whose wheels would last 100 hours in bad water conditions and 300 hours in water free from sand. All propellers turn the same way; this arrangement gives no trouble and does not affect directional stability at all. The use of salt-water resisting alloys throughout has reduced maintenance costs to a small figure.

The 21-in. Motor Torpedo Boat

The first motor torpedo boats were armed with 18-in. torpedoes and eight Lewis guns.

The latest design carries two 21-in. or four 18-in. torpedoes, two 20-mm. and one 25-mm. guns in weather-proof turrets. Its speed is over 43 knots with full war equipment. It has no mast or deck fittings, is very difficult to see, and is absolutely silent at 10 knots.

The machinery consists of three 1,000 hp. Rolls-Royce-Power-Merlin engines.

THE FIFTY-THIRD ANNUAL GENERAL MEETING

Convened at Headquarters, Montreal, on January 26th, 1939, and ajourned to the Chateau Laurier, Ottawa, Ontario, on February 14th, 1939

The Fifty-Third Annual General Meeting of The Engineering Institute of Canada convened at Headquarters on Thursday, January twenty-sixth, nineteen hundred and thirty-nine, at eight o'clock p.m., with President J. B. Challies, M.E.I.C., in the chair.

The Secretary having read the notice convening the meeting, the minutes of the Fifty-Second Annual General Meeting were submitted, and on the motion of J. A. McCrory, M.E.I.C., seconded by R. H. Findlay, M.E.I.C., were taken as read and confirmed.

Appointment of Scrutineers

On the motion of S. F. Rutherford, A.M.E.I.C., seconded by Huet Massue, M.E.I.C., Messrs. R. E. Heartz, M.E.I.C., Walter G. Hunt, M.E.I.C., and E. Nenniger, A.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 H. B. Montizambert, A.M.E.I.C., seconded by Ernest Peden, A.M.E.I.C., that the meeting do adjourn to reconvene at the Chateau Laurier, Ottawa, Ontario, at ten o'clock a.m., on the fourteenth day of February, nineteen hundred and thirty-nine.

ADJOURNED GENERAL MEETING AT THE CHATEAU LAURIER, OTTAWA, ONTARIO

The adjourned meeting convened at ten fifteen a.m., on Tuesday, February 14th, 1939, with President J. B. Challies in the chair.

The President announced that Col. A. L. Bishop, M.E.I.C., of Toronto, Ontario, had accepted the chairmanship of the Nominating Committee of the Institute for the year 1939, and that each branch of the Institute was represented thereon as follows:

Nominating Committee, 1939

Chairman A. L. Bishop, M.E.I.C.

Branch	*Representative*
Halifax Branch	C. A. Fowler, M.E.I.C.
Cape Breton Branch	J. R. Morrison, A.M.E.I.C.
Saint John Branch	J. H. McKinney, A.M.E.I.C.
Moncton Branch	E. B. Martin, A.M.E.I.C.
Saguenay Branch	G. F. Layne, A.M.E.I.C.
Quebec Branch	P. Methé, A.M.E.I.C.
St. Maurice Valley Branch	A. C. Abbott, A.M.E.I.C.
Montreal Branch	R. E. Jamieson, M.E.I.C.
Ottawa Branch	A. K. Hay, A.M.E.I.C.
Peterborough Branch	W. M. Cruthers, A.M.E.I.C.
Kingston Branch	D. S. Ellis, A.M.E.I.C.
Toronto Branch	W. E. P. Duncan, M.E.I.C.
Hamilton Branch	W. Hollingworth, M.E.I.C.
London Branch	D. S. Scrymgeour, A.M.E.I.C.
Niagara Peninsula Branch	W. Jackson, M.E.I.C.
Border Cities Branch	C. G. R. Armstrong, A.M.E.I.C.
Sault Ste. Marie Branch	A. M. Wilson, A.M.E.I.C.
Lakehead Branch	E. L. Goodall, A.M.E.I.C.
Winnipeg Branch	T. C. Main, A.M.E.I.C.
Saskatchewan Branch	S. Young, M.E.I.C.
Lethbridge Branch	J. M. Campbell, A.M.E.I.C.
Edmonton Branch	R. M. Dingwall, M.E.I.C.
Calgary Branch	F. J. Heuperman, A.M.E.I.C.
Vancouver Branch	G. L. Tooker, A.M.E.I.C.
Victoria Branch	F. C. Green, M.E.I.C.

Awards of Medals and Prizes

The General Secretary announced the awards of the various medals and prizes of the Institute, stating that the formal presentation of these distinctions would be made by Her Excellency, the Lady Tweedsmuir, at the Annual Dinner of the Institute that evening.

The Past-Presidents' Prize to P. C. Perry, M.E.I.C., Regina, Sask., for his paper, "Stream Control in Relation to Droughts and Floods."

Gzowski Medal to A. W. F. McQueen, A.M.E.I.C., and E. C. Molke, A.M.E.I.C., for their paper, "The 18-Foot Diameter Steel Pipe Line at Outardes Falls."

Plummer Medal to H. I. Knowles, chief chemist, Atlantic Sugar Refineries, Saint John, N.B., for his paper, "Building Invisible Edifices."

Leonard Medal to J. J. Denny, M.C.I.M.M., Schumacher, Ont., co-author of the paper, "The Prevention of Silicosis by Metallic Aluminum."

Students' and Juniors' Prizes

H. N Ruttan Prize (Western Provinces) to C. Neufeld, S.E.I.C., for his paper, "A Photo-Elastic Investigation of Stress Conditions in an End Block of the Border Bridge at Ceepee, Sask."

John Galbraith Prize (Province of Ontario) to T. E. Edson, S.E.I.C., for his paper, "The Sandcasting of Crankshafts."

Phelps Johnson Prize (Prov. of Quebec, English) to S. G. Lochhead, Jr.E.I.C., for his paper, "The New Westmount Trunk Sewer, 1935."

Ernest Marceau Prize (Prov. of Quebec, French) to J. G. Belle-Isle, S.E.I.C., for his paper, "Projet de Developpement Hydro-Electrique."

Sir John Kennedy Medal awarded to Past-President Colonel J. S. Dennis, M.E.I.C. Colonel Dennis died on November 26th, 1938, but the medal had been presented to him in hospital, in Victoria, on November 4th, by President J. B. Challies, in company with C. A. Magrath, Hon.M.E.I.C.

Report of Council

On the motion of C. K. McLeod, A.M.E.I.C., seconded by R. L. Dobbin, M.E.I.C., it was Resolved that the report of Council for the year 1939, as published in the February, 1939, Journal, be taken as read and accepted.

Report of Treasurer

On the motion of deGaspe Beaubien, M.E.I.C., seconded by P. E. Doncaster, M.E.I.C., it was Resolved that the report of the Treasurer be taken as read and accepted.

Report of Finance Committee

In presenting the report of the Finance Committee, the chairman of that committee, J. A. McCrory, M.E.I.C., pointed out that the Institute was fortunate this year in having a small surplus. Over a period of years, from about 1920 to 1928, the Institute had had some good years, and had been able to set aside certain funds for investment. Those seven good years had been followed by seven bad years, in which that surplus had been pretty well used up, although not entirely. He would like to see that surplus replaced, and felt that the only way that that could be accomplished was by increasing the membership. It was important, not only from a financial viewpoint, but from the standpoint of the activity of the Institute that the membership be built up. An active Institute membership committee could accomplish a certain amount along that line, but the spadework had to be done by the membership committees, or similar bodies, in the branches themselves. Council hoped that the policy re-established during the past year of having the General Secretary visit the branches would have a great effect in stimulating activity along that line.

On the motion of J. A. McCrory, M.E.I.C., seconded by B. E. Bayne, A.M.E.I.C., it was Resolved that the report of the Finance Committee be accepted.

Reports of Committees

On the motion of E. P. Muntz, M.E.I.C., seconded by H. A. Lumsden, M.E.I.C., it was Resolved that the reports of the following committees be taken as read and accepted: Library and House; Papers; Publication; Legislation; Western Water Problems; Membership and Management; Professional Interests; International Relations; Membership; Board of Examiners; Employment Service; Canadian Chamber of Commerce, report from Institute representative.

Branch Reports

On the motion of W. E. Bonn, M.E.I.C., seconded by H. F. Bennett, M.E.I.C., 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, the Council had presented for the consideration of corporate members certain proposals for the amendment of Sections 32 and 35 and for the introduction of a new Section 77. These had been published in the Engineering Journal for December, 1938, and mailed to all corporate members.

The General Secretary then read the proposed amendment to Section 32 as follows, the proposed changes being underlined:

"Section 32 (as now proposed):

"The entrance fees, payable at the time of application for admission to the Institute, shall be as follows:

Members	$10.00
Associate Members	10.00
Juniors	5.00
Affiliates	10.00

"Honorary Members and Students shall be exempt from entrance fees."

This scale of fees had been authorized by resolution at the Annual General Meeting held at London, Ontario, on January 31st, 1938. The proposed change was suggested simply to record the information correctly in the By-laws.

On the motion of W. R. Manock, A.M.E.I.C., seconded by C. G. Moon, A.M.E.I.C., it was Resolved that the proposed amendment to Section 32 be approved by this Annual General Meeting and sent out to ballot in accordance with Section 75 of the By-laws.

The General Secretary then read the proposed amendment to Section 35 as follows, the proposed changes in wording being underlined:

"Section 35 (as now proposed):

"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 equivalent to the unexpired portion of the year, calculated from the beginning of the month in which the election takes place."

This change is desired by Council in order to simplify for all concerned the method of computing the portion of the first annual fee to be paid by new members, and also to put such payments on an absolutely equitable basis. It is expected that the change will be of assistance to the various membership committees.

John Murphy, M.E.I.C., was entirely in sympathy with intent of the proposed amendment, but felt that some improvement in the wording might be made. In accordance with his suggestion, on the motion of C. R. Young, M.E.I.C., seconded by H. F. Bennett, M.E.I.C., it was Resolved that the words, "equivalent to" be replaced by the words "based on."

On the motion of A. B. Gates, A.M.E.I.C., seconded by J. A. Vance, A.M.E.I.C., it was Resolved that the proposed amendment to Section 35 (with the verbal amendment as suggested) be approved by this Annual General Meeting, and sent out to ballot in accordance with Section 75 of the By-laws.

The General Secretary then read the proposed new Section 77 as follows:

"An association which enters into an agreement in accordance with the provisions of By-law 76 shall, when requested by the association, and for the purpose of that By-law, be termed a "component association."

Section 76 of the By-laws, which was approved by a very large majority of corporate members by ballot in March, 1938, provides for co-operation between the Institute and any provincial association or corporation of professional engineers. It has since been found that in one province at least, the conclusion of an agreement for such co-operation would be facilitated if such co-operating associations could be referred to as "component associations" in the Institute By-laws. For this reason the Council recommends the approval of this new section.

On the motion of J. A. McCrory, M.E.I.C., seconded by P. L. Pratley, M.E.I.C., it was Resolved that the proposed new Section 77 be approved by the Annual General Meeting and sent out to ballot in accordance with Section 75 of the By-laws.

Membership Classification

The President reported that following a recommendation of the Committee on Membership and Management, under the chairmanship of Professor R. A. Spencer, A.M.E.I.C., Council, the day previous, had unanimously agreed that an amendment to the By-laws should be submitted to the membership, by which the present two corporate classifications of membership should be consolidated, thereby eliminating the classification of Associate Member. As P. M. Sauder, M.E.I.C., had led the discussion at the Council meeting, the President asked him to read to the meeting the resolution adopted by Council.

To explain the proposed changes, Mr. Sauder read portions of the exhaustive report of the Committee on Membership and Management, and concluded with the announcement that two decisions were reached by Council, and that the two corresponding resolutions read as follows:

Whereas the Committee on Membership and Management has carefully investigated the question of Classification of the Membership of the Institute, and

Whereas its findings have been carefully reviewed and discussed by this meeting, and

Whereas it is the opinion of Council that to facilitate co-operation with other engineering bodies and for the benefit of the engineering profession throughout Canada, that there should be at this time only one grade of Corporate Membership in the Institute,

Therefore be it resolved

First, that the present grade of Associate Member be abolished and that the present Associate Members (A.M.E.I.C.) be given the grade of Member (M.E.I.C.) and that the grade Member (M.E.I.C.) be the only grade of Corporate Membership,

Second, that the details of qualifications and fees be determined by Council,

Third, that amendments to the By-laws to give effect to the above be submitted to the next Annual General Meeting of the Institute.

Mr. Sauder explained that the decision that details of qualifications and fees should be determined later by Council was reached because it was felt that the question of fees and of minimum age qualification required further consideration.

The second resolution had to do with the possibility of a new classification known as "Fellow." Mr. Sauder explained that this resolution had been kept separate from the previous resolution in order to avoid confusion. It was thought if the two were put together in one proposed amendment it would be very difficult for the members to indicate a clear opinion and that it was better to clear up the matter of consolidating the two corporate memberships before deciding on the merits of a new class of membership.

The second resolution read as follows:

Whereas the report of the Committee on Membership and Management shows that a substantial body of opinion favours the setting up of a new class of Fellow with high present and future qualifications, and

Whereas Council views this proposal with favour but is of the opinion that action at this time is not opportune,

Therefore, be it resolved, that no action be taken on the creation of a new class of membership to be known as Fellow until the question of combining the two grades of Corporate Membership has been determined and until the necessity and desirability of such action is further demonstrated.

The President, in order to simplify the discussion, explained that these resolutions were simply a declaration of policy, and a decision of Council to consolidate the classifications of Member and Associate Member, and secondly, that the proposal of setting up a new classification of "Fellow" should remain in abeyance. He also explained that these resolutions were simply a decision of Council to be submitted to the meeting. The meeting could discuss amendments, or could submit entirely new resolutions if it wished. He also pointed out that these amendments could not go out to ballot until they were approved by the next Annual General Meeting, as a decision had been reached too late this year to give the proper notice which was required by the By-laws. Therefore, sufficient time was at the disposal of Council to work out every detail.

Clarence M. Pitts, A.M.E.I.C., stated that he thought the Council of the Institute was to be congratulated on the steady progress which had been made towards co-operation. He also expressed his approval of the decision to do away with the classification of Associate Member. He reported that Gordon M. Pitts, M.E.I.C., had personally consulted a great many members on this same subject, and the decision reached by Council was in accordance with the majority of the opinions which had been submitted to Mr. Pitts. He also congratulated Professor Spencer's Committee on the excellent work which it had done. He asked that this Annual General Meeting endorse the action of Council as he thought the decision was for the good of the profession and for the good of the Institute as well.

R. H. Findlay, M.E.I.C., suggested that it might strengthen the hands of Council if the meeting, by resolution, approved of Council's action with regard to the resolutions. Upon the President's assurance that such a decision would be of assistance to Council Mr. Findlay moved as follows:

That this meeting go on record as approving of the two resolutions passed by Council and that it be left to Council to expedite the matter during the coming year.

This motion was seconded by Robert F. Legget, A.M.E.I.C.

Considerable discussion followed, and P. L. Pratley, M.E.I.C., stated his reasons for thinking that the Institute should go slowly in making any such changes. However, in view of the many considerations which were involved he stated that he was not opposed to unifying the two grades if it would facilitate meeting the legislative requirements of the Institute. He was of the opinion that consideration of a possible new classification should be given at the same time as the first one.

Colonel L. F. Grant, M.E.I.C., expressed himself as regretting that the first resolution was necessary, and yet in view of the negotiations with the Provincial Associations he was willing to vote in favour of it. He pointed out some of the complications that might follow if the classification "Fellow" were established. He thought that it would be simpler and perhaps more satisfactory in the negotiations if the grade of "Fellow" were not established.

Brian R. Perry, M.E.I.C., commented on the opportunities which are now available to The Engineering Institute, and he thought there were too many grades of membership to-day. He also spoke at considerable length on the value of the work which had been done by Professor Spencer. As Mr. Perry was on Professor Spencer's committee he was in an excellent position to know.

P. E. Doncaster, M.E.I.C., expressed the opinion of the Lakehead Branch, and stated that the first resolution read by Mr. Sauder seemed to have settled all the points which were raised by his branch. He also reported that the branch had instructed him to announce that they thought such matters as this should be decided for the branch membership through the elected councillors after they had made a canvass of local opinion. The branch was averse to having such matters the subject of letters from individual members to individual members instead of from the constituted authorities to the branches. "It was felt that this practice has not worked to the best advantage of the Institute and the profession in the past and should be discouraged."

P. B. Motley, M.E.I.C., was of the opinion that both changes in classification should be settled at the same time. He was in favour of delaying action at the present in order that the whole business might be done in one stroke.

W. R. Manock, A.M.E.I.C., presented the opinion of the Niagara Peninsula Branch, and read three resolutions which had been passed by that executive. These were as follows:

(1) That the grade of Associate Member be abolished and that all present Associate Members be graded as Members.

(2) That the executive of this branch oppose any lowering of qualifications for the grade of Member below those proposed by the Engineers' Council for Professional Development.

(3) That the grade of Fellow be established with qualifications similar to those recommended by the Engineers' Council for Professional Development.

At this point the President explained that at the back of the hall he saw Mr. Perry, the chairman of the E.C.P.D., and Colonel Davies, the assistant secretary, and suggested that one of them come to the front of the room and explain to the meeting the qualifications as determined by the E.C.P.D.

Colonel C. E. Davies outlined quickly the recommendations which have been made by the E.C.P.D. after a great deal of consideration. Their recommended classifications were Student Member, Junior Member, Member and Fellow.

C. G. Moon, A.M.E.I.C., of St. Catharines, elaborated on the report which Mr. Manock had read as coming from the Niagara Peninsula Branch. It was his personal opinion that the class of "Fellow" was not required.

At this point, Mr. J. P. H. Perry, the chairman of the E.C.P.D., spoke to the meeting and explained how the American Society of Civil Engineers had gone through the struggle which the Institute was now experiencing. Personally, he was not enthusiastic about the grade of "Fellow" as he believed that many people thought that it was an honorary grade, and he also reminded the meeting that a proposal to establish such a grade had been defeated by ballot in the American Society of Civil Engineers. In conclusion he suggested that we "make our foundations secure," and said he would like to leave the thought with the meeting that all engineers in the Institute think of themselves as members, and then if they want to go on like the architects do, or the American College of Surgeons, a higher classification might be established later.

O. Holden, A.M.E.I.C., described the deliberations which had taken place in the Toronto executive. He agreed with the unification of the two classes of membership, but thought that a "Fellow" grade should be established with very high requirements and very restricted in number.

H. F. Bennett, M.E.I.C., expressed the opinion of the London Branch. They, too, thought that some consideration should be given to the establishment of "Fellow," but admitted there was much difference of opinion as to the qualifications.

E. P. Muntz, M.E.I.C., presented the view of the Ontario professional association. He hoped that the first proposal would meet with the approval of the members as he thought that the members of the provincial associations would see in this "a very serious effort on the part of the Institute to meet them half way." He stated that it was his opinion that if this meeting, or any meeting, decided to create a classification of "Fellow" in any considerable number, he was afraid the benefit of the first resolution would be largely nullified. He thought that those engineers who are unquestionably entitled to some higher classification would waive their rights for the present in order to facilitate the successful merging of the present two classes of membership. He also recommended to the meeting that it was a little premature to talk about consolidation. He asked that the word "co-operation" be substituted throughout the discussions.

Finally, the motion of Mr. Findlay and Mr. Legget was CARRIED without a single dissenting vote.

Reorganization of Council

The President announced that the question of the reorganization of Council was also dealt with at the Council meeting.

Colonel Grant explained to the meeting that the following resolution had been passed unanimously at the Council meeting:

> THAT it is the opinion of Council that no further steps should be taken at this time with regard to the reorganization of Council.

Colonel Grant went on to explain why he was so much in favour of this decision. He thought that it was very important that every branch should have its own member representing it on the governing body. Speaking for his own branch, Kingston, he said they were very jealous of their right of appointing one of their own members.

H. A. Lumsden, M.E.I.C., stated that the Hamilton Branch had come to the same conclusion as was indicated in the resolution. Mr. Pratley also expressed himself as being in entire accordance with it.

Mr. Pitts suggested that in view of the negotiations with the provincial associations he thought the door should not be closed entirely to the possibility of these associations having representation on Council.

The President described his visits to all the branches and explained that at each one of them the question of the organization of Council was thoroughly discussed. He described the sum total of all these opinions as being "that as Council is getting along very well the way it is, they would prefer that we would stop worrying about its set up and get on with some other things which are more in the interests of the Institute and the profession." He thought that while the Institute was going through a transition period in relationship to the provincial associations the set up of Council should be left as it is. He also pointed out, in response to Mr. Pitts' comment, that the present arrangements permit of representation of a co-operating association on Council, and described developments in Saskatchewan to illustrate the point.

On the motion of Colonel Grant, seconded by J. A. Vance, A.M.E.I.C., it was RESOLVED that this meeting endorse the resolution passed by Council to the effect that no further steps should be taken at this time with regard to the reorganization of Council. This decision was reached unanimously.

Reception to American Guests

The President then announced that a reception would be held at two-thirty in order that the members of the Institute might meet the distinguished visitors from the United States. He said that he thought that the visit of this delegation was as great a compliment as the Institute had ever had paid to it.

On the motion of Mr. Pitts, the meeting adjourned at twelve o'clock noon.

At four o'clock p.m., after the reception, the meeting reconvened.

Presentation to Secretary Emeritus Durley

The President expressed sincere regret that owing to illness Secretary Emeritus Richard John Durley was not able to attend the meeting, as it was the intention to have presented to him an illuminated address and a cheque in recognition of his faithful and loyal service during the past fourteen years. However, Mrs. Durley had come to Ottawa to receive the presentation on behalf of Mr. Durley, and the President asked Vice-President H. O. Keay, a former colleague of Mr. Durley's at McGill, to escort Mrs. Durley to the platform. Amidst the enthusiastic plaudits of the meeting, Dr. Challies received her with "Royal Honours," a spontaneously graceful gesture that greatly delighted the entire company. Past-President Desbarats spoke in glowing terms of the service rendered to the Institute by Mr. Durley. He expressed the hope that he would continue to place his experience and ability at the disposal of the Institute and of his country should they call upon him. Mr. Desbarats handed Mrs. Durley the address and the cheque, and she was escorted back to her place to receive the congratulations of the entire meeting. A reproduction of the illuminated address along with a letter of acknowledgment appears on page 133.

W. L. McFaul, M.E.I.C., addressed the meeting, feeling that there had been an omission in the arrangements of the programme. He would like to correct this oversight. He said, "I have much pleasure, on behalf of the members of The Engineering Institute of Canada, in moving a vote of appreciation of the great work which our President, Dr. Challies, has carried on during the past year for the development of the engineering profession. I would also like to present to the distinguished presidents from the United States, our President, who has done so much in promoting friendly relationships with our sister societies across the border."

This resolution was received with a great show of enthusiasm and applause, and Dr. Challies rose to say, "In view of those kind words and the lateness of the hour, I am going to ask if you will allow me to depart from tradition. Will you take the retiring President's address as read. It will be published in the March number of the Journal."

Election of Officers

At the request of the President, R. E. Heartz, M.E.I.C., read the report of the scrutineers appointed to canvass the officers' ballot for 1939, and the officers named therein were declared duly elected as follows:

President	H. W. McKiel, M.E.I.C.
Vice-Presidents:	
Zone A (Western Provinces)	P. M. Sauder, M.E.I.C.
Zone C (Province of Quebec)	Fred Newell, M.E.I.C.
Councillors:	
Vancouver Branch	J. Robertson, M.E.I.C.
Edmonton Branch	W. R. Mount, M.E.I.C.
Saskatchewan Branch	A. P. Linton, M.E.I.C.
Lakehead Branch	P. E. Doncaster, M.E.I.C.
Border Cities Branch	T. H. Jenkins, A.M.E.I.C.
London Branch	J. A. Vance A.M.E.I.C.
Toronto Branch	A. U. Sanderson, A.M.E.I.C.
Ottawa Branch	W. F. M. Bryce, A.M.E.I.C.
Kingston Branch	L. F. Grant, M.E.I.C.
Montreal Branch	Huet Massue, M.E.I.C.
	Brian R. Perry, M.E.I.C.
St. Maurice Valley Branch	E. B. Wardle, M.E.I.C.
Saguenay Branch	A. C. Johnston, A.M.E.I.C.
Saint John Branch	S. Hogg, A.M.E.I.C.
Halifax Branch	I. P. MacNab, M.E.I.C.

At this point Dr. Challies asked Past-Presidents H. H. Vaughan and General C. H. Mitchell to escort Dean McKiel to the chair. Dr. Challies greeted him and said, "Mr. President, I am proud to address you as President. To you I hand over the gavel with complete confidence in the future welfare of the Institute."

President McKiel spoke as follows: "Mr. Past-President, other past-presidents, distinguished guests, I can scarcely find words at the present time to say what is in my heart. I appreciate deeply the honour you have done me. I fear it will be impossible for me to live up to the achievements of the man whom I am succeeding in the Chair. All I can promise is that I will do my best.

"Here is an item of news which will interest you. During the luncheon to-day I entered into an agreement with Gladstone Murray, the general manager of the Canadian Broadcasting Corporation, whereby The Engineering Institute will supply a series of radio talks with a view of putting before the public the engineer and his relations to the public. Further, we hope to set up, within the Institute, a permanent committee of co-operation with the Canadian Broadcasting Corporation. That is being done, not at our suggestion, but at the request of the Canadian Broadcasting Corporation, and I think that it should prove an excellent factor in promoting the affairs of the Institute.

"I would like again to pay tribute to the man who has been my predecessor, and those other men who have been my predecessors. Recently I went through the Semicentennial number of the Journal, and after reading about the type of men who have occupied this position, and the services they have rendered to the Institute, may I confess to you that I have had my misgivings. I again thank you for the support you have given me, and look forward to its continuance. If you will support me as you have supported Jack Challies then I think we can carry on and make the Institute go a step further."

On the motion of B. E. Bayne, A.M.E.I.C., seconded by S. W. Gray, A.M.E.I.C., it was unanimously RESOLVED that a hearty vote of thanks be extended to the Ottawa Branch for their hospitality and activity in connection with the Fifty-Third Annual General Meeting. The Institute desires to express its appreciation and gratitude to them for all the favours and courtesies they have extended to the members present at the meeting.

On the motion of R. L. Dobbin, M.E.I.C., seconded by R. B. Jennings, M.E.I.C., it was unanimously RESOLVED that a hearty vote of thanks be accorded to the retiring President and members of Council in appreciation of the work they have done during the past year.

The President said that he was very glad to add his own personal appreciation to that contained in the resolution. He also asked that the General Secretary transmit Mr. Bayne's resolution to the secretary of the Ottawa Branch.

Dr. Challies suggested that the meeting should not conclude without a formal motion of thanks to the distinguished gentlemen who had invaded Canada so agreeably and so acceptably. He moved that the General Secretary be instructed to prepare a suitably worded resolution thanking these gentlemen for their co-operation.

The President said that such a motion did not need a seconder, and turning to the American delegates, he said, "I appreciate fully the courtesy you have shown us in coming up here this year. I agree most heartily with Dr. Challies in his desire to insure better relations between our Institute and the engineering societies in the United States. I know that I am speaking for all the members when I say this. I heartily appreciate all your kindness and courtesy in being with us to-day. Will you kindly accept this as an expression of our appreciation."

There being no further business the meeting adjourned at four forty-five p.m.

Council Meeting

Monday's largely attended Council meeting had many new features. In the first place this was the first time it had met in advance of the Annual General Meeting. By arranging the programme this way it was possible to give an entire day to the business of Council, thus making available sufficient time for important issues to be discussed to acceptable conclusions.

There was also the advantage, which was a decided one, that by the time the Annual Meeting was in session members of Council were able to contribute more constructively to the discussion by reason of the firm decisions on important matters of policy already reached by the Council. It is doubtful if a more harmonious or successful annual meeting has ever taken place and in the opinion of many this was due to the fact that Council had spent all of the previous day clearing the ground and making the road.

Some very important decisions were reached and it is suggested that members read the minutes of the meeting which are in this number of the Journal. There were councillors from Vancouver to Halifax, as well as five past-presidents. In all there was a total attendance of thirty-six. In the opinion of everyone present this year's arrangement worked to great advantage and the hope was expressed that a similar procedure would be followed in the future.

Technical Sessions

On Wednesday morning many papers on the western water problem were discussed. This year practically all papers were devoted to various phases of the same subject, in somewhat the same manner as was done last year. Such a policy permitted a rather thorough study of the subject and doubtless will produce more helpful results. It was surprising to many easterners to observe the general interest which was taken in a discussion of a western problem. It was made quite evident that the east appreciates that the drought problem of the west is decidedly a matter of concern for all Canada.

An unusual number of discussors were present and it was evident that most of them had come prepared to take part in the proceedings. It is doubtful if more complete discussions have ever been supplied. It is the plan of the Chairman of this committee, G. A. Gaherty, M.E.I.C., to continue the work of his committee until all the papers and the discussions, as well as conclusions, are in such shape that they can be published in the Journal and in some form of book for circulation among private individuals and business houses and firms which are specially interested in this problem.

The morning session was carried on under the chairmanship of Dean Mackenzie of Saskatoon, and in the afternoon, Dean Featherstonhaugh, of Winnipeg, presided. At 5.30 the meeting had to be adjourned as there was no time for further discussion. It was apparent that several discussors

Dean Mackenzie presides while E. E. Eisenhauer delivers his paper

were still hoping for an opportunity to contribute their share, and consequently the Chairman requested any persons who had not been heard and had something to offer, to put it in writing and send it to the Headquarters of the Institute, where it would be very welcome and would be added to the other contributions.

During the afternoon session consideration was given to a timely and important paper on "American Industry Looks at Canada." This brought forth a different set of discussors and it was very evident that the subject was one of general interest. These discussions too will be made available to all members and to other interested parties. The attendance at both sessions was quite unusual and the auditorium was substantially occupied all day.

A complete list of papers and their authors follows:

Some Problems Involved in the Expansion of Canada, by C. A. Magrath, Hon.M.E.I.C.

Mountain Water for Prairie Grassland, by F. H. Peters, M.E.I.C.

Irrigation Development, Its Possibilities and Limitations, by D. W. Hays, M.E.I.C.

Prairie Farm Rehabilitation, by George Spence.

Water Conservation on the Western Prairies, by C. H. Attwood, A.M.E.I.C.

Livestock Production in the Rehabilitation Programme, by Dr. E. S. Archibald.

The Problem of Saskatchewan, by the Hon. T. G. Taggart and E. E. Eisenhauer, A.M.E.I.C.

Drought—A National Problem, by G. A. Gaherty, M.E.I.C.

Rehabilitation Through Water Conservation, by Howard J. McLean, A.M.E.I.C.

American Industry Looks at Canada, by M. W. Maxwell, A.M.E.I.C.

Mining Methods of the Canadian Malartic Mines, by E. V. Neelands and J. P. Millenbach, M.C.I.M.M.

The Banquet

Beyond a doubt the principal feature of the social programme was the banquet on Tuesday night. Their Excellencies, the Governor General and The Lady Tweedsmuir, were guests of honour, and His Excellency took part in the proceedings by presenting the Honorary Membership to Mr. C. A. Magrath, and Her Excellency took a corresponding part by presenting the prizes.

President McKiel was in the chair and conducted the proceedings with the dignity, charm and tact of a veteran toastmaster. The speaker was Colonel Willard Chevalier, Vice-President of the McGraw-Hill Publishing Company of New York, and publisher of "The Business Week." He spoke on "The Engineer Faces a New World," and gave a most interesting and inspirational address to one of the largest and most enthusiastic engineering audiences in the history of the Institute. Over 650 members and friends packed the huge ballroom and the adjoining corridors.

Colonel Chevalier possesses a very easy style and a pleasant manner, and charmed his audience beyond measure. He spoke of the engineer's obligation to society for the economic effect of his work. He said that unless cognizance was taken of the new concepts of responsibility, the problems of to-day would not be solved. The engineer must understand social trends or he would have to abdicate his professional position and become a mere craftsman.

"One of the problems in the old days was scarcity. It has been solved so well that it has been succeeded by the problem of over-abundance. Engineers should be concerned with such things. Scientific progress is now so rapid that machines and structures quickly become obsolete. We now cannot afford to wear out things we once considered permanent. We must scrap them to keep in step with progress."

Colonel Willard Chevalier faces the camera after the banquet

In conclusion he said, "The Engineer should be the architect of society."

In presenting Mr. Magrath with his certificate of Honorary Membership the Governor General said: "I am glad to welcome you to that small and exclusive body to which I myself have the honour to belong." Mr. Magrath said how pleased he was to receive this honour at the hands of His Excellency, and spoke of his long associations with the Institute.

Just prior to the banquet the following were presented to Their Excellencies, President and Mrs. McKiel, Hon. and Mrs. Howe, Hon. and Mrs. Grote Stirling, Col. Chevalier, Mr. and Mrs. Magrath, Senator and Mrs. Copp, Past-President, Mrs. and Miss Ethel Challies, President and Mrs. Sawyer, President Christie, President and Mrs. Parker, Chairman Perry, Secretary and Mrs. Seabury, Secretary and Mrs. Henline, Secretary and Mrs. Wright.

The Luncheons

The luncheon on Tuesday was addressed by Dr. R. C. Wallace, Principal of Queen's University. He spoke on "The Practical Side of Life," and called attention to the engineer's responsibility for the economic effects of his creations upon society. He thought that education should not be too practical, that life held more than just the discovery of new methods of performing old operations. He recommended that some consideration be given to the advisability of adjusting our needs to nature rather than nature to our needs, as the engineer was trying to do to-day. "We must put the brakes on against the enthusiasm and the ability of the scientist to use his new knowledge too quickly."

The attendance ran up to four hundred and twenty-eight, which is in itself something of a record. J. H. Parkin, M.E.I.C., Chairman of the Ottawa Branch, presided, and Mayor Lewis was present to welcome the visitors to Ottawa.

At the Wednesday luncheon, The Honourable J. G. Gardiner, Minister of Agriculture of the Dominion Government, spoke on "The Need for Resettlement in Western Canada." He told of the experiments which are being made of moving families from poor land to better and irrigated land. He thought that such methods held hope of a solution of a great deal of the problem of the dry areas. Mr. Parkin again presided, as due to illness Vice-President Buchanan was unable to be present.

One of the outstanding features of the luncheon and of the whole meeting was the presentation of a silver tray from the Councillors to the retiring President, Dr. Challies. President McKiel, after an appropriate speech, turned to Dr. Challies and handed him the tray. Dr. Challies was taken completely by surprise, and although he made a valiant effort to tell the meeting how much he appreciated this honour, he was not able to find the flow of words which is customarily his. Amidst a tremendous outburst of applause he sat down with a gesture indicating he was entirely unequal to the occasion.

Dr. Challies' year in office had been a most unusual one. So much good had been accomplished for the Institute and so many friends had been made by him personally, that Council's action was entirely spontaneous. After the conclusion of Monday's meeting the idea developed and was pushed through rapidly so that the presentation could be made before the meeting broke up.

The ladies await transportation

For the Ladies

No matter how good a programme may be it is no good if it does not properly provide for the entertainment of the ladies. This programme maintained its high average by offering the ladies a series of functions that answered their every need. Under the chairmanship of Mrs. F. H. Peters, every last detail was attended to by the ladies' committee.

On Monday night Mrs. J. B. Challies entertained in her apartment so that the wives of the councillors might meet Mrs. McKiel. It was a very successful affair and admirably fulfilled its objective.

The Ottawa branch made a very nice gesture of hospitality in inviting all visiting ladies to be their guests for the luncheons on Tuesday and Wednesday. This was very much appreciated.

On Tuesday afternoon a trip was arranged to the Parliament Buildings and the Memorial Tower, followed by tea in the Quebec Suite at the Chateau.

On Wednesday afternoon, Her Excellency The Lady Tweedsmuir graciously received the ladies at Government House. This feature of the programme proved very attractive, and over sixty ladies took advantage of it. It was particularly commented upon by the guests from the United States.

The personnel of the Ladies' Committee was: Convener, Mrs. F. H. Peters; Mrs. Charles Camsell, Mrs. G. J. Desbarats, Mrs. C. D. Howe, Mrs. A. G. L. McNaughton, Mrs. G. G. Gale, Mrs. J. L. Rannie, Mrs. E. W. Stedman, Mrs. W. L. Cassels and Mrs. C. P. Edwards. The Institute is very much indebted to them for their thoughtful planning, and their hospitable welcome to all guests. Their contribution was one of the most helpful of the entire meeting.

The Casino

On Wednesday night members were permitted to indulge themselves in a sort of denatured type of gambling. Games of chance of many kinds were set up in the interesting Jasper room, and about three hundred people risked their financial future (up to fifty cents) on the flip of a card or the turn of a wheel. There was roulette, horse racing, crown and anchor, and other devices well known in the so-called gambling world.

Musical numbers and some juvenile dancing were interspersed with the other events in order to give variety to the programme. A very generous quantity of paper money in impressive denominations was given at the door for the fifty cents entrance fee and it was possible to bet substantial amounts without fear of sacrificing the old homestead. It provided a very pleasant finish to a very successful Annual Meeting. Clarence Pitts made a splendid master of ceremonies.

The President's Dinner

In the past there have been many outstanding dinners given by the retiring presidents, but it is not likely that any have ever equalled that which was given by President Challies at the Rideau Club on Monday evening. There were over ninety guests, the company being made up of councillors, officers and past officers and friends of the Institute from Ottawa and other parts of the country.

At the head table there were such important personages as The Honourable C. D. Howe, The Honourable Grote Stirling, Mr. C. A. Magrath, Mr. J. B. Hunter, Deputy Minister of Public Works, Past-Presidents H. H. Vaughan, A. R. Decary, C. H. Mitchell, S. G. Porter, O. O. Lefebvre, F. A. Gaby, G. J. Desbarats, and the President-elect Dean H. W. McKiel, Loring Christie, W. P. Dobson, G. G. Gale, S. W. Gray, Dr. T. H. Hogg, C. D. Harrington, E. P. Muntz, Major General A. G. L. McNaughton, A. L. Bishop, Dr. A. Frigon, Dean E. P. Fetherstonhaugh, G. A. Gaherty, Fraser Keith, Dean C. J. Mackenzie, W. R. McCaffrey.

The speakers of the evening were J. P. H. Perry, Chairman of the Engineers' Council for Professional Development, and Mr. C. E. Davies, Secretary of the American Society of Mechanical Engineers and Assistant Secretary of the Engineers' Council for Professional Development. Mr. Davies outlined the aims and objects of the E.C.P.D. and by means of a diagram on a blackboard, pointed out how the Council was aiding students and young engineers in the various phases of their development. Perhaps there is no person in North America who is so well able to speak on this subject as Mr. Davies, inasmuch as he has been the permanent officer of the organization since its inception.

Mr. Perry told of the work which the E.C.P.D. had done on accrediting colleges, as well as other phases of the Council's work. He also talked of the things which are planned for the future and referred to some of the difficulties which they were encountering, brilliantly and frequently illustrating his points by what he was pleased to call parables. As an after-dinner speaker Mr. Perry has few peers.

The Honourable C. D. Howe and the Honourable Grote Stirling also spoke to the meeting and made very pleasant and amusing references to each other and to the fact that the House was now in session and that they both either had to stay away or both attend. It was quite a compliment to the gathering that these two high-ranking political leaders both remained until practically the end of the programme.

As an outcome of this meeting it is now possible that the Institute may be permitted to share to an even greater extent in the activities of the E.C.P.D.

Two Ottawa citizens, Mrs. A. G. L. McNaughton and Past-President G. J. Desbarats

Our distinguished guests from the United States—H. H. Henline, National Secretary of the A.I.E.E.; Col. C. E. Davies, Secretary of the A.S.M.E.; J. P. H. Perry, Chairman of the E.C.P.D.; Col. D. H. Sawyer, President of the A.S.C.E.; Professor A. G. Christie, President of the A.S.M.E.; J. C. Parker, President of the A.I.E.E. and G. T. Seabury, Secretary of the A.S.C.E.

Reception to Distinguished Visitors from the United States

On Tuesday afternoon at 2.30 a party of distinguished guests from the United States assembled on the platform in the auditorium, together with the past-presidents and officers of the Institute. The company of visitors was made up of Colonel D. H. Sawyer, President, and Mr. George T. Seabury, Secretary, of the American Society of Civil Engineers; Professor A. G. Christie, President, and Colonel C. E. Davies, Secretary, of the American Society of Mechanical Engineers; Mr. John C. Parker, President, and Mr. H. H. Henline, National Secretary, of the American Institute of Electrical Engineers, and Mr. J. P. H. Perry, Chairman of the Engineers' Council for Professional Development. President Challies was master of ceremonies, and in opening the meeting referred to the honour which was done the Institute by the presence of these eminent engineers. He would ask the several past-presidents to express to them the Institute's hearty welcome.

In presenting the President of the American Society of Civil Engineers, Past-President Brigadier-General C. H. Mitchell spoke of Mr. Sawyer's work in the Federal Emergency Administration of Public Works, his long experience in the construction industry, and his important duties with the U.S. Federal Government. His presence was a token of the cordial relations which have always existed between his society and the Institute.

President Sawyer desired to present the respects of the Board of Direction of the Society, and to convey the hope that joint occasions like the present would be more frequent. The engineers of Canada and Britain would have a great opportunity to meet those of the United States at the Engineering Congress to be held in New York in September.

Mr. Sawyer felt that two serious problems faced the engineer to-day, the first of which was, how to keep at work the multitude of technical men and artisans whose activities have made possible the technological advances which have so greatly increased our permanent wealth and the amenities of life. This could be done by further development of the resources of the engineering mind.

The second task for the engineer was to take a more effective part in the administration of public affairs. He should assert himself in public matters and so use his talents as to lead the way from discord and suspicion to a world of stability and confidence.

The President of the American Society of Mechanical Engineers, Professor A. G. Christie, was then introduced by Past-President H. H. Vaughan, who referred to Prof. Christie's leadership in the investigations which have so greatly increased the efficiency of fuel-driven power stations, his Canadian birth, and the kindness and hospitality which the Institute has always received from the great society over which he presides. The introduction was gracefully acknowledged by Prof. Christie, who reminded the audience that he was a graduate of the University of Toronto.

Past-President Desbarats next presented Mr. J. C. Parker, President of the American Institute of Electrical Engineers, as an eminent engineer of long experience in the public utility field, and the head of a body whose publications form a most valuable source of professional inspiration for electrical engineers in Canada.

Mr. Parker took great personal pleasure in bringing greetings from the American Institute of Electrical Engineers, largely because his early professional work had been in Canada, and his birthplace, Detroit, was in early days as French as Montreal and Quebec, and as British as Toronto.

It is no accident, said Mr. Parker, that two great democratic nations stand together to-day in a world of turmoil. The individualism of the French, with their clarity and logical thought, and the British respect for law and order are the common heritage of our two great nations of the western world.

These ideals, he believed, applied in problems of professional development, of social recognition of engineering as a profession, and of the economic rewards for engineering effort. The fullest status of our profession could only be attained by realization of the importance of individual merit, individual dignity and individual responsibility. With a common philosophy of living, engineering societies could give stimulus to the personal development and the professional awareness of the individual engineer.

The introduction of the Chairman of the Engineers' Council for Professional Development was in the hands of Past-President Lefebvre, who welcomed Mr. J. P. H. Perry as the presiding officer of an organization sponsored by the principal American engineering societies and actively engaged in co-operative action to improve the professional status of the engineer. The valuable information obtained during their investigations, and their conclusions as regards engineering education, professional training, and the development of the young engineer had been freely placed at the Institute's disposal.

Mr. Perry, in a reply whose humour was fully appreciated by the audience, outlined the aims and accomplish-

Mr. Parker, President of the A.I.E.E., brings greetings to the E.I.C.

ments of the Council and hoped that the common interests of professional engineers in Canada and the United States would be furthered by continued joint action on the part of his Council and the Institute.

President Challies then introduced the secretaries of the American Society of Civil Engineers (Mr. G. T. Seabury), the American Society of Mechanical Engineers (Col. C. E. Davies) and the American Institute of Electrical Engineers (Mr. H. H. Henline), each of whom spoke briefly in reply. Dr. Challies mentioned that in coming to this general meeting of the Institute, Mr. Seabury was continuing a series of welcome visits which had extended over many years. Col. Davies—a member of the Institute—was equally welcome, whether as secretary of the A.S.M.E. or as an officer of the E.C.P.D., while the presence of Mr. Henline, an authority on engineering society organization, was appreciated as a token of his interest in the advancement of the engineering profession both in Canada and in the United States.

It was a most unusual occasion. It is doubtful if at any meeting in the United States or in Canada as many chief officers of the principal engineering societies have been assembled at one meeting. The members of the Institute were very pleased to have an opportunity to meet and to listen to such distinguished engineers, and beyond a doubt the meeting produced the effect of bringing the members of the profession in both countries much closer together.

It is impossible to adequately thank these gentlemen for the sacrifices which they made in order to make this visit, or to tell them how much their presence added to the pleasure and success of the entire meeting. The fact that most of them brought their wives with them was an additional reason for the pleasure which it gave the Institute to be their host.

Miscellaneous—But Important

After the banquet on Tuesday night there was a dance. This, too, was a great success, and it is announced that about seven hundred people took part.

Although it was no part of the Annual General Meeting, President McKiel's address to the Ottawa Rotary Club was an important event. He spoke of the engineer in everyday life and emphasized his contributions to modern civilization, at the same time pointing out the necessity of keeping the economic effect of this clearly in mind. He defined engineering as the adaptation of natural energy to the progress of mankind.

In many ways the National Research Council of Canada made a very substantial contribution to the success of the convention. For instance in the room just outside the convention hall and opposite the registration desk, the Council staff had set up a half-dozen or more very interesting scientific exhibits, using equipment and methods which are standard practice in the Council's laboratories. This was probably the most generally popular feature of the meeting.

Another feature which contributed substantially to the success of the meeting from the point of view of the visitors from the United States, was that the Canadian Pacific Railway Company put a special car on their Ottawa train in order to accommodate these guests on their trip from Montreal to Ottawa on Tuesday morning. They were guests of the railway, and chief engineer J. E. Armstrong, A.M.E.I.C., and Mrs. Armstrong acted as hosts on behalf of the Company. R. S. Eadie, M.E.I.C., and Mrs. Eadie, on behalf of Council, met the party at the Montreal West Station and joined with Mr. and Mrs. Armstrong in looking after arrangements until the arrival in Ottawa.

The Honourable C. D. Howe, Hon.M.E.I.C., placed his private car at the disposal of the same parties for the return trip from Ottawa to Montreal on Wednesday evening. Past Vice-President J. A. McCrory at the request of Council returned with them to Montreal in the capacity of host. These kindnesses on the part of Sir Edward Beatty and Hon. Mr. Howe added substantially to the pleasure of our visitors. Such co-operation is much appreciated by the Institute.

Mere statistics are not necessarily interesting, but the following ones do give some extra light on the attendance record, and are rather impressive in their magnitude.

Total registration	541
Ottawa members and ladies	255
Out of town members and ladies	230
Non members and guests	56
Attendance at banquet	656
Attendance at Tuesday luncheon	412
Attendance at Wednesday luncheon	383
Attendance at Government House reception for ladies	67
Attendance at ladies' tea, Tuesday	140
Attendance at the "Casino"	291

J. L. Busfield and J. W. Lucas arrange the reservations for the banquet

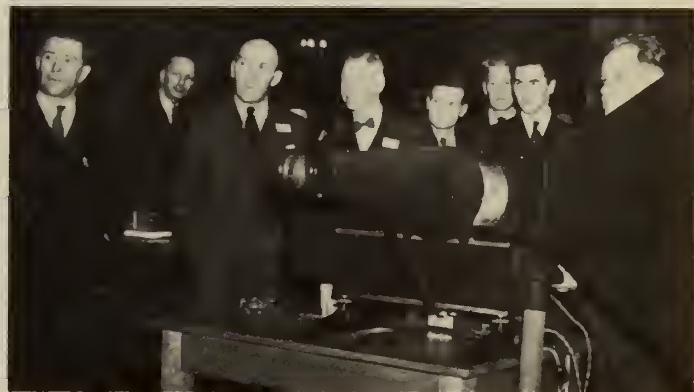
W. Lindsay Malcolm, formerly of Queen's, now Dean of Civil Engineering at Cornell

The Chairman of the Papers Committee, G. A. Gaherty, receives congratulations from J. A. McCrory of Shawinigan

The ladies are on their way to Government House

The technical papers were interesting

The Hon. C. D. Howe and Chairman Parkin listen to the Hon. J. G. Gardiner



The National Research Council illustrate an interesting principle

Past-President Porter discusses the programme with Les Rannie

Dr. Dafoe of the *Winnipeg Free Press* is interested in the Western Water Problem. So is Dr. Challies

Dean Mackenzie explains it to General McNaughton

Dr. Wallace, Mayor Lewis and Dean McKiel pose for the photographer

A president is installed

Editorial Comment...

ANNUAL MEETING

There are varying degrees of success for Annual Meetings, but no one will hesitate to apply superlatives to the one which was held last month in Ottawa. A meeting which provides liberally of education, inspiration, entertainment and congeniality to an appreciative group of engineers deserves all the fine things that can be said of it.

From every angle the meeting was a noteworthy event. Starting from the Council meeting which was held the day before the general meeting, unusual features attended every function. Thirty-six councillors and past-presidents from Halifax to Vancouver sat from ten in the morning until almost six in the afternoon, deliberating on the affairs of the Institute. Many decisions were reached unanimously which will have important and favourable effects for all time on the future developments of the Institute. Doubtless the peculiar success of this meeting was attributable to a great extent to the fact that it was held in advance of the general meeting and that a full day was set aside for it. This innovation also had a favourable influence on the general meeting.

The retiring President's dinner that night at the Rideau Club, when ninety guests greeted their host, was unique in many ways. The opportunity of hearing the two principal officers of the Engineers' Council for Professional Development describe the work of that excellent body was unusually interesting and instructive. It is expected that as an outcome of the visit of these officers much valuable material and helpful co-operation will be made available to the Institute.

The Annual General Meeting on Tuesday was well attended and full approval was given to the decisions made by Council the previous day. Decision on every item of the agenda was reached without controversy, and complete unanimity pervaded the gathering. It is encouraging to know that these important matters of policy find such wholesome approval from such a representative audience.

An unusual event was the reception to the special guests from the United States. The chief officers of four of the leading engineering societies and the secretaries of three were introduced by past-presidents of the Institute, and each responded shortly and appropriately. Their presence throughout the convention provided a pleasant international flavour, and gave a decided fillip to events. The Institute was very proud to be their host.

Tuesday night's banquet was something which had to be experienced to be appreciated. The presence of Their Excellencies, the skill of the speaker, the presentation of prizes, the decorations and the enthusiasm of the assembly brought about a function which many believed to have set a new "high." Over six hundred and fifty attended.

The professional meeting probably brought out the most complete discussions that have been developed for many years. The principal topic was the western drought problem. Experts from all parts of the west as well as from the east joined together to bring to the attention of all Canadians, deplorable conditions which exist in certain parts of the west and to explain policies and methods by which they could be overcome. It was the wish of those who were responsible for this portion of the programme that some sane policy could be evolved and that proper support would follow once the policy was clearly indicated.

The luncheons, at which the attendance averaged four hundred, the presentation to the retiring president, the presentation of an honorary membership, the presentation to the Secretary Emeritus, the special functions for the ladies, the dance, the reception, the casino, the exhibit of the National Research Council, the installation of the new president, combined with the other features to make up a genuinely successful annual meeting which will be remembered for a long time by those who were privileged to attend.

To the Ottawa Branch go the thanks of all members. It seems impossible to imagine a better prepared programme, more complete and detailed arrangements, or a more interested and helpful committee. The results must be very gratifying to those who carried the burden. The magnitude of the task cannot be overestimated. This work of the branch has set new standards, which if maintained by subsequent meetings will do tremendous things for the Institute and for the profession.

ECONOMICS AND THE ENGINEER

It was a matter of considerable comment that almost all the speakers at the Annual General Meeting touched on the same subject. Without any knowledge of what was in the minds of the other speakers, each referred to the engineer's responsibility for the economic effect of his inventions or his creations upon society. It was a new thought, that the responsibility for much of the world's economic chaos of to-day is his, because of his failure to prepare the world for his brain children before he gave them birth.

Dr. Wallace said that mistakes had been made in the past by developments which had effected a revolution in the mode of living and which had been entirely unforeseen and for which no provision had been made. He referred to the automobile and its detrimental effects on the home and on the financial stability of Government. The radio had changed methods of living and had disturbed many established customs and institutions, and its final effect was yet to be seen.

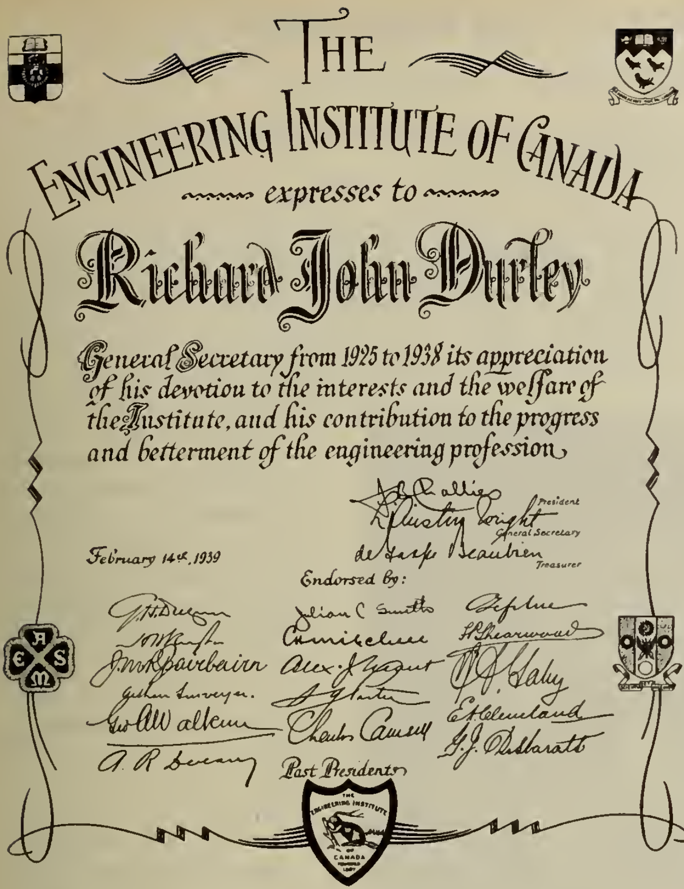
Colonel Willard Chevalier said that engineers must be aware of the social and economic implications of their work, although he admitted that it was difficult for even the best of prognosticators to see clearly how the future would be affected by the developments of the present.

Dean McKiel, speaking at the Rotary Club, suggested that there was some truth in the statement that engineering developments had gone ahead too fast without sufficient thought to their effects on economic life and without any plan for this in advance.

There was a trace of the same thought in the luncheon address of the Honourable Mr. Gardiner and in the remarks of one or two of the guests from the United States. Such a general outbreak of an idea must be of some significance. Are the engineers responsible for the evolutions of society which follow their inventions, and if they are, what can be done about it?

In considering such a difficult topic, sight should not be lost of the fact that the engineer's work usually stops with the perfecting of the article itself. The economics of manufacturing or building it are decidedly within his field, but it is not customary that he is consulted with regard to the social economics of it. Engineers are responsible for the design of to-day's automobile but it is not likely that they set the production schedules or determine the marketing methods. As far as they go, their economics are sound. The manufacturer employs engineers to discover materials and improved methods of manufacture, but is not his the responsibility for the impact of these upon society?

It is an interesting thought, and perhaps after all, at least some of the responsibility is the engineer's. If so he should be working at its solution. How can he best prepare society for the still greater things that are yet to come, and which will bring about an even greater evolution than has yet occurred?



THE ENGINEERING INSTITUTE OF CANADA
expresses to
Richard John Durley
General Secretary from 1925 to 1938 its appreciation of his devotion to the interests and the welfare of the Institute, and his contribution to the progress and betterment of the engineering profession

February 14th, 1939

President
General Secretary
Treasurer

Endorsed By:

Past Presidents

Photographic reproduction of the illuminated address presented to Secretary Emeritus R. J. Durley, containing signatures of officers of the Institute and all living past presidents

MR. DURLEY EXPRESSES HIS APPRECIATION

Mr. L. A. Wright,
The Engineering Institute of Canada,
2050 Mansfield Street, Montreal.

Dear Mr. Wright:

Will you please express to the President and Council my great regret that it was impossible for me to attend the recent Annual General Meeting in order to receive personally the illuminated record of my service with the Institute and the very acceptable cheque which accompanied it. I understand that this generous and timely donation was made up by contributions from the various branches of the Institute, to whose executive committees I beg that you will express the sincere gratitude of Mrs. Durley and myself for their generous action. In fact this presentation comes as an unexpected climax to the series of kindnesses which I have received during the past fourteen years from the officers and members of the Institute in all parts of the Dominion.

My acute disappointment at missing the ceremony at the Ottawa meeting was lessened when Mrs. Durley told me of the charming way in which she was welcomed in my place, the graceful manner in which the presentation was made to her, and the appreciative remarks which she heard about my work as General Secretary. The memory of all this will be treasured; in return I offer my heartfelt thanks, and express the hope that from time to time there will be opportunity for me to be of some further service to the Institute.

Very sincerely yours,

(Sgd.) R. J. Durley.

Westmount, February 20, 1939.

Louis Trudel, the newly-appointed assistant to the General Secretary

APPOINTMENT OF ASSISTANT TO THE GENERAL SECRETARY

Acting on the recommendation of the finance committee, Council in February unanimously approved of the appointment of Louis Trudel, B.A., B.A.Sc., A.M.E.I.C., as assistant to the general secretary, the position formerly occupied by John F. Plow. Mr. Trudel took office on March 1st.

He is a graduate in Arts of the University of Montreal, and in Engineering of the Ecole Polytechnique (1936). At college he took a special interest in many activities. He was associate editor of "Le Quartier Latin," the University of Montreal students' weekly, and was president of the Students' Council of the same institution, as well as president of the students in Engineering at the Ecole Polytechnique. He was also a councillor of the Athletic Association.

In 1935 he won the Institute students' prize, and in 1936 gained the Ernest Marceau prize, another of the Institute's honours. In his graduating year he won also the Ecole Polytechnique Alumni medal for the best thesis of the year.

Last year he was vice-chairman of the Junior Section of the Montreal Branch, and has always taken a real interest in Institute affairs. Since graduation he has been with the Provincial Electricity Board, the Southern Canada Power Company and Marine Industries Ltd.

Mr. Trudel is specially qualified for this position. With his interest in and knowledge of Institute affairs, and his many contacts with young engineers, it is expected that he will be at ease in his new work in a very short time.

TRAGEDY STRIKES IN HALIFAX

At the last moment before printing, word had been received at Headquarters that the secretary-treasurer of the Halifax Branch, Robert Roy Murray, A.M.E.I.C., and Mrs. Murray are listed among those missing in the terrible fire which destroyed the Queen Hotel. An exchange of telegrams with Councillor MacNab and Vice-President Dunsmore of Halifax fails to give us any hope that they may have been spared from this disaster.

Mrs. Durley receives the illuminated address from Past-President G. J. Desbarats

HAROLD WILSON McKIEL, B.A., B.Sc., M.E.I.C.

PRESIDENT OF THE ENGINEERING INSTITUTE OF CANADA, 1939

At the Annual Meeting in Ottawa, the last steps of the formalities required for the election of a president were complied with, and Dean McKiel became President McKiel. Escorted to the platform by the two senior past presidents present, H. H. Vaughan and General Mitchell, he received the congratulations of Dr. Challies and the enthusiastic applause of the meeting.

It is interesting to see these long careers of Institute activity culminate in the presidency. It is 20 years since the new president joined the Institute. In that time he has progressed from a member of the staff of the engineering faculty of Mount Allison to senior Dean of the University, and from a mere member of the Institute to President. Those are simple statements to make and yet within their limitations lies history, important both to the man himself and to the profession.

It is the first time in the history of the Institute that a president has been chosen from the Maritimes. Rotation of this office is desirable, and it is part of the Institute policy to see that it is carried out. The presidency swings back and forward across the continent, distributing its benefits and obligations from one city to another, and raising the level of Institute activity wherever it rests.

Smith, Sackville, N.B.

Harold Wilson McKiel, B.A., B.Sc., M.E.I.C.

Although to-day Dean McKiel is considered to be a Maritimer, the fact remains that his career began in Gananoque, Ont., inasmuch as that was where he was born. His college is Queen's from which he was graduated a Bachelor of Arts in 1908 and a Bachelor of Science in 1912 with honours in chemical engineering.

In 1911 he was assistant chemist with the Canada Cement Company, after which he became assistant in electro-metallurgical research at Queen's University under the Federal Department of Mines. In 1918 he was making explosives with the British Chemical Company. In 1929 he became consulting engineer to the Maritime Coal Railway and Power Company, which position he still occupies, as well as acting in the same capacity to Enamel and Heating Products Limited.

Between this work just mentioned and for relatively short periods of time, he was a demonstrator and a tutor in physics at Queen's and Director of the Academic Department of Mount Royal College, Calgary. In 1913 he became professor of Mechanical Engineering at Mount Allison. In 1920 he was appointed Brookfield Professor of Engineering, a title which he still possesses. He was made Dean of the faculty in 1934.

He has held many offices in the Institute. He has been a branch chairman, a councillor and a vice-president, so he comes well prepared for his new responsibilities. He is also a member of the New Brunswick Association of Professional Engineers and has occupied in that organization, the positions of councillor, vice-president and president.

His interest in educational matters goes beyond the bounds of his own college, and he is a member of the Board of Governors of the Nova Scotia Technical College at Halifax. He is a Fellow of the Canadian Institute of Chemistry and has been a councillor, chairman and vice-president of the Maritime Section. He has also been a chairman of the Maritime Chemical Association. He is member of the American Society of Mechanical Engineers, is a charter member of the Sackville Rotary Club and has served as secretary, vice-president and president of it.

Surely with all this experience in service, President McKiel has unusual qualities to bring to his new office. President Cody of the University of Toronto has said that the presidency of The Engineering Institute of Canada is "the highest position in the gift of the profession." It is evident that the new incumbent has the experience and training, the inspiration and the energy necessary to meet the exacting requirements of this high office, and the strength of character which justifies his fellow-engineers in thus honouring him.

ADDRESS OF THE RETIRING PRESIDENT

DR. J. B. CHALLIES, M.E.I.C.

Delivered before the Fifty-Third Annual General Meeting of The Engineering Institute of Canada, Ottawa, Ont., February 14th, 1939.

It is doubtful if the valedictory address of any president of the Institute finally took the form which he had planned when he assumed office. There is no exception in my case. Ever since my installation at the London meeting last February, I have hoped to be able to present an address on an engineering subject worthy of this occasion. Such a subject was chosen and its contents outlined; however, it has seemed advisable that I should discuss briefly and generally matters that are more directly concerned with the Institute and which have not been referred to in the Report of the Council.

Permit me at the outset to make my personal acknowledgment of the high honour which was done me by the membership of the Institute; I especially appreciate the fact that my nomination originated from the branch that I shall always recognize as my Institute home. During the past year I have not had the leisure to do what I should have done to justify the action of the Ottawa Executive and the Nominating Committee. I suspect that my regrets as I look back over twelve crowded and responsible months are by no means unprecedented.

It is difficult to assess my indebtedness during my period of office. I could not wish for a mentor more encouraging than the distinguished former Deputy Minister who preceded me; for past-presidents more generous; for honorary members more considerate; for vice-presidents more helpful; for councillors more alert for opportunities to serve; for a general secretary more efficient; or for a Headquarters staff more co-operative. We have all worked well together, and while our sins of omission and commission may have been many, I can say with confidence that our successors will find an Institute alive to its opportunities for service—both to the public and to the profession—branches from the Atlantic to the Pacific ready and willing to function for the local requirements of the membership, and a devoted Headquarters personnel keen to carry out the will of Council.

Reflecting on the events of 1938, I have no hesitation in saying that, notwithstanding the business recession, and in spite of the drought in the west, the year has been unquestionably a notable one for the Institute.

As to Internal Affairs

It would be shirking a duty if I did not call attention to a widespread desire among the members for less subjective debating and for more objective discussions, for less attention to matters of procedure and for more concern for a positive programme. At every branch I have visited interested members, old and young, have urged that we stop arguing about the size, set-up and quorum of Council; about admission qualifications, and devote our energies to constructive work along the lines of mutual help and public service. They have said to me in effect, the foundation of the Institute's home is on bed-rock. Let us stop moving the furniture around, decorating here and extending there; let us sit around the family fireside for awhile and get better acquainted with each other, not forgetting to bring in our engineering neighbours, so that we can concentrate upon the main objects of the Institute's existence which are the development of the professional and social interests of its members, the dissemination of professional and technical knowledge and the promotion of professional co-operation and unity on a Dominion-wide basis. These are the lines along which it is felt that the efforts of Council and of our branches should now be directed.

Not only has such advice been pleasing to a frequently distracted president, but it has appealed strongly on account of its obvious common sense. I commend it to the earnest consideration of the membership everywhere.

There is one very important consideration of which Council should never lose sight. The Institute need not slavishly follow all the fundamental traditions of the British institutions or the basic practices of the Founder societies, but it is particularly advisable that all contemplated changes in the size and set-up of Council, in membership qualifications and nomenclature should be most carefully considered, and very slowly accomplished. Sudden constitutional changes are fraught with difficulty and danger. Council will therefore be wise if it makes the most searching study of all proposals for by-law alterations that involve important matters of policy. Every branch should be fully consulted. Let all restless councillors remember the epitaph on the health crusader's tombstone: "I was well; I wanted to be better; here I am."

All councillors will agree that I should commend the work of the Committee on Membership and Management, and especially of its Chairman, whose efforts to find appropriate and acceptable replies to remits emanating from the semi-centennial plenary meeting of Council should prove of great benefit to the Institute. It may well be that as a result of the researches of this committee, changes in the qualifications and nomenclature of the Institute membership may be instituted. I hope so. It is also possible that the council may, in a few years, find it advisable to recommend changes in its own constitution. If so, I am sure full consideration will have been given to what many consider to be the warp and woof of the organization of the Institute, namely, the right of every branch to be continuously represented on Council by one of its own members chosen in the manner and for the period the majority of the branch membership may desire.

One important lesson which I have learned during a very busy year in the office of president that has brought me into contact with the personnel of every branch, is the urgent need, indeed the imperative necessity, for The Engineering Institute to extend its services to the young engineer. That has been impressed upon me with increasing emphasis as I visited our principal centres of engineering education. It is my belief that the curricula of our Canadian engineering colleges and their laboratory facilities compare quite favourably with those of similarly situated institutions in other countries. Something, however, is lacking. A comparatively small proportion of the several thousand engineering students in Canadian colleges seems desirous of associating with the members of our Canadian, British and American engineering societies, or of learning about their aims and objects, or their codes of ethics. Many of these students hear of The Engineering Institute and the provincial registration associations for the first time a year or two after their graduation. Few of them seem to have any opportunity to acquire even the rudiments of a professional consciousness during their student days. The correction of this unsatisfactory condition is peculiarly the responsibility of The Engineering Institute of Canada.

I believe that the great mission of the Institute lies in intelligent, aggressive, devoted ministration to the young men who are choosing engineering as their life's work. Until recently it has done very little in an organized fashion to inform them as to the philosophy of our profession. That, in my opinion, is a real task for the incoming Council. If this is done properly, the year 1939 will prove to be the most fruitful in the long history of the Institute.

As to External Affairs

The Institute's relations with other engineering bodies at home and abroad have been greatly improved. The best evidence of this fact is the unique honour accorded the Institute this afternoon by the official visit of the presidents and general secretaries of the three senior American Founder societies, and the chairman of that creation of the four founder and their associated societies—the Engineers' Council for Professional Development, an exploratory and promotional institution that is ministering to the young American engineer in a way and to a degree that is inspiring The Engineering Institute to extend its own efforts to advise and assist the young Canadian engineer. The presence of these distinguished leaders in organized engineering from the United States is much more than a courteous gesture, it is a token of confidence in The Engineering Institute of Canada coming from men who are most competent to judge. Without realizing it and without intending it, those participating in this friendly American invasion have challenged the Institute to march on to greater achievements in the interest of the Sons of Martha.

The Institute's relations with the institutions of Great Britain were never so cordial. One of our senior past-presidents is now in London on a mission from the Council that should promote better and more frequent contacts between English, American and Canadian engineers. Quite recently, Headquarters had the privilege of entertaining a past-president of the Institution of Electrical Engineers from London, who, as chairman of a "Joint Committee on Engineering Co-operation Overseas," is endeavouring to foster co-operation between the members of the Institute and the resident members in Canada of eight major British engineering institutions.

Sure and steady progress is being made towards a real *entente cordiale* with all the provincial professional associations. As a result of conferences during recent months, the officers of these registration and licensing bodies, of which the Institute was the progenitor, are now aware that the Council is prepared to consult with them whenever and wherever they desire to discuss ways and means for joint action to advance the prestige of the profession and to increase its usefulness to the public. The Institute's agreement with the Association of Professional Engineers of Saskatchewan shows that this objective can be realized with benefit to both bodies.

It is highly important that the Council of the Institute should promote cordial co-operative relations with the Dominion Council, the advisory body which the Provincial Associations have set up to promote the standardizing and the strengthening of the licensing movement.

Engineers in Public Service

I must not conclude this brief valedictory without paying a tribute to both the work and the worth of the members of our profession who are engaged in the service of the Dominion of Canada. No one privileged as I was to spend 21 years as an employee of the permanent service could avoid becoming thoroughly familiar with the organization and with the personnel of the principal governmental departments centring in the Capital, but spread over the whole of this Dominion. After this long sojourn within official circles and after an additional 15 years of close co-operation with public officials, I am able to state that there are no better qualified professional groups than those that are so ably and efficiently serving the Government of Canada. No other country can boast of technical bureaux furnishing services of such widespread benefit at more reasonable costs than the engineering staffs of the important departments of Public Works, of Transport, of Mines and Resources and of National Defence, the National Research Council, the Geological, Topographic, Geodetic and Hydrographic Surveys, and by the Dominion Water and Power Bureau; in fact I might say in practically every branch of Government activity. That these engineering bodies are so well manned to-day is due very largely to their freedom from the curse of political patronage.

In this connection I repeat what I have emphasized before each of the 25 branches of the Institute from Halifax to Victoria: "The engineering profession owes a debt of gratitude to all those right honourable gentlemen who, as Prime Ministers of Canada, since the Civil Service Commission was established in 1908 have stood staunchly behind the principle of merit in appointments and promotions, and who have steadfastly refused to permit the partisan politician to interfere with the technical services of the Dominion." It is a far cry from the conditions of the turn of the century, when the engineer had little more status in the Federal public service than that of a clerical employee, to 1939 when he is legally recognized as a member of a leading profession although perhaps not always compensated accordingly.

Fundamentals

As a final word I would like to emphasize something which I have tried to make clear at every appropriate occasion during my term of office, the simple truth that professional status rests but slightly on transient law, a little more on specialized knowledge, still a little more on society preferment, but a great deal more than the sum of all these upon the respect and support of the public. We must never forget that "there has been no true profession that has not with dignity and authority advised and counselled the people, that has not guarded the common weal. For a true profession exists only as the people allow it to maintain its prerogatives by reason of confidence in its integrity and belief in its general beneficence."

Wednesday's luncheon listens to the Hon. J. G. Gardiner

MEETING OF COUNCIL

A meeting of the Council was held at the Chateau Laurier, Ottawa, Ontario, on Monday, February 13th, 1939, at ten-fifteen a.m.

There were present: President J. B. Challies in the chair; Past-Presidents G. J. Desbarats, F. A. Gaby, O. O. Lefebvre, C. H. Mitchell and S. G. Porter; Vice-Presidents R. L. Dunsmore (Maritime Provinces), H. O. Keay (Province of Quebec), and J. A. McCrory (Province of Quebec); Councillors B. E. Bayne (Moncton), W. E. Bonn (Toronto), R. W. Boyle (Ottawa), J. L. Busfield (Montreal), H. J. A. Chambers (Border Cities), J. B. D'Aeth (Montreal), A. Duperron (Montreal), R. H. Findlay (Montreal), A. B. Gates (Peterborough), L. F. Grant (Kingston), O. Holden (Toronto), A. Lariviere (Quebec), J. L. Lang (Sault Ste. Marie), H. A. Lumsden (Hamilton), W. R. Manock (Niagara Peninsula), F. Newell (Montreal), and J. A. Vance (Woodstock); Treasurer deGaspe Beaubien and the General Secretary. Also attending the meeting were President-Elect H. W. McKiel; Vice-President-Elect P. M. Sauder; Councillors-Elect S. Hogg (Saint John), I. MacNab (Halifax), H. Massue (Montreal), B. R. Perry (Montreal), and J. Robertson (Vancouver). There were also present by invitation E. P. Muntz, M.E.I.C., immediate Past-President of the Association of Professional Engineers of Ontario, and S. W. Gray, A.M.E.I.C. President of the Association of Professional Engineers of Nova Scotia. All councillors and guests were welcomed by President Challies.

Past-President Desbarats reported regarding his investigations during the past year in connection with the Engineering Public Relations Committee, which had been formed in London in 1937 by fourteen of the principal British Engineering Societies. This report was adopted and referred to the incoming Council for attention.

Mr. Sauder presented a report prepared by Prof. R. A. Spencer, chairman of the Committee on Membership and Management, and discussion followed on the various topics which had been referred to that committee.

The President explained the work which had been done in the United States by the Engineers' Council for Professional Development regarding the classes of membership in the principal engineering societies in the United States. The E.C.P.D. had recommended that the classifications in engineering societies should be "Fellow," highly restricted and used only for recognizing outstanding professional service; "Member" with qualifications somewhat similar to the qualifications of the present Associate Member of the Institute, and "Junior" and "Student." Following these recommendations the American Society of Mechanical Engineers had changed their nomenclature, but the American Society of Civil Engineers had not yet done so. The Institute Committee on Membership and Management had now reported, recommending that the recommendations of the E.C.P.D. be adopted by the Institute. Mr. Sauder pointed out that the recommendation of the committee was that the age limit for membership should be lowered to twenty-five at least.

After considerable discussion it was apparent that members of Council favoured the consolidation of the two classes of corporate membership as recommended in Mr. Spencer's report, but that there was considerable difference of opinion as to the advisability of establishing the class of "Fellow." In order that the Council might come to some definite conclusion it was arranged that a committee suggested by Mr. Dunsmore, consisting of Messrs. Sauder, Dunsmore, Holden, Perry and Vance, should meet during the noon recess to consider the forms which the resolutions of Council should take.

One of the questions submitted to Mr. Spencer's committee was that of possible improvement in the present organization of Council. Mr. Sauder reviewed the opinions which the committee had received, the general viewpoint being that no change in the organization of Council was advisable at the present time. After further discussion, on the motion of Colonel Grant, seconded by Mr. Vance, it was *resolved* that it is the opinion of Council that no further action should be taken at this time.

Mr. Sauder then commented on the committee's report regarding the question of increased local autonomy in the provinces. Mr. Newell stated that judging from the work of the sub-committees of the Committee on Professional Interests, in each province, Provincial Divisions were not needed as far as negotiations with any of the professional associations were concerned. It was then *resolved*, on the motion of Mr. Sauder, seconded by Mr. Newell, that more local autonomy in the provinces is not desirable, and that it is not advisable that Provincial Divisions should be set up.

Mr. Sauder remarked that Mr. Spencer's committee had obtained a great deal of information regarding the fees of other engineering organizations, which had been included in tables attached to the committee's report. On the motion of Mr. Newell, seconded by Mr. Sauder, it was *resolved* that the information contained in these tables should be published in the Journal.

As regards the best method of disseminating a better knowledge of Institute affairs throughout the membership, Mr. Sauder and Mr. Vance referred to the advantages of printing material of this kind in the Journal. It was decided that this policy be continued and expanded.

It was then moved by Mr. Newell, seconded by Mr. Grant, and unanimously *resolved*, that a very hearty and sincere vote of thanks be tendered to Mr. Spencer and his committee for the great amount of work they have done, and for the way in which they have put these important matters before the Institute.

The General Secretary presented a letter from the secretary of the Joint Committee on Engineering Co-operation Overseas, an organization created and supported by eight of the principal engineering societies in England, whose object is to bring together members of the various societies resident overseas. The President reported that Mr. F. Gill, a past-president of the Institution of Electrical Engineers, and chairman of the Joint Committee,had visited Montreal on January 27th, and had been present at a luncheon consultation with members of Council. Mr. Gill had stated that his committee would greatly appreciate the co-operation of The Engineering Institute of Canada, and particularly any suggestions which might lead to a betterment of conditions for the profession The President had assured Mr. Gill that the subject would receive the consideration of Council, and that definite recommendations would be made if investigation showed that the Institute could assist the movement in any way.

Treasurer deGaspe Beaubien reported that the Province of Quebec Association of Architects were seeking an amendment to their charter which would appear to limit the activities of engineers in regard to certain construction work. The Corporation of Professional Engineers of Quebec was opposed to this amendment, and Mr. Beaubien suggested that the Institute might assist the Corporation by joining in this protest. The proposed restrictions would appear to be of more than provincial interest inasmuch as the movement might spread to other parts of Canada. In the President's view, the Institute should stand behind the Corporation in this matter. While it was not the Institute's desire to keep the architects from getting any reasonable amendment to their Act, he thought the Institute should oppose legislation which would appear to cripple its own members. After discussion, this view was approved by Council, and the following committee was appointed to take whatever action proves to be necessary: deGaspe Beaubien, chairman; J. B. Challies, O. O. Lefebvre, A. Lariviere and F. Newell.

Mr. Bonn and Mr. Muntz referred to a similar condition which had existed in Ontario, and outlined the activities

(CONTINUED ON PAGE 153)

NEWLY ELECTED OFFICERS OF THE INSTITUTE

Fred Newell, M.E.I.C., chief engineer of the Dominion Bridge Company Limited, Montreal, is the newly elected vice-president for the province of Quebec. Mr. Newell was born in Portsmouth, England, and received his education at the London and Woolwich Polytechnic School, and received a Whitworth Exhibition in 1902. After several years engineering experience in England he came to Canada. Shortly after his arrival in Canada he joined the staff of the Dominion Bridge Company in 1908 as a designer in the mechanical department. Since that time he has held successively the positions of chief mechanical engineer and assistant chief engineer and in 1937 was appointed to his present position. Mr. Newell is chairman of the Institute's Committee on Professional Interests. He has been a valued member of Council for seven years.

Fred Newell, M.E.I.C.

P. M. Sauder, M.E.I.C., of Lethbridge, Alta., newly elected vice-president for the western provinces, was born near Preston, Ont. He attended the University of Toronto and graduated with diploma in mechanical and electrical engineering. In 1904 he obtained a position with the Irrigation Branch of the Department of the Interior and remained with the department until 1920. His first position with the Lethbridge Northern Irrigation District was that of division engineer on the eastern portion of the project. In 1923 he was made assistant project manager and the following year project manager and district engineer in full charge of the operation and maintenance of the works of the project.

Mr. Sauder was a member of Council in 1927 and chairman of the Lethbridge Branch in 1936. In 1935 he was President of the Association of Professional Engineers of Alberta and is serving the last of a three-year term as Alberta representative on the Dominion Council of Professional Engineers.

W. F. M. Bryce, A.M.E.I.C., of Ottawa, is the newly appointed councillor for that branch. He was born at Toronto and graduated from the University of Toronto in 1908. His first engineering experience was gained on the Toronto-Sudbury branch of the Canadian Pacific Railway. In 1908 he entered the city engineer's office in Ottawa. After a year on tests and surveys he was made sidewalks engineer, then in 1910 he became sewers engineer and has remained in this position until the present time. Mr. Bryce was chairman of the Ottawa Branch in 1938.

P. E. Doncaster, M.E.I.C., district engineer, Fort William, Department of Public Works of Canada, is the newly elected councillor of the Lakehead Branch. He was born at Oshawa, Ont., and attended the School of Mines, Kingston, Ont., before he started his career as an engineer in 1904. For two years he was on railway surveys of the Transcontinental Railway. From 1906-08 he was on construction of the Temiskaming and Northern Ontario Railway in Ontario. He then entered the Department of Public Works of Canada as assistant engineer in the Toronto office. During the years 1912-1915, he was chief assistant to the district engineer at Chase and New Westminster offices. From 1915-1917 Mr. Doncaster was overseas with the Canadian Expeditionary Force, as works officer on construction and maintenance of trench light railways. In 1918 he resumed his duties with the Department of Public Works as chief assistant to the district engineer at New Westminster, B.C., in 1921 became district engineer, Kootenay-Yale-Cariboo district and in 1932 was transferred to the Fort William-Port Arthur district.

L. F. Grant, M.E.I.C., associate professor of engineering, Royal Military College, is the newly appointed councillor for the Kingston Branch. Born in Toronto, he attended the Royal Military College and Queen's University, obtaining a diploma with honours from the former in 1905 and the degree of B.Sc. from the latter in 1926. In 1910 he was passed as a British Columbia Land Surveyor. From 1905 until 1909 he was engaged on railway work as draughtsman, levelman and resident engineer successively on the Grand Trunk Pacific Railway in British Columbia. He then became associated with the firm of F. S. Clements and later with that of Dutcher Maxwell and Company in Vancouver, B.C.

During four years overseas he was with the Canadian Overseas Railway Construction Corps as captain for two years and later received the promotion to major, second in command of the 5th Battalion, Canadian Railway Troops. On his return to Canada he was engaged in surveying for three years when he was made instructor in engineering at the Royal Military College, becoming associate professor the following year. He holds the title of Lieutenant-Colonel.

During the 1936-37 term of office Professor Grant was secretary-treasurer of the Kingston Branch, and in April, 1938 he was appointed to Council to replace J. E. Goodman, A.M.E.I.C., who had resigned.

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

Sidney Hogg, A.M.E.I.C., of the Saint John Drydock and Shipbuilding Company, is the newly elected councillor for the Saint John Branch. He was born at Dundee, Scotland, and received his education there, attending the Harris Academy, Dundee High School and the Dundee Technical College, from which he graduated as naval architect in 1922. The following year he came to Canada and became structural steel detailer with Canadian Vickers Limited.

T. H. Jenkins, A.M.E.I.C., the newly elected councillor for the Border Cities Branch, was born at Toronto, Ont. He attended the Humberside Collegiate Institute and later the University of Toronto, graduating from the latter in

1925 with the degree of B.A.Sc. He then entered the Canadian Bridge Works at Walkerville, Ont., as structural steel detailer. A year later he became connected with the Grand Trunk Western Railroad Company, Detroit, Mich., first as structural draftsman on bridges and buildings and later as designer and estimator of bridges and buildings. He holds this position at the present time.

A. C. Johnston, A.M.E.I.C., electrical superintendent of the Aluminum Company of Canada Limited, is the newly elected councillor for the Saguenay Branch. He was born in Dundee, Scotland, where he received his education. He came to Canada in 1904 and entered Smart-Woods Limited, Montreal, as assistant electrician and mechanic. In 1909 he became master mechanic and electrician of the Matabetchewan power house and after a year in this position was made construction electrician of the Canadian Westinghouse. He remained with this company in various capacities until 1919 when he entered the Northern Aluminum Company as technical assistant, becoming assistant superintendent in 1922. In 1927 he was appointed to his present position.

A. P. Linton, M.E.I.C., chief bridge engineer with the Department of Highways, Saskatchewan, has been elected councillor for the Saskatchewan Branch. Born at New Hamburg, Ont., he attended the Galt Collegiate Institute and the University of Toronto, graduating from the latter in 1908 with the degree of B.A.Sc. Following graduation he was with the Dominion Bridge Company as draughtsman until 1911. In 1911-12 he was with the St. Lawrence Bridge Company working on the design of the Quebec Bridge, and from that time until 1915 was chief bridge engineer with the Department of Highways of Saskatchewan. From 1915 until 1919 Mr. Linton was overseas, serving with the 1st Canadian Pioneers, 9th Battalion, Canadian Railway Troops, in France, and commanded the 1st Bridging Company, Canadian Railway Troops, in Palestine. He was promoted to the rank of Major, was mentioned in despatches, and received the O.B.E. His present rank is Lieutenant-Colonel. Returning to Canada in 1919, he was re-appointed to the position which he still holds. Mr. Linton was chairman of the Saskatchewan Branch in 1935-36.

Ira P. MacNab, M.E.I.C., of the Board of Commissioners of Public Utilities of Nova Scotia, is the newly elected councillor for the Halifax Branch. A graduate of the Nova Scotia Technical College in 1913, he obtained his first engineering experience with the Truro Foundry and Machinery Company. From this position he went to the Tramway and Power Company Limited, Halifax, as superintendent. He left Halifax in 1923 to go to Calgary in an executive position with the Riverside Iron Works. In 1925 he went to Venezuela to inspect a plant at Maracaibo which had been recently acquired by the Royal Securities Company of Montreal. He was appointed general manager of the Venezuela Power Company shortly after his inspection of the plant and remained until 1931 when he went to Monterey, Mexico, and became associated with the Monterey Railway Light and Power Company. He returned to take his present position in 1935.

Mr. MacNab is an active member of the Halifax Branch, serving as chairman of the branch in 1938. He has also been on the council of the Association of Professional Engineers of Nova Scotia and has always taken a keen interest in the welfare of the profession.

H. Massue, M.E.I.C., newly elected councillor for the Montreal Branch, graduated from Laval University in 1913 with the degree of B.A.S., and following this took up post-graduate work at the Massachusetts Institute of Technology for eight months. Returning to Montreal, Mr. Massue became connected with the Quebec Streams Commission, remaining with that organization until 1928, when he joined the staff of the Shawinigan Water and Power Company, Montreal, as assistant engineer.

During 1937 Mr. Massue was chairman of the Montreal Branch of the Institute.

Wilfred Rowland Mount, M.E.I.C., newly elected councillor for the Edmonton Branch and engineer and superintendent of the waterworks of the City of Edmonton, was born at Reading, England. He received his technical education at the School of Metalliferous Mining, Camborne, Cornwall, receiving a certificate from here in 1908. After gaining practical experience in several mines in Cornwall in the various branches of mining, metallurgy, surveying and assaying he went to Gold Coast Colony, West Africa, as surveyor and assayer with the Broomassie Mines Limited. He remained there a year and came to Canada in 1911. He was first associated with the Canadian Northern Railway in Alberta as assistant to division engineer, later he was engaged on surveys for the Dominion Government and the Alberta Government. In 1913 he entered the engineering department of the City of Edmonton as instrumentman. For his services overseas he received the Military Cross. Upon returning from the war he re-entered the engineering department of the City of Edmonton and advanced to the position of resident engineer, then assistant engineer and superintendent of waterworks and finally to the position which he now holds.

Brian R. Perry, M.E.I.C., newly elected councillor for the Montreal Branch, was born at Hilton, Man., and graduated from McGill University in 1915 with the degree of B.Sc. in civil engineering. He gained his early engineering experience as instrumentman on the Intercolonial Railway and as engineer on foundations for the New England Foundation Company and as draftsman for the Shawinigan Water and Power Company. He left this last position to serve overseas and resumed it upon his return. In 1920 he became superintendent on construction with P. Lyall and Sons. Two years later he was placed in charge of the business of the Mackinnon Steel Company in Montreal territory and acted in this capacity until 1925. Since that time he has been engaged in private practice as consulting engineer.

Mr. Perry was chairman of the Montreal Branch of the Institute for 1938.

James Robertson, M.E.I.C., engineer of the Dominion Bridge Company, Pacific Division, is the new councillor for the Vancouver Branch. He was born at Kilmarnock, Scotland, and was educated at Kilmarnock Academy. After serving as an articled pupil for three years with Glenfield and Kennedy, Kilmarnock, he came to Canada and joined the Dominion Bridge Company in 1907. From 1910 to 1914 he attended McGill University, obtaining the degree of B.Sc. in civil engineering. He then rejoined the staff of the Dominion Bridge Company as designing engineer in the Montreal office. In 1918 he was appointed erection engineer, and in 1929 was promoted to his present position. Mr. Robertson was chairman of the Vancouver Branch in 1936 and has always been an extremely active member of the engineering profession.

A. U. Sanderson, A.M.E.I.C., newly elected councillor for the Toronto Branch, was born at Toronto, Ont., and graduated from the University of Toronto in 1909 with the degree of B.Sc. Following this he became an assistant engineer with the Canadian Pacific Railway Company. In 1910 he joined the staff of the City of Toronto Works Department as assistant engineer and from 1911 to 1913 he was assistant resident engineer on design and construction for the filtration plant. From 1914 to 1917 he was resident engineer on the construction of a drifting sand filtration plant for the Department of Works, and in 1918 became superintendent of the plant. In 1929 he received the appointment of assistant mechanical and electrical engineer with the Water Supply Section, Department of Works, Toronto, and is now chief engineer of the Section.

Mr. Sanderson was chairman of the Toronto Branch of the Institute for the year 1937. He is also past-president of the Canadian Section of the American Waterworks Association.

(CONTINUED ON PAGE 158)

INSTITUTE PRIZE WINNERS

H. I. Knowles, who received the *Plummer Medal* for 1938 for his paper "Building Invisible Edifices," is the chief chemist of the Atlantic Sugar Refineries, Saint John, N.B. He was born in Montreal and received his early education at Westmount Academy. In 1905 he moved to Boston, where he was employed in the dyestuff business and became an experimental dyer. He later attended the Massachusetts Institute of Technology, from which he graduated in 1915 with the degree of Bachelor of Science. He was appointed assistant chemist with the Atlantic Sugar Refineries Limited and later chief chemist. He has been with this firm continuously since that time except for two short periods when he was with J. T. Donald & Co. at Montreal and the Canadian Electro Products Co. at Shawinigan Falls.

Niagara Falls, Ont., where he remained until 1937. He is now with Roberts and Schaefer Company, Chicago, Ill., as structural engineer.

A. W. F. McQueen, M.E.I.C., is joint author with E. C. Molke, A.M.E.I.C., of the paper "The 18-Foot Diameter Steel Pipe Line at Outardes Falls," which was awarded the *Gzowski Medal* for 1938. He graduated from the Faculty of Applied Science of the University of Toronto in 1923 and entered the service of the Hydro-Electric Power Commission of Ontario. For three years he was assistant engineer of tests and for another three years he remained with the Commission in charge of various hydrological and hydraulic investigations. In 1929 he became assistant engineer with H. G. Acres and Company Limited, consulting engineers, Niagara Falls, Ont., and in 1934 hydraulic engineer, which position he holds at the present time.

H. I. Knowles

A. W. F. McQueen, M.E.I.C.

E. C. Molke, A.M.E.I.C.

P. C. Perry, M.E.I.C.

E. C. Molke, A.M.E.I.C., is one of the co-recipients of the *Gzowski Medal* for 1938, awarded for the paper "The 18-Foot Diameter Steel Pipe Line at Outardes Falls," by Mr. Molke and A. W. F. McQueen, A.M.E.I.C. A graduate of the Technische Hochschule, Vienna, Mr. Molke came to Canada in 1922. He was employed with the Trussed Concrete Steel Company of Canada, Walkerville, Ont. Then from 1928 to 1932 he held the position of designing engineer with the Hydro-Electric System of the City of Winnipeg, during which time he was engaged on the design of the substructure of the Slave Falls powerhouse. He then joined H. G. Acres and Company, consulting engineers,

P. C. Perry, M.E.I.C., has been awarded the *Past-Presidents' Prize* for his paper "Stream Control in relation to Droughts and Floods." Mr. Perry has held the position of division engineer of the Canadian National Railways at Regina, Saskatchewan, since 1920. Prior to this he was resident engineer of the Grand Trunk Pacific Railway, having served in various capacities for this line since 1906.

J. J. Derry
Winner of the Leonard Medal

S. G. Lochhead, Jr.E.I.C.
Winner of the Phelps Johnston Prize

J. G. Belle-Isle, S.E.I.C.
Winner of the Ernest Marceau Prize

C. Neufeld, S.E.I.C.
Winner of the H. N. Ruttan Prize

T. E. Edson, S.E.I.C.
Winner of the John Galbraith Prize

The Banquet—Head Table—Mr. Magrath thanks the Governor-General

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

Beaudry Leman, A.M.E.I.C., president of the Banque Canadienne Nationale, has been chosen as joint president of the Montreal reception committee for the visit of their Majesties, the King and Queen.

E. M. Dennis, A.M.E.I.C., has been made general executive assistant of the Lands, Parks and Forests Branch of the Department of Mines and Resources, Ottawa. Mr. Davis, who graduated from Queen's University in 1904, was with the Surveyor-General, Ottawa, from that time until 1912 when he became assistant chief in the Topographical Surveys Branch of the Department of the Interior. In 1924 he was made chief of administration in the Topographical and Air Survey Bureau of this Department and held this position until 1937 when he became chief of administration of the Hydrographic and Map Service of the Department of Mines and Resources.

W. Hamilton Munro, M.E.I.C., general manager of the Ottawa Electric and Gas Companies and Ottawa Light Heat and Power Company Limited, was elected to the Board of Directors of each of these companies on February 6th.

Lt.-Col. G. R. Turner, M.C., D.C.M., R.C.E., A.M.E.I.C., who has been attending a course at the Imperial Defence College, London, England, has returned to Canada and is now on the General Staff at Headquarters M.D. No. 11, Esquimalt, B.C.

Major J. C. MacDonald, M.E.I.C., has resigned his position as comptroller of Water Rights, which he has held since 1926 in the Department of Lands of British Columbia, to act on the new British Columbia Public Utilities Commission. Major MacDonald was born in Nova Scotia but went to British Columbia in 1909 and became a member of the firm of Cleveland and Cameron of Vancouver. After serving with distinction overseas he entered the Department of Lands of British Columbia.

Ernest Davis, M.E.I.C., former assistant comptroller of Water Rights and chief engineer of the Department of Lands of British Columbia, has been made comptroller, succeeding Major J. C. MacDonald, M.E.I.C.

R. W. Tassie, M.E.I.C., has been recently elected vice-president of Emprezas Electricas Brasileiras, S.A., and is now in charge of the American and Foreign Power Company Inc. interests in Brazil. He is located in Rio de Janeiro. For the past twelve years Mr. Tassie has been with the Venezuela Power Company Limited and the Montreal Engineering Company, with which the former is affiliated.

W. F. Angus, M.E.I.C., president of the Dominion Bridge Company, has been elected chairman of the board of governors of the Financial Federation drive for funds to be held later this year in Montreal.

C. J. McGavin, M.E.I.C., chief engineer of Water Rights for the Government of Saskatchewan, accepted the *Past-Presidents' Prize* on behalf of P. C. Perry, M.E.I.C., who was unable to attend the Annual Meeting in Ottawa.

F. R. Pope, Jr.E.I.C., who graduated with honours in mechanical engineering from McGill University in 1935 and who has since then been employed by the Bell Telephone Co. of Canada, lately as Field Engineer at Ottawa, recently left the Bell to take up a position with the Western Clock Co. at Peterborough.

P. H. Morgan, A.M.E.I.C., who has been construction superintendent of the Beauharnois Heat and Power, is now with the Demerara Bauxite Company at Georgetown, British Guiana.

P. M. Sauder, M.E.I.C., project manager for the Lethbridge Northern Irrigation District, addressed a meeting of the Technical Agriculturists in the Marquis Hotel on Thursday, January 26th, 1939, on the "Constitution, By-laws and Code of Ethics of The Engineering Institute of Canada."

F. G. Cross, M.E.I.C., superintendent of Operation and Maintenance, Canadian Pacific Railway, Department of Natural Resources, Irrigation Branch, Lethbridge, and an outstanding artist, was recently elected a Vice-president and Director of the Canadian Society of Painters in Water Colors.

J. B. Challies, M.E.I.C., has been appointed vice-president of the St. Maurice Power Corporation.

John Murphy, M.E.I.C., recently retired from the staff of the Department of Transport, has been elected president of the Ottawa-Hull Better Business Bureau.

P. S. Gregory, M.E.I.C., assistant general manager of the Shawinigan Water and Power Company, has been elected a director of the Quebec Power Company, filling the vacancy caused by the death of the Hon. J. P. B. Casgrain, A.M.E.I.C.

R. A. C. Henry, M.E.I.C., former vice-president and general manager of the Beauharnois Power Corporation Limited, has been appointed a vice-president of Montreal Light, Heat and Power Consolidated. Mr. Henry graduated from McGill University with the degrees of B.A. and B.Sc., receiving the latter in 1912. Following graduation he entered the service of the Department of Railways and Canals as inspecting engineer and in 1913 he was made assistant engineer. He held this position until 1923, when, following the reorganization of the Canadian National Railways, he joined their staff in Montreal. In 1929 he became Deputy Minister of Railways and Canals and after holding this position for a year he joined the Beauharnois Power Corporation Limited.

H. R. Younger, A.M.E.I.C., former division engineer of the Canadian Pacific Railway at Nelson, B.C., has been made superintendent of the Kettle Valley Division and will be located at Penticton, B.C.

W. S. Lea, M.E.I.C., and **Jules Archambault** are the two engineer members of the committee of five recently appointed by the Quebec Government to investigate the Tramways situation in the City of Montreal. Mr. Lea is vice-chairman of the committee.

A UNIQUE RECORD?

H. F. Bennett, M.E.I.C., who has just been elected to the chairmanship of the London Branch of the Institute, has occupied a similar position in two other branches, namely, Saint John in 1923, and Halifax in 1929. In addition he has represented Sault Ste. Marie on Council, and has been an officer of Provincial Professional Associations.

VISITORS TO HEADQUARTERS

R. W. McColough, M.E.I.C., chief engineer of the Department of Highways for Nova Scotia, when in Montreal recently found time to visit Headquarters to discuss Institute affairs in his province.

S. W. Gray, A.M.E.I.C., President of the Association of Professional Engineers of Nova Scotia, was a very welcome visitor at Headquarters on his way home from the Annual Meeting of the Institute in Ottawa, where he represented the Association of Professional Engineers of Nova Scotia.

PRESIDENTIAL ACTIVITIES

Dean McKiel spoke to the Rotary Club of Ottawa on February 13th on the subject, "The Engineer in Everyday Life."

President McKiel represented the Institute at the annual banquet of the Royal Architectural Institute of Canada which was held in Ottawa on Saturday, February 18th.

During the President's visit to Ontario he held two meetings with branches of the Mount Allison Federated Alumni, one at the Chateau Laurier in Ottawa on the 17th and the other at Wymlwood, Toronto, on the 20th.

On February 21st the President visited Headquarters, and during the day met with several officers to discuss matters pertaining to Institute policy and programme.

OBITUARIES

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

Thomas Walker Coxworth, A.M.E.I.C., in Chicago, on October 13th, 1938, due to an accident. He was born on September 2nd, 1903, at Deloraine, Man., and received his education at the University of Manitoba, graduating from this institution in 1926 with the degree of B.Sc. He then entered the firm of W. & A. Smadbeck, Inc., New York, as field engineer in charge of land, topographic and subdivision surveys in the states of New Jersey, New York and Minnesota. In 1927 he moved to Chicago and was employed in various capacities in the fabricating shop and erection department of McClintic-Marshall Corporation until 1929 when he was made assistant engineer. He held this position until 1937 when he became assistant engineer in the fabrication division of Bethlehem Steel Company in the same city. He was still with this company in this capacity when his sudden death occurred.

Mr. Coxworth joined the Institute in 1935 as an Associate Member.

Joseph Honoré Landry, A.M.E.I.C., in Montreal, on February 2nd, after several months' illness resulting from an automobile accident. He was born at Maskinongé, Que., on February 27th, 1889. Attending Laval University he obtained his B.A. degree in 1909 and the degree of B.Sc. in civil engineering in 1913. He then became assistant engineer of the Department of Public Works of Canada, Montreal District; later he was made senior assistant engineer and remained in this position until 1937 when he was promoted to that of district engineer. He supervised many district works, particularly along the Richelieu River, Sorel Harbour and Friar's Island Dam. He was deeply interested in the St. Lawrence Waterway plan and had prepared important data upon the subject. During the war he acted as inspector for the Department of Naval Service on construction of trawlers built by Canadian Vickers, Montreal.

Mr. Landry joined the Institute in 1919 as an Associate Member.

ELECTIONS AND TRANSFERS

At the meeting of Council held on February 13th, 1939, the following elections and transfers were effected:

Member

Sargent, Albert Elbridge, B.Sc., (McGill Univ.), supt., Dow Brewery, National Breweries Ltd., Montreal, Que.

Associate Members

MacNamara, William Stafford, struct'l. designer, Hamilton Bridge Co. Ltd., Hamilton, Ont.
Nicol, William Brown, (Heriot-Watt College), struct'l. steel designer, Hamilton Bridge Co. Ltd., Hamilton, Ont.
Smith, Donald Sinclair, M.A.Sc., (Univ. of B.C.), sales engr., Northern Electric Co. Ltd., Montreal, Que.

Juniors

Dugas, Alexandre, B.A.Sc., C.E., (Ecole Polytechnique), engr., Provincial Electricity Board, Montreal, Que.
Morrison, Frederic Charles, B.Eng. (Elec.), (N.S. Tech. Coll.), lubrication engr., Dominion Steel & Coal Corpn., Sydney, N.S.
Oulton, Roger Reynolds, B.Eng., (N.S. Tech. Coll.), head of inventory party, Engineering Service Co., Halifax, N.S.
Sharpe, Russell Neville, B.Sc. (Civil), (Univ. of Man.), 121 Sherburn St., Winnipeg, Man.
Thurston, Arthur Munroe, B.Eng., (McGill Univ.), engr., Shawinigan Water & Power Company, Montreal, Que.

Transferred from the class of Associate Member to that of Member

Fraser, Isaac Matheson, B.Sc., (McGill Univ.), professor of mech'l. engrg., University of Saskatchewan, Saskatoon, Sask.
McQueen, Andrew William Fraser, B.A.Sc., C.E., (Univ. of Toronto), hydraulic engr., H. G. Acres & Co. Ltd., Niagara Falls, Ont.
Williams, Guy Morris, B.Sc. (C.E.), (Univ. of Nebraska), prof. of civil engrg., University of Saskatchewan, Saskatoon, Sask.

Transferred from the class of Junior to that of Associate Member

Brownell, Harold Ross, B.Sc. (Mech.), (McGill Univ.), sales service engr., Bailey Meter Co. Ltd., Toronto, Ont.
Lochhead, Stuart George, B.Eng. (Civil), (McGill Univ.), dftsman., Dominion Bridge Co. Ltd., Montreal, Que.
McAlpine, Robert Fraser, B.Sc., (Mech.), (N.S. Tech. Coll.), mgr., Cape Breton Branch, William Stairs Son & Morrow Ltd., Sydney, N.S.
Morton, Philip S. A., B.A.Sc., (Univ. of Toronto), asst. to district service engr., Montreal office, Can. Gen. Elec. Co. Ltd., Montreal, Que.
McIntyre, Douglas Vallance, B.Sc. (E.E.), (Univ. of Alta.), 1195 Palmer Ave., Niagara Falls, Ont.
Weatherbie, Weston Ewart, B.Sc. (Civil), (N.S. Tech. Coll.), asst. engr., Dept. of Highways of Nova Scotia, Truro, N.S.

Transferred from the class of Student to that of Associate Member

Tatham, William Carlyle, B.Eng., (McGill Univ.), asst. engr., Courtaulds (Canada) Ltd., Cornwall, Ont.

Students Admitted

Anderson, Lloyd Francis, (Univ. of Alta.), 11032-89th Ave., Edmonton, Alta.
Anderson, Paul Chenery, (Univ. of Toronto), 68 Indian Road Crescent, Toronto, Ont.
Bartlett, Ewart Horwood, (N.S. Tech. Coll.), 29 Brenton St., Halifax, N.S.
Bielby, George Gordon, B.A.Sc., (Univ. of Toronto), 83 Epworth Circle, Niagara Falls, Ont.
Birt, Thomas William, B.Sc. (E.E.), (Univ. of Man.), 4 Scotia St., Winnipeg, Man.
Boyd, Robert Norman, (Univ. of Toronto), 84 Pine Crest Road, Toronto, Ont.
Cuthbertson, Charles Cassells, B.Sc., (Chem.), (Queen's Univ.), 196 Stuart St., Kingston, Ont.
Doehler, Rolf John, (McGill Univ.), 5514 Queen Mary Rd., Montreal, Que.
Dumaresq, James Philip, (N.S. Tech. Coll.), 96 Oxford St., Halifax, N.S.
Garvie, William Laurence, (Univ. of B.C.), 819 Eighth Ave., New Westminster, B.C.
Gray, Cyril John, (Univ. of N.B.), 245 Westmorland St., Fredericton, N.B.
Gunter, Allan Nelson, B.Sc. (Chem.), (Univ. of Alta.), 10649-125th St., Edmonton, Alta.
LaBrish, Alfred Gordon, ap'tice, E. G. M. Cape & Co., Montreal, Que.
Laird, David William, (Univ. of Man.), P.O. Box 307, Portage la Prairie, Man.
McKie, William Massey, (Univ. of Man.), 348 Stradbrooke Ave., Winnipeg, Man.
Rapsey, William Woodside, (Univ. of Toronto), 87 Ava Road, Toronto, Ont.
Smith, Arthur Dale, (Univ. of Toronto), 610 Ontario St., Toronto, Ont.
Smith, Edgar Bernard, (N.S. Tech. Coll.), Caledonia, N.S.
Steiman, Morris Irvin, (Univ. of Man.), 456 Pritchard Ave., Winnipeg, Man.
Stewart, Murray Douglas, (Univ. of Toronto), 282 Glencairn Ave., Toronto, Ont.
Strachan, Jack Lyon, (Univ. of Man.), 28 Berrydale, St. Vital, Man.
Sutton, Arthur Leslie, (Univ. of B.C.), 3217 West 7th Ave., Vancouver, B.C.
Wardrop. William Leslie, (Univ. of Man.), Whitemouth, Man.
Young, Robert Evans, B.A.Sc. (Univ. of Toronto), Markham, Ont.
Young, William Mackay, (Univ. of Toronto), P.O. Box 130, Dunnville, Ont.

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 following is a synopsis of the paper presented to the Border Cities Branch at the monthly dinner meeting of January 20, 1939.

Choosing the subject, **"The Evolution and Future of the Home Radio Receiver,"** Mr. Stanley C. Polk, of Detroit, delivered the first part of his paper over radio station CKLW.

Mr. Polk paid tribute to the engineers whom he considered to be largely responsible for the comparatively recent and rapid development of the commercial radio.

Starting with the amateur crystal sets commonly used in 1920 the problem of selectivity was solved by the perfection of the superheterodyne set. In 1924 the earphones were replaced by the first all electric receivers. The electrodynamic loud speaker, and the birth of the cabinet radio in that year gave such a stimulus to the industry that manufacturers could not keep up with the public demand. The development of short wave sets which followed was aided by the telephone engineers.

Mr. Polk believed that commercial television for distances of 25 to 50 miles will be realized very soon, but due to the high cost of relays, and the insulation of cables against electrical interferences, it will be some time before television reaches the present-day standard of radio.

At the conclusion of Mr. Polk's address Mr. Jones of the same firm spoke briefly of the Radio Listeners' Foundation of United States, in which he has played a dominant rôle. Formed for the purpose of allowing the listener to have some control over the type of radio programme and thus eliminate undesirable features, it has to date been very successful. It has received the support of the press and has made a determined effort toward obtaining better announcers, programmes and co-operation in the broadcasting industry.

CALGARY BRANCH

B. W. Snyder, a.m.e.i.c. - *Secretary-Treasurer*
G. W. O'Neill, a.m.e.i.c. - *Branch News Editor*

A general meeting of the branch was held at the Palliser Hotel on Dec. 8th, 1938, to hear an illustrated address given by J. R. Wood, m.e.i.c., assistant city engineer of Calgary, entitled, **"Problems of the City Engineer."**

In Mr. Wood's opinion, replacement of the steel truss bridge at East Calgary, over the Bow River, should be the first consideration of Calgary when finances will permit. Of next importance, said Mr. Wood, is the Elboya bridge, which he labelled as "reminiscent of horse and buggy days."

Narrowness of the Bow River bridge makes it quite unsuitable for modern traffic, said Mr. Wood. When the age of this bridge and its present dead and live loads are taken into consideration, without allowance for snow and wind loads, the stresses that can be developed in the truss members are far too high, he warned. Narrowness of this bridge has actually been a redeeming feature of the structure in so far as it affects safety, since only one line of trucks or buses in one direction is possible.

In place of the present Elboya bridge, Mr. Wood recommends a double span, rigid frame structure, giving maximum river clearance and head room. He deplored the fact that the present bridge gives little clearance above possible high water.

The major portion of Mr. Wood's address dwelt on technical phases of the duty of the city engineer's department, such as bridges, paving, sewage, waterworks and miscellaneous works.

He referred to instances of poor paving in Calgary, brought about by the use of clay-coated gravel, poor sand and little cement. Wood blocks laid on a concrete base were a "nightmare" of the paving department, as this type of paving is not suited for western Canada weather and climatic conditions.

"There is a real necessity for Calgary to own a proper transit mixer type of truck, as now used in Vancouver, to transport concrete over long hauls," said Mr. Wood, as such a move would eliminate mixing of concrete on the job and save the taxpayers many dollars.

He remarked that the existing sewer system of Calgary is too small to handle the maximum discharge during peak storms, without flooding, although various steps have been taken by the city in recent years to improve this utility.

Mr. Wood was tendered a vote of thanks, on behalf of those present, by E. W. Bowness, m.e.i.c., Branch Chairman.

A general meeting of this branch, on Jan. 6th, heard a talk by Professor H. R. Webb, of the Department of Civil Engineering, University of Alberta. He spoke on **"The Grand Coulee Project,"** and stated that almost every one of the statistics connected with the construction of the Grand Coulee Dam in Washington State constituted a world record. The finished project would cost 394 millions of dollars and was expected to provide a living, mainly as a result of its irrigation possibilities, for from 75 to 120 thousand people. Professor Webb's illustrations gave a detailed explanation of the methods of construction used on the huge dam across the Columbia River. Having spent some time at the site of this project, he had a thorough knowledge of his subject. Many of the illustrations used were actual photographs taken by the speaker. He was tendered a hearty vote of thanks by the Branch Chairman.

This branch feels indebted to Mr. Webb for the time and effort spent in preparing this address, which proved to be most enjoyable and interesting.

HALIFAX BRANCH

R. R. Murray, m.e.i.c. - *Secretary-Treasurer*
A. G. Mahon, a.m.e.i.c - *Branch News Editor*

The annual joint banquet of the Halifax Branch of The Engineering Institute of Canada and The Association of Professional Engineers of Nova Scotia was held at the Nova Scotian Hotel, January 17th, 1939. Interesting addresses and a varied programme of musical entertainment were the highlights of the evening, together with a very enjoyable dinner. Approximately two hundred members and guests attended the gathering.

The principal speaker of the evening was Dr. Donald F. MacDonald, Professor of Geology at St. Francis Xavier University, Antigonish. Dr. MacDonald's subject was the **"Application of Geology to Engineering."** This topic was illustrated by the speaker's personal experiences in solving many engineering problems by the aid of geology.

Speakers, in addition to Dr. MacDonald, were M. L. Gordon, A. D. Nickerson, a.m.e.i.c., S. W. Gray, a.m.e.i.c., I. P. Macnab, m.e.i.c., H. C. Burchell, m.e.i.c., dean of the engineering profession in Nova Scotia, and the Honourable A. S. MacMillan, Minister of Highways.

During the programme, a short silence was observed in memory of R. J. Bell, D. W. Robb, m.e.i.c., both of Amherst, and W. G. Yorston, m.e.i.c., of Truro, members of the engineering profession who passed away during the year.

The meeting was ably handled under the joint chairmanship of S. W. Gray, Past-President of the A.P.E.N.S., and Allan Nickerson, Chairman of the Halifax Branch of the E.I.C.

K. L. Dawson, M.E.I.C., directed the entertainment, adding some items of his own as an extra measure. The volume of the applause and the number of encores requested were ample indications of the enjoyment of the audience.

The annual meeting of the Association of Professional Engineers of Nova Scotia was held on January 17th. One of the important items of business, which is of considerable interest to the members of the Halifax Branch of The Engineering Institute of Canada, was a proposed agreement for closer co-operation between The Engineering Institute and the Nova Scotia Association of Professional Engineers. The agreement as drafted was not ratified at this meeting. However, a committee of five members was appointed to consider the modifications thought desirable. The amended proposal will be submitted to the members of the A.P.E.N.S. for their approval at an early date.

LETHBRIDGE BRANCH

E. A. LAWRENCE, S.E.I.C. - *Secretary-Treasurer*

The Lethbridge Branch held a regular meeting in the Marquis Hotel on Saturday, January 7th, under the chairmanship of R. F. P. Bowman, A.M.E.I.C. About 45 members, ladies and guests, sat down to dinner, during which music was provided by Geo. Brown's instrumental quartette. Community singing and two solos by E. Rannard, which were appreciated by all, completed the musical part of the evening.

After a short adjournment, Professor H. R. Webb, A.M.E.I.C., of the department of civil engineering at the University of Alberta, presented an interesting description of the **"Grand Coulee Project"** on the Columbia River 90 miles west of Spokane, and illustrated his talk with diagrams and pictures. Professor Webb described the action of the melting ice cap in past ages in creating conditions suitable for irrigating an expanse of land of about 12,000,000 acres. It is proposed that eventually this land will be irrigated by water pumped from the Columbia River; the final development provides for ten dams between the Grand Coulee dam and Bonneville so as to develop all the available power in this stretch of the Columbia River.

The present main project, including the Grand Coulee dam, the largest structure ever attempted by man, was described by Professor Webb in its various stages. The dam itself is of concrete, approximately 4,300 ft. long, 550 ft. high and about 500 ft. wide at the base and about 30 ft. wide at the top when completed. It will contain about 12,000,000 cu. yd. of concrete, about 20 miles of inspection tunnels and many miles of pipe used during construction for cooling the concrete when setting and for grouting the construction joints.

For power development, turbine units of 150,000 hp. will be installed, and the ultimate power developed will amount to about 2,700,000 hp.

For irrigation purposes the water will be pumped by 10 pumps, each capable of delivering about 10,000 gal. per sec. and each driven by a 65,000 hp. motor. The water will be pumped up 280 ft. into two equalizing reservoirs from which the main irrigation ditches will be led. It is estimated that power can be sold for 0.24 cents per kw.h.

For the irrigated land, legislation has been enacted to prevent speculation in land values. It is expected that irrigable land will be sold in lots of 40 acres per head at about $10.00 per acre and that after the fifth year the annual charges for water service and maintenance will be approximately $5.10 per acre. It is believed that the irrigation project will provide land for about twenty-five thousand families.

LONDON BRANCH

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

The regular monthly meeting of the branch was held in the Normal School on February 22nd, 1939, and the speaker was the writer, Jno. R. Rostron, A.M.E.I.C., retired Bridge and Structural Engineer to the City of London. His subject was **"London's Bridges—Old and New."** The talk was illustrated by lantern slides. The meeting was presided over by H. F. Bennett, M.E.I.C., chairman of the branch.

After mentioning the various bridges and subways in and around London, Mr. Rostron spoke more particularly of the eleven large city bridges over the River Thames and three outside the city limits—one a suspension bridge. Distinguishing between "through" and "deck" bridges (with examples thrown on the screen) he pointed out the economy of the "through" type, by reason of the great depth of the trusses. This depth enables the same strength to be obtained as with shallower trusses, with only around half to three-fourths the weight of steel. For aesthetic reasons, however, the tendency now is towards the "deck" bridge type for city bridges provided there is sufficient headway over the river or road underneath.

Four of the new bridges, for important physical reasons, are of the same type. The Thames River is subject to high flood conditions and the Warren truss type was therefore chosen as giving the most possible clearance underneath and avoiding unsightly overhead bracing. The grades of the roads could not be altered and so the depth of floor construction was limited. Any other type such as the bowstring (steel or concrete), owing to the long spans and consequent high trusses, would have to be braced overhead, which was not desired. The Warren trusses adopted are embellished by ornamental stone piers at the ends. These four bridges accommodate 32 ft. roadways and six ft. sidewalks.

The selection of this type of bridge was amply justified during the high floods of 1937. The speaker then described the old "pin-connected" type of bridge and the objections to it, particularly with regard to modern traffic.

Of the four bridges mentioned as of the same type Westminster Bridge (carrying King's Highways Nos. 2 and 4) was selected as a typical example for detailed description. Mr. Rostron explained that with a span of 160 ft. the economic limit for this type is rather exceeded as, for aesthetic reasons, the depth of trusses is only 16 ft. Therefore he chose a steel grid floor (filled and overfilled with asphalt), for its light weight. This floor, electrically welded, is that fabricated by the Sarnia Bridge Co. and was fully described and illustrated on the screen. It is good for H20 loading. A cardboard model was used to demonstrate (by application of a weight) the effect of the compressive stresses both on the top chord and web system in this type of bridge and the means of combating these stresses by heavier posts.

The ornamental stone piers (or pylons) are of Queenston stone and similar in design to those at the north end of Westminster Bridge, London, England, which carry the ornamental railing around Westminster Hall of historic fame.

The special characteristics of the three other bridges of similar design were then given. These are Victoria Bridge, 255 ft. long (two spans); Kensington, 317 ft. long (three spans), and Wellington, 220 ft. long (two spans).

Time only permitted a brief reference to the remaining bridges: Richmond St., 160 ft. span; Suspension Bridge, 235 ft. span, at the Municipal Golf Links, Springbank; Blackfriars Bridge, 219 ft. span (Bowstring type); Chelsea Green, 163 ft. span, and two spans 50 ft. each; Oxford St., 417 ft. long (three spans); King St., 160 ft. span, and Vauxhall Bridge, 210 ft. long (three spans).

A vote of thanks to the speaker was proposed by J. A. Vance, A.M.E.I.C., seconded by V. A. McKillop, A.M.E.I.C., and unanimously carried.

In returning thanks Mr. Rostron gave voice to his appreciation of the "Life Membership" in the E.I.C. recently granted to him by the president and members of Council of the Institute.

Thirty-one members and guests were present.

MONTREAL BRANCH

E. R. Smallhorn, a.m.e.i.c. - *Secretary-Treasurer*

On January 27th the Montreal Branch visited the new postal terminal on St. James Street. During the tour of inspection J. H. Beaulieu of the publicity department described the mailing system to a large and interested group.

Annual Branch Smoker

About 450 members and their friends gathered at the Windsor Hotel on February 2nd to attend the Annual Branch Smoker. The Smoker Committee under the chairmanship of Dick Heartz, m.e.i.c., arranged a most intertaining programme. Mr. John Pratt acted as master of ceremonies. Willis Malone, jr.e.i.c., and Maxwell Ford wrote the music and words of a new song about The Engineering Institute, and Mr. Ford, himself, presented several original skits that were received with great glee by the audience. In addition to these numbers, there were singing and dancing acts and the Dominion Bridge Orchestra, as usual, provided excellent music.

On February 9th, Dr. F. S. Goucher of the Bell Telephone Laboratories, New York, spoke on the subject of **"The Early Microphone and Recent Research."** He began his demonstrations with the "gallows-frame telephone" invented by Alexander Graham Bell and traced the evolution of the carbon microphone from this model and those of Edison, Berliner and Hughes. A picture of microphonic action, based on recent researches on contacts, was described and illustrated with lantern slides, models and demonstrations; and certain non-communication applications of this principle discussed. Both the branch and the Institute of Radio Engineers enjoyed this lecture, which was preceded by a courtesy dinner at the Windsor Hotel. Mr. J. R. Haynes assisted Dr. Goucher and S. Sillitoe, jr.e.i.c., acted as chairman.

On February 16th the branch heard an interesting lecture by S. B. Cooper on **"Recent Developments in Urban Transportation."** Mr. Cooper is the special representative of the Transportation Sales Department of the Westinghouse Electric and Manufacturing Company and since 1930 has represented his company on the President's Conference Committee on car research and development. The discussion included the application of electricity to city transportation through the use of trolley coaches, P.P.C. cars, streamlined street cars and Diesel electrics. It was the speaker's opinion that street cars would not be replaced by buses on the most heavily travelled routes of cities the size of Montreal because the former ease congestion far more than the latter. However, buses serve a logical need, he said, in all city transit systems.

Prior to the meeting a courtesy dinner was held at the Windsor Hotel. D. E. Blair, m.e.i.c., was chairman of the gathering.

Cancellation of the paper scheduled for Thursday, February 23rd, was necessary on account of the speaker's illness. Instead, Prof. R. E. Jamieson, m.e.i.c., kindly consented to show moving pictures taken by him in Italy last summer. R. H. Findlay, m.e.i.c., gave a short report of the annual meeting in Ottawa, which was supplemented by an exhibit of candid camera pictures of those attending this convention.

NIAGARA PENINSULA BRANCH

George W. Griffiths, a.m.e.i.c. - *Secretary-Treasurer*
J. G. Welsh, s.e.i.c. - *Branch News Editor*

On Friday evening, February 3rd, 1939, the Niagara Peninsula Branch held a dinner meeting at the Welland Club in Welland, Ont. Chairman C. G. Moon, a.m.e.i.c., presided. Ashtrays cast in the shape of small frying pans were presented to each person present by Canada Foundries and Forgings Ltd. The same company also presented a nickel steel frying pan as a door prize. C. H. Burns, m.e.i.c., introduced the speaker of the evening, Mr. Clarke Wales, Assistant General Manager of Algoma Steel Corporation Ltd.

Mr. Wales spoke on **"The History of the Steel Industry in Ontario,"** a synopsis of which follows.

The history of the iron and steel industry in Canada until recently has been one of disappointment, largely due to small population and lack of domestic raw materials. A vigorous steel industry in times of peace or war is the very foundation of industrial development in any country. The development of the steel industry in Canada, despite lack of coal and ore in close proximity, is justifiable on the grounds that it provides work for Canadian labour on steel for Canada's requirements and it also provides for the development of a sound secondary industry.

Early blast furnaces in Canada, as in the United States, used charcoal as a fuel. As the size of furnaces increased, however, in spite of the plentiful supply of wood, coke made at the coal mine in beehive ovens became more economical. This was still wasteful, since all of the volatile matter of the coal was lost. To eliminate this condition and produce still further economies, it became the practice to import the coal and make coke in Canada in by-product coke ovens, the coke oven gas and tar being used as a steel plant fuel. Later the tar became useful for purposes other than fuel and has been replaced with such fuels in the steel plant as blast furnace gas, oil, or producer gas.

The establishment of the Algoma Steel Corporation was based on the use of hematite ores from the Michipicoten district, the water power at the Sault, the tremendous demand in Canada at the turn of the century for rails, and the energy and genius of the late F. H. Clergue.

The first standard rails made in Canada were rolled at the Sault in 1902. In 1908 the Bessemer process gave way to the open hearth process for making steel at the Sault. From 1912 until 1919, expansion at the Algoma plant was very rapid and recent expansions of the Algoma Steel Corporation include the development of the New Helen mine at Michipicoten, new battery of coke ovens at the Sault, changes in fuel practices and design of furnaces in the Open Hearth Department, installation of a most modern plant for the manufacture of grinding balls and construction of a sheet and tin mill, which will soon go into operation.

Through the medium of slides, Mr. Wales portrayed the Algoma development. The views showed the recently opened Michipicoten area, where hematite is obtained at the surface only eleven miles from Michipicoten Harbour, and also the mill, coal storage areas, furnaces (both Bessemer and open hearth), the blooming mill and then the various rolling mills, including the sheet mill just nearing completion.

Following the talk Mr. Wales replied to a number of questions.

R. C. McMordie, a.m.e.i.c., moved a hearty vote of thanks to the speaker. Mr. Burns, Mr. Dyson, and Mr. Griffiths were congratulated for their organization of this, the season's best attended meeting.

SASKATCHEWAN BRANCH

J. J. White, m.e.i.c. - *Secretary-Treasurer*

The regular meeting of the Saskatchewan Branch was held on Monday, December 19, 1938, in the Kitchener Hotel, Regina. J. W. D. Farrell, m.e.i.c., acted as chairman for the joint meeting, as members of The Association of Professional Engineers of the Province of Saskatchewan and the Saskatchewan section of The American Institute of Electrical Engineers had also been invited to attend.

Sixty-eight persons sat down to dinner, which was followed by a lecture on Scientific Crime Detection, given by Dr. Maurice Powers, Surgeon of the Royal Canadian Mounted Police, with Headquarters in Regina. Dr. Powers discussed the **"Aims of the Criminal Investigation Department"** in a very general way, the progress that has been made by research in crime, the past and present status of the department, and illustrated his discourse by lantern slides. The lecture was of a somewhat confidential nature, was well illustrated by photographic slides and was provocative of much discussion.

A hearty vote of thanks was tendered the speaker for his interesting and instructive address.

VANCOUVER BRANCH

T. V. Berry, A.M.E.I.C. - *Secretary-Treasurer*

The Vancouver Iron Works Ltd. were hosts to about seventy-five members and friends of the Vancouver Branch to an inspection of their pipe fabricating plant on Saturday, January 14th.

This firm is manufacturing approximately 25,000 feet (2,840 tons) of electrically welded steel pipe for the Greater Vancouver Water District for the extension of its Capilano system to the westerly part of the city. The pipe varies from 60 in. to 32 in. inside diameter and is fabricated from plate varying from 9/16 in. to 5/16 in. in thickness. The plate is of Canadian manufacture throughout.

The 48 in. dia. pipe on which the shop was working is manufactured in lengths of 32 ft. 6 in. made up of five courses of 6 ft. 6 in. each. The 7/16 in. plate of which the 48 in. pipe is fabricated is bevel planed for welding. Both longitudinal and circular seams are tack welded prior to automatic butt welding by the unionmelt process which provides a completely shielded arc weld with a single pass. The longitudinal seam welds are made against a copper back-up bar and the circular automatic welds are made up against a hand-welded bead on the inside. Each length of pipe is belled at one end for field assembly.

Prior to the coating process, all pipe is subject to a hydrostatic test for tightness, the 48 in. pipe being tested to 325 lb. per sq. in. and all welds hammered while under pressure.

Pipe is prepared for coating by blasting with steel grit, followed by spray priming, drying and pre-heating. The inside coat of enamel is centrifugally applied hot by spinning the pipe. The outside coat is applied by a spiral application. Both inside and outside coats are tested for "holidays" by means of high tension spark apparatus and weak spots patched with hot enamel applied by brush. The final process consists of the simultaneous application of hot enamel and asbestos felt spirally wound on the outside of the pipe.

Following the inspection of the pipe plant a number of the visitors travelled to the south side of False Creek where a section of 48 in. centrifugally spun concrete pipe was being assembled preparatory to launching and sinking in the bottom of False Creek. This 48 in. concrete pipe forms the underwater section of the new Capilano main extension and is being laid by the Greater Vancouver Water District by its own force.

News of Other Societies

Items of interest regarding activities of other engineering societies or associations

ASSOCIATION OF PROFESSIONAL ENGINEERS OF ONTARIO

Saturday, February 4th, at the Royal York Hotel, Toronto, was the day and place chosen for the Annual General Meeting of the Association of Professional Engineers of Ontario. The afternoon meeting was attended by about 350 members and E. P. Muntz, M.E.I.C., the retiring President of the Association, occupied the chair. The large number of out-of-town members who attended the meeting was particularly encouraging to those in charge.

The result of the annual elections was as follows:

President—W. P. Dobson, M.E.I.C., Chief Engineer of the Ontario Hydro Electric Power Commission Testing Laboratories.

Vice-President—J. W. Rawlins, Toronto.

Civil Engineers on Council:

W. E. Bonn, M.E.I.C., of Canadian Dredge and Dock Co. Ltd., Toronto.
Warren C. Miller, M.E.I.C., City Engineer of St. Thomas.
J. Clark Keith, A.M.E.I.C., Manager of the Windsor Utilities Commission.

Chemical Engineers on Council:

Robt. A. Elliott, Deloro, Ont.
W. R. Patterson, Brantford, Ont.

Electrical Engineers on Council:

Arthur L. Dickieson, A.M.E.I.C., Peterboro, Ont.
O. S. Mitchell, Secretary of Ontario Hydro Electric Power Commission of Ontario.
Commander Chas. P. Edwards, A.M.E.I.C., Chief of the Air Services, Dept. of Transport, Ottawa.

Mechanical Engineers on Council:

Wm. H. Bonus, University of Toronto.
Prof. L. T. Rutledge, M.E.I.C., Queen's University.
C. C. Cariss, Brantford, Ont.

Mining Engineers on Council:

A. G. Irving, Timmins, Ont.
Roy J. Henry, Toronto.

The afternoon session was largely an open session and those present took full advantage of the opportunities for voicing their views. Several members pressed for more action by the Association to bring engineering and engineers to the attention of the public, while others thought that the first duty of the Association was to sell itself to engineers themselves, inasmuch as less than half the engineers in Ontario were as yet members of the Association.

E. P. Muntz, retiring president, urged the members to show a public spirit beyond their daily activities and to participate in public affairs because their special training undoubtedly qualified them for leadership. The Association served two purposes, stated the President, to protect the public against the abuses of incompetent and unsound engineering and to protect the engineer against unfair competition. The Council, he said, was now vested with sufficient powers by provincial legislation to discipline unqualified and unscrupulous practitioners. As a result of greater strength obtained in the 1937 professional engineers' act, the number of registrations of engineers had doubled during the past year.

W. P. Dobson, M.E.I.C.

The evening session was given over to a dinner attended by 300 members and invited guests. The legal and medical professions were represented by Chief Justice R. S. Robertson and Dr. Harris McPhedran. Hon. Paul Leduc, Ontario

Minister of Mines, represented the Government and Tracy D. LeMay, City Planning Commissioner of Toronto, represented the Ontario Land Surveyors. Alberta Professional Engineers were represented by G. A. Gaherty, M.E.I.C., and those of British Columbia by W. W. Cushing. Others at the head table included Brig.-Gen. C.H. Mitchell, M.E.I.C., Dean of the Faculty of Applied Science, University of Toronto; Dr. T. H. Hogg, M.E.I.C., Chairman of the Ontario Hydro Electric Power Commission; J. W. Rawlins, Vice-President of the Association; Dr. J. B. Challies, M.E.I.C., President of The Engineering Institute of Canada; Rev. Dr. H. J. Cody, President of the University of Toronto, and Prof. R. W. Angus, Hon.M.E.I.C., Professor of Mechanical Engineering, University of Toronto.

Speaking in reply to a toast to the sister professions, law, medicine and the clergy which was proposed by J. Clark Keith, A.M.E.I.C., the Hon. Paul Leduc, K.C., Ontario, Minister of Mines, impressed on the engineers what a great part they are playing in the development of the Province of Ontario and said that "every professional man should be proud of his work because it tends to raise the level of his profession."

Dr. J. B. Challies, of Montreal, President of The Engineering Institute of Canada, asserted that "to-day the professional engineer enjoys a status undreamed of by the pioneers of engineering science," and expressed the opinion that even greater heights would be achieved by engineers in the future and that the engineering educational course of the future would include two years' training in the liberal arts previous to technical study. Dr. Challies declared that Canada led the world in the organization of engineers, and that no other nation had such a professional body as The Engineering Institute of Canada.

The President of the Dominion Council

The principal speaker of the evening was C. C. Kirby, M.E.I.C., of St. John, New Brunswick, President of the Dominion Council of Professional Engineers, who spoke as follows:

"I appreciate the honour you have done me and also the Dominion Council of Professional Engineers in inviting me to address you on this occasion, and I extend to you the thanks of the body which I have the privilege of representing for this opportunity to demonstrate in a small way the fact that the professional engineers of Canada desire to work together as far as may be possible, for the good of the Dominion and the profession of engineering.

"I presume that in inviting me to be your speaker on this occasion your Committee wish me to convey to you a broader picture of this movement amongst engineers than that of your own province, and perhaps I may be able to do so because of the privilege I have enjoyed of being a member of every inter-provincial or national committee dealing with this subject since that original committee which met in 1919 under the auspices of The Engineering Institute of Canada. That Committee, consisting of one representative of each of the thirteen branches of the Institute that then existed between Victoria and Halifax, was charged with the task of preparing something definite as to how the profession of engineering could be given control of itself under the law. It drew up what was termed a 'Model Act' for the engineers in each province to follow in seeking the necessary powers and authority from their respective legislatures.

"It is possible to labour the differences and analogies between the different professions to inordinate length but the fact remains that the engineers of Canada have requested and obtained the authority to control their profession and they are accepting that responsibility with enthusiasm and becoming seriousness and do not have to apologize to anyone.

"The Engineering Institute of Canada is a body of very different constitution to that of the provincial associations of professional engineers and being a voluntary society under a federal charter its true functions are essentially different and it does not desire to change them. The membership of the two groups is quite largely made up of the same individuals.

"Perhaps the best way to distinguish between the objects and ideals of these two groups is to reflect that in the life of every man who desires to follow a profession there comes a crisis when he applies for recognition as a qualified person to pursue his chosen vocation to the fullest extent. It is here that the associations of professional engineers take a vital place in his contact with society by either granting or declining this privilege. If a man is admitted to the profession he is required to continue as a member of the provincial association in order that he shall do his part in maintaining the organization that will undertake the responsibility and work of admitting future members to the profession and seeing to it that its honour is upheld through its ethical standards. Also that an organization may exist that will safeguard the public interest against unauthorized practice by unqualified persons.

"In this way, we believe we are contributing to the democratic body politic of this Dominion and are avoiding bureaucratic or dictatorial regimentation. We believe that every man should do his part and be allowed if he so desires to express his opinions upon the methods adopted and the results obtained. Apart from these obligations the contact of members with their association may practically cease.

"The other groups of engineers represented by The Engineering Institute of Canada and the voluntary societies of the United States which maintain branches in Canada make their contact with the individual after he has been admitted to the profession, or so it will be in the future. Their object is to provide facilities for the personal contact between members throughout the rest of their lives and in so doing advance the usefulness of the member to the profession, his employer, and the public state, also to provide for continued education by exchange of knowledge or experiences and last, but not least, to promote social amenities.

"The fact that there are so many of our members who are not also members of one or other of the voluntary societies creates a situation that has its complications in those areas where the voluntary societies do not exist or have strong and active organization, and there is a natural tendency to desire that one organization should fulfill all of the functions that are now carried on by several. There is nothing in the charters of some of the provinces to prevent the provincial associations from embarking upon more activities than are concerned with their essential duties to the detriment of the voluntary societies. It was one of the principles of the 'Model Act' that this should not come about, for the reason that a compulsory body has a different background to that of a voluntary body. When a man is compelled by law to join an organization and pay an annual fee, it is only reasonable and fair to the individual that his money should not be used for purposes that he does not desire to take part in and that are not essential to the administration of the law, particularly social matters, so it behooves us to let our conscience be our guide when these questions arise, and only undertake those things that we have reason to believe the general membership approves of and is willing to pay for. A great many of us believe we have a moral obligation to support the voluntary societies for the use they are to the profession and the state and the fact that they existed before us and have an historical background that is an asset to the Dominion and well worth the effort and money that we are called upon to give. That these two groups of engineers can be linked together in a co-operative arrangement is being demonstrated in some of the smaller Provinces at the present time and there is no reason to doubt that such an arrangement will be of benefit wherever it can be made to work.

"The Engineering Institute of Canada does not need any eulogies from me as it is firmly established as one of the leading organizations of our country; I can only say that I have been an enthusiastic supporter of it for thirty years and will continue to be so.

"There are some who resent the old Canadian Society of Civil Engineers having changed its name to The Engineering Institute of Canada, thereby, as they supposed, having usurped the right to embrace all branches of Engineering. Perhaps they forget that the term 'civil engineer' was originally used in the sense of being non-military as the development of engineering was performed by the military forces. In the Province of Quebec today, the law uses this descriptive term of civil engineer in that sense and our brothers in the Quebec Corporation are all termed civil engineers. The Canadian Society was formed in the Province of Quebec 51 years ago.

"In describing the Dominion Council of Professional Engineers whom I represent, it should be made quite clear that it is not a governing body in any sense. It is composed of one representative from each of the eight provincial bodies in order that it may meet together without incurring any very large expenses. It does not set up any permanent staff or incur any but the minimum of operating expenses for its correspondence. As it is an advisory body pure and simple there is no necessity for it to come to any decision by a majority vote and therefore proportional representation upon it would have no practical advantage.

"Nothing is recommended by this Council that has not received the unanimous support of its members. We believe that a recommendation from it to a provincial association should receive greater consideration coming with the support of representatives from all of the associations than from a bare majority.

"In the practice of engineering, more than any other profession, there is a more frequent need to cross the inter-provincial boundaries and therefore anything that can be done to make inter-provincial relationship smooth working and harmonious is worth doing. What we desire is reciprocity between the provinces and the avoidance of barriers against any Canadian engineer.

"We believe that a step towards our ideal would be the creation of a central examining board, the enabling authority which was provided for in the 'Model Act' and at present exists in the acts of five of the provinces, i.e., British Columbia, Manitoba, Ontario, New Brunswick and Nova Scotia. The primary purpose of such a board would be to lay down the standards of admission of future members who will come from the ranks of the young men rather than for the admission of experienced men who may become residents of this country in adult life.

"Such a board will also be a help to the smaller associations who are now faced by the need of setting up standards and machinery to conduct examinations for only occasional use.

"The sovereign powers of each association will, of course, require to be safeguarded and I am sure you can appreciate there are a larger number of thorny points to be dealt with in an endeavour such as this. In some provinces the conduct of examinations is the sole responsibility of the provincial university, in others the university shares the responsibility with the Association Council and in others the Council has a free hand.

"There are very many instances of variations in regulations between the provinces, most of which are of some importance to us all. Whilst there is no reason to try and obtain a close approach to uniformity, it is nevertheless of some practical value to obtain a sufficient measure of uniformity to avoid confusion.

"The provincial associations of professional engineers are truly representative of the practising engineers of this country. There should therefore be a net gain to the Dominion in having an organization that will at least link them together."

The New President

President W. P. Dobson, M.E.I.C., closed the meeting on an optimistic note. He said that the enthusiasm of the meetings had convinced him that the engineers of Ontario were behind the association with a realization that they had a job to do and a readiness to do it. The frank discussions from the younger engineers was very significant and Council felt that thereby they had been assisted in the framing of a policy for the year.

He expressed his appreciation of the remarks of Dr. Challies and Mr. Kirby and their broadmindedness on the subject of co-operation. He was sure that the Ontario Council would approach this question with the same open mind. He believed that "a national engineering society in Canada is a necessity, and if the technical as well as the professional needs of Canadian engineers can be harmonized and included in the functions of such an organization, it should have the enthusiastic support of all Canadian engineers. The methods of working out this objective have yet to be established, but I believe it can be done."

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF MANITOBA

The annual general meeting of the association was held in Winnipeg on January 19th. 1939, and the following is the Council for the year 1939:

President, W. Youngman; *Vice-president,* F. S. Adamson; *Secretary-Registrar,* C. S. Landon; *Councillors,* A. L. Cavanagh, A.M.E.I.C., Dean E. P. Fetherstonhaugh, M.E.I.C., E. W. M. Hill, J. A. Meindl.

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF NEW BRUNSWICK

The annual meeting of the association was held in the Admiral Beatty Hotel, Saint John, N.B., on January 24th, 1939.

At this meeting the following officers were elected for the year 1939:

President, C. B. Croasdale, Fredericton; *Vice-president,* G. A. Vandervoort, A.M.E.I.C., Saint John.

New Councillors, V. St.C. Blackett, A.M.E.I.C., Moncton District; C. C. Kirby, M.E.I.C., Saint John District.

Councillors remaining in office: H. F. Morrisey, A.M.E.I.C., Saint John District; G. L. Dickson, A.M.E.I.C., Moncton District; L. L. Theriault, Chatham District; J. D. McKay, Fredericton District.

Secretary-Registrar, A. A. Turnbull, A.M.E.I.C., Saint John.

Auditors, V. S. Chesnut, A.M.E.I.C., Saint John; H. R. Logie, Saint John.

Following the annual meeting a joint dinner was held with the Saint John Branch of The Engineering Institute of Canada at which the speaker of the evening was Dr. John Stephens, M.E.I.C., of the University of New Brunswick.

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF NOVA SCOTIA

The new members of the Council are: President, S. W. Gray, A.M.E.I.C., Nova Scotia Light and Power Company; Vice-President, R. B. Stewart, M.E.I.C., New Glasgow; Councillors, O. S. Cox, A.M.E.I.C., District Engineer P.W.D., Halifax; C. P. Roper, Civil Engineer, Halifax; J. W. Ritchie, Robb Manufacturing Co., Amherst, and C. W. McCarthy, Highway Department, Truro.

In the evening a combined banquet of the Halifax Branch of The Engineering Institute and the Association was held in the Nova Scotian Hotel at which over two hundred members and guests were present. A delightful programme was enjoyed, consisting of orchestral selections, under the leadership of Mr. Harry Cochrane, interspersed with dancing by a number of young ladies. Several solos were well rendered by Miss Lillian Ethier, and several duets were also rendered by Miss Ethier and Mr. Cross. An interesting address was given by Dr. D. F. McDonald of St. Francis Xavier University, Antigonish, on the Application of Geology to Engineering. A toast was proposed to the King;

a toast to The Engineering Institute was proposed by M. L. Gordon, past-president of the Association, and responded to by A. D. Nickerson, A.M.E.I.C., Chairman of the Halifax Branch of the E.I.C. A toast to the A.P.E.N.S. was proposed by I. P. MacNab, M.E.I.C., past-president of the Halifax Branch of the E.I.C., responded to by S. W. Gray, president of the A.P.E.N.S.

The meeting was under the Chairmanship of S. W. Gray, President A.P.E.N.S., and A. D. Nickerson, Chairman Halifax Branch E.I.C.

Guests at the banquet were Brigadier H. E. Boak, Hon. A. S. MacMillan, Provincial Minister of Highways; His Worship Walter Mitchell, Mayor of Halifax, and H. C. Burchell, M.E.I.C., dean of professional engineering in Nova Scotia. Entertainment was provided by the Northern Electric Co., Canadian General Electric Co., Canadian Fairbanks Morse Co. and the Canadian Industries Ltd. Favours were donated by the Canadian Cement Company, Moloney Electric Co. of Canada, Canadian Westinghouse Limited, and D. C. Keddy, manufacturers' agent, Wm. Stairs, Son and Morrow Limited and the Nova Scotia Light and Power Commission. The banquet was a huge success and was thoroughly enjoyed by all present.

THE CANADIAN INSTITUTE OF MINING AND METALLURGY

The Canadian Institute of Mining and Metallurgy offers a very attractive programme of papers for its annual meeting which takes place in Quebec on March 13, 14, 15. Herewith are the details as supplied by Secretary E. J. Carlyle.

March 13th, 1939—Monday A.M.

Presidential address—E. A. Collins.
The Mineral Industry of Canada in 1938—W. H. Losee.

Monday P.M.

Canadian Malartic Mine—Neelands and Millenbach.
Noranda Stoping—Hall, Porritt and Carmichael.
No. 3 Shaft, King Mine—J. G. Ross and Staff.
Profitable Gold Mine Operation—I. M. Marshall.
Milling Industrial Minerals—R. K. Carnochan.
Limestone as a Raw Material—M. F. Goudge.
Limestone and Lime Production—Staff of North American Cyanamid Company.
Limestone in Iron and Steel Industry—Norman B. Clarke.

March 14th, 1939—Tuesday A.M.

Tailing Disposal, Sullivan Mill, B.C.—A. L. Irwin.
Instrumental Control, Open Hearth Practice—E. W. Bailey.
Amalgamating Auriferous Concentrates—A. E. Flynn.
Recent Smelting Practice at Noranda—W. B. Boggs.
Dust Control, Hollinger Mill—P. J. Dunlop.

Tuesday P.M.

Mechanized Mining, Modern Trends—T. L. McCall.
Spiral Stoping, Beattie Mine—Jay Tuttle.
Functions, A Dominion Department of Mines—R. C. Rowe.
Failure of Rope at Princess Colliery—Farnham and Cameron.
Lime in Milling and Flotation—H. R. Rose.
Limestone in Pulp and Paper Industry—H. Rowley.
Industrial Mineral Development in Canada—L. H. Cole.

March 15th, 1939—Wednesday A.M.

A Geology of Quebec—Dennis and Dresser.
Expansion of Mining in Quebec—J. E. Gill.
Great Slave Lake Area—Henderson and Jolliffe.
Iron Deposits, Steeprock Lake—M. W. Bartley.

Wednesday P.M.

Newfoundland and Labrador—A. K. Snelgrove.
Gold Dredging in the Yukon—W. H. S. McFarland.

LE SOCIETE DES INGENIEURS CIVILS DE FRANCE

The Council of the Société des Ingénieurs Civils de France consists of the following:

President, M. R. Berr; *Vice-president*, M. F. Harlé; *General Delegate*, M. P. Lecomte; *Treasurer*, M. P. Gassier.

THE NATIONAL LUMBER MANUFACTURERS ASSOCIATION

Timber Bridge Design Contest

WASHINGTON, January 24.—A timber bridge design contest under the joint auspices of the National Lumber Manufacturers Association, American Forest Products Industries, Inc., and the Timber Engineering Company, in which the latter company is offering prizes of $1,500 in cash, was announced here to-day.

Open to students of architecture and engineering as well as graduates of both schools, the contest is aimed primarily at providing suitable designs for short span timber bridges for secondary highways.

The rules require that the design submitted shall be of a highway bridge constructed of timber and employing the timber connector method of construction. The live load may be H-10 or H-15 and the span may vary from 30 ft. to 70 ft., measured from centre to centre of bearings, but using only spans divisible by ten. The roadway must be 18 ft. in the clear. Piers of supports need not be designed beyond the anchorage of the bridge to a concrete pier which shall be assumed to have already been designed. Assumption for dead loads should be stated on the drawing and the design should be predicated on the use of American Standard sizes of dressed lumber and timber surfaced on four sides.

Beside providing suitable bridge structures for highways the purpose of the contest is to acquaint designing engineers with the latest developments and design practices of modern timber construction. As an added incentive to students the prize money has been divided into two classifications: (1) for all contestants and (2) for students only.

The grand prize will be $500 in cash and will be awarded to that contestant who submits, in the opinion of the judges, the best design for secondary highway use. In addition there will be six other prizes in this division from $200 for second best design down to $50.

The student submitting the best design will receive $200 in cash, unless a student design is selected for the grand prize. Seventeen other student prizes totalling $300 will likewise be awarded, making twenty-five awards in all amounting to $1,500.

The decision of the judges will be final. The competition is open to Canadians.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

J. M. Thomson, chief designing engineer of the Ferranti Electric, Limited, Toronto, Ont., is the nominee for vice-president of the Canadian District. The election takes place August 1, 1939.

The 1938 Lamme Medal of the American Institute of Electrical Engineers has been awarded to Marion A. Savage, Designing Engineer, General Electric Company, Schenectady, N.Y., "for able and original work in the development and improvement of mechanical construction and the efficiency of large high speed turbine alternators." The medal and certificate will be presented to him at the annual Summer Convention of the Institute, which is to be held in San Francisco, California, June 26-30, 1939.

ENGINEERS' CLUB OF TORONTO

H. C. Don Carlos has been elected to the presidency of the Engineers' Club of Toronto for the year 1939. Mr. Carlos is a graduate of the University of Toronto in electrical engineering and is chief operating engineer for the Hydro-Electric Power Commission of Ontario, in charge of the operation and maintenance of generating and transforming stations and transmission lines on all systems.

Wm. C. Foulds, B.A.Sc., also a graduate of the University of Toronto, is secretary manager of the Club.

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.

American Institute of Electrical Engineers:
Transactions, Vol. 57, 1938.

American Society for Testing Materials:
Proceedings of the 41st Annual Meeting, 1938, Vol. 38.

Highway Research Board.
Soil-Cement Mixtures for Roads, Proceedings 17th Annual Meeting, pt. 2. Washington, 1937.

Junior Institution of Engineers:
Journal and Record of Transactions, Vol. 48, London, 1938.

National University of Ireland:
Calendar for the year 1937.

Nova Scotian Institute of Science:
Proceedings, Vol. 19, pt. 4, 1937-38, Halifax, 1939.

Royal Society of Canada:
Section 3, Chemical, Mathematical and Physical Sciences; Transactions, Vol. 32, May, 1938.

REPORTS

Alberta Department of Lands and Mines:
Schedule of Wells Drilled for Oil and Gas to 1938.

Bell Telephone System: Transmission Features of the New Telephone Sets; Stabilized Feedback Oscillators; Coaxial Cable System for Television Transmission; An Experimental Study of the Rate of a Moving Atomic Clock; The Influence of Moisture Upon the D.C. Conductivity of Impregnated Paper; Application of Statistical Methods to Manufacturing Problems; An Electron Diffraction Examination of Some Linear High Polymers; The Mechanism of Hearing; Transmission Theory of Spherical Waves; Currents to Conductors Induced by a Moving Point Charge; The Time Lag in Gas-Filled Photoelectric Cells; The χ^2-Test of Significance; Correlation of Optical Properties and Photoelectric Emission; Electron Microscope Studies of Thoriated Tungsten; The Bridge-Stabilized Oscillator; Dielectric Constant and Dielectric Loss of Plastics as Related to Composition; The Exponential Transmission Line; Ultra-Short-Wave Transmission and Atmospheric Irregularities; The Dielectric Properties of Insulating Materials —II; Devices for Controlling Amplitude Characteristics of Telephonic Signals; Effect of Space Charge and Transit Time on the Shot Noise in Diodes; Fundamentals of Teletypewriters Used in the Bell System; Amplitude Range Control; Sound Pictures in Auditory Perspective. (Monographs B 1082, 1085-1107).

Canada Department of Labour:
27th Annual Report on Labour Organization in Canada, 1937.

Canada Department of Mines and Resources Bureau of Mines:
Petroleum Fuels in Canada, 1937.

Canada Department of Mines and Resources Lands, Parks and Forests Branch:
The Strength of Eastern Canadian Spruce Timbers (Forest Service Circular 54).

Canadian Institute of Steel Construction:
Canadian Steel Construction, Toronto, 1939.

Danmarks Naturvidenskabelige Samfund:
Urban and Suburban Railways, Studies of Transport Problems and Network Design.

Edison Electric Institute:
Reconditioning Flood Damaged Electrical Equipment.

Engineering Foundation:
Annual Report 1937-38.

General Lighting Information Service
By H. L. Juliusburger, London.

Lehigh University:
Bibliography and Abstracts of the Publications of Lehigh University Faculty Members, 1938.

Power Corporation of Canada, Montreal:
The McKenzie Falls Hydro-Electric Generating Station of the Dryden Paper Company, Dryden, Ont.

Ohio State University:
Wearing Properties of Some Metals in Clay Plant Operation (Engineering Experiment Station Bulletin No. 97).

Rationalization of British Railways:
By W. L. Waters. (Presented before the American Society of Mechanical Engineers, Railroad Division).

Rensselaer Polytechnic Institute:
The Value of History in Engineering Education by H. W. Dickinson; Amos Eaton as a Chemist by H. S. Van Klooster. (Engineering and Science Series No. 55, 56.)

U.S. Department of the Interior Bureau of Mines: Carbonizing Properties of West Virginia Coals and Blends of Coals from the Alma, Cedar Grove Dorothy, Powellton A, Eagle Pocahontas, and Beckley Beds; Studies of Certain Properties of Oil Shale and Shale Oil; Quarry Accidents in the United States, 1936 (Bulletin 411, 415 and 416). Safety Education in Schools of Mining Districts (Miners' Circular 37). Federal Placer-Mining Laws and Regulations; Small-Scale Placer-Mining Methods; Flow of Air and Natural Gas Through Porous Media (Technical Paper 591, 592).

U.S. Treasury Department, Public Health Service:
Studies of Sewage Purification VII, VIII.

University of Illinois: Summer Cooling in the Warm-Air Heating Research Residence with Cold Water; Investigation of Creep and Fracture of Lead and Lead Alloys for Cable Sheathing. (*Bulletin Vol. 35, Nos. 101, 102*).

TECHNICAL BOOKS

Air Conditioning in the Home, by Elmer Torok.
New York, Industrial Press, 1937. 296 pp., illus., tab., 9½ x 6 in., cloth, $3.00.

Canada Official Postal Guide, 1938-39:
Ottawa, King's Printer, 1939. 344 pp., 10 x 6½ in., cloth, $1.25.

(The) ENGINEERS' MANUAL
By R. G. Hudson, 2 ed. New York, John Wiley & Sons, 1939. 340 pp., diagrs., charts, tables, 8 x 5 in., lea., $2.75.

The purpose of this work is to provide, in a book designed to fit the pocket, a collection of engineering formulas, mathematical operations and tables that are constantly wanted by engineers and students of engineering. This edition has been revised and extended, and the chapter on heat rewritten. The chapter on electricity has been largely rewritten also.

John Fritz Medal:
Biography of Frank Baldwin Jewett, Medalist for 1939. New York, 1939. Pamphlet.

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 GEOPHYSICS in the Search for Minerals
By A. S. Eve and D. A. Keys. 3 ed. Cambridge, England, University Press; New York, Macmillan Co., 1938. 316 pp., illus., diagrs., charts, maps, tables, 9 x 6 in., cloth, $4.25.

This well-known treatise, the first to appear in English, is now issued in a third edition. The various exploratory methods now available: magnetic, electrical, electromagnetic, gravitational, seismic, radioactive, etc., are discussed theoretically and practically. A chapter has been added dealing with the chief advances since the previous edition. There is a bibliography.

BACKGROUND to MODERN SCIENCE
Ed. by J. Needham and W. Pagel. New York, (The) Macmillan Co.; Cambridge, England, at the University Press, 1938. 243 pp., diagrs., 8 x 6 in., cloth, $2.00.

This volume contains ten lectures on the history of science at the University of Cambridge. The lectures deal chiefly with developments in various fields of science, such as physics, astronomy, physiology and genetics, during the last forty years, and are the work of eminent professors at the University. Two introductory chapters treat of the beginnings of scientific thinking among the Greeks and of developments from Aristotle to Galileo.

(The) BIRTH OF THE OIL INDUSTRY
By P. H. Giddens, introduction by I. M. Tarbell. New York, Macmillan Co., 1938. 216 pp., illus., maps, tables, 9 x 6 in., cloth, $3.00.

The origin and development of the petroleum industry in western Pennsylvania up to 1870 are presented in narrative form. Early discoveries and uses are briefly treated, the major part of the book being devoted to the social, technical and financial phases of the period following the drilling in 1859 of Col. Drake's famous well and the formation of the early companies.

BLAST FURNACE PRACTICE
By R. H. Sweetser. New York and London, McGraw-Hill Book Co., 1938. 356 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

A comprehensive, practical manual on all aspects of the production of pig iron. It covers the blast furnace plant, equipment, and raw materials, operating practice, character and utilization of products and by-products, theories of the process, commercial aspects, and obsolescence, with emphasis on the operating man's viewpoint. The book is the first American work on its subject to be published in many years, and will be welcomed by every furnaceman.

CAPITAL CONSUMPTION AND ADJUSTMENT
By S. Fabricant. New York, National Bureau of Economic Research, 1938. 271 pp., charts, tables, 9 x 6 in., cloth, $2.75.

This report is a study of the records of capital consumption and adjustment in the

United States since 1918. The concept of capital consumption is developed, the nature of the available records considered and the changes necessary to adapt them to a broader economic view are discussed. Capital adjustment data and their economic significance are then reviewed and their economic significance considered. An appendix applies the results to the interpretation of book values of capital assets and changes in these values.

CONTRIBUTIONS TO THE MECHANICS OF SOLIDS Dedicated to Stephen Timoshenko by his friends on the occasion of his sixtieth birthday anniversary

New York, Macmillan Co., 1938. 277 pp., illus., diagrs., charts, tables, 10 x 6 in., cloth, $5.00.

In celebration of the sixtieth birthday of Professor Timoshenko, this collection of papers by various friends has been published. Twenty-eight contributions upon the mechanics of solids are included, dealing with a wide variety of problems. There is also a brief biographical sketch and a list of Timoshenko's published books and papers.

CONVEYING MACHINERY

By W. H. Atherton. London, The Technical Press, 1937. 188 pp., illus., diagrs., charts, tables, 10 x 6 in., cloth, 21s.

The descriptions of equipment, installations and uses of package and bulk conveyors are in great part a record of the author's first-hand experience. A separate chapter discusses the relation of conveyors to a specific industry (foundries). A very full table of densities of bulk materials and a short list of references are appended.

DANIEL WILLARD RIDES THE LINE, the Story of a Great Railroad Man

By E. Hungerford. New York, G. P. Putnam's Sons, 1938. 301 pp., illus., 9 x 6 in., cloth, $3.50.

Engine driver, superintendent, vice-presi dent, president: This is the story of a man who not only left the impress of his personality on every railroad that he was connected with, but also played an important part in the general railroad and labor situation of the whole country.

(The) DESIGN OF DAMS

By F. W. Hanna and R. C. Kennedy. 2 ed. New York and London, McGraw-Hill Book Co., 1938. 478 pp., illus., diagrs., charts, maps, tables, 9 x 6 in., cloth, $5.00.

A comprehensive work, covering all types of modern dams and presenting scientific, practical methods. Chapters are also included on accessories for dams, surveys for reservoirs and dam sites, rainfall and stream flow, hydraulics and stream measurement and dam failures. The new edition has been revised and new material added upon earthquake stresses, models in dam design and other topics.

DESIGN OF INDUSTRIAL EXHAUST SYSTEMS

By J. L. Alden. New York, Industrial Press, 1939. 220 pp., diagrs., charts, tables, 9 x 6 in., cloth, $3.00.

"The purpose of this book is to tell the engineer how to design and build or how to buy an exhaust system that will adequately and economically perform the functions prescribed by the industrial hygiene expert or by the law." The book discusses the flow of fluids, hood forms, piping design, dust separators, conveyors, exhaust fans, planning of systems, etc.

ECONOMICS OF TRANSPORTATION

By D. P. Locklin. rev. ed. Chicago, Business Publications, Inc., 1938. 863 pp., diagrs., maps, tables, 9 x 6 in., cloth, $4.00.

This comprehensive volume emphasizes the problems of rate making and regulation chiefly with respect to railroad practice, although the subject of pipe line, water, highway and air transportation are also considered critically. The effect of railroad development on the general economic system is discussed, the various ways in which undue discrimination is practised are explained, and the provisions of the several regulatory Transportation Acts are described. The book ends with a chapter on transport co-ordination.

(The) ELECTROCHEMISTRY OF GASES AND OTHER DIELECTRICS

By G. Glockler and S. C. Lind. New York, John Wiley & Sons, 1939. 469 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $6.00.

This monograph, which was undertaken at the request of the Committee of Electrical Insulation of the National Research Council, brings together the material on the behavior of liquids and gases in the electric field. Part one, "typical reactions in various forms of electrical discharge," discusses the physical aspects of various kinds of discharge. Part two, "the chemical reactions in electrical discharges," describes the reactions that have been studied. Part three, "the physical and theoretical aspects of discharge reactions," discusses the underlying theory.

FRACTIONAL HORSEPOWER ELECTRIC MOTORS

By. C. G. Veinott. New York and London, McGraw-Hill Book Co., 1939. 431 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.50.

This book will fill a long-felt want for a comprehensive book on fractional-horsepower motors. Eighteen major types are described, the descriptions explaining their principles of operation, usual forms of construction, speed-torque characteristics, methods of connection, repairing, rewinding, testing, etc.

FUNDAMENTAL PRINCIPLES OF PHYSICS

By H. G. Heil and W. H. Bennett. New York, Prentice-Hall, 1938. 631 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $5.00.

The subjects usually found in an elementary text are here so arranged as to facilitate increasing use of the calculus in handling problems as the book progresses. This arrangement is the result of the modern tendency to correlate the elements of calculus with fundamental principles of physics and engineering in simultaneous courses. Many problems are included.

GMELIN'S HANDBUCH DER ANORGANISCHEN CHEMIE

8th rev. ed. edited by Deutsche Chemische Gesellschaft. System-Nummer 59; Eisen, Teil C, Lfg. 1. Härteprüfverfahren. Berlin, Verlag-Chemie, 1937. 162 pp., diagrs., charts, tables, 10x7 in., paper, 18.75 rm.

This section of Gmelin's Handbook is devoted to methods for testing the hardness of iron and steel, and summarizes the literature to April, 1937. The first section is a comprehensive review of the various methods of testing hardness, hardness tests of welds, sheet wire and other special materials, testing machines and the relations of hardness numbers to each other and to other mechanical properties. Finally, the methods commonly used are studied critically. The result is a comprehensive guide to our knowledge of the subject.

GREAT BRITAIN. Dept. of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 10, No. 1, June, 1938

London, His Majesty's Stationery Office, 1938. 94 pp., tables, 10 x 6 in., paper, (obtainable from British Library of Information, 270 Madison Ave., New York, $1.35).

This publication provides abstracts of the publications upon food which appear in a large number of current periodicals. The field covered includes the problems of the storage and preservation of various animal and vegetable food products, of canning and cold storage, and of the engineering aspects of the food industry.

HOW TO ESTIMATE Carpentry, Masonry, Lath and Plaster, Marble and Tile, Air Conditioning, Electrical Wiring, Sheet Metal, Plumbing, Linoleum, Glass, Painting, Hardware

Carpentry, Masonry, Lath and Plaster, Marble and Tile, Air Conditioning, Electrical Wiring, Sheet Metal, Plumbing, Linoleum, Glass, Painting, Hardware.
By G. Townsend, J. R. Dalzell and J. McKinney; Electrical Sections by C. H. Dunlap. Chicago, American Technical Society, 1939. Sections paged separately, illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.75.

This book presents in detail practical methods for estimating materials and labor for residences and moderate sized buildings.

INTRODUCTION TO HIGHWAY ENGINEERING

By J. H. Bateman. 3 ed. New York, John Wiley & Sons, 1939. 442 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

This is an elementary textbook for students of civil engineering which aims to present the fundamental principles of the theory of highway engineering together with comprehensive descriptions of current practice. The economics, financing, location, design, construction, maintenance and operation of highways are discussed. This edition has been carefully revised and much new material added.

KANADA. (Technik und Wirtschaft im Ausland)

By G. A. Langen. Berlin, VDI-Verlag, 1938. 55 pp., illus., diagrs., maps, tables, 8 x 6 in., paper, 3.35 rm.

This book, by a German engineer with several years of experience in Canada as a salesman, is intended as a guide to German exporters. Canadian economic conditions are described and trade possibilities discussed, especially in the field of machinery. Advice is given on marketing, packing, advertising, etc.

KEMPE'S ENGINEER'S YEAR-BOOK 1939

45th annual issue, revised under the direction of L. St.L. Pendred. London, Morgan Bros., 1939. 2,824 pp., illus., diagrs., charts, tables, 7 x 5 in., lea., 31s. 6d.

An annual British publication covering modern practice in civil, mechanical, electrical, marine, gas, aero, mine and metallurgical engineering. In addition to explanatory technical information in these fields the book contains useful formulae, rules, tables and other engineering data. There are also sections on patents, depreciation, legal questions and costs. Some 230 pages are devoted to descriptions of particular pieces of engineering equipment.

MATHEMATIQUES GENERALES. (Aide-Mémoire Dunod)

By Maurice-Denis Papin. Paris, Dunod, 1939. 274 pp., diagrs., tables, 6 x 4 in., cloth, 25 frs.

The subject matter of this small pocketbook of descriptive and tabular information covers algebra, plane and solid geometry, plane and spherical trigonometry, analysis of functions, the calculus, differential equations, probabilities, analytic geometry, infinitesimals, graphical methods and vectors.

(CONTINUED FROM PAGE 137)

of the Association of Professional Engineers of Ontario, which had resulted in a satisfactory solution. Mr. Muntz thought the Ontario Association would undoubtedly be willing to help the Quebec Corporation and the Institute in any way which was feasible.

The President spoke of the International Engineering Congress to be held in New York during the week of September 4th, 1939. Dr. Fairbairn had reported that the Institution of Civil Engineers had accepted the Institute's invitation for a three days post-Congress tour of a central portion of Canada and that the party from England would possibly consist of from one hundred and fifty to two hundred persons. The President explained the tentative arrangements which had been made for the entertainment of the party in Canada, and mentioned particularly the kindness of Dr. Hogg, on behalf of the H.E.P.C. of Ontario, Mr. G. Gordon Gale, of the Gatineau Power Company, Mr. W. H. Munro, of the Ottawa Electric Company, and the Hon. C. D. Howe, Minister of Transport. Arrangements would also be made in Montreal through the kindness of Dr. Julian C. Smith, President of the Shawinigan Company, Mr. R. A. C. Henry, vice-president of the Montreal Light, Heat and Power Cons., and Dr. O. O. Lefebvre, of the Provincial Electricity Board. The Montreal Branch of the Institute would also join in the entertainment of the visitors. The kind co-operation of the Hon. Mr. Howe was greatly appreciated. Arrangements were also being made for a buffet luncheon and reception, which would take place in the Canadian Pavilion at the New York World's Fair, at which Canadians would be hosts. It was decided to leave future arrangements with the Committee on International Relations.

Mr. Newell, chairman of the Committee on Professional Interests, reported progress with regard to the proposed agreement between the Institute and the Association of Professional Engineers of Nova Scotia. The proposal had again been reviewed and had been changed in a way which he understood would make the agreement acceptable to the Association. As regards Ontario, he reported that a special meeting had taken place between representatives of the Institute and of the Association, and that it was expected that further developments would ensue.

Following Mr. Newell's report, the President commented on the splendid work which Mr. Newell had done as chairman of the committee. He hoped that in Ontario progress would shortly be made. This view was supported by Mr. Muntz. The President expressed Council's gratitude to Mr. Muntz for the very wise counsel received from him in regard to this matter.

Referring to the Council's policy towards the Dominion Council of Professional Engineers, the President urged that the Institute should support that body at every opportunity. He had been favourably impressed by the speech delivered by Mr. Kirby, the President of the Dominion Council, at the Annual Banquet of the Association of Professional Engineers of Ontario.

The report of the Finance Committee was received, and two resignations were accepted, and the names of two members removed from the list of members.

Mr. McCrory reported that the Finance Committee would recommend the adoption of the suggestion made last fall that an award should be arranged for presentation to members of Council and officers on completion of their term of office. After discussion, it was unanimously resolved that this recommendation of the Finance Committee be accepted, and that the committee be asked to study the form which the award should take and make recommendations to Council accordingly.

Mr. McCrory also reported that the Finance Committee would recommend the appointment of an assistant to the General Secretary, and would recommend Mr. Louis Trudel, A.M.E.I.C., as being well qualified for the position. The committee also recommended that Mr. Durley be retained as Secretary Emeritus. During the discussion, Mr. Busfield explained that while in principle he approved of an assistant to the secretary, funds were limited, and he felt that it would be preferable to expend the money on several other activities. He would move that the appointment of an assistant to the secretary be referred to the incoming Finance Committee for their consideration and report. After further discussion Mr. Busfield withdrew his amendment, and on the motion of Mr. McCrory, seconded by Mr. Lariviere, these recommendations of the Finance Committee were approved unanimously.

A letter from Mr. C. C. Kirby was read, informing the Institute that the Province of Manitoba now had representation on the Dominion Council of Professional Engineers, this making the representation complete for all the provinces.

The President reported a discussion with Mr. C. D. Harrington, the President of the Canadian Construction Association, at which Mr. Muntz had been present, looking to the support of the Institute to the Association's proposals for measures to aid in the revival of the construction industry. On the motion of Mr. Findlay, seconded by Mr. Manock, it was *resolved* that Mr. Muntz, the Institute's representative on the National Construction Council of Canada, be authorized to negotiate with Mr. Harrington so that the support of the Institute could be given to the Association's proposals.

Mr. Sauder then presented the report of the sub-committee appointed to draw up resolutions referring to changes in the by-laws concerning classification of members. The sub-committee's conclusions had been embodied in two resolutions, the first recommending the adoption of one class of corporate membership, and the second regarding the proposal to establish a class of "Fellow." These resolutions were approved by Council for presentation at the Annual General Meeting, and will be found in their final form on pages 123 and 124 of this issue of the Journal.

The President expressed satisfaction in the action of the Institute in taking hold of a national problem such as the drought situation in the west, and drew attention to the excellent work which had been done by Mr. Gaherty, chairman of the Committee on Western Water Problems. The subject would be a principal topic of discussion at the General Professional Meeting, Tuesday, which he hoped all councillors would attend so as to take part in the discussions.

Mr. Lumsden stated that as the next meeting of Council would take place after President Challies' term had expired, he hoped that this meeting would not adjourn without expressing Council's appreciation of Dr. Challies' work as President throughout the year, and the great pleasure which it had given members of Council to be associated with him. He hoped the President would accept this modest expression of esteem. The President said that the year had been one of extreme enjoyment for both Mrs. Challies and himself, and thanked Mr. Lumsden for his kind remarks.

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

Elections		Transfers	
Member	1	Assoc. Member to Member	3
Assoc. Members	3	Junior to Assoc. Member	6
Juniors	5	Student to Assoc. Member	1
Students admitted	25		

The Council adjourned at six o'clock p.m., to reconvene the following day.

The adjourned meeting of Council convened at five o'clock p.m. on Tuesday, February 14th, 1939, with President H. W. McKiel in the chair. The following members of Council were present: Past-President J. B. Challies; Vice-Presidents R. L. Dunsmore, H. O. Keay, F. Newell and P. M. Sauder; Councillors B. E. Bayne, W. F. M. Bryce, R. H. Findlay, A. B. Gates, S. Hogg, O. Holden, H. A. Lumsden, I. MacNab, W. R. Manock, H. Massue, J. Robertson, J. A. Vance, E. Viens, and the General Secretary.

Formal appointments were made of L. Austin Wright, A.M.E.I.C., as General Secretary, and deGaspe Beaubien, M.E.I.C., as Treasurer. The chairmen of the standing committees were appointed as follows, with a request that they submit the names of the other members of their committees for approval at the next meeting of Council.

Finance Committee	F. Newell, M.E.I.C.
Library and House	B. R. Perry, M.E.I.C.
Papers Committee	J. A. Vance, A.M.E.I.C.
Publication Committee	J. L. Busfield, M.E.I.C.
Legislation Committee	A. Lariviere, M.E.I.C.

As the work of the Committee on Membership and Management is now completed, it was *resolved* that that committee be discharged. A resolution was passed expressing appreciation of the vast amount of research work which had been done, and which had resulted in such a splendid report.

The Committee on International Relations, and the Committee on Professional Interests were appointed as follows:

Committee on International Relations

J. B. Challies, M.E.I.C., *Chairman*
R. W. Angus, Hon.M.E.I.C.
C. Camsell, M.E.I.C.
J. M. R. Fairbairn, M.E.I.C.
M. J. McHenry, M.E.I.C.
J. C. Smith, M.E.I.C.
H. H. Vaughan, M.E.I.C.

Committee on Professional Interests

F. Newell, M.E.I.C., *Chairman*
J. B. Challies, M.E.I.C.
O. O. Lefebvre, M.E.I.C.

The Committee on Western Water Problems, and the Committee on the Deterioration of Concrete Structures, were reappointed as follows:

Western Water Problems

G. A. Gaherty, M.E.I.C., *Chairman*
C. H. Attwood, A.M.E.I.C.
C. Camsell, M.E.I.C.
L. C. Charlesworth, M.E.I.C.
T. H. Hogg, M.E.I.C.
O. O. Lefebvre, M.E.I.C.
C. J. Mackenzie, M.E.I.C.
F. H. Peters, M.E.I.C.
S. G. Porter, M.E.I.C.
J. M. Wardle, M.E.I.C.

Deterioration of Concrete Structures

R. B. Young, M.E.I.C., *Chairman*
E. Viens, M.E.I.C., *Vice-Chairman*
G. P. F. Boese, A.M.E.I.C.
C. L. Cate, A.M.E.I.C.
A. G. Fleming, M.E.I.C.
W. G. Gliddon, A.M.E.I.C.
O. O. Lefebvre, M.E.I.C.
J. A. McCrory, M.E.I.C.
C. J. Mackenzie, M.E.I.C.
J. H. McKinney, A.M.E.I.C.
R. M. Smith, A.M.E.I.C.

The President reported that largely through the co-operation of Past-President Desbarats, an arrangement had been made, on behalf of the Institute, with the General Manager of the Canadian Broadcasting Corporation whereby the Institute would supply a series of radio talks featuring the engineer's work and his relation to the public. It had also been suggested that a committee be appointed to co-operate with the Canadian Broadcasting Corporation. It was unanimously *resolved* that a committee be appointed for this purpose, its membership to be arranged in consultation with the President.

The President expressed the opinion that a most important feature of the Institute's work should be the promotion of the welfare of the young engineer. He thought that one of the most valuable committees which could be set up at the present time would be one which would further the interests of the young engineer, beginning with the student, and following through his early years after graduation. The future of the Institute lay with the young engineer of to-day. The President had discussed the matter with Harry F. Bennett, M.E.I.C., of London, who was keenly interested in the subject, and he thought that Mr. Bennett would be willing to accept the chairmanship of such a committee should it be formed. After discussion it was unanimously *resolved* that such a committee be appointed, and that Mr. Bennett be asked to accept the chairmanship, and, in consultation with the President, to name the other members of the committee.

It was unanimously *resolved* that a hearty vote of thanks be accorded to the chairman of the local committee, the chairman of the local branch, the manager of the Chateau Laurier, and to all who had contributed to the success of the Fifty-third Annual General Meeting of the Institute.

There being no further business, the Council rose at six o'clock p.m.

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.

COMING MEETINGS

The Corporation of Professional Engineers of the Province of Quebec—annual meeting, The Engineering Institute, 2050 Mansfield Street, Montreal, March 25th at 2 p.m.

Electrochemical Society, Inc., spring convention at Columbus, O., April 26th to 29th, 1939.

Canadian Institute of Mining and Metallurgy, Chateau Frontenac, Quebec, March 13th, 14th, 15th.

American Society of Mechanical Engineers — Ontario Section, on April 13th, speaker, Col. Frank Chappell, General Motors of Canada, on "Preview of Progress"; on May 11 in Toronto, speaker, Mr. McEwen, Director of Research of the Westinghouse Company.

Announcement is made that the semi-annual meeting of the **American Society of Heating and Ventilating Engineers** will be held this year at Mackinac Island, Michigan, July 4 to 6. The Michigan Chapter of Detroit and the Western Michigan Chapter of Grand Rapids will act as hosts to the society membership.

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

AIR CONDITIONING

Research Corporation, 405 Lexington Avenue, New York, are distributing a 16-page booklet describing their system of air conditioning, featuring chemical dehumidification. The booklet is illustrated with views of installations, charts and diagrams and contains a number of tables of sizes and weights of standard equipment.

NI-RESIST VALVES AND FITTINGS

A 4-page leaflet has been issued by Crane Limited, Montreal, announcing that their regular cast iron valves and fittings are now procurable in "Ni-Resist." The leaflet illustrates a number of the fittings cast in the Company's Montreal factory, and contains representative data on the corrosion resistance of Ni-Resist as compared with unalloyed cast iron.

COOLING TOWERS

A 4-page bulletin describing the Coey Multi-Stage Cooling Towers has been issued by Research Corporation, 405 Lexington Avenue, New York. In addition to general descriptive matter and illustrations the bulletin contains a sectional view of the tower and tables of capacities for various types of service and sizes and weights of various models.

WOOD PRESERVATION

A 20-page booklet dealing with the "Osmose" treatment for wood preservation has been issued by the Osmose Wood Preserving Company of Canada, Limited, Castle Building, Montreal. The booklet describes the method used by this company in its preservative treatment and instructions for the proper carrying out of the treatment, as well as many illustrations of its actual application, with records of performance.

WORM GEAR SPEED REDUCERS

The second edition of No. 102-B Catalogue on Worm Gear Speed Reducers has been issued by Hamilton Gear & Machine Co., Industrial and Cut Gear Specialists, Toronto, Ontario.

The catalogue contains twenty pages of reference information, and after describing various types of units, it provides detailed specifications for the various component parts. Sections are devoted to a description of the Company's test methods; quality of its products with general instructions and information as to how to select the correct size of reducer. In addition, some eight pages of useful tables are included in the catalogue.

INTERNATIONAL NICKEL PUBLICATIONS

Currently there are 151 Inco publications dealing with applications, the properties and the fabrication of pure nickel and high nickel alloys including Monel and Inconel. Virtually every modern industry using metals is concerned in view of the consistent trend towards wider uses of these materials. All are catalogued in a new publication, 'List "B",' available from The International Nickel Company of Canada Ltd., 25 King St. West, Toronto, Ont.

CROMPTON PARKINSON DIAMOND JUBILEE

An interesting supplement appeared in the London Evening Standard of December 16th last, on the occasion of the Diamond Jubilee of Crompton Parkinson Ltd., one of the constituent firms of Bepco Canada Ltd. This supplement is in the nature of a historical review of the development of this Company during the past sixty years.

INKLESS RECORDING INSTRUMENTS

Continuous accurate operation for 30 days without attention, at temperatures as low as -10F and as high as 120F, is made possible by the new Type CF-1 line of inkless recording single- and double-range a/c ammeters and voltmeters just announced by the General Electric Company, Schenectady, N.Y. The units are in the low-price range and are particularly well suited for voltage surveys, complaint investigations, and checking circuit load conditions. The inkless mechanism, which uses a typewriter ribbon, to make the record by a series of dots, results in greater simplicity, small size, and lightweight. There is no inkwell to clean, no pen to start, and nothing to freeze in cold weather. A cast aluminum alloy case protects the mechanism and further suits the new instruments for service while exposed to the weather. Although they are portable, the new instruments may be wall- or pole-mounted.

MARINE DRIVE

"The new type Marine Drive for Modern Merchant Ships" is the title of a sixteen-page brochure issued by Farrel-Birmingham Co. Inc. of Buffalo, N.Y., and Elliott Co. of Ridgeway, Pa., which describes the first application of merchant reduction gear and electro-magnetic slip coupling drive in the western hemisphere.

This application was embodied in the design of the sister ships "Imperial" and "Petrolite" of the Imperial Oil Shipping Co. Ltd. of Toronto. A fund of interesting information is contained in the bulletin, copies of which may be obtained on application to the Canadian representatives, Messrs. F. S. B. Heward & Co. Ltd., Montreal.

CHEMI-SEALED PENCILS

A 4-page bulletin is being distributed by the Eagle Pencil Company of Canada, Toronto, which contains the report of Investigating Committees of Architects and Engineers of New York, together with descriptive information regarding the Eagle "Chemi-sealed" and "Verithin" coloured pencils. The pamphlet is in the nature of an official bulletin of approved products and is accompanied by a card, upon the return of which sample pencils will be supplied upon request.

SALT GLAZED PIPES

The first of a series of bulletins on the use of salt glazed pipes in sewage and drainage work has been issued by Clay Products Technical Bureau of Great Britain, 19 Hobart Place, Eaton Square, London, S.W.1, England. Subsequent issues will include technical data derived from intensive research directed to the study of the behaviour of salt glazed pipes when subjected to the action of aggressive fluids, abrasion and other conditions which are more or less destructive in their effect on certain materials.

WESTINGHOUSE APPOINTMENTS

The Canadian Westinghouse Company announces the appointment of C. H. Mitchell to the position of Manager of Works; L. F. Merrick to the position of Assistant Manager of Works; J. T. Tiplady to the position of General Superintendent and F. S. Strickland to the position of Superintendent, Electrical Department. Mr. Mitchell joined the Canadian Westinghouse Company in 1906 and after serving in various capacities was promoted to Assistant Manager of Works in 1919. Mr. Merrick entered the employ of the Company in 1925 as assistant to the Manager of Works and was advanced to the position of Assistant Manager of Works, Merchandise Division, in 1938.

ARC-WELDING ACCESSORIES

A 12-page catalogue of Arc-Welding Accessories has been issued by the Canadian General Electric Company, Limited, Toronto, which illustrates and describes the various accessories of this kind produced and supplied by the C.G.E. The Company has also issued an interesting 8-page booklet entitled "Handy Estimator for Determining Arc-welding Electrode Quantities," which comprises six pages of tables with a general description of how these may be used.

PROPERTIES AND USES OF HEAVY NICKEL DEPOSITS

Salvaging worn and mismachined parts, protection of machine parts against both wear and corrosion, manufacture of thin sheet metal, perforated strip and new electroformed screens as well as other engineering uses for thick nickel deposits were reviewed in a paper by W. A. Wesley, research chemist for the International Nickel Company, before a combined meeting of the A.E.S. branch and Hartford chapter, A.S.M.

Because of interest aroused in the subject, Mr. Wesley's paper has now been published as a technical bulletin, "Physical Properties and Uses of Heavy Nickel Deposits," which details and illustrates structures of hard and soft nickel deposits and correlates their mechanical properties. Copies are available from the International Nickel Company of Canada Limited, 25 King St. West, Toronto.

SAFETY CODE FOR COMPRESSED AIR MACHINERY AND EQUIPMENT

The American Standards Association has announced the completion and approval of the first safety code for Compressed Air Machinery and Equipment. This code is designed to cut down the number of accidents resulting from the wide use of compressed air today in garages, for rock drilling, for mining machinery, for cleaning, chipping, hoisting, and numerous other industrial applications. Nineteen national organizations and two departments of the Federal Government have participated in its development under the administrative leadership of the American Society of Mechanical Engineers and the American Society of Safety Engineers.

The code is being published by the American Society of Mechanical Engineers in a nine-page booklet. It includes specific recommendations for the construction and use of compressors, tanks, pipe lines, etc., with separate sections on receivers and on utilization apparatus. It may be obtained from either the American Society of Mechanical Engineers or the American Standards Association.

NATURAL LAWS APPLIED TO PRODUCTION

The third printing of the book "Natural Laws Applied to Production" is being printed through the Claxton Company of Cleveland, and a limited number of copies are available for distribution upon application to Mathews Conveyer Company, Limited, of Port Hope, Ont. The revised edition has been improved to the extent of making it more easily understood by the layman. The text deals with the subject under eight headings and brings to light innumerable possibilities toward the improvement of handling materials in industry and also bettering national distribution of products. The eight chapters occupy 32 pages and bear the following captions: (1) Facts vs. Principle, (2) The Law of Least Action, (3) Functional Sequence, (4) The Laws of Production, (5) The Laws of Materials Handling, (6) The Function of Management, (7) From Here On, (8) Basic Elements of a Conveyer System.

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

CHIEF DRAUGHTSMAN, for an Ontario steel fabricating plant, central location, capacity 2,500 tons per month, specializing in buildings and miscellaneous steel. Prefer Canadian graduate engineer. Must be fast and capable of handling men. Usually employ from 10 to 20 draughtsmen. Replies confidential. Apply to Box No. 1845-V.

EXPERT ROAD ENGINEER, competent to introduce the necessary improvement on local methods of road building, and familiar with the building of low cost roads compatible with endurance. Road materials such as bitumen, gravel, stones, sand, etc., are available locally and it is essential that the required engineer should know the manner in which such rudiments ought to be used or modified to suit the method of construction which he shall adopt as a result of the research work to be carried out by him on the latest scientific lines. The position is in Europe, and the period of service for three years. The salary would be about £2,000 per annum. The applicant should have qualifications of Member in the *Institute.* Further particulars may be secured through the Employment Service Bureau of the Institute, or address application to Box No. 1846-V.

ELECTRICAL SUPERINTENDENT, for service in Central America. Some knowledge of Spanish, coupled with general utility background, desirable. Young unmarried electrical graduate preferred. Applicants should enclose photograph. Apply to Box No. 1847-V.

ENGINEER, required to operate branch office already established in Montreal, selling electrical and mechanical equipment. State experience if any, and salary expected. Moderate investment required. Apply to Box No. 1850-V.

SITUATIONS WANTED

INDUSTRIAL ENGINEER, B.Sc. (McGill), with fifteen years broad experience in general design and construction and in practically all departments of industrial design and operation, would consider responsible permanent position with progressive industrial concern. Apply to Box No. 492-W.

CIVIL ENGINEER, B.A.Sc. (Toronto '27). Age 34. Married. Five years railway and construction work as building inspector and instrumentman. Level engineer and on construction of a long timber flume for a pulp and paper mill. Field engineer for a sulphite company, in charge of the following mill buildings, acid, digester, blow pit, barker room, chip storage and acid towers. Available immediately. Apply to Box No. 714-W.

ELECTRICAL ENGINEER, B.Sc. '31, (U.N.B.), Jr.E.I.C. Age 30. Single. Experience in electrical wiring construction of concrete wharves, inspection of piling, rip rap, concrete reinforcing, forms, and dredging. Instrumentman during the preliminary survey of a concrete road. Final calculations of quantities of concrete and excavation for concrete road. Junior engineer during the construction of a frost-proof shed, a steel shed and a boiler house, which included a general inspection of wiring system for sheds lighting and to the unit heaters in the frost-proof shed. Available at once. Apply to Box No. 722-W.

ELECTRICAL ENGINEER, B.Sc. '31 Jr.E.I.C. Age 31. Experience includes: eight months on installation of power and lighting equipment; three years as supervisor of an electrical and service dept.; seven months testing power and radio equipment; one year as inspector on electrical equipment and control. At present employed. Available on one month's notice. Location immaterial. Apply to Box No. 740-W.

CIVIL ENGINEER, B.Sc. '29. Married. Experience includes building construction, hydro-electric development in South America, road construction and paper mill construction and maintenance. Desires permanent position with good prospects. Apply to Box No. 744-W.

CIVIL ENGINEER, A.M.E.I.C. Experienced in general construction, buildings, gravel and asphalt roads. Acting in charge P.W.D. West Africa. Chief field engineer refinery construction. Survey Angola Rly., West Africa. General Office work. Apply to Box No. 765-W.

MECHANICAL ENGINEER, Jr.E.I.C., technical graduate, bilingual, age 36, married. Experience includes five years with firm of consulting engineers, design of steam boiler plants, heating, ventilating and air conditioning. Seven years with large company on sales and design of heating systems, air conditioning, steam specialties, etc. Available on short notice. Apply to Box No. 850-W.

SALES ENGINEER, B.A.Sc., Jr.E.I.C. Age 29. Married. Presently employed. Five years experience in sales and field engineering seeks position with more future. Bilingual. Available on few weeks' notice. Apply to Box No. 1107-W.

CIVIL ENGINEER, A.M.E.I.C. Age 48. Married. Ten years municipal work. Five years highway construction, familiar with all types of paving. Presently with consulting engineers on municipal work, water supply, etc. Best of references. Available immediately. Further particulars on request. Apply to Box No. 1141-W.

CIVIL ENGINEER, B.Sc., A.M.E.I.C. Aged 29, enthusiastic, competent, wishes new position. Four years experience in design, draughting, and estimating steel and concrete structures and bridges. Six months field work bridge erection, four years paper mill engineering-design of mill buildings and hydro plant, paper machine installation, heating and ventilating, heat recovery and economy, etc. Now available in Montreal. Apply to Box No. 1295-W.

FIRE PROTECTION AND SAFETY ENGINEER, A.M.E.I.C., B.Sc. '24, (Mech. Engrg.). Age 35. Bilingual. Twelve years experience with insurance underwriters inspection bureau covering phases of field work. Thoroughly familiar with insurance requirements. Position desired industrial or other concern maintaining self insurance or relative departments. Location Montreal or vicinity preferred. Apply to Box No. 1395-W.

ELECTRICAL ENGINEER. B.Eng. (McGill '35), El.Eng. M.El.Eng. (Rensselaer '36), S.E.I.C. Single. Age 25. Experience includes planning and production work in large factory and two years electrical and mechanical engineering on temporary staff of National Research Council, Ottawa. Available at once. Apply to Box No. 1468-W.

CIVIL ENGINEER, B.A.Sc. (Toronto '35), Jr.E.I.C. Age 26. Experience in highway layout and construction, concrete bridge construction, draughting, office work, and surveying. Further details on request. Good references. Available immediately. Location immaterial. Apply to Box 1832-W.

ELECTRICAL ENGINEER, B.Sc. (Manitoba '36), S.E.I.C. Practical and theoretical experience in radio. Have done experimental work. At present doing radio service work. Available at once. Apply to Box No. 1833-W

CIVIL ENGINEER, B.Sc. '37, S.E.I.C. Age 22. At present employed, desires position with construction firm. Experience includes field instructing of transit and chain survey crews, draughting for geologist, instrument work and general supervision on highway construction work, purchasing in paper mill. Available on few weeks' notice. References and details on request. Willing to locate anywhere that offers required class of work. Apply to Box No. 1840-W.

CIVIL AND MECHANICAL ENGINEER, B.Sc., M.E.I.C., R.P.E., Military Service Lieut. C.E. Married, age 47. Twenty years experience in heavy manufacture, drafting, designing, estimating and production, also design manufacture and maintenance of buildings and machines, including transporting equipment (hoists, cranes, etc.), interested in plant works or production management. Available on short notice. Apply to Box 1853-W.

ELECTRICAL ENGINEER, A.M.E.I.C. Age 32. Married. At present employed in responsible commercial position, but desires change. Over sixteen years experience in electrical industry. Trained in English factory. Seven years resident in Canada. Apply to Box No. 1854-W.

SALES ENGINEER REPRESENTATIVE, B.A.Sc., C.E. Age 30. Contact in Northern Quebec mine belt. Interested in selling any kind of materials. Experience in heating and air conditioning. Speaks both English and French. Available at once. Apply to Box No. 1859-W.

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

MECHANICAL ENGINEER, Dipl. Ing. (Stuttgart '24). A.M.E.I.C. Married. Over ten years experience in airplane, tractor and agricultural machinery design and steel mill plant maintenance work. Read, write and talk German and Russian. Seeking permanent position. Location immaterial. Available on short notice. Apply to Box No. 1862-W.

WANTED TO PURCHASE

SLIDE RULE, 20 in., similar to K. & E.'s No. 4051 or No. 4035-5. Give full particulars and price to Box No. 25-P.

PRELIMINARY NOTICE

of Applications for Admission and for Transfer

February 11th, 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 April, 1939.

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

BUCHANAN—ALBERT MILLAR, of Dundas, Ont. Born at Hamilton, Scotland, Jan. 18th, 1892; Educ.: 1908-12, Royal Technical College, Glasgow, Scotland. 1908-12, ap'tice dftsman., John Marshall & Sons, Motherwell, Scotland; 1912-14, dftsman., London Foundry Co., London, Ont.; 1914-16, engr., London Street Rly Co., London, Ont.; 1919-21, designing chain making and wire forming machy., Globe Engrg. Co., Hamilton, Ont.; 1922-26, plant engr., Gartshore-Thomson Pipe & Foundry Co. Ltd.; 1926, at Birmingham, Ala., studying the design for, and the manufacture of, sand spun and cast iron pipe; 1926-29, i/c design and erection of centrifugal pipe foundry, and from 1929 to date, plant engr. and supt. of above plant for Gartshore-Thomson Pipe and Foundry Co. Ltd., Hamilton, Ont.

References: J. B. Challies, A. O. Wolff, H. A. Lumsden, J. A. Vance, E. V. Buchanan W. L. McFaul.

CARRY—WILLIAM CHARLES, of Edmonton, Alta. Born at Winnipeg, Man., March 19th, 1905; Educ.: B.Sc. (E.E.), Univ. of Man., 1926; 1924-25 (summers), axeman and transitman, C.P.R.; 1926-27, lecturer in civil engrg., Univ. of Man.; 1927-32, detailer, designer, asst. to contract engr., plant engr., timekeeper, Dominion Bridge Co. Ltd., Winnipeg; 1932-35, revision of capital assets acct., pricer on engrg. estimates, salesman, Manitoba Bridge & Iron Works, Winnipeg; 1935-36, asst. to manager, Western Claude Neon Co., Winnipeg; 1936, mech'l. detailer, 1936-37, revision of inventory, 1937-38, sales engr., 1938, shops inspector, Riverside Iron Works, Calgary; Nov. 1938 to date, sales engr., Standard Iron Works Ltd., Edmonton, Alta.

References: H. M. White, A. Campbell, R. M. Dingwall, A. E. Macdonald, J. N. Finlayson.

FRASER—WILLIAM STANLEY, of Calgary, Alta. Born at Hamiota, Man., June 5th, 1895; Educ.: B.Sc. (E.E.), Univ. of Man., 1922. With the Canadian Westinghouse Co. Ltd., as follows: 1920-21 (summers) and 1922-23, test dept., Hamilton; 1923-25, asst. district engr., Winnipeg; 1925-29, engr. i/c service and erection work in the Fort William District; 1929 to date, engr. i/c of service and erection work, and at present district engr. for the Province of Alberta.

References: J. P. Fraser, E. P. Fetherstonhaugh, T. Schulte, H. B. LeBourveau, H. J. McEwen.

GROUNDWATER—JAMES ROSS, of 4371 Draper Ave., Montreal, Que. Born at Wick, Scotland, July 9th, 1891; Educ.: Bennett College, Sheffield, England, and Sothern's College, Glasgow, Scotland. Fully qualified shipbuilder and marine engr.; 1907-12, indentured ap'tice, Thames Iron Works, Engrs. and Shipbldrs. of London, England, and Dunsmuir & Jackson Ltd., Engrs. and Boilermakers, Govan, Scotland; 1912-14, with various engrg. and shipbldg. firms in Scotland; Sept., 1914, His Majesty's Navy, Portsmouth Naval College. Qualified as asst. engr., appointed to 10th Cruiser Squadron, 1914, and remained on active service during the entire war; 1919, appointed to North Russian Expedition; appointed to H.M. Salvage Ships, to assist in raising German fleet at Scapa Flow; transferred to Chatham as care and mtce. officer; 1920, resigned from Navy as Engr. Lieut.; 1924, after several private ventures came to Canada and joined service of W. Crawford Ltd., ship-owner and broker, Montreal, as supt. engr. of 23 ships; 1929-31, on staff of Sun Life Assurance Company, supervising constrn.; Acting Surveyor for Lloyd's Register of Shipping; 1931 to date, plant engr., Bruck Silk Mills, Cowansville, Que., installed complete power plant and converted entire factory to by-product steam from electrical generation. (Member of Institute of Engrs. & Shipbldrs. in Scotland. Assoc. Member, Institution of Naval Architects, London.)

References: C. N. Monsarrat, C. K. McLeod, J. G. Hall, A. G. Scott, F. S. B. Heward, F. A. Combe.

HAULTAIN—ROBERT MITCHELL, of Ottawa, Ont. Born at Winnipeg, Man., June 26th, 1891; Educ.: Grad., R.M.C., 1912; 1913-14, civil engrg., American Corres. School, Chicago; 1912-13, rodman, C.N.R.; 1914, canoeman, topog'l. survey of Lake Athabasca; 1913-14, asst. to bridge engr., C.N.R.; 1914-15, Lieut., R.F.A., and 1915-18, Lieut. and Capt., Can. Field Artillery; 1919-23, director and lubricating oil sales mgr., Anglo Oil Co. Ltd., Toronto; December, 1938, to date, field director, civil security survey section, R.C.M. Police, with special reference to hydro-electric power plants, Ottawa, Ont.

References: C. Camsell, R. E. Smythe, W. E. Blue, A. L. Bishop, F. D. Reid, H. J. Lamb, L. A. Wilmot.

HUSBAND—JOHN, of 2267 Melrose Ave., Montreal, Que. Born at Troy, N.Y., Oct. 23rd, 1902; Educ.: completed corres. course in struct'l steel designing, Wilson Engrg. Corpn., Cambridge, Mass., 1936; 1920-23, junior struct'l. dftsman., Dominion Bridge Co.; 1923-26, struct'l. dftsman., Canadian Vickers Ltd., Montreal; 1926-28, struct'l. detailing and checking, Dominion Bridge Co.; 1928-29, designing and dfting., bridge dept., C.P.R., Montreal; 1929-30, strut'l. designing, 1930-33, asst. to vice-president, struct'l. steel dept., Canadian Vickers Ltd., Montreal; 1933-34, on loan from Canadian Vickers Ltd. to Foundation Co. of Canada Ltd., i/c struct'l. steel work for 1930 and 1933 extensions, Courtaulds (Canada) Limited; 1934 to date, chief dftsman., also i/c of designing, struct'l. steel dept., Canadian Vickers Ltd., Montreal.

References: G. Agar, R. C. Flitton, K. K. Pearce, E. R. Smallhorn, P. F. Stokes.

PEARCE—WILLIAM, of 1674 McGrail Ave., Niagara Falls, Ont. Born at Oshawa, Ont., Nov. 6th, 1893; Educ.: B.Sc. and Engr. of Mines, Michigan College of Mines, 1930; 1910-13, rodman, Ontario Power Co., Niagara Falls, Ont.; 1913-14, chainman, D.L.S., western Canada; 1915-18, junior instr'man., Canadian Niagara Power Co., Niagara Falls; 1931-36, Noranda Mines Ltd., i/c of party on general mine surveying and mapping; 1936-37, Kiena Gold Mines Ltd., Toronto, i/c of general mine surveying and mapping; 1937-38, Kerr-Addison Gold Mines Ltd., Larder Lake, Ont., i/c of layout and inspection on constrn. of mine surface plant.

References: W. Jackson, M. F. Ker, R. J. Montague, T. H. Hogg, C. H. Mitchell, T. Hughson.

SURVEYER—JOSEPH BERNARD EDOUARD, of Arvida, Que. Born at Montreal, Aug. 20th, 1915; Educ.: 1933-36, Rensselaer Polytechnic Institute; 1937 to date, ap'tice engr., Aluminum Co. of Canada, Ltd., Arvida, Que.

References: F. T. Boutilier, R. H. Rimmer, A. C. Johnston, M. G. Saunders, M. DuBose.

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

CHAMBERS—HAROLD JOSEPH ASHBRIDGE, of Windsor, Ont. Born at Swindon, Wilts., England, Aug. 11th, 1902; Educ.: B.A.Sc., Univ. of Toronto, 1924, M.A.Sc., 1925; 1935, i/c struct'l. design of Halifax Public Bldg., and other structures, and 1937, i/c struct'l. design of Connaught Plaza Widening, Dept. of Public Works of Canada; 1924 to date, with the Canadian Bridge Co. Ltd., as struct'l detailer and checker, asst. engr., and sales engr., 1930-35, i/c design, and estimating, and 1936 to date, i/c design, estimating and contracting (St. 1920, A.M. 1930.)

References: F. H. Kester, R. A. Spencer, P. E. Adams, C. M. Goodrich, A. E. West, J. C. Keith, D. A. Williamson, C. R. Young.

COKE—REGINALD NORMAN, of 305 Strathearn Ave., Montreal West, Que. Born at Jamaica, B.W.I., Aug. 24th, 1892; Educ.: B.Sc., McGill Univ., 1914; 1915-19, overseas, 2nd Lieut., Royal Engrs., and Lieut., Mech'l. Transport, A.S.C., attached to R.G.A.; 1919, engr., Saskatchewan Telephone Co.; 1920, asst. traffic engr., Bell Telephone Company; 1920-22, erecting engr., Canadian Westinghouse Co.; 1922-29, asst. to elect'l. engr. and mgr. electric utilities, Winnipeg Electric Co., responsible for operation and engrg. matters; 1929-34, asst. gen. supt., and 1934 to date, vice-chief engr. and gen. supt., Montreal Light Heat and Power Cons., Montreal, Que. (Jr. 1917, A.M. 1923.)

References: E. V. Caton, R. A. C. Henry, O. O. Lefebvre, G. E. Templeman.

GARDNER—WILLIAM McGREGOR, of 313 Grosvenor Ave., Westmount, Que. Born at Montreal, Que., April 15th, 1896; Educ.: B.Sc., McGill Univ., 1917; 1917-19, overseas, C.E.F.; with the Montreal Tramways Company as follows: 1919, field engr., 1919-22, trackwork engr., 1922-27, engr. on special trackwork, 1927-30, principal asst. to engr. of rapid transit, 1930 to date, supt. of constrn. and mtce. (1927-30, Member of Rail Corrugation Committee, Canadian Transit Assn., investigating problems of undulating rail wear and rail specifications.) (St. 1916, Jr. 1919, A.M. 1923.)

References: D. E. Blair, E. Brown, J. L. Busfield, A. Duperron, J. H. Hunter, J. A. McCrory, G. St.G. Sproule, G. E. Templeman.

HOLDEN—JOHN HASTIE, of Westmount, Que. Born at Westmount, May 20th, 1902; Educ.: B.Sc., McGill Univ., 1923; 1923-24, asst. to plant engr., Northern Electric Co.; 1924 to date, with Geo. W. Reed & Co., Montreal, as follows: 1924-31, asst. to head estimator and chief dftsman., 1931-37, sales mgr., and at present manager, i/c charge of sales and estimating, giving technical information regarding products to engineers and architects. (St. 1921, Jr. 1930, A.M. 1935.)

References: B. R. Perry, W. G. Hunt, J. L. Busfield, T. M. Moran, E. R. Smallhorn.

LESLIE—ROY CAMPBELL, of 2334 Chilver Road, Walkerville, Ont. Born at Mount Forest, Ont., Jan. 17th, 1902; Educ.: B.A.Sc., 1923, M.A.Sc., 1924, Univ. of Toronto; R.P.E. of Ont.; with the Canadian Bridge Company, Walkerville, Ontario, as follows: 1924-26, dfting., 1926-29, checking shop drawings for struct'l. steel, 1929 to date, sales engr., on design, pricing, and contracting for structures, generally in the field of transmission line towers, substations and radio structures of all kinds, responsible for work, and in general supervision of the execution of such work, in office, field and shop. (Jr. 1925, A.M. 1930.)

References: S. E. McGorman, C. M. Goodrich, H. J. A. Chambers, J. C. Keith, T. H. Jenkins, H. A. McKay, W. A. Dawson.

MOES—GERLACUS, of North Shore Blvd., Aldershot P.O., Ont. Born at Bussum, Holland, Aug. 10th, 1902; Educ.: 1921-25, Liverpool University, England, cert. in engrg.;1925-26, experimental elect'l. engr., high tension research lab., Simplex Wire and Cable Co., Cambridge, Mass.; 1926-28, engr. dftsman., switching equipment engrg. dept., and 1928-30, elect'l. engr., plant engrg. dept., Canadian Westinghouse Company; 1930-32, engr., i/c industrial elect'l. dept., Allen Engrg. Co., Consltg. Engrs., Hamilton, Ont.; 1932 to date, gen. mgr., Hamilton Sterling Electrical Co. Ltd., Hamilton, Ont. (engrs. and contractors), design and erection of industrial and commercial elect'l. installns. (A.M. 1930.)

References: E. M. Coles, J. R. Dunbar, H. A. Lumsden, J. J. MacKay, W. Hollingworth, E. P. Muntz, A. R. Hannaford, R. K. Palmer.

FOR TRANSFER FROM THE CLASS OF JUNIOR

CORNISH—CHARLES RISCHMAN, of Banff, Alta. Born at Vancouver, B.C., March 22nd, 1906; Educ.: B.A.Sc. (Civil), 1929; 1924-28 (summers), rodman, and instr'ment work; 1929-31, hydrometric recorder, Water Power and Reclamation Bureau, Dept. of Interior, Vancouver; 1931-34, instr'man., engrg. service, Dept. Interior, on constrn. of Big Bend Highway, etc.; 1934-35, junior engr., engrg. service, Dept. Interior, as res. engr. on Big Bend Highway constrn.; 1935 to date, asst. engr., engrg. service, Dept. Interior (now Dept. of Mines and Resources) as res. engr. and supt. of constrn., Big Bend Highway, Donald base. (St. 1928, Jr. 1932.)

References: W. H. Powell, C. E. Webb, J. M. Wardle, T. S. Mills, C. K. LeCapelain, G. F. Horsey, A. Peebles.

HARVIE—ALLIN C., of Port Colborne, Ont. Born at Peterborough, Ont., Jan. 6th, 1900; Educ.: B.Sc., Queen's Univ., 1923; 1923-33, dftsman. and field engr., and 1933 to date, asst. works engr., International Nickel Co. Ltd., Refining Division, Port Colborne, Ont. (St. 1922, Jr. 1927.)

References: R. L. Peek, W. D. Bracken, C. N. Geale, E. Grummitt, C. H. McL. Burns.

MENZIES—JOHN ROSS, of 4989 Connaught Ave., Montreal, Que. Born at Molesworth, Ont., July 17th, 1898; Educ.: B.A.Sc. (Civil), Univ. of Toronto, 1926; 1926-28, transitman i/c party, Sutcliffe Co. Ltd., New Liskeard, Ont.; 1928 (Aug.-Dec.), res. engr., townsite work, Abitibi Power & Paper Co.; 1929-30, asst. engr., and 1930 to date, district engr., public health engrg. divn., Dept. of Pensions and National Health, Montreal, Que. (St. 1926, Jr. 1927.)

References: H. W. Sutcliffe, D. A. Nichols, G. H. Ferguson, D. C. Beam, F. M. Brickenden.

McCANN—EDWARD HOWARD, of 207 South Norah St., Fort William, Ont. Born at Peterborough, Ont., Dec. 26th, 1908; Educ.: B.Eng. (Mech.), McGill Univ., 1934; B.Sc. (Bus. of Eng. Administration), Mass. Inst. Tech., 1938; 1934-36, asst. to plant mgr., plastics divn., Canadian Industries Ltd., Brownsburg, Que., i/c production and mtce.; 1937-38, production dept., i/c modifications on aircraft, Blackburn Aircraft Ltd., Brough, England; at present, engr., production dept., aviation divn., Canadian Car & Foundry Co. Ltd., Fort William, Ont. (St. 1934, Jr. 1936.)

References: C. H. Jackson, D. Boyd, E. Brown, G. H. Herriot, E. M. G. MacGill.

FOR TRANSFER FROM STUDENT

ARCHIBALD—MANNING CLIFFORD, of 372 Drew St., Woodstock, Ont. Born at Bear River, N.S., Oct. 31st, 1909; Educ.: B.Sc. (E.E.), N.S. Tech. Coll., 1933; R.P.E. of Ont.; 1929-30 (summers), line work, checking transformer loads, Maritime Electric Co.; 1931 (summer), switchboard mtce., Island Telephone Co., Charlottetown; 1935, i/c Better Light—Better Sight Campaign, Maritime Electric Co.; Jan. 1936, to date, engr., Woodstock Public Utilities Commission, Woodstock, Ont. (St. 1931.)

References: J. A. Vance, W. G. Ure, W. P. Copp, H. R. Theakston, F. T. Julien

BEAUDET—GUY, of Thetford Mines, Que. Born at Thetford Mines, Oct. 8th, 1911; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1938; 1937, staff engr. at King's Mine, Asbestos Corporation of Canada, Thetford Mines; at present, city engr., Thetford Mines, Que. (St. 1936.)

References: S. A. Baulne, T. J. Lafreniere, A. Frigon, G. A. McClintock, H. R. Lynn.

GRANVILLE—FRANCIS XAVIER, of Charlottetown, P.E.I. Born at Halifax, N.S., Nov. 17th, 1911; Educ.: B.Sc. (C.E.), N.S. Tech. Coll., 1934; 1935-37, instr'man., and asst. engr., Dept. of Highways of Nova Scotia; 1937-38, field engr., Dufferin Paving Co., Toronto; 1938 to date, asst. engr., Dept. of Public Works and Highways of P.E.I. (St. 1930.)

References: R. W. McColough, J. E. Belliveau, H. Thorne, E. L. Miles, S. Ball, C. S. Creighton.

SHERWOOD—HARRIS MITCHELL, of Brownsburg, Que. Born at Medicine Hat, Alta., Nov. 11th, 1911; Educ.: B.Sc. (Chem.), Univ. of Alta., 1933; 1929-30, Dept. of the Interior, Alta.; 1934, Alberta Highways; 1935 to date, ammunition divn., and at present, production engr., Canadian Indu tries Ltd., Brownsburg, Que. (St. 1935.)

References: C. H. Jackson, J. W. Houlden.

THE GOLDEN GATE INTERNATIONAL EXPOSITION 1939

(CONTINUED FROM PAGE 120)

engineer or the chemist, but in this case the sand fill of the new island had to be prepared for plant and tree life first by reducing the chlorine content by pumping, washing, and fertilizing, then by applying 100,000 cubic yards of rich top soil; and finally the 4,000 trees (some weighing as much as 40 tons) and a multitude of shrubs, annuals and perennials, had to be transported and put in place. Much of the planting will remain as a permanent feature after the exposition closes.

The United States Government is represented by a stately building and a series of comprehensive national exhibits. Many European nations and the other American republics have striking pavilions. Canada is not participating as a Dominion, though British Columbia is exhibiting in the Hall of Western States.

Among the engineering features of the Exposition the structural design of the buildings, specially worked out to speed erection and facilitate dismantling, is noteworthy. Strap-and-pin steel joints of a new type have been used for the heavy frame construction. Incidentally it may be mentioned that the 30 million board feet of lumber used in the Exposition buildings included a great deal of heavy timber, notably such items as 36 pieces of seventy-eight foot 12 by 16 in.

As regards finance, western business and industry contributed $7,500,000 in subscriptions, returnable to the donor in whole or in part as the final surplus may permit. To this the Federal Government grant—over $7,000,000—was added, covering the cost of dredging, airport buildings, water supply, sewerage, landscaping, and other work of permanent use. Pre-opening revenue from rental of exhibit space and building sites, charges for concessions and so on, provides nearly $6,000,000, and there is an appropriation of $5,000,000 from the State of California. These sums, together with the expenditure of other states, foreign nations, industrial exhibitors and concessionnaires, estimated at $20,000,000, make a total of nearly $50,000,000 as the cost of the 1939 "Pageant of the Pacific."

NEWLY ELECTED OFFICERS OF THE INSTITUTE

(CONTINUED FROM PAGE 139)

J. A. Vance, A.M.E.I.C., has been appointed councillor for the London Branch. He was born at Woodstock, Ont., and in 1914 went into business as a general contractor, designing and erecting steel and concrete highway bridges, dams, etc. He has held the position of general manager and chief engineer in his firm since its beginning. As vice-chairman of the Annual Meeting Committee in 1938 Mr. Vance contributed greatly to the success of this meeting.

E. B. Wardle, M.E.I.C., the newly appointed councillor for the St. Maurice Valley Branch, was born at Slatersville, R.I., and received his education at Dartmouth College, graduating in 1899 with the degree of B.Sc. Since that time he has held the position of engineer in charge in the following companies: Oxford Paper Company, Rumford Falls, Me., Champion Coated Paper Company, Hamilton, Ohio, Laurentide Paper Company Ltd., Grand'-Mere, Que., Crocker-McElwain Company, Holyoke, Mass., Ryegate Paper Company, East Ryegate, Vt., Anglo-Newfoundland Development Company Ltd., Grand Falls, Nfld., Champion Fibre Company, Canton, N.C., Fitchburg Paper Company, Fitchburg, Mass., Powell River Paper Company, Powell River, B.C., and the St. Croix Paper Company, Woodland, Me. In 1914 he became chief engineer of the Laurentide Company at Grand'Mere and in 1928 he accepted the same position in the Canada Power and Paper Corporation when this company took over the Laurentide Company. He still holds this position with this company, which has since become the Consolidated Paper Corporation Limited.

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PROGRESS IN THE NORTHWEST TERRITORIES

CHARLES CAMSELL, C.M.G., LL.D., M.E.I.C.
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SUMMARY—Notes on the history, physiography, population and living conditions of the Territories are followed by pertinent data on transportation and the development of the mining industry, notably as regards radium at Great Bear lake, gold in the Yellowknife area, and the available fuel and power resources.

That portion of the federal domain known as the Northwest Territories is still a land of romance and mystery where the pelt of the fur-bearing animal is a common item of barter and the explorer has opportunities rarely to be equalled elsewhere. But on September 5th last year an event took place at Great Slave lake which is perhaps destined to mark *the* turning point in its history and a most propitious change in its economic value to the Dominion. That event was the pouring of the first brick of Territorial gold—the outward and visible sign that the frozen assets of the country are beginning to thaw and swell the stream of Canada's golden wealth.

A full appreciation of the mining activities which are taking place can really be gained only from an understanding of the character of the country and the series of explorations and victories over great natural forces that paved the way for them. Crowning achievements are usually the result of years and years of effort in which many play a part.

In this article, therefore, which is more or less a revision of an address I delivered before the Canadian Institute of Mining and Metallurgy in September, 1937, the section on to-day's mining activities is preceded by an outline of the history, native population, features, and administration of the country.

Fig. 1—Canyons on the South Nahanni River Looking West

Eskimos and Indians

The population, as one would expect in the latitudes of the Territories, is largely Eskimo and Indian. At the census of 1931, the Eskimos numbered 4,670; the Indians, 4,046; and the whites, mainly traders, missionaries, trappers, prospectors, or administrative officials, 1,007. The total to-day is roughly 11,000 as a result of the growth of mining activity, but even at that figure it is equivalent to only one person in more than twice the area covered by the city of Montreal.

Generally speaking, the Eskimos of to-day are scattered along the treeless shores of the mainland and some of the islands, and they only go inland to hunt chiefly the caribou. The Indians on the other hand are essentially men of the woods, who shun the Arctic coasts, not knowing how the Eskimo secures warmth and shelter or how he captures seals and porpoises. Both they and the Eskimos, ethnologists tell us, are descendants of Asiatic peoples who crossed the Behring Sea about 4,000 years ago; in part support of this are their eyes, which have the Mongolian slant, and their language, especially that of the Indians, which has points of resemblance to the ancient tongues of China and Tibet.

The development of the fur trade by the white race was not without harm to the aborigines. Accustomed to living mainly by hunting and fishing, the Indians were presented with a market where they could exchange hides for rifles, ammunition, tea, flour, tobacco, sugar, and various other commodities. Their babiche snares, with which they enmeshed even the moose, their bows and arrows, their tools of stone, bone, antler, and copper, were gradually discarded for the new firearms and steel traps, and their life became less hard. But association with the white traders and trappers and their congregation at the trading posts, led to so great an intermarriage that the number of full-blooded Indians in the country is now greatly reduced. This, combined with diseases previously unknown among them, played such havoc that their population declined 66 per cent during the nineteenth century. This condition had to be combated. With the medical and other measures which have been introduced and the support of the missionaries the fight is being won, although diseases still claim too many lives. In hunting, fishing, trapping, and as a guide, the Indian will always be of great value, and in new fields of activity which development of the Territories is opening he is capable of rendering services as meritorious as those which brought success to the white man's explorations in the early days.

The Eskimo had little contact with the white race until near the end of the last century when American and Scotch whalers turned their attention to Canadian waters for the pursuit of the bowhead whale. This commercial undertaking lasted about 25 years but it had reached its peak of production in 1893. The American whalers brought with them Eskimos from Alaska, who helped to man the boats and hunt for caribou. This induced the local Eskimos to interest themselves in trading with the whalers. They began to trap the white fox, an animal of the country which had been of little use to them; and thus emerged an occupation which to-day is the principal one, sometimes the only one, engaged in by the Eskimo for purposes of trade. His association with the white race has not altered his mode of life, except that now, in addition to modern equipment for the hunt, he usually has the Primus stove for cooking and warmth and, frequently, the Diesel-engined schooner for travelling.

The Eskimos have a physique that endues them, both men and women, with powers of great activity and endurance, which indeed they must have in order to wrest a livelihood from the Arctic littoral, where conditions for existence are perhaps harsher than those any other race has to contend with. Give an Eskimo a rifle, a team of dogs, and a knife with which to carve out blocks of hard-packed snow for his igloo, and he will go forward and successfully meet the exigences of life on dreary, treeless lands where nothing but the passing wind breaks the solitude. And with it all he is cheerfulness personified; there is nothing of that melancholy in his expression that frequently mars an Indian's. He is keenly intelligent, mechanically ingenious, and is blessed with a lively sense of humour that serves him well in hardship.

Character of the Country

The Northwest Territories is comprised of parts of the main physiographic divisions of the North American Continent. In the west there is a strip of 30,000 sq. mi. lying

Fig. 2—Tailings Dump at Eldorado Mines

in the Cordilleran region, where peaks in the Mackenzie mountains rise as high as 8,500 ft. East of this strip and extending roughly to a line through Great Bear and Great Slave lakes to the Arctic coast is a section of the interior plains. This section, known as the Mackenzie lowlands, contains the most striking feature of the Northwest Territories—the Mackenzie and Slave river waterway. Though the surface of the lowlands for the most part does not rise much above the level of this waterway, there are prominent elevations here and there, notably Mount Clark, 3,500 ft. high, in the Franklin range. Adjoining the Mackenzie lowlands on the east is the greater portion of the mainland of the territories, which, as well as a large share of the island area, is in the Canadian shield. It has a low relief and ascends gradually from the Arctic on the north and from the Hudson Bay on the east to form an immense plateau, where, over wide areas, the land only occasionally rises 100 ft. above the neighbouring waters, although near its western boundary the difference in level may exceed 800 ft. Countless lakes mark the surface. They are of all sizes and shapes, with irregular shore lines and many islands, with rivers and streams flowing off in various directions, generally without defined valleys and with gradients broken by steep cascades. The direction of flow of rivers in the central part of the plateau can often be determined only by looking for evidences of a current at a narrows. Another peculiarity is the very short distance which often separates the headwaters of rivers of opposite flow. The Thelon river is the best water route in this portion of the territories; it is 3 to 14 ft. deep, and from its junction with the Hanbury river to Hudson Bay, a distance of 550 mi., there are only two rapids to hamper navigation.

Throughout this poorly drained area, the tree species naturally differ in number, distribution, and size from those in the Mackenzie lowlands, where comparatively well-drained, deeper and richer soils occur along river banks. In point of fact, much of the area, in addition to, of course, the Arctic archipelago, is barren of trees of any kind. Northerly and easterly from Great Bear lake and Great Slave lake the trees become dwarfed under the influence of the increasingly unfavourable conditions of soil, drainage and climate, and the white spruce, black spruce, birch, and tamarack become more and more confined to narrow fringes along streams until they give place to stunted willows, alder, and ground birch, and then to mosses and other small vegetation. Heather, which is very plentiful, is of great value to the Eskimo, for, being rich in resin and igniting even when moderately wet, it provides him with a quick-burning, though very smoky, fuel.

More than one-third of the Territories is without any growth of timber. Despite this, most of the lumber used in the country is of local origin and manufacture; the source of the timber sawn in mills operating on the Slave and Mackenzie waterway being the white spruce which grows thickly along sections of the rivers and attains in favoured places a diameter of two ft. and a height of 100 ft. Even at the Eldorado mine on Great Bear lake, the timber required, except that for the chute bottoms and sides, is secured reasonably close.

Though trees on the Territories' forested lands may be quite scattered and small, as they largely are in the present areas of mining activity, the value of the timber they afford, which it would take years and years to reproduce, cannot be over-estimated. Consequently it is a most serious matter when man, intentionally or through gross carelessness, is the cause of fires like those of last year that deprive the mining industry of needed raw material and the natives of needed hunting and trapping grounds.

Vegetable life, all life in fact, in the north is governed more by the vagary of the weather, particularly the winds and blizzards, than by the temperature. For the thermometer does not fall nearly as low as is generally believed. On the Arctic circle, for example, the average temperature of July ranges from 42 deg. in Baffin Island to 60 deg. in the Mackenzie valley, and the mean annual highest temperature from 65 deg. to 85 deg. respectively. The lowest temperature in the same latitude averages -35 deg. in Baffin Island and -57 deg. in the Mackenzie valley. The total annual precipitation, computed in inches of rain, ranges from an average maximum of 20 in. or more on the southeast coast of Baffin island to an average of less than 10 in. in parts of the Arctic archipelago. In the Mackenzie valley the annual amount is between 10 in. and 20 in., or between one-quarter and one-half of what it is in Montreal.

The pursuit of agriculture at such points is clearly very limited, but meets with fair success at most settlements along the Mackenzie and Slave rivers. At Simpson, for example, there is a farm with 24 acres under cultivation where hay, oats, wheat, potatoes, beets, celery, cauliflower, lettuce, onions, peas, beans, squash, tomatoes, cucumbers, and small fruits are raised. Produce from these settlements now finds its way to the mining camps. Outside the Mackenzie river country special devices and precautions would have to be resorted to for gardens of any kind; one enthusiast at Great Bear lake seeded in June, when the ice was still thick in the bays, on soil that he had transported to the south slope of a hill, and, watering during the dry weather, he had harvested by the beginning of September lettuce, radish, Swiss chard, turnips, beans, beets, carrots, and a small crop of potatoes.

Administration

From what has been written the impression may have been gained that the Northwest Territories is a country of negative attributes, contributing nothing to the national economy except furs, which had an average output-value of $1,325,259 a year between June 30, 1934, and June 30, 1937. That impression as a matter of fact prevailed for a long time and was emphasized by the argument that profitable development, except in the unlikely event of something extraordinarily rich being discovered, was out of the question in a region so remotely and unfavourably situated. Mindful of how Alaska was bartered for a song because of its seeming worthlessness, the Dominion Government was undeterred by this public attitude and kept steadfastly to its task of acquiring knowledge of the country.

The management of this large area, more than one-third of all Canada, is in the hands, not of a legislative assembly like that of our provinces, but of a Commissioner and six

Councillors appointed by the Governor General in Council. The present directors, as it were, are officials attached to either the Department of Mines and Resources, External Affairs or the Royal Canadian Mounted Police and they serve on the Territorial Council without extra remuneration.

The Council, which sits at Ottawa, administers the Northwest Territories Act and other Dominion legislation, as well as the ordinances which the Commissioner has authority to make under instructions from the Governor General in Council or the Minister of Mines and Resources respecting direct taxation for revenue, property and civil rights, jurisdiction, and, generally speaking, all local matters.

For the maintenance of law and order there is a detachment of the Royal Canadian Mounted Police at each of 21 strategic points, including the schooner "St. Roch" that keeps a floating detachment in touch with a large area adjacent to the western Arctic coast. The staff numbers only 49, but they are all specially selected and trained men. They enforce also the Northwest Game Act and other acts, and are frequently assigned to additional duties such as collecting taxes, issuing timber permits, and acting as postmasters, mining recorders, and coroners. In summer and winter they carry out patrols during which they visit natives, trappers, and traders, and secure information about the country. In 1929, for example, Inspector Joy examined interior parts of Devon and Ellesmere islands in his tortuous journey of 1,700 miles from Dundas Harbour to Bache Peninsula, and he erected cairns here and there to mark his visit.

When special problems are discussed by the Council, the government departments affected are represented at the meetings. There is hardly a department that is not in some way linked with the Territories, and as the technical officers whom it is often necessary to question have their headquarters in Ottawa, the Council is able to secure from the permanent Civil Service of Canada the best of advice without delay or added expense. Moreover, as the executives of trading and mining companies and the Missions likewise live outside the Territories, they too can be readily convened at Ottawa. It is because of such co-operative discussion that the Northwest Territories now have airmail and wireless services, landing bases for aircraft, wharves for the handling of freight, direction-finding stations in Hudson Strait, and such facilities as those that special surveys, maps and hydrographic charts, and aerial photography provide.

In spite of the difficulties inevitably associated with administering a widely-scattered population, the Council spares no effort in dealing with matters of health, education, and general welfare. It maintains full or part-time medical officers at all principal centres who patrol their districts in power boats during the summer and by dog-team in winter; provides for the salaries of graduate nurses in Mission hospitals and residential schools; and supports by grants the schools and hospitals conducted under its authority by Anglican and Roman Catholic Missions.

In order to conserve the fur-bearing animals and offset a decline in the sources of food and clothing for the natives, various measures have been taken. For example, five game preserves have been set aside with a total area of 584,000 sq. mi. in which only natives are allowed to hunt and trap; sanctuaries have been established, such as the Thelon Game Sanctuary, 15,000 sq. mi. in extent, which though primarily for the preservation of the few remaining musk-ox on the mainland affords some protection also to the caribou; and 3,000 reindeer were purchased in Alaska in 1929 for transference to a reserve of 6,600 sq. mi. east of the Mackenzie delta, which 2,370 reached after a five years' journey of change and chance in which they were moved 1,600 mi. on the hoof—pushed and driven better describes it. The herd to-day is in excellent shape. It now numbers more than 4,500 head despite inevitable losses associated with herding and the numbers slaughtered to provide meat and clothing. Based upon those slaughtered, the average weight is 15 lb. greater than in 1935. Plans are under way for starting a herd, distinct from the main herd, under the care of natives whom the Government has trained to the task.

Transportation

In the development of a country of vast extent situated north of the 60th parallel of latitude and far removed from railways and populated areas, transportation naturally presents a major problem. Fortunately, the Northwest Territories is penetrated in its western part by the Mackenzie river system which affords a navigable waterway of 1,400 miles without obstruction all the way to the Arctic Ocean. Great aid though this is, it is much to be doubted whether the enterprises now under way would have been undertaken without the availability of transport by the aeroplane, which has come to be regarded as the *sine qua non* in the opening up of the territories; it has been the instrument that has speeded up topographical and geological mapping,

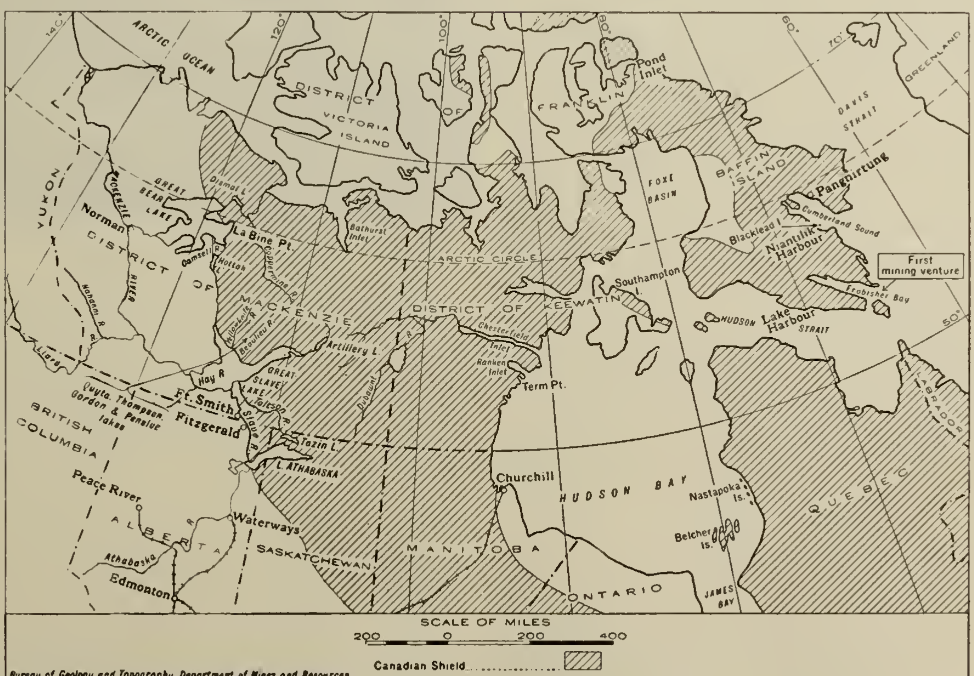

Fig. 3—Map Showing Extent of Canadian Shield

Fig. 4—Fort Norman Looking West

both very essential to any undertaking there, and it has overcome the handicaps occasioned by the short open season in cold northern latitudes, enabling prospectors and others to be flown in before the spring break-up begins.

Below Fort Smith navigation for vessels of any size is usually not possible till well in the second week of June and lasts only about four months. Last year the first good-sized boatload of freight reached Yellowknife on Great Slave lake on June 23, about a fortnight being required to cover the distance of 607 mi. from the railroad at Waterways in Alberta. Farther north the period of open water is still shorter, the latter part of July, for instance, being the time of the year when freight in quantity can first start moving across Great Bear lake. Between Yellowknife and Waterways, boats and pontoon-planes can usually operate from about the first week of June till the middle of October and ski-planes from about the first week of December till April 15th.

For about three to four months of the year the Northwest Territories is therefore practically inaccessible. As a consequence operators in the area must carefully plan their purchases of supplies and equipment. Self-sufficiency, at any rate as regards complete facilities for general repairs, should be their aim if work is not to be disrupted or completely tied up. Any changes a mining company may find it desirable to make as a result of winter tests in its plant cannot be applied until equipment arrives the next summer. Then there is the question of freight costs to be considered, which are inevitably high because of the distance from rail-head and sources of supplies. This is an important factor, for example, in determining the economic limit to which concentration of the pitchblende-silver ore can be carried out at the Eldorado mine on Great Bear lake. It obviously precludes base-metal mining for the time being or until the area is more closely bound with civilization than it is now, and gold ores must be of high grade to enable 100-ton milling operations to surmount the handicaps of distances of 600 and more mi. from Waterways, which itself is 250 mi. from Edmonton.

Freight costs, though high, have been greatly reduced in recent years. Eldorado Gold Mines Ltd., through embarking upon freighting by both water and air on its own account and adding modern steel boats, oil tankers and barges to the fleets of the Northern Transportation Co. and of Goldfields Transportation Co., both of which it now owns, has effected a reduction of well over 50 per cent in the $240 per ton that was paid in 1933 for water-borne freight to its mine, 28 mi. south of the Arctic Circle.

Freight rates by rail and water from Edmonton to Yellowknife are now, thanks in part to the 20 per cent reduction in carrying charges by Northern Alberta Railways, between $50 and $60 a ton compared with $90 a year or so ago. These rates include portage charges between Fitzgerald and Fort Smith. Over this portage with its 16-mile motor road a record haul was established last summer when 550 tons of freight were conveyed in four days and nights by eight Dodge trucks and two Lynn tractors. In 1938 the water-borne freight handled for interests in the Northwest Territories amounted to 20,000 tons. The great bulk of this freight was conveyed by the Hudson's Bay Co. and the Northern Transportation Co., which, with their augmented fleets of steam and oil-driven boats and tugs, scows and barges, are the outstanding navigation companies. The freight figures exclude, of course, the freight transported direct to or from the territories by aviation companies, which carried 1,200 tons in 1937.

Apart from transportation by boat to the nearest docking point, the haulage of heavy and bulky machinery to the actual scene of mining discoveries in the territories will usually necessitate the building of roads. The first such road to be constructed, a winter-tractor road, was that between Yellowknife bay and the Camlaren mine, a distance of nearly 80 miles. It was completed at the end of 1937 at a cost of approximately $10,000, and during that winter 800 tons of freight were hauled over it. If mining is to be conducted far from the point where heavy machinery has to be landed, the road construction and the subsequent freighting might increase transportation costs to such an extent as to jeopardize the enterprise.

Helping to lessen such costs is the Dominion Government's policy of assistance towards the improvement of transportation facilities into mining areas. Under this policy, in effect since the fiscal year 1936-7, the Department of Mines and Resources has borne, or is bearing, the entire cost of constructing at various points public wharves, seaplane bases, and winter aircraft fields; building roads in Fort Smith settlement, including, in a new location, the one to the water front that was destroyed by a landslide in 1937; improving the Great Bear river portage road, and providing aids, such as flashing acetylene lights and day beacons, to navigation on Great Bear lake, Great Slave lake, and lake Athabaska. In addition, the Department has paid out of appropriations under this policy half the

Fig. 5—The "Great Bear" Unloading Cargo Drums of Oil at Eldorado

cost of the 80 mi. winter tractor road between Yellowknife and Gordon lake, and contributed last July $50,000 towards the expenditures to be incurred by the Dominion Department of Public Works in overcoming impediments to navigation occasioned at times of low water. In the eight mi. stretch below Waterways (at which place jetties are being constructed to check bank erosion) very shoal water exists. Boats of even only 20 to 24 in. draught have great difficulty in low-water seasons. The Government has arranged to have deepened to 4.5 ft. at low water a channel 100 ft. wide. Again, where the delta streams of the Athabaska river enter the lake of that name, a huge bar is formed by the silt deposited when the dead water of the lake is met, the entrance to which during low-water season is thereby blocked. The difficulty is aggravated when west winds drive the water to the east end of the lake, though this may be countervailed at times by the Peace river, which at high water backs into and raises the level of Lake Athabaska. Consideration is being given to methods of deepening a channel through the shoal other than by perpetual dredging. Except for the relatively small amounts carried by aeroplane, there have been as yet no bulk movements of freight to the mining fields in winter. Indeed there has been no real necessity for such since the navigation companies have been able to handle all that has been offered. As the picture of mining develops, however, and there is a greater assurance of permanence to the mineral industry, consideration must be given to alternative methods of transportation, the first of which will be winter tractor haulage.

Mining

As has already been stated, the aeroplane is practically a necessity in the development of the territories. It certainly has been *the* factor in enabling mining to make headway, for, thanks to it, the prospector has become less restricted as to both time and range for his activities. In 1929 his interest in the northwest was such as to make the Government resort to the aeroplane and the aerial photograph to cope with his demand for maps of a more detailed nature than those available at that time. By the fall of 1931 an area of 11,000 sq. mi. had been photographed on the east side of Great Bear lake, and, to date, including the 28,400 sq. mi. lying for the most part north and northeast of Yellowknife Bay that were photographed in 1938, a total of 165,000 sq. mi. has been so covered in the Northwest Territories. With the aid of the control points established by the Topographical Survey, maps are prepared from the oblique aerial photographs. These maps, together with the valuable information furnished by prints from vertical aerial negatives and by the annual field work of the Geological Survey (which mapped in 1938, for example, 6,500 sq. mi.), are the means for guiding prospectors to areas favourable for the occurrence of minerals.

These areas are in the western part of the territories. In the eastern part very little intensive prospecting has been carried on, yet minerals are known to occur there: for example, the coals of the central and southern archipelago, including the lignite near Pond Inlet which is mined to meet a local need of 50 tons annually; the graphite mentioned by Frobisher in 1577 and mined in 1916-18; the mica near Lake Harbour and Pangnirtung, of which small quantities were once hauled from the latter place over a narrow-gauge railway to the coast for export; and iron ores of Belcher and Nastapoka islands; the copper-nickel deposit on Ranken Inlet, where drilling in 1937 failed to find any extension to an ore body of 120,000 tons averaging 4.62 per cent nickel, 1.22 per cent copper, and .11 oz. per ton platinum; and the gold occurrences on and near the west coast of Hudson Bay, including the rich pocket of ore near Term Point from which 1,100 lb., hand-picked, yielded $10,000 worth of the precious metal.

It is the westerly part of the mainland of the territories, or the Mackenzie district as it is more usually called, where progress in prospecting and mineral developments is being registered. But even this district received little recognition until the Norman oil field, 100 mi. south of the Arctic circle, was discovered in 1920. And yet long before that discovery frequent mention had been made of the oil seepages and burning coal measures along the Mackenzie river; the native copper of the Coppermine river valley; and the gold the Indians knew about along the Liard and Nahanni rivers.

A real interest began to be shown in the Mackenzie district in 1928 and 1929 when mineral exploration companies, penetrating the barren lands to stake copper deposits, clearly demonstrated that the aeroplane could be used to advantage in these northern latitudes. In 1929 Gilbert LaBine reached the region by air, and in 1930, with his companion Charles St. Paul, staked on the east side of Great Bear lake a property which has since proved to be the world's richest source of radium, and the only known economic source of that metal in the British Empire. On this property numerous veins occur, only three of which, the major ones, known as Nos. 1, 2, and 3, have been exploited. The main underground work has been undertaken from an adit which, driven into the hillside, intersected No. 2 vein 377 ft. from the portal. The shaft is now down to 920 ft. but recent development work has been confined to the upper levels, chiefly to the mining of No. 2 vein on the 375 ft. and the 500 ft. levels and to cross-cutting on the 650 ft. level to No. 3 vein. Drifting costs $16.754 per ft. cross-cutting $16.039 per ft. and stoping $4.311 per ton broken (these are typical development and mining costs at the property). The concentrator installed in 1933 had a daily capacity of 50 tons whereas the present installation can handle 100 to 125 tons a day. Milling costs (including drying and sacking) are $3.976 per ton milled. Three types of pitchblende concentrates are produced as well as a silver-copper concentrate. A refinery built at Port Hope,

Fig. 6—View of South Part of Yellowknife Settlement

4,000 mi. away by shipping distance, began in 1933 to recover radium, uranium oxides, and silver from the mine concentrates, and by November, 1936, had completed the production of its first ounce of radium. The refinery has since been expanded so as to enable it to produce over 100 grams of radium a year and over one ton of uranium salts every working day. The output of radium in 1937 was nearly 24 grams despite interruption during plant expansion, and is likely to be almost three times as much in 1938. About 40 metallic minerals have been identified in the ores, some of which, in addition to those furnishing radium, uranium, silver, and copper, may become economically important, notably cobalt-nickel minerals and native bismuth, which are being found in increasing quantities.

The success of this mine, where 100 men are employed, and the skilled way in which difficulties have been overcome, certainly confounded those skeptics who maintained that mining could not be profitably carried on where winters are long and cold, transportation costly, and timber is scarce.

LaBine's discovery so stimulated prospecting that other pitchblende and native silver occurrences were found, as far south even as 100 mi., but the only other producing mine in the Great Bear lake area is at Contact lake, seven mi. away. This silver mine is developed by an adit and two other levels to a depth of 300 feet. Recent underground work (which revealed a pitchblende discovery) has shown a marked improvement at depth, development work on the 3rd level, for instance, having already opened up a 61-ft. length of ore, 14 in. in width, returning 114 oz. in silver. A substantial increase in daily production has recently been effected by overhauling the mill and installing better crushing and screening equipment. The 25-ton mill on the property had been in operation only very occasionally between December, 1935, and June, 1938. During October, 1938, 30 men were employed and 305 tons were milled.

Yellowknife Region, Great Slave Lake

Three years after LaBine's discovery, two prospectors, equipped with a map published by the Dominion Geological Survey, panned gold on Quyta lake, 25 mi. north of Yellowknife bay, the bay from near which two samples containing gold were said to have been taken during the rush to Klondike. In September, 1934, a party, sent in to develop the Quyta lake discovery and to prospect the vicinity, found the first visible gold in a small rich shoot only four mi. north of the Indian settlement on Yellowknife bay. A mild rush followed but with little result until the work of a Dominion Geological Survey's party, inaugurated under the Government's million dollar geological programme of 1935, led directly to the second discovery and indirectly in 1936 to the find by The Mining Corporation of Canada, Ltd., on Gordon lake, 50 mi. northeast of Yellowknife bay. That particular field work demonstrated that at least 3,000 sq. mi. of the 10,000 sq. mi. examined that year were favourable for prospecting. So many goldbearing veins have since been found that to keep track of them is practically impossible. There is authentic record (according to Dr. Jolliffe of the Federal Geological Survey) of 85 veins carrying visible gold in an area of 12,000 sq. mi. around Yellowknife bay besides probably many more from which gold has been panned or shown by assay to be present in appreciable quantity. The area in which gold finds have already been made is not much short of 100 mi. in dia., and those who have not been there will find it difficult to conceive of so extensive an area with such good surface indications, with so large a part of its terrain free from the overburden of bush and muskeg that characterizes the leading gold-producing areas of eastern Canada, and with so many lakes that there is hardly a section of it that cannot be reached by aeroplane.

Eig. 7—"Con" Mill, Yellowknife

In general the geology of this part of the Canadian Shield resembles that of the gold fields in Ontario and Quebec. The oldest rocks, in which almost all the gold deposits so far known have been found, are a complex, everywhere intensely folded, of volcanics and sediments. The volcanics are much like the Keewatin rocks of eastern Canada. The sediments are predominantly unaltered greywackes of Temiskaming type (the "cool" sediments) and their altered schists (the "hot" sediments). Of the 85 veins (referred to above), 21 are in the cool sediments, 31 in the hot sediments, and 33 in the volcanics. The youngest consolidated rocks are generally similar to the Keweenawan intrusives of Lake Superior. Cutting all the rocks are many great faults.

Out of the total number, namely 5,819, of mining claims in good standing in the Northwest Territories on November 14, 1938, over 4,000 were in the Yellowknife area. There are about 40 mining or prospecting companies active in the field, including some of the financially strongest in Canada. The most developed properties from the production standpoint are the Con and Rycon of the Consolidated Mining and Smelting Company. At the Con where a shaft is down to 500 ft. and 2,500 ft. of lateral work has been done on the 125 ft. and 250 ft. levels, a 100-ton cyanide mill was completed in August, 1938, and the first gold brick (72½ lb.) produced in the Northwest Territories was poured on September 5, 1938. A cross-cut on the 500 ft. level has been started to connect the Con shaft with the Rycon shaft. South of the Rycon, Negus Gold Mines is sinking a shaft to connect on the 100 ft. level with an inclined prospect shaft where 225 ft. of lateral underground work has been completed, and is building a 50-ton mill expected to be producing in January, 1939. Sufficient ore has been indicated in the shoot opened up to feed the mill for six months. Surface work and diamond drilling have revealed at least five places where ore shoots can be expected. Camlaren Mines, on the site of the first gold discovery at Gordon lake, has a shaft down to 380 ft. and more than 1,000 ft. of drifting has been done on the 200 ft. and 350 ft. levels. Not sufficient ore has yet been indicated to justify the 50-ton mill which had been contemplated. Two other gold-bearing veins lie within a mile of the shaft. On one of these a shaft was sunk to 200 ft. in the summer of 1938. The other was discovered in August, 1938, in the course of the company's mapping of its claims. On the surface it is 110 ft. long with an average width of 15 in. and assayed (cut) 1.22 oz. of gold per ton. During the winter of 1938-9 this vein will be diamond drilled.

A number of new gold discoveries were made in 1938. On the Mon, Lily-Jack, Try-me (Macdonald lake) and Pan (Murray lake) groups of claims of Consolidated Mining and Smelting Co. varying amounts of work were done with gratifying results. Operations will be continued during freeze-up on most of these. On the Thompson-Lundmark property of 46 claims around Thompson lake is a spectacular showing of gold-bearing quartz and sampling on the Kim vein (one of the four chief veins out of the many which surface explorations has exposed) over a length of 1,250 ft. is reported to have indicated appreciable gold content throughout, with one section 450 ft. long averaging 0.878 oz. gold per ton across 25.8 in. of quartz included in a total width of nearly seven ft. Diamond drilling, at present under way, and other work will be carried on during the winter. Near Pensive lake, 15 mi. south of Gordon lake, Dome Mines and Chan Yellowknife Gold Mines have established winter camps to develop the prospects discovered in 1938. On one group of claims there four veins have been found, samples from one of which indicated, according to reports, a high average content of gold for a length of 220 ft. over a width of 54.6 in.

Among other interesting finds are the Mosher discovery near Russell lake, the visible gold at Sunset lake (Beaulieu river), the zinc-copper-lead-silver property at Turnback lake (where there will be a winter camp), the discovery of free gold some 30 mi. east of Francois river, the XXXX and Sol groups of claims staked by Morris, and the find made towards the end of the 1938 field season by Territories Exploration Co. at Wray lake (150 mi. north of Yellowknife bay), where six men stayed in to open up the prospect.

With such widespread occurrences of gold-bearing quartz veins, it is only reasonable to expect that here and there throughout the region gold mines will be developed.

Fuel and Water-Power Resources

The Norman oil field near the Arctic circle supplied 900,000 gal. (est.) in 1938 against 400,000 in 1937. Under expected mining developments in 1939 at least 1,500,000 gal. will be required in the Northwest Territories, of which the Yellowknife area will take about 1,000,000 and the mines at LaBine Point and Contact lake 350,000. Norman oil cost 28 cents a gal. delivered at Yellowknife in 1938, which compared with 38 cents for oil brought from Edmonton. Athabaska bituminous sands should prove an important source of fuel and Diesel oil. It has been estimated that if oil were piped across the Fitzgerald-Fort Smith portage, the freight rate from the plant of the International Bitumen Co. at Bitumen in Alberta to Yellowknife could be brought down to 7½ cents a gal., perhaps less. The Consolidated Mining and Smelting Co. in 1938 gave this company a contract for 75,000 gal.

Wood in the Great Bear lake and Yellowknife mining areas costs roughly $10.00 per cord. Hardly any wood is burnt at LaBine Point now that Norman oil (which is piped 8½ mi. over the rapids on Great Bear river) is used both for Diesel-power and heating purposes at the mine and plant of Eldorado Gold Mines. The Con property used 1,500 cords in 1937, but probably less than 500 in 1938.

Though few power surveys have been made and there is a dearth of stream-flow records, the fall of the principal rivers in the Northwest Territories and their drainage areas have been quite closely established in recent years, thanks largely to aerial methods of mapping. Consequently, in conjunction with the known run-off and hydrometric records of other northern Canadian watersheds in similar territory, it has been possible to arrive at the reasonably correct estimates of 285,000 hp. available in the Territories under conditions of ordinary minimum flow and of over 730,000 hp. ordinarily available for six months of the year, none of which has yet been developed. This water power is chiefly in the Mackenzie district. The most attractive source of power is the Lockhart river, which enters the east end of Great Slave lake. This river, which affords excellent opportunities for storage, gathers its waters from a chain of large lakes and in its final course from Artillery lake to Great Slave lake has a descent of nearly 700 ft. in 25 mi.

The Taltson-Tazin river system, which enters Great Slave lake from the south, has numerous rapids and falls, the Twin Gorge falls on the Taltson being especially noteworthy with a reported total descent of 130 ft. The power available for use in the Northwest Territories from this system will be reduced to some extent owing to the diversion of water from Tazin lake into lake Athabaska for the hydro-electric development under way by the Consolidated Mining and Smelting Co. in behalf of its 1,000-ton mill at Goldfields in northwestern Saskatchewan. Snowdrift river, also to the south of the lake, although a comparatively small stream, is reported to have a descent of 500 ft. in six mi. and to offer considerable power possibilities. Hay river enters the lake from the west, and about 44 mi. from its mouth the abrupt Alexandra and Louise falls provide concentrations of 140 and 52 ft. respectively.

Flowing into the north shore of Great Slave lake are the Yellowknife (with its tributary the Cameron) and the Beaulieu rivers, both of which for most of their length consist of a series of lakes with little perceptible current, the water spilling from one lake to another through short stretches of falls and rapids. The length of the former is about 150 mi. and it drains an area estimated at 6,300 sq. mi., while the latter is 100 mi. long with a drainage area of 1,100 sq. mi. Extensive lake areas occur in both river basins but most of them in the Beaulieu are in the lower reaches where the surrounding land is comparatively flat and the shore banks low.

In 1937 a reconnaissance* of the Yellowknife was carried some 30 mi. above its mouth and in the case of the Beaulieu about 45 mi. above Great Slave lake. The flow records secured indicated that, with storage, six sites on the Yellowknife-Cameron river system would produce an aggregate average of 20,400 hp. and four sites on the Beaulieu an aggregate average of 6,350 hp. As, however, the flow recorded during 1938 was very much less than in 1937, measurements are being continued in order to ascertain more closely the normal water supply of these rivers.

The Yellowknife and Beaulieu are comparatively small rivers and, under the severe winter conditions that prevail, the minimum flow is much below the yearly average. Moreover, all the sites have comparatively low heads. The most attractive site on each river appears to be near its mouth, and if any appreciable amount of power is required, it will have to be derived through their development and through full use of available storage. The best two sites on the Yellowknife are 10 to 20 mi. from mine properties on Yellowknife bay and about 40 to 50 mi. from Gordon lake. The sites on the Beaulieu are all of relatively small capacity and perhaps cannot be regarded as economical sources of power supply except where mineral discoveries are made reasonably near.

In the Great Bear lake area, a head of possibly 25 ft. is afforded by the rapids on Great Bear river, and at White Eagle falls on the Camsell river, which has been hydrometrically surveyed, a head of approximately 70 ft. could be secured, the development of which would make available over 4,000 hp. at ordinary minimum flow and over 10,000 hp. for six months of the year.

Elsewhere in the territories there are such possible power sites of magnitude as those indicated by Virginia falls on South Nahanni river, Bloody falls on Coppermine, the falls and rapids of Dubawnt river, and the waters of the Slave river, where, just south of Fort Smith, 220,000 hp. to 500,000 hp. could probably be developed at two concentrations and made readily available for purposes in the Northwest Territories.

*By the Dominion Water and Power Bureau of Department of Mines and Resources, Ottawa.

THE PLACE OF RESEARCH IN THE EVOLUTION OF THE AUTOMOBILE

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Abridgment of address given before the joint meeting of the Hamilton Branch of The Engineering Institute of Canada and Hamilton members of The American Institute of Electrical Engineers, October 6, 1938

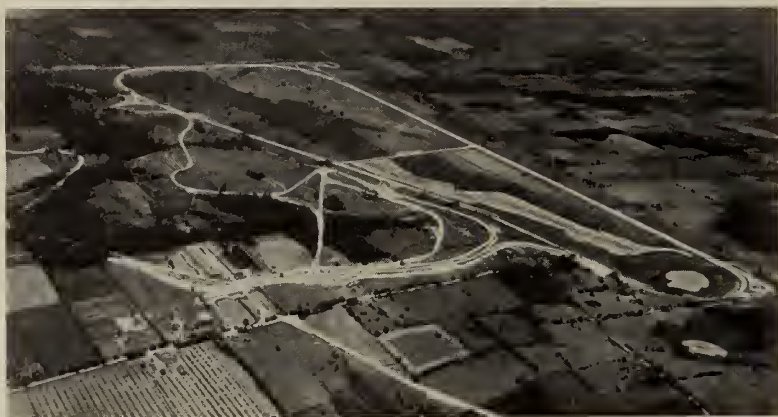

Fig. 1—An Automobile Proving Ground

In 1910, or thereabouts, rubber cost three dollars a pound. A small tire sold for 35 dollars. A big tire cost 125 dollars, 500 dollars for a set, and they would run only 5,000 miles. So the cost of the tire item alone was then 3 to 10 cents for each mile driven.

Thus it is not strange that at that time people should have been trying hard to make synthetic rubber. The best starting materials for the rubber synthesis appeared to be two hydrocarbons, called by the chemist, *butadiene* and *isoprene*. Unfortunately, neither of these compounds was easy to get. But it was known that both could be made from butyl alcohol.

Just at that time a very important discovery was made. A micro-organism or ferment was found which would ferment starch, not into the customary ethyl alcohol alone, but into a liquid of which each ten gallons contained 6 gallons of butyl alcohol, 3 gallons of acetone, and only 1 gallon of ethyl alcohol. This new ferment was given a long scientific name, of course, but in common language it was called the "butyl bug." Because it would make the butyl alcohol needed in the search for synthetic rubber, its habits were studied with the minutest care.

Then in 1914 came the World War and with it a huge demand for powder. Now the smokeless powder used in England required the use of acetone as a solvent. The acetone needed had always been got as a by-product in making charcoal out of wood. But now the amount of powder needed was so very large that the wood distillers could not possibly make enough acetone to supply it. In this emergency, the "butyl bug" already mentioned was put to work in England, in India, and in Canada, converting starch into acetone. The two gallons of butyl alcohol which it made for each one gallon of acetone was then a useless by-product which was generally thrown away.

Next the United States got into the War. When President Wilson ordered all whisky distilleries to shut down, one distillery with an experimental minded manager continued to operate. This it did by changing its ferment from yeast to the new "butyl bug," and soon a use was found for the butyl alcohol. Research in other quarters had yielded, as another important discovery, a method of making concentrated solutions of nitrocellulose or pyroxylin which were fluid enough or free-flowing enough to be sprayed on automobile bodies to make a new and much better finish than paint. It was in 1923 that this great improvement in car finishes began to be used. And then the stock of butyl alcohol and the method of making more of it out of corn by the aid of the "butyl bug" became very valuable indeed. For butyl alcohol is easily converted into butyl acetate, a solvent which proved to be indispensable in the development of the synthetic finishes.

The man who discovered the "butyl bug" was Dr. Chaim Weizmann, a professor of chemistry at the University of Manchester, England. So outstanding was the service rendered to Britain by his discovery, in solving an acute problem in relation to the powder supply, that Lloyd George sent for Professor Weizmann and said to him: "You, sir, have rendered great service to the nation, and I should like to ask the Prime Minister to recommend you to His Majesty for some appropriate honour." "But there is no honour that I want," replied modest Professor Weizmann. "Well, isn't there something that can be done as a recognition of your invaluable aid to the nation?" "Yes, I should like you to do something for my people."

Prof. Weizmann then told Lloyd George of the aspiration of himself and many other Jews to make Palestine once again the home of the Jewish people. The result, to make a long story short, was that later on the British Foreign Secretary issued the famous Balfour Declaration, which became the charter of the Zionist movement.

Now this story about the "butyl bug" illustrates an important fact, namely, that the various items of the motor car's construction came from research, out of research conducted in many quarters, both within the automobile industry proper and outside of it.

There has perhaps never been a greater borrower or adapter from other fields of endeavour, both old and new, than the automobile industry. This borrowing is in addition to all the immense amount of research and engineering done within the motor car industry itself throughout the years of its life. That is to say, while through active research of their own, automobile makers have been straining every effort to build cars better and cheaper, they have meanwhile been seizing upon new developments in every quarter and applying them to the motor car as well. This alertness and openmindedness of the men in our industry in adopting the new, from whatever source, has been a large factor in the rapid evolution of the automobile.

In saying that the automobile is altogether a product of research, I should explain that research is intended to include any search or experimentation or development which aims to better the product, or to make it at lower cost. Research and engineering are here considered together, research being the quest for new knowledge and engineering being the putting of that knowledge to practical use. The difference then is that, if research is science, engineering is *applied* science.

Now the automobile is not really an invention in the accepted sense. At least it does not appear to have been invented by any of those who claim the credit for it. On the contrary, the motor car has a long genealogy. Long before the gasoline-power automobile came on the scene, there were muscle-power carriages, wind-power carriages, and steam-power carriages—pretty successful ones too. When the pioneers of the 1880's and the 1890's began their work, most of the really essential features of the motor car were already in existence—although some of them were in a very primitive condition. These features included the gasoline engine with the cylinder and piston, the valves, the crankshaft, the connecting rod, the carburetor, and electric ignition, as well as the gasoline and oil to run the engine on. Already in existence then, too, were the pneumatic tire, the gear, the sliding gear transmission, the differential, the leaf and the spiral spring, independent wheel steering, and other features.

What our early pioneers did really consisted more of research and engineering than of basic invention. Such an interpretation of what they did does not reduce the greatness of their accomplishment. For, in spite of all they had to draw upon in the way of basic elements, the difficulties which they had to overcome in combining them into a vehicle that would go were very real.

The automobile as it first came on the American scene in the 1890's was just a buggy without a horse—and sometimes without horsepower as well, for the greatest question about those early cars was whether they would run or not.

When in 1899 the U.S. War Department bought three automobiles for the use of army officers, it was stipulated that provision be made for hitching mules to them for towing purposes. Theodore Roosevelt is said to have been the first President of the United States to ride in an automobile. That was in 1902 during a visit which he made to Hartford, Connecticut. One newspaper editor in commenting upon the event—and it was commented upon quite widely—said, "Roosevelt's display of courage was typical of him."

The marvellous advances which have since been made over the crude and unreliable vehicle of the 1890's were due to the intelligent form of experimentation which for short is called research.

Now what has the concrete effect of all this experimentation been? Well, in the mechanical field it has yielded such things as more dependable, more powerful, more economical, lighter and smoother engines; better means of carburetion, of lubrication, of ignition, of cooling; improved transmissions; easier and safer steering devices; better brakes; better springs and suspensions; and mechanical advances of many,

Fig. 2—Starting Tests in a Cold Room

many kinds. We have more beautiful and more comfortable bodies, better and more durable finishes, better and cheaper fuels and lubricants, better and cheaper tires, better steels and useful metal alloys of many kinds.

Improvements in means of fabricating cars have also aided greatly in reducing cost. Thus from 1925 to 1937 the average retail price of cars in the United States dropped from $1,007 to $704, a reduction of 30 per cent. At the same time, the appearance, performance, comfort, and general utility of cars was being greatly improved.

But, in spite of the fact that we now have such good-

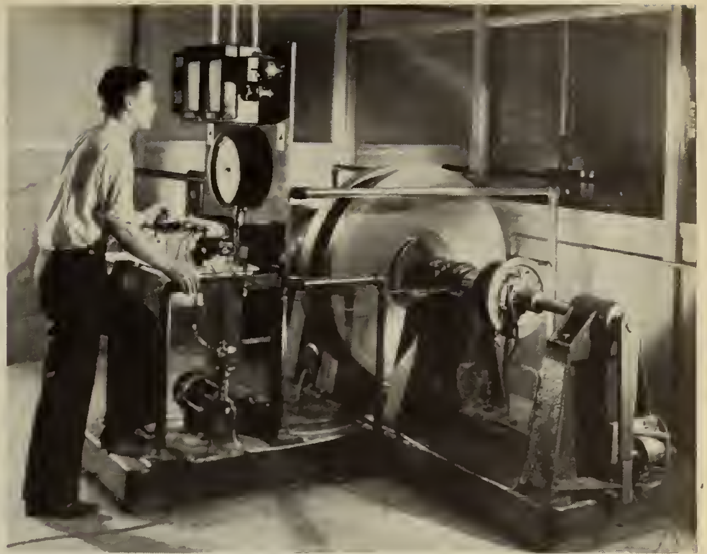

Fig. 3—Machine for Research on Brakes

looking and such good motor cars, no one thinks that they have yet reached perfection. In thus making cars better and better, we have, however, reached the stage at which all the easy things have already been done—or nearly all of them. So we are having to dig deeper and deeper for improvements, or to turn more and more to the real pioneering or fundamental form of research. To show that this is so, I need only name a few specific instances of further advances that would be desirable.

Thus one thing needed is cheaper light metals. Strange as it may seem, there is not as much aluminum as rubber in the average car. This is not because aluminum could not be much more useful, but rather because, in spite of large reductions made through past research, it still costs too much. Really cheap aluminum can not be had, until some better means has been found for prying the metal loose from the oxygen and silicon with which it is always united in nature. Getting the aluminum ore is not the problem. In nature aluminum is more plentiful than iron. It is, in fact, the third most abundant element in the world. But how better to set aluminum metal free from its ores—that is the problem, and it is one which demands the highest form of pioneering research.

Even in the case of iron and steel, much more needs to be known. One thing that is particularly needed is a more perfect way to keep iron from rusting. The advantages to be gained by finding out how to keep oxygen from attacking iron, and of doing so cheaply, are beyond computation.

We could use still better and lighter engines, more perfect transmissions, better brakes, better springs, still better finishes, and the like. We need better lighting systems for driving at night. We ought to have glass that is more truly "safety" glass than that which the term stands for now. What is needed perhaps is the equivalent of flexible glass. We should like to know how to run engines on leaner fuel mixtures and thus to get more miles per gallon. To this end we need to know more about what really happens when gasoline burns in an automobile engine. As yet we know very little about that event. This is so in spite of the fact that the whole automotive industry, and all automotive transportation in fact, depends upon it. This is why, in the General Motors Research Laboratories, we have long been making an earnest effort to replace ignorance with knowledge in this important matter of what goes on within the automobile engine.

Visitors to an automobile research laboratory sometimes ask: "What's the use of all this research business anyway? Don't you really think that the automobile is just about as perfect now as it ever will be?" The use of research is to help make sure that the future of the automobile will be just as glorious as its past.

THE BAIE COMEAU ELECTRICAL INSTALLATION OF THE QUEBEC NORTH SHORE PAPER COMPANY

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Paper presented before the Montreal Branch of The Engineering Institute of Canada, November 10th, 1938

SUMMARY—The paper discusses the design and installation of the electrical equipment for a two-machine newsprint mill with a capacity of 325 tons a day, located on the north shore of the St. Lawrence 230 miles below Quebec. A 70,000 hp. hydro-electric plant serves the mill and town site.

Fig. 1—Outardes Falls

The north shore of the St. Lawrence River below Tadousac has been logged for many years to provide both pulpwood for paper mills and lumber for building purposes. The Ontario Paper Company Limited, the parent company of this organization, secured timber limits at Franquelin and Shelter Bay during the War. About 1922 they acquired the Manicouagan Limits and power rights for the building of a groundwood mill. Preliminary studies of the power possibilities of the Outardes and Manicouagan rivers showed that at falls near tidewater considerable blocks of power were available. The site at Outardes Falls proved to be the most economical and eventually after several changes in plans the site was developed on the basis of 222 feet gross head. The Manicouagan Falls site, which had a lower head, had a much greater quantity of water which was harder to handle, and was abandoned. Consideration was given to the fact that at both sites direct driven grinders for grinding of pulpwood were possible but shipping facilities from the proposed mill sites at the falls were extremely poor and Baie Comeau was chosen as the mill site on account of its harbour possibilities. Figure 2 gives the relative location of the rivers and Baie Comeau.

Early schemes for the development of the project were based on a groundwood mill which was later changed to a paper mill. By 1930 the dams at the power site at Outardes were finished and the newsprint mill site at Baie Comeau was cleared. The plan was for a two-machine mill which later might be expanded to four machines. Under depression business conditions the project was left in abeyance for nearly six years. With business on the upgrade it was re-opened in 1936 and the first paper was made in January of 1938.

The Outardes River at its mouth has a drainage area of about sixty-three hundred sq. mi. and the minimum river flow makes it possible that under worst conditions 42,000 hp. can be delivered to the mill on week days with the Sunday flow ponded up and distributed over the remaining six days. The decision to instal two 262 in. newsprint machines capable of turning out 325 tons daily required that 35,000 hp. be made available at all times for mechanical power. To provide against contingencies it was decided to instal two 35,000 hp. turbines driving two 26,315 kva. generators, one of which would be considered a spare and would be used to supply power to the electric boilers.

In designing the power system great care was taken to provide good speed regulation and a large surge tank was provided at the end of a 17 ft. 6 in. dia. pipe line, which is over a mile long, conducting the water from the intake to the power house. From an electrical point of view the conditions of both transient and static stability were thoroughly analyzed. The considerations dictated high speed circuit breakers, low reactance generators, transformers and grinder motors and good line regulation. The results from the design based on these studies have been highly satisfactory, since it has been found possible to start a 3,500 hp. grinder motor, whilst the power house was carrying 52,000 kw., without breaking the paper on the machines.

High Tension Switching System

The design of the high tension switching scheme was given a great deal of detailed study by H. G. Acres and

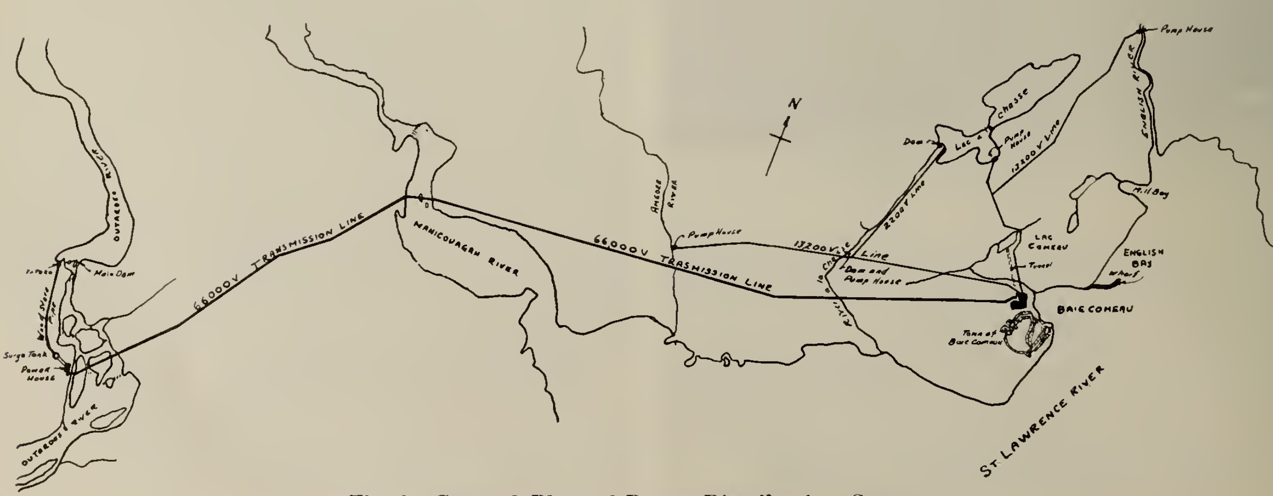


Fig. 2—General Plan of Power Distribution System

Company and the Ontario Paper Company's engineers. The possibilities of a low tension switching system on the power house with horn gap switches on the high tension side were thoroughly explored but the idea was dropped on account of the small additional cost of a high tension ring bus. The transmission line voltage was also computed for three voltages, 33,000, 44,000 and 66,000, and it was found for a

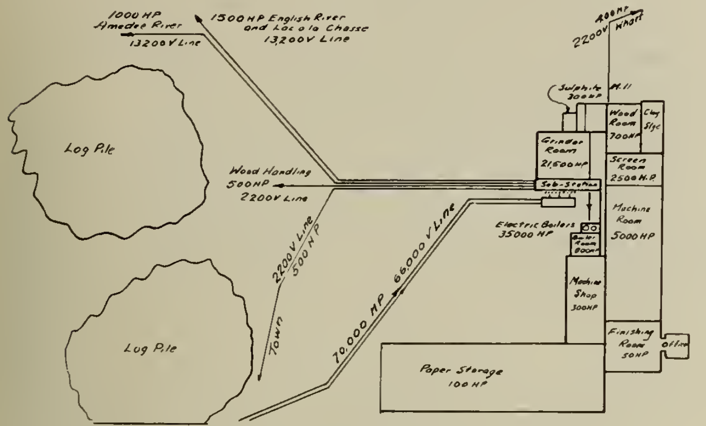


Fig. 3—General Plan of Mill Distribution System

given regulation that 66,000 volts was the cheapest. The deciding factor was that with two per cent regulation at full load using a high tension ring bus the load could be dumped on a single circuit without upsetting mill operation should a fault occur on one line. The station service at the power house was taken from the low tension leads of one of the generators. For standby service a 300 hp. gasoline engine was provided and connected to the station service bus.

The general layout of transmission lines at the mill is shown in Fig. 3 and Fig. 4 gives a view of the outdoor transformer and switching station at the Falls. The system load from mill motors was estimated at 32,000 hp. for 350 tons daily output, which is 3,000 hp. below the turbine rating. This figure has now been reached and it was believed that if the six 3,500 hp. grinder motors were designed for 90 per cent power factor loading that the load on the generator bus would have 97 per cent power factor. The result has been that with the induction motors load at 75 per cent power factor and including line and transformer reactance the power station operates at an average power factor of 98 per cent, which fully justifies the selection of the generators at 95 per cent power factor. The step-up transformer banks at the power house were made 25,000 kva. which is close to the generator capacity when losses are considered.

At the mill substation it was decided to instal three transformer banks, one for the boiler house, one for large motors at 2,200 volts and a third bank for small motors at 550 volts. Here again the ring bus proved very economical and gave a high degree of flexibility since it often happens that boiler loads on small systems must be segregated so to minimize their disturbance on paper mill operation.

The mechanical power load at the mill consists of two loads fed by transformer banks at 550 and 2,200 volts which total 32,000 hp. or 24,000 kw. The boiler load is fed from a 25,000 kva. bank which operates at 4,400 volts and is fully loaded. The 22,000 kw. load on the 2,200 volt system is fed from a 25,000 kva. transformer bank. To supply the small motors at 550 volts a 5,000 kva. bank is provided.

To reduce the investment in spare transformers for the 2,200 volt system and the electric boilers a single transformer with a series parallel set of connections on the low tension winding provides a spare unit for both services.

Mill Substation

The location of the mill substation with respect to the various departments was considered from many angles and it was finally found possible to locate it at the electric centre of gravity of the entire plant, which made a saving in feeder cable costs and also made it possible to have a central substation where all loads could be supervised by a single operator at all times.

The choice of power distribution system including the selection of a suitable voltage was given very careful study. Grinder motors are operated at 13,200, 6,600, 2,200 and in some cases 550 volts in mills. The costs at 6,600 and 2,200 volts were carefully computed. Comparative schemes were estimated on the basis of total cost of high and low tension switching, transformers, motors and starters, and feeder cables. The most economical scheme proved to be a 2,200 volt system for all large motors and including motors as small as 100 hp. The largest difference in costs proved to be in the case of the grinder motors, where an increase of 10 per cent was found if 6,600 volt motors were used.

The scheme as selected provided for very heavy buses at both 2,200 and 550 volts. Had a 6,600 volt scheme been used on the large motors the 550 volt motor load would have been increased 50 per cent, with a corresponding increase in switching equipment because of the small number of motors in the mill that could be made 6,600 volts. Some mills have three voltages, namely, 6,600, 2,200 and 550 volts. Studies on this scheme showed much added cost especially in feeder cables. There are also some mills where small step-down transformer banks are located throughout the plant. In the design it was found by careful estimating that a single bank centrally located was cheaper. A single line diagram of the whole power system is given in Fig. 5.

The rupturing capacity of all 2,200 volt breakers was made 250,000 kva. with a high thermal capacity. All 550 volt breakers were built for 75,000 kva. rupturing capacity. Current transformers for meters and relays were all specially braced to withstand short circuit conditions from heavy currents.

Referring to Fig. 3 it will be noted that the heaviest motor load to handle is the grinder room and there the feeder runs average only a hundred feet. Next in importance in size of load is the machine room and the average length of run line is about four hundred feet whilst the screen room is only three hundred feet away. The feeder runs to the other departments are not great and the loads comparatively small. To provide power supply to pumps for fresh water and logging purposes located at some distance from the

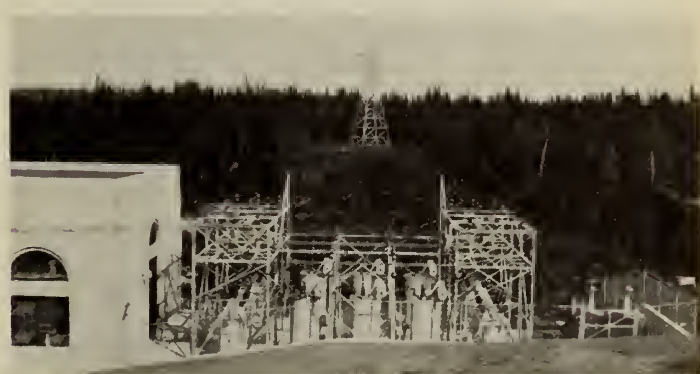


Fig. 4—Outdoor Transformer and Switching Station at Outardes Falls

mill step-up banks of transformers were located on the west side of the substation stepping up the voltage to 13,200 volts.

The substation building consists of two floors which house the control room, the switching room, the auxiliary power supply room and the exciter room. See Figs. 6 and 7.

The two four hundred horsepower Diesel engines which were used for construction purposes to build the plant are now permanently located in the basement near the passageway. An emergency connection is provided to the Diesels so that mill lighting, town lighting and other essential services can be taken care of in case of a power supply failure. Over the Diesel engine room is located the exciter room where all direct current is generated for synchronous

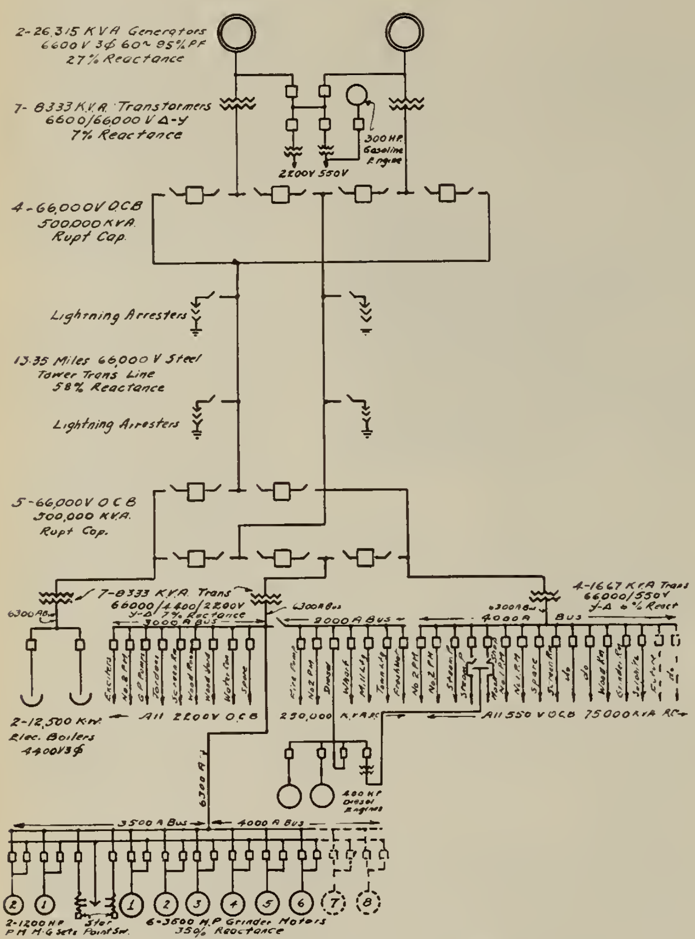


Fig. 5—Single Line Diagram of Power System

motor use in the mill. Two 250 kw. 110 volt d.c. generators, one of which is spare, were installed. The control room which is on the same floor as the exciter room contains all switchboards controlling every feeder to the mill as well as a bench board and relay panel for the high tension switching.

The general arrangement of the switchboard is U-shaped so that the operator with a central position can see all instruments. All instruments are of the illuminated dial type. For feeder protection over-current relays of the inverse time limit type with instantaneous trip on short circuit were selected. On synchronous motor feeders no voltage relays were added. The tripping or control circuit is fed from a 60 cell Exide battery which is charged continuously by a battery charging motor generator set.

The switch room contains fifty-two oil circuit breakers which are built into metal-clad structures. The main buses coming from the transformer banks pass through wall bushings and immediately inside the wall the delta bus connection is made. From this point the buses which are formed channel copper are carried across the top of the room to points where they drop down to distribution buses over the oil circuit breakers. The buses over the oil circuit breakers are gum filled on the 2,200 and 4,400 volt bus, but metal enclosed only in the 550 volt structures. Metal-clad switching was selected in preference to open type on account of its improved safety features and reduction in building space requirements as compared to open type switching. See Fig. 8.

Provision for filtering oil and repairs to transformers was made in a bay for repairs at the west end of the substation.

Distribution Cable System

The power distribution system consists of paper-insulated lead-covered armoured cables. All cables are connected to the metal-clad switch structures through potheads of the capnut type, thus preventing moisture from entering the cable in any way. For similar reasons at large motors or distribution panels capnut potheads are used. In the case of the grinder motors 2,000,000 c.m. single phase cables were used. These were carried in 3½ in. fibre ducts which have forced ventilation so as to maintain even temperature throughout. For 550 and 2,200 volt feeders three-conductor armoured cables were used which were carried on steel channels bolted on walls. This arrangement also gave good ventilation and practically no reduction in current carrying capacity was necessary on account of the cables being close to one another. A comparison of armoured cables versus conduit and cable inside showed that the cost was about equal with complete elimination of the hazard of the destruction of conduit through rust and corrosion. The operating experience so far has been highly satisfactory without a single interruption of any kind. It is also the author's belief that the erection of armoured cables supported on structural channels is faster than putting up conduit and pulling in cable.

Motors

The motors for grinders, air compressors, jordans, vacuum pumps and the motors for driving the paper machine motor-generator sets are all synchronous. Their selection is in accordance with operating experience for many years and at the same time their cost is lower than for induction motors of either squirrel cage or slip ring type. One might almost say all the large motors in the mill are synchronous having high efficiency and unity or leading power factors.

Wound rotor induction motors are used for starting heavy loads like drum barkers and conveyors. Lightly loaded conveyors, however, are driven by high torque squirrel cage motors which have double cage rotors. For pumps, fans, blowers, etc., standard squirrel cage motors are used. All cranes are operated by wound rotor motors.

Motors of the squirrel cage type 50 hp. or less are started by the across-the-line method. Above this size reduced voltage type starters are used. A notable exception is the 400 hp. fresh water pumps where double cage rotors are used and a primary resister type starter is employed so as to permit starting by the Diesel engines if necessary under emergency conditions.

Fig. 6—General View of Substation at Baie Comeau

All induction motors were built to NEMA standards where possible and are of the drip proof or protected type. Anti-friction bearings were used almost in every instance.

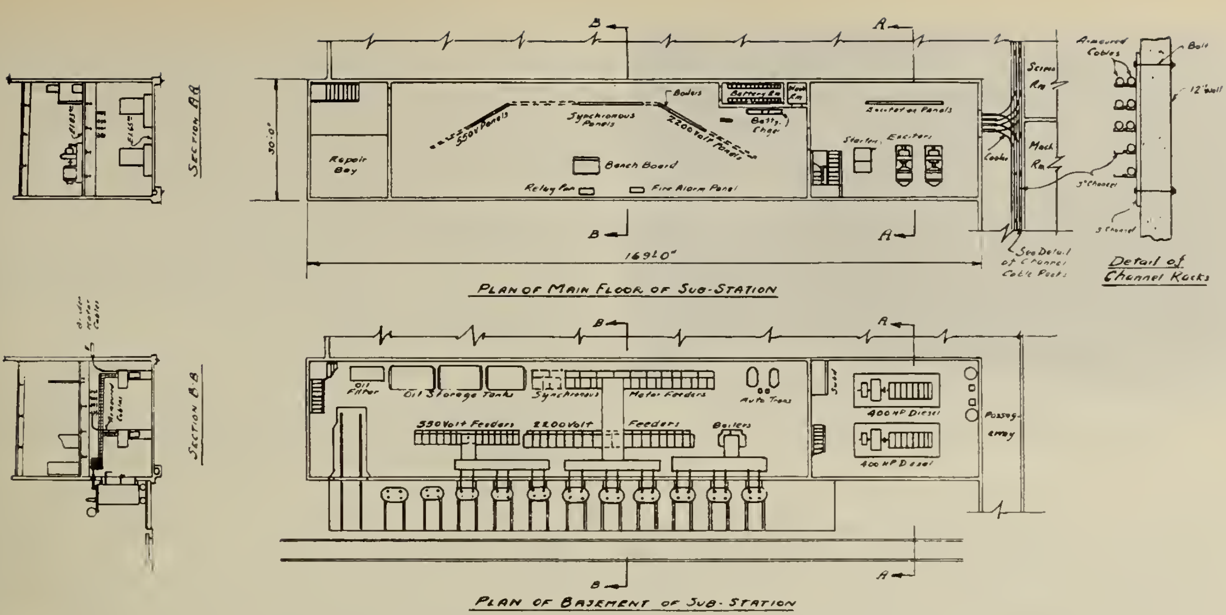


Fig. 7—General Plan and Section of Substation Baie Comeau

Motor Control Equipment

The problem of motor control in any large mill is a difficult one and in the Baie Comeau project was given very serious study because of the relatively small power supply, the large motors to be started, and the possibility of speed fluctuation due to frequency variation from starting loads on the power system.

Large grinder motors are started by the reduced voltage system in most Canadian mills, using one or two auto transformer taps. In one instance, however, across-the-line starting is used. In Europe auto-synchronous motors are generally used. Reduced voltage automatic starting with push button control was adopted as the most suitable for the job. To prevent bumps on the line between steps the closed transition method was used and excitation is applied just before the motor reaches synchronism. For smaller synchronous motors the slip frequency relay system is used.

From a safety point of view the motor starter is a point of difficulty. Oil switches for substations are selected so as to take care of all eventualities but motor starters located in the mill are seldom capable of interrupting more than six times full load current of the motors they start. This question is very important in the case of 2,200 volt starters where the power supply comes from a large power system. There is also the problem of branch fuses and disconnecting switches in the case of 2,200 volt motors.

This problem was solved by selecting high rupturing capacity 2,200 volt oil-immersed contactors and fuses which were mounted inside sheet steel cubicles with disconnecting switches on the line side for isolating purposes. These are shown in Fig. 9. Where two or more starters were grouped together, a bus connection is carried along the top of the cubicles which had steel doors provided in front and rear for inspection purposes. The extra cost of cubicle construction at 2,200 volts was justified by the reduction of field work since they came from the manufacturer completely assembled and did not require any special room to contain them. One or two serious troubles have occurred but the equipment took care of the situation without any serious results.

Power distribution panels for 550 volts were of the cabinet type with a dead front when the branch connection door was opened. For branch connections up to 50 hp. the switches could be opened under load, or in other words the switch had a horsepower rating.

Paper Machine Drive

To operate the paper machines a sectional drive was purchased. Since the War direct current motors have been applied to the sections of paper machines with great success and the mechanical drives with slip belts and cone pulleys have almost disappeared. The big problem has been speed control over a range of high speeds, at the same time taking care of the draw or shrinkage of paper between the respective sections. This has been accomplished by a differential type of regulator operating on the shunt field of the sectional motors. Fig. 11 shows the paper machine drive motors.

Fig. 8—Metal Clad Switchgear at Substation

For starting up the respective sections several methods have been employed, namely, kicker motors, armature resistance control and Ward-Leonard control through the medium of a special or starting generator. Each scheme has its particular advantages. In our case the manufacturer recommended the starting generator scheme and the results have been very gratifying. The speed of the machine is controlled

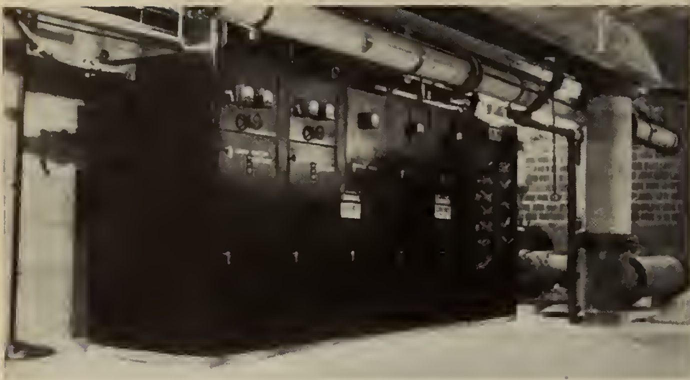


Fig. 9—Cubicle Type Motor Starter

by a master governor or governor lock as it is called. It works on the basis of controlling the speed directly instead of maintaining a constant voltage as was previously the method employed. So far the results have been highly satisfactory and paper speeds have been maintained within half of one per cent even with frequency variation of upwards of two cycles.

All sections of the paper machine are started, stopped and inched by controllers placed on pedestals in the tending aisle between the paper machines. See Fig. 10.

Paper Mill Wiring

Most of the branch lighting and power wiring is carried in rigid conduit and rubber-covered wire. In basements or wet locations lead covering is used on all insulated cables.

The paper machine drive is wired up entirely with lead-covered armoured cable so as to protect against moisture. The results so far have been excellent as not one ground has occurred. Grounds on the control circuits of paper machine drives are often exceedingly troublesome.

To take care of acid and fumes in the sulphite mill lead-covered cables with a tinned copper armour were used exclusively. It is hoped that this scheme will reduce the maintenance cost of wiring in this department.

Lighting

The importance of lighting in paper mill work can scarcely be over-estimated. Accidents, breakage of machinery and production are all affected by the quality of illumination. The Baie Comeau mill was designed for high illumination throughout, especially the machine and screen rooms where the most important parts of the process are concentrated. To provide ample lighting in these departments a light intensity of ten-foot candles was provided. Similarly in the machine shop the intensity was also high.

Fig. 10—General View of Paper Machine Room

Holophane units on high mounting lights with 500 watt units were used exclusively. In damp locations vapour-proof units were used. Behind the dryer cylinders a special narrow beam holophane unit was used with advantage. For yards, the wharf and wood piles large floodlights of 2,000 watts each were used exclusively. This scheme proved very effective and at night it was possible to read a newspaper by the flood lights in most parts of the yard.

To provide power for lighting, transformer banks fed from a 2,200 volt feeder were located at various points in vaults. The branch distribution circuits were protected by No-Fuz circuit breakers.

Outside Power Distribution

Leading out from the mill, over fifteen miles of pole lines were constructed to deliver power to fresh-water pumps, jack ladders, and flume water supply pumps.

These lines were for the most part 13,200 volt lines and were carried on wooden poles with wishbone type of cross arms. To feed these lines two banks of transformers were located at the mill stepping up from 2,200 to 13,200 volts. Along the flumes for sluicing wood into the mill, lighting fixtures were located every 150 feet. These lights were fed by 13,200 220/110 volt transformers located at intervals of a half a mile. Over seven miles of flumes were lighted in this manner.

Fig. 11—Paper Machine Drive Motors

Town Distribution System

Town power supply is taken from the main 2,200 volt bus in the substation and under terms of its charter the company is to supply to the town power at $12.50 per hp. year based on a 20 minute peak. The town in turn retails it to the domestic customers at rates which average less than a cent per kwh. The results of this scheme have been very gratifying and with about 225 meters installed the monthly consumption per meter averages 700 kwh. The load factor is over fifty per cent due to a large use of water heaters and stoves. Outdoor types of meters were used entirely.

The town distribution lines which are a combination of street lights, telephone and domestic power distribution are over three miles in length. The street lighting system is of the multiple type with relays at intervals controlling groups of lights all operated from a central time switch.

Telephone and Fire Alarm Systems

To provide telephone service to the town and mill a 150 terminal automatic telephone switchboard was installed. All connections to subscribers are made through lead-covered cables carried on the power line poles through the town. Upwards of 200 subscribers are now served from this board, which has both individual and party lines.

For long distance work a short wave Marconi station connects with Rimouski and this provides telephone connection to outside points through the land lines of the Bell and other connecting companies. In addition to the automatic telephone board a manual board of twenty terminals provides interconnection between magneto phones at outside points and automatic subscribers.

An automatic fire alarm system protecting the mill, hotels, wood piles, and domestic residences has been installed. A supervisory alarm system for the sprinkler system is also provided.

The work of electrical installation at Baie Comeau, which has extended over two years, has at times employed as many as 180 men. Over 125 carloads of material and equipment have been used. The connected load of motors installed and now running totals over 40,000 hp. not including 2,000 hp. spares. The power system which has now operated over 12 months has turned out from the beginning of the year almost 1,000,000 kwh. per day.

The author wishes to thank the following manufacturers and others for their hearty co-operation in carrying out this work: Canadian General Electric Co., Canadian Westinghouse Co., English Electric Co., Commonwealth Electric Co., Northern Electric Co., Bepco Canada Ltd., Canadian Ohio Brass Co., Dominion Electric Protection Co., Allen Engineering Co., Canadian Hoosier Co., and the Canadian Comstock Co. who installed the wiring. Thanks are also due to John Stadler, M.E.I.C., the Consulting Engineer.

THE SMEATONIAN SOCIETY OF CIVIL ENGINEERS

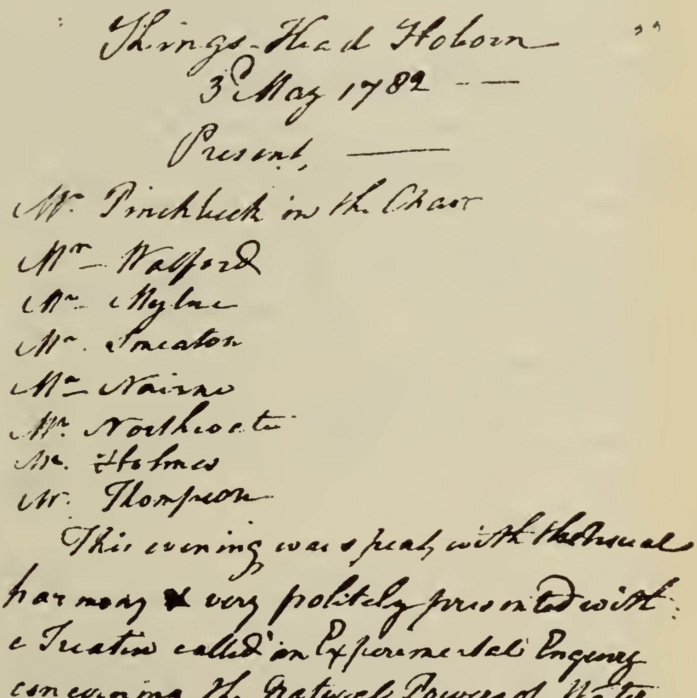
A PAGE FROM ENGINEERING HISTORY

Among the recent accessions to the Institute library there is a modest brown covered volume, presented by one of our London members, Lt.-Col. C. G. DuCane, which is of more than passing interest. It records the early doings of the Smeatonian Society of Civil Engineers, a body which was established in England nearly a hundred and seventy years ago, and still continues to hold regular meetings. Our presentation copy is a facsimile reproduction of the first minute book of the Society; its 142 manuscript pages cover the period from March, 1771, to April, 1792. Their story is not quite continuous. Some of the pages, indeed, are blank, but the actual minutes of the meetings are amplified by an assortment of memoranda, statements of receipts and disbursements (including one of 1s 2d, the cost of the original book), addresses of members, and even one or two rough sketches which presumably represent the first glimmerings of some member's ideas for an invention or engineering achievement. The book is in fact a document of historic value, for it throws light on the lives of many of the men whose work at that time was producing fundamental changes in transport and industry in Britain. By the middle of the eighteenth century, a notable class of civilian engineers had arisen, whose occupation it was to design and construct canals, roads, bridges, harbours, mills and machinery and other works analogous to those formerly executed by engineers in military service.

John Smeaton, then prominent in engineering work of this kind in England, particularly in connection with the drainage of the fens and the building of the first Eddystone lighthouse, was among the first of these practitioners who adopted the title of "civil engineer" to distinguish themselves from the military branch. At the same time he saw the advantage to the members of this new profession that would arise if they met together from time to time for friendly discussion. A society was accordingly formed for this purpose; its first meeting took place on March 15th, 1771, in London, at the King's Head Tavern, Holborn, Mr. Smeaton being present although not in the chair. Its first resolution was as follows:

> "Agreed that the Civil Engineers of this Kingdom do form themselves into a Society consisting of a President, a Vice President, Treasurer Secretary and other Members who shall meet once a fortnight on Saturday evenings at seven o'clock from Christmas or so soon as any of the country members come to Town (of which they shall give notice to the President) to the end of the sitting of the Parliament at the King's Head in Holborn. It is further agreed that each Member in Town shall pay a forfeit of one shilling for being Absent, unless he is out of Town. It is also agreed that Rules and Orders shall be constituted for the well governing of this Society."

Members of the new Society were not long in realizing the fundamental importance of finance in their operations,


Kings-Head Holborn
3 May 1782 —
Present —
Mr Pinchbeck in the Chair
Mr Walford
Mr Mylne
Mr Smeaton
Mr Nairne
Mr Northcote
Mr Holmes
Mr Thompson
This evening was spent with the usual harmony & very politely presented with a Treatise called an Experimental Enquiry concerning the Natural Powers of Water and Wind by our worthy Member Mr Smeaton and Mr Walford as politely presented this Society with Englands Improvement by Land by Yarranton —

for at the very next meeting it was found that funds other than the "forfeits" must be provided and properly administered. Accordingly, it was then voted as follows:

> "And whereas there will be some expences attending the carrying on the business of the Society it is agreed

that all forfeitures shall be applied to that purpose, and that each Member shall pay into the common Stock three pence Weekly to be laid out as the Society shall think proper which weekly payments shall commence from the first meeting of the Society, March 15, 1771."

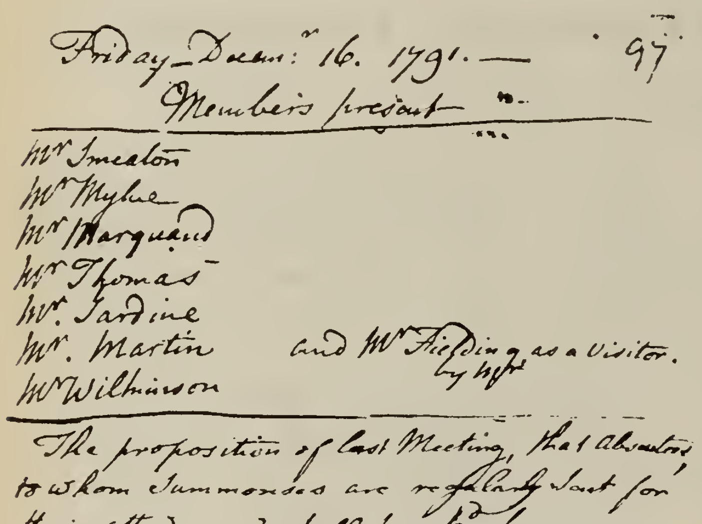
This system of finance seems to have proved somewhat difficult in practice, for just a year later it was

"Resolved that every person admitted a member shall upon such admission pay one Shilling for the benefit of the Society in lieu of all Fines, Forfeitures and Weekly Contributions."

But after only six years, on March 14th, 1777, the amount had to be increased to five shillings.

These rulings, however, were subject to temporary modification in cases of emergency, for it is recorded that at the very next meeting, on March 21st, 1777,

"Mr. Pierce our Landlord was elected a Member of this Society and instead of the customary fee for introduction, furnished a five shilling Bowl of Punch and then this meeting was adjourned to this day s'ennight."


Friday Decem^r: 16. 1791. — 97
Members present —
M^r Smeaton
M^r Mylne
M^r Marquand
M^r Thomas
M^r Jardine
M^r Martin and M^r Fielding as a Visitor.
M^r Wilkinson
The proposition of last Meeting, that absentees to whom Summonses are regularly sent for their attendance, shall pay 6^d. for every Absence was put to the Vote and carried unanimously. —
The Bill — £1-6-10
2-2 Servant
£1-9-0
Paid by 9 persons present 1-8-0
and advanced by M^r Mylne 1-0
£1-9-0
Adjourned to Friday the 6 Jan^y. 1792.

With such prudent management, and with the motto, *Omnia in numero pondere et mensura*, the Society flourished for twenty years, when its roll of over sixty members included the names of such prominent engineers, natural philosophers, and constructors as Smeaton, Grundy, Whitworth, Priestley, Boulton, Watt, and Rennie.

Apparently many of the first members were concerned with schemes for public works or enterprises for which parliamentary sanction was needed. This would explain their presence in London and the holding of meetings while Parliament was sitting. No doubt it was this common interest which led to their association as a society for the communication of ideas and knowledge and for regular meetings. The old minute book records that one of these evenings was "spent canallically, hydraulically, mathematically, philosophically, mechanically, naturally, and socially"; another meeting is chronicled as being "agreeably contradictory," a characteristic which is not unknown in some societies of the present day.

But the young society had its ups and downs. There are apt to be very critical people in all such bodies. Even Smeaton is believed to have commented unfavourably on some of the reports made by brother engineers. There were finally "some untoward circumstances in the behaviour of one gentleman, towards Mr. Smeaton" which "gave rise to disunion." In fact in 1791 there was a distinct unpleasantness. An attempt to patch it up resulted in Mr. Smeaton's accepting an apology, but "the remembrance of it had an effect on all present." Shortly thereafter, in May, 1792, the society ceased to exist, by mutual consent of its members.

Without much delay it was arranged to renew the society "in a better and more respectable form." Smeaton agreed to be a member, but he died in October of that year, and the first meeting of the reconstituted society did not take place until April, 1793.

That Society still exists in London as the Smeatonian Society of Civil Engineers. It now consists of forty-eight engineer members and twelve honorary members, who dine together six times a year, and of course have an Annual General Meeting. As Sir Alexander Gibb points out in his life of Telford, the reformed Society was "from the outset eclectic, and only the senior and the eminent were eligible" for membership. Its list of presidents—continuous since 1841, except for the years of the war—reads like a catalogue of distinguished engineers, including as it does such names as Rennie, the Stephensons, Brunel, Donkin, Siemens, Wolfe Barry, Baker, Kennedy, Unwin, Fitzmaurice and Denny.

The Society takes pride in maintaining that respect for custom and tradition which is characteristic of so many British organizations. In fact, since 1794, the following toasts have invariably been proposed at its dinners:

"The King and Constitution,"
"The Society of Civil Engineers,"
"Absent Members,"
"The Memory of our late worthy brothers: Mr. Smeaton, Mr. Mylne, Mr. Watt and Mr. Rennie," and
"Success to Waterworks, public or private, that contribute to the comfort, or the happiness of mankind."

These are always followed by a sentiment: "Dam the Canals, Sink the Coal Pits, Blast the Minerals, Consume the Manufactures and Disperse the Commerce of Great Britain and Ireland."

At the 150th anniversary of the foundation of the Society, celebrated in 1921, its President, John Strain, M.Inst.C.E., stated that "forty-seven years after the Society was formed, it constituted a nucleus from which The Institution of Civil Engineers was established on January 2nd, 1818." Thus the Smeatonian Society of Civil Engineers—probably the oldest engineering society in the world—was in a sense the parent of that senior Engineering Institution whose long and honourable record goes back to the very early days of the development of engineering as a profession.

A full account of the Society's early history is given in the preface to the "Reports of the late John Smeaton" which were published in four volumes by the Society in 1812, and from which much of the material in this article has been drawn. To mark the Society's centenary in 1893, there was published a facsimile copy of the minute book of the original society of 1771, together with lists of presidents and members. A second issue of this volume was made in 1937; it is a copy of this edition which has been presented to the Institute.

Our readers will be interested in deciphering some of the quaint entries in this book as given in the accompanying reproductions of two of its pages.

DISCUSSION ON WELDING IN SHIP CONSTRUCTION

Paper by William Bennett,[1] presented before the Montreal Branch of The Engineering Institute of Canada, October 27th, 1938, and published in The Engineering Journal, September, 1938.

F. P. Shearwood, m.e.i.c.[2]

This subject is of intense interest, not only to shipbuilders, but to all those using steel for structures and machines, because welding, due to its ability to connect two pieces of steel together without loss of section or the need of extra weight of connecting material, is bound to more and more displace riveted and bolted construction.

In the case of the *Fullagar* it is noted that there was no corrosion after a considerable period of service, especially at and near the welds. Is this the experience with other ships? I have always been led to believe that material which is highly strained is more liable to suffer from corrosion than parts which are not so highly strained.

The author refers to the failures or troubles when high strength steel (that is low ductile steel) is used. This indicates that for many structures the real factor of safety is the strain margin rather than the nominal margin between the figured stress and the ultimate strength of the steel. That is, a high ductility in many cases will provide greater safety than high ultimate strength.

The paper also refers to the possibility of a ship adjusting itself in various ways so that the internal strains which have been set up during fabrication will be neutralized. The author features the fact that a welded ship has less opportunity for this adjustment on account of the rigidity of its joints as compared with a riveted vessel which is supposed to do what is called a "shake-down." This evidently is a slight slipping of the rivets in their holes and perhaps some springing or bending of the limber angle connections, which are absent in welded construction. It would be interesting to know if a new riveted ship has to have many rivets caulked after its first voyage and, if so, is not the slip in these rivets due to assembling strains being more or less relieved, while in the case of welds this adjustment cannot occur? If, however, this slipping is counted on to soften the impact of a ship in a rough sea, will it not result in continual working of the joints and eventually cause trouble?

The paper refers to the probable relief of internal straining over a period of time, which I firmly believe takes place and is perhaps verified by experience. Old structures and especially badly corroded ones will stand up to excessive overloading because a readjustment can slowly take place so as to equalize the strains and bring every part of the structure to participate to its utmost value in the resistance, even to the extent of bringing the inner fibres of material, in bending, to take a far greater share of the stress than their distances from the neutral axis would warrant. It has also been noted that cracks, etc., are more likely to occur directly or soon after fabrication than later. It is often a practice to let castings weather for a time so as to allow such relief to the cooling strains before using them.

E. R. McMillan[3]

In the reference at the beginning of his paper, to the historical aspect of welding as applied to ship construction, the author might have mentioned whether or not anything occurred during the life of the *Cedros* ex *Fullagar*, which would indicate the presence of locked up stresses after a number of years in service. Although this vessel may be the classic example of welded ship construction, several noteworthy all welded or partly welded vessels were built in various countries between 1920, the year of building of the *Fullagar*, and 1935, the year of building of the second oldest of the vessels described in the paper, from all of which valuable lessons were learned in the art of building welded ships.

In the case of the *Franquelin*, it is noted that the framing consists of inverted angles welded toe to the shell plating, whereas in the other vessels of which drawings are shown all frames have faying flanges to the shell, although not all of them are intended for operations in which canals are regularly negotiated. In these latter vessels advantage has not been taken of the saving of hull weight due to the former method, although it is noted that faying flanges have been dispensed with on bulkhead stiffeners.

The type of construction of the 245 ft. tanker built in 1935 for Norwegian owners is very interesting and it is noted that all internal surfaces of the cargo tanks are free from obstruction and thus easily cleaned by the special tank cleaning apparatus which is installed. It would also be interesting to know what means were provided for ensuring freedom from dangerous gases in the double bottom and side spaces in way of the cargo tanks, or if the efficiency of the welding was found sufficient to obviate the necessity of providing for such contingencies.

It is not apparent why the bulkhead boundary angles on the *Beeceelite* are fully welded heel and toe. For the purpose of sealing the joint, only a light run of welding would be required, but for strength purposes intermittent welding would appear to be sufficient, and in this connection it is noted that the faying flanges of the frames are intermittently welded, not sealed.

There does not appear to be any particular advantage in slotting the bulkheads, in way of the brackets to the longitudinals, as shown in Fig. 11, as the strength of the connection is no greater than that of the weld attachment to the longitudinal as shown in the diagram. Figure 13 substitutes a round bar for the bracket slotted through the bulkhead and causes one to consider the difficulty of getting down into the root of the joint of the bar with the longitudinal to ensure a satisfactory weld.

In addition to the sequence of welding outlined by the author, it might be suggested that if it were possible to proceed with welding on top as well as simultaneously on bottom and sides, the tendency of the ends of a welded ship to rise during construction would be greatly reduced if not avoided. Such a procedure may not always be practicable, however, and careful attention to this tendency, and suitable corrective measures have given very satisfactory results, where the regular methods of construction were followed.

The suggestion that the shell welding should be completed and the internal structure, also, before they are welded together is not quite clear and might be construed to mean that the "panel" system of shell construction, in which automatic welding may be used as mentioned elsewhere in the paper, is not favoured by the author so much as the method in which the framing is erected and completed first and the shell plating added thereto, plate by plate.

It is perhaps becoming less necessary to stress the importance of using good quality electrodes in a proper manner, but the necessity of careful workmanship under proper supervision cannot be over-stressed.

With reference to the use of distillate for checking welding prior to watertesting, it is believed it was first used in connection with ship work on the first two electric-welded oil tankers built in Canada—the tow barge *Bruce Hudson* (165 ft. long) and the twin screw motor tanker *Transiter* (180 ft. long), both of which were built at Fort Erie on the Niagara River in 1936.

(author's reply will be found on page 186)

[1] Principal Surveyor for the United States and Canada, Lloyd's Register of Shipping.

[2] Consulting Engineer, Dominion Bridge Company, Montreal.

[3] Surveyor, British Corporation Registry of Shipping, Toronto, Ont.

Abstracts of Current Literature

Contributed abstracts of articles appearing in the current technical periodicals

AIR RAIDS, STRUCTURES AND A.R.P. IN BARCELONA TO-DAY

By C. Helsby, M.I.Struct.E., in The Structural Engineer, January, 1938

Abstracted by Prof. R. F. Legget, m.e.i.c.

(Note—A tragic interest is now attached to this paper on the partial destruction from the air of a notable European city so well known to many Canadians. The paper and its discussion attracted such attention, possibly because of the comparisons made between Air Raid Protection work in Spain and Great Britain, that they have been reprinted as a separate pamphlet.)

This paper is a record of the author's observations made in Barcelona and a comparison of them with his opinions regarding Britain's position in the event of being exposed to attacks by hostile aircraft. Barcelona is briefly described at the outset and it is mentioned that the subsoil is a compact clay containing about 50 per cent of sand and gravel which greatly facilitates construction. Town planning has been carried out on ambitious lines and has achieved great success. At the outbreak of the Civil War the city was in the process of being completely rebuilt and replanned. Building was rigidly controlled as regards planning but there were no regulations regarding the stability of structures. This resulted in most of the buildings being of brick. Against this may be set the fact that the designers aimed at creating airiness and coolness in the streets and buildings and the author states that he feels sure that this planning contributed in no small measure to the health of the people during the last two and a half years of war.

The air raids which have taken place in Barcelona have been carried out by a diversity of methods and with many kinds of bombs. The author states that in his opinion there is sufficient evidence that raids would not have been made near to civil populations unless the true objective of the raids had been to break the morale of civilians. The fact that villages around Barcelona have been mercilessly bombed with the excuse that a road or a railway passed through the village confirms the author's view that the bombing had as its principal object that of terrorizing the people in order to make them accept a peace.

The greatest damage of all was done by the collapse of the upper portions of affected structures owing to failure of supports. In addition, the inertia of gases produced by the explosions created a partial vacuum which caused most complete collapse of the unframed structures in Barcelona. Frameless structures have suffered very great damage. A clear contrast between the behaviour of frameless and framed structures is obtained and illustrated by descriptions of the few framed structures which have suffered from direct hits. The Market Hall in Barcelonetta was hit by bombs on innumerable occasions but the frame still stands. It is a framed structure having a steel truss roof supported by cast iron columns. The author found only one example of a reinforced concrete structure that had been subjected to a direct hit, this being a market hall constructed with double cantilever beams supported by a single row of columns. A remarkable feature of this explosion was that the only damage done to the structure was that of the punching shear of the bomb itself. The evidence presented leads the author to the conclusion that in the case of framed structures damage by the most serious bombs used (namely of 1,000 kilos in weight) can be localized in so far as complete destruction is concerned.

The comparison between A.R.P. measures in Spain and Great Britain is not of special interest for Canadian readers, but it may be noted that the comparison is not always to the credit of the existing British plans.

TURBINE TRENDS

By W. E. Blowney in Power, January, 1939

Abstracted by Prof. L. M. Arkley, m.e.i.c.

In an informative article on Turbine Trends, W. E. Blowney of the General Electric Company of Schenectady, N.Y., asks the question, "What would a fashion show of this year's turbines exhibit? Tops or condensing, 3,600 or 1,800 r.p.m., how about pressure, and temperature, and hydrogen cooling for units over 10,000 kw.?" He then proceeds to give the answers to these questions by comparing the large turbines bought during the past four years from the General Electric Company with those purchased during the last four years of the 1920's.

In his article the author presents twelve charts from which the following information may be obtained:

Average Size

(a) The average size of all turbines 10,000 kw. and larger sold in 1926-29 (exclusive of marine) was 35,300 kw. and for 1935-1938 it was 35,200 kw.

Increase in Initial Steam Pressure

(b) From the chart the great increase in 1,200 lb. and 1,250 lb. usage and the new 800-850 lb. pressure range in 1935-1938 are seen to be significant.

Turbine Speeds

(c) Approximately the same number of kilowatts have been sold during 1935-1938 for 1,800 r.p.m. and 3,600 r.p.m. operation, although a much greater number of 3,600 r.p.m. turbines have been sold; of course the average size of the high speed machines is much smaller than those operating at the lower speed. Progress has been made towards standardization at 60 cycle frequency during the past few years.

Superposed Turbines

By 1935 ten years of experience had shown that the superposed turbine was practical and offered a highly desirable method of improving the economy of old low pressure stations. Results from recent installations of superposed turbines are gratifying and indicate that expected large reductions in station heat rates are being realized.

Type of Generator Cooling in Steam Turbine Electric Units, Hydrogen versus Air

The first hydrogen-cooled generator (Dayton) was placed in service in October, 1937, and within a year there were more than 400,000 kw. of generators actually operating in hydrogen. There has been a great increase in the proportion of kilowatts sold with hydrogen-cooled generators, this amounting to about 45 per cent for the years 1935-1938.

The 150,000 kw. State Line generator, which has been rebuilt, has been using hydrogen for the past year with marked improvement. This calls attention to the immense size of turbines which are being built to-day, this one steam turbine furnishes nearly as much power as four of the water turbines in the Queenston plant at Niagara.

Hydrogen as a Cooling Medium for Generators

Hydrogen has only seven per cent of the density of air. Therefore, the windage friction of a rotor running in hydrogen at atmospheric pressure will be only seven per cent of that of the same rotor in air.

Hydrogen has the further advantage that at the same pressure its conductivity for heat is 7.5 times that of air. A hydrogen filled machine will therefore run much cooler than one filled with air; furthermore, for a given surface temperature drop, 30 per cent more heat will be transferred from a heated surface by circulating hydrogen than by circulating an equal amount of air, and the hydrogen can be re-cooled 30 per cent more effectively by circulating it through a cooler, than if air is the medium, or the cooler may be smaller for a given effectiveness.

Hydrogen cooling is particularly attractive for high-speed machines because in such machines the windage friction of the rotor constitutes one of the largest losses. As mentioned above it is cut down to one-tenth or less by substituting hydrogen for air. In high voltage machines, hydrogen also cuts down the deterioration of the insulation by corona.

At first sight one would think that all these advantages would be offset by the danger of the hydrogen exploding, but there is no danger from explosions as long as the hydrogen is at least 70 per cent pure. Instruments are installed which record at all times the degree of purity of the hydrogen and an alarm is rung if the purity drops below 91 per cent.

Resuperheating

Resuperheating was popular during the 1920's and some of the most efficient stations of that period used this method. The resuperheating cycle made it possible to reduce moisture content of steam in the low pressure stages and thereby increase the turbine efficiency. A simpler method of reducing the moisture content was made available by use of 900-950 deg. F. initial steam temperature instead of the earlier 750 deg. F.

In recent years there have been no resuperheating turbines sold for stations having steam pressures of 1,200 lb. and lower. With initial pressure higher than 1,200 lb. and with 950 deg. F. maximum initial temperature, moisture content in the low pressure stages begins to increase and the need for resuperheating reappears. The 2,400 lb. 940 deg. F. steam turbine, now being built for Twin Branch, has resuperheating to 900 deg. F. between the high and low turbines.

Extraction Heating

The practice of bleeding steam for feed water heating was common for both periods studied and will undoubtedly continue as it is a simple method of improving heat balance. There has, however, been a tendency to use more heaters recently.

ICHTHYOL—ITS SOURCE AND PROPERTIES

U.S. Bureau of Mines, Information Circular No. 7042, by O. C. Blade

Abstracted by A. A. Swinnerton, a.m.e.i.c.

Ichthyol is the trade-mark name of a product manufactured by the Ichthyol-Gesellschaft, Hamburg, Germany, and marketed in America by Merck and Company, Inc. Although used rather loosely, the name really refers to the product obtained by sulphonating, and then neutralizing, a distillate from the oil retorted from a high-sulphur bituminous shale found near the village of Seefeld in the Austrian Tyrol. (The name is derived from the words "ichthys," a fish, (Gr.) and "oleum," oil, (Lat.), and is due to the presence of fish fossils in the associated rocks.)

At times there has been a good deal of publicity concerning Ichthyol, due to its rather unusual name, and also because there was a shortage of this material during the World War. An idea has gradually arisen that any peculiar crude oil or tar, or one that contains a large amount of sulphur, must contain Ichthyol, and is, therefore, very valuable. To correct this erroneous idea and provide answers for the many inquiries about this subject, the Bureau of Mines has prepared this report summarizing all the known information about this material.

In the Austrian Tyrol, crude tar from bituminous shale has been employed for centuries as a remedy for sores and wounds, and the Seefeld shales have apparently been processed more or less continuously since 1350. The sulphonated material was first made by Schröter, a Hamburg chemist, in 1882. He called it "Ichthyol," and subsequently a company—the Ichthyol-Gesellschaft—was organized to manufacture and market this material. In Europe, deposits of bituminous shale worked for medicinal purposes have been found in virtually all sections of the Alps, and although claims have been made that deposits, from which Ichthyol may be made, occur in Russia, Poland, and the United States, the indications are that the "Ichthyolite" shales are peculiar to the region of the Alps. Generally speaking, the shales in the Tyrol are characterized by thin bituminous veins, or beds, associated with marl and limestone. The richer shales have a dark colour and characteristic odour, and burn readily.

The production and refining of the oil from the Tyrolean shales consist, briefly, of retorting in special equipment the shale obtained by tunnel-mining methods. Actual details of the process are apparently very difficult to obtain, as they are considered to be trade secrets, but a primitive form of downward distillation has been employed by the natives for many years. Preliminary treatment of the resulting tarry oil and fractionation under carefully controlled conditions are necessary because of its unstable composition. Fractions are treated with an excess of sulphuric acid, then neutralized, washed, and further purified to make water-soluble products of therapeutic value.

From its first introduction, Ichthyol has been used largely as an external application for skin diseases and inflammations. It is incorporated in salves and ointments, and can be used alone when diluted with water, and numerous modifications have been developed for specific purposes. The present (1938) wholesale price of Ichthyol is from $4.00 to $4.25 a pound. A table is given, showing the amounts of Ichthyol and related substances imported into the United States since 1909, and it would appear from it that there has been a steady decline in the last few years. The maximum amount imported, 98,000 lb. in 1920, has declined to about 1,400 lb. in 1937.

The report concludes by emphasizing the fact that Ichthyol is a manufactured product and does not occur naturally, and that because a crude oil may have an odour similar to Ichthyol, it is no indication that Ichthyol could be made from it.

A very complete bibliography of 150 references is included in the report.

HYDRAULIC DECOKING OF COKE CHAMBERS

By W. F. Court in Petroleum World, February, 1939

Abstracted by A. A. Swinnerton, a.m.e.i.c.

A new and improved method of disrupting and removing coke from the coke chambers of cracking and coking stills has been developed by the Shell Petroleum Corporation and is now in commercial use.

The method consists of cutting the coke by means of high impact-producing water jets. The conventional cable method formerly used consisted of suspending layers of steel cable, in spiral form throughout the chamber, which at the end of the coking operation were pulled out by a hoist, thereby disrupting and removing the coke from the chamber.

The operation of removing the coke hydraulically consists essentially of:

1. Boring a hole downward through the coke; and
2. Cutting and removing the coke from the chamber.

In the first step, a hole approximately 18 in. in dia. is bored downward through the coke bed by means of a revolving cutter head, which derives its power from the reaction of water jets discharging horizontally.

In the second step, the boring tool is removed and replaced by a cutting head. The nozzles in the cutting head discharge horizontally, cutting the coke into slices working from the bottom up, so that during the cutting operation the coke and water fall through the bottom man-hole of the chamber directly into side-dump railroad cars. The water, draining from the cars, goes to a settling tank, from which it is again pumped by a high pressure pump to the cutting nozzles in the chamber. The rate of flow to the cutting nozzles is approximately 700 gal. per min. and the pressure is between 900 and 1,000 lb. per sq. in.

The hydraulic method of coke removal has the following advantages over the cable method: Reduction of cleaning out time by about 50 per cent; clean out crew reduced from twenty to eleven men; important savings effected by the elimination of cable, clamps, hooks, etc.; coke is completely removed from chamber walls, hence no hand-scaling required; clean out crew not required to enter coking chamber at any time, which was always a hazardous operation.

Experience, to date, shows that the cost of maintenance of jetting nozzles is very low, and tests have indicated that the cutting action of the jets has no action on the chamber walls. This hydraulic method of decoking chambers is covered by patents held by the Shell and associated companies.

USE OF TRIANGULATION

By William Bowie, in The Military Engineer, November-December, 1938

Abstracted by J. L. Rannie, M.E.I.C.

Triangulation has been used to settle numerous scientific controversies such as the size and shape of the earth, but it is mainly employed as a higher surveying method for fixing the geographic positions of boundaries or a network of isolated points and to co-ordinate charts and maps. While it is often used in the survey of small areas where the earth's curvature need not be considered, the method is usually applied to large areas where curvature must be taken into account and where the cumulative errors of less precise surveys become important.

Contemporary scientific uses for triangulation are investigations of the earth's shell, which has been determined by triangulation to have a depth of about 60 miles, the relative extent to which points on the earth's surface move during earthquakes and the velocity of light.

But it is in practical affairs that triangulation is of the greatest usefulness. In the making of accurate maps and charts it is essential that a framework of accurately known points be available so that all regions will be shown with their correct position, area, distance and direction. The parallel of the steel framework of a building is apt. The steel gives shape and strength to the building and the triangulation gives these same elements to all other surveys.

All of the major triangulation of North America is based on the same North American datum which is the geographic position finally determined from United States triangulation data for a point in Kansas. Canada and Mexico have adopted this datum and have extended their triangulation systems from United States nets.

In other countries the same happy result has not been feasible and numerous datums exist in different countries with consequent gaps, overlaps and offsets at their boundaries. The International Geodetic Association has urged all adjoining countries to join their national triangulation systems, and this has already been done in a number of cases. One of the most important and far reaching is the joining of the triangulation systems of North America with those of Asia and Europe, and plans have been made whereby this can be carried out.

North American triangulation has been carried north by the Geodetic Service of Canada and the U.S. Coast and Geodetic Survey along the Pacific Coast to the boundary between Alaska and Yukon at White Pass. Canada will have a comparatively small job in extending her system northward through Yukon to the 141st Meridian west of Dawson. From there the U.S. Coast and Geodetic Survey's net will carry the work westward to Behring Sea where it would meet the Soviet nets which can be extended as far as Europe. When this great piece of geodetic work will be done is not known, but it is hoped that its initiation will not be long delayed.

GAUGING IN MACHINE TOOL MANUFACTURE

By T. Curson in Engineering, January 27, 1939

Abstracted by R. H. Field, A.M.E.I.C.

This paper (one of a symposium on machine tool practice recently discussed by The Institution of Mechanical Engineers, London,) presents a picture of the gauging organization in a firm using modern methods of precise measurement. The two main problems comprise: first, the provision and maintenance of a standard of length (reference bars and gauges verified annually by the National Physical Laboratory in terms of the legal standard), and, second, the transference of standard lengths to manufactured components through a sort of genealogical tree, or sequence, of gauges ending with that actually used by the mechanic. Instruments indicating to as small as a one-millionth of an inch are used in the necessary comparisons of the reference gauges, which are carried on in a room controlled to the usual standard temperature of 68 deg. F. (20 deg. C.) to within ±1.5 deg. F.

A wear allowance is set for gauges in each class and when this is exceeded the gauge concerned is transferred to the succeeding group. Records are kept of the periodical check measurements. The wear allowances are given in the following table:

Group or Set of Gauges	Use	Wear Allowance
Gauge control room working set	For use with Zeiss Optimeter and Orthotest	—0.00002 in.
Tool room gauge inspection department set	For checking gauges in course of manufacture	—0.00003 in.
Machine shop gauge stores set	For observing condition of gauges after use	—0.00005 in.
General gauge makers set	For setting snap gauges, etc.	—0.00008 in.
Final inspection for tools and fixtures set	For checking gear centres, slots, etc.	—0.00010 in.
Jig boring department set	For accurate setting of work tables	—0.0002 in.
Fitting and grinding department set	For jig setting and micrometer checking	Up to —0.0003 in.

The system of manufacture employed by the firm in cylindrical fits is based on a hole of nominal size, while the male component is varied in diameter to produce the required fit. "Go-and-not-go" plug limit gauges are manufactured in the tool room to a tolerance of 0 to +10 per cent of the limit on the "go" end and ±5 per cent of the limit on the "not go" end. There appears to be a general tendency to work to the low limit of the hole, which causes excessive wear on the "go" end of the gauge. The wear tolerances, averaging 15 per cent of the limit, mean in practice that the low limits of the holes may be decreased by that amount.

Working gauges are returned to the gauge stores each week, for checking, and when re-issued, "small" gauges are given to the inspection department and "large" gauges to the workshop. Those outside the wear allowance are sent for chromium plating and regrinding. The plating increases the wearing qualities by 3 to 5 times, while recent investigations have shown that by using tungsten carbide a further increase of 10 to 15 times is achieved.

For external diameters, micrometers, gap gauges and stand comparators are employed. The first (most commonly used) are checked against cylindrical standards of the same nominal diameter as the component to be checked, in preference to flat standards. When quantities justify, gap gauges of the solid adjustable type are favoured, and are checked by the stores with slip (block) gauges, being corrected if necessary. For components made to very close limits, gap gauges of the indicating type are preferred. These are set by slip gauges and show size variations to 0.00005 in.

All tapped holes are produced with ground-thread taps of one make. The only check found necessary for ordinary threads is a "not-go" effective diameter gauge, truncated at crest and root. This is checked for form and pitch on a toolmaker's microscope, and for effective diameter on a three cylinder instrument. Full form "go" and truncated "not-go" gauges are used when internal threads are produced on a thread milling machine.

For external threads a Wickman gauge with two pairs of anvils is used. One pair carries the full form of thread with length approximating the engagement of the component, and is set to the maximum limit of the component. The other pair, with truncated crest and root clearance is set for the minimum size. These ensure control of form, pitch error and effective diameter, as well as the maximum dimension for the major and core diameters.

Male taper gauges are checked on a co-ordinate measuring machine, sensitive to 0.00001 in., and female gauges by "bluing" the male—a final test being to draw three lines with a black pencil down the male and then to rotate it in the female.

Special gauges are made for such components as splined shafts, while a measuring instrument for lead screws registers pitch errors in half ten-thousandths of an inch. For gears, Parkinson gear testing machines are used, as well as an optical dividing head. A transit (mounted on the plate) together with a fixed collimator, permits the spacing of holes in index plates to be checked to one second of arc.

THE STEAM TURBINE LOCOMOTIVE

By W. D. Bearce, in the General Electric Review, February, 1939

Abstracted by Prof. L. M. Arkley, m.e.i.c.

In this article the author describes what he calls the most forward looking design of motive-power since the beginning of railroading. In general the locomotive is a 5,000 hp. machine and the power is generated by two steam turbine electric units of 2,500 hp. each, one for each side. These units are identical and capable of either multiple or independent operation under the control of one man. Each unit consists of a 2 C.C. 2 running gear surmounted by a stream-lined cab designed for normal operation in one direction only. The cycle of operation is not greatly different from stationary practice. The steam is generated at 1,500 lb. per sq. in. and 920 deg. F. After passing through the main steam turbine it exhausts to an air-cooled condenser.

The Steam Boiler

The boiler is of the water-tube forced circulation type compactly built and includes an oil-fired furnace, superheater, economizer, air pre-heater and burners for "Bunker C" fuel oils. The pressure carried is very high, 1,500 lb. per sq. in. with a temperature of 920 deg. F., which means a superheat of 124 degrees. The forced circulation feature is new to locomotive practice on this continent although it has been used in Europe for years in stationary boilers. By replenishing the water losses in the closed system with evaporator steam, practically all scaling and corrosion of tubes is eliminated.

Main Turbogenerator Set

This unit contains:

(a) High and low pressure turbines.

(b) A two-armature direct current generator driven from these turbines through a gear reduction of approximately 10 to 1. This generator is self-ventilated from a fan located between its armatures, the air being drawn in through the commutator risers and discharged at the centre through the roof of the locomotive. In cold weather this warm air can be used for cab heating.

(c) A 220-volt three-phase A.C. generator connected to the main generator shaft through a flexible-disk coupling. This alternator furnishes power for train air-conditioning, traction motor blowers and other accessories.

(d) A variable voltage exciter, the armature of which is mounted on the same shaft as the alternator. This machine supplies excitation for the main generator during motoring and for the traction motors during electric braking.

The Condenser

The condenser is mounted on each side of the rear end of the locomotive cab, and consists of finned type vertical tubes. Headers at the top receive the exhaust steam from which the condensate is drained by gravity to a sump tank under the locomotive cab. Ventilation for the condenser is provided by turbine-driven propeller-type fans drawing air through louvres in the sides of the locomotive, and discharging it through openings in the roof. This heated air may be used for heating the cab when required.

Motors for Propulsion

There are six propulsion motors connected through gears to the six main axles; they are designated as G.E. 725.

Auxiliary Set

The auxiliary set is a variable-speed unit driven by a turbine which takes steam extracted from the main turbine. Its function is to supply and regulate the combustion air and fuel oil delivered to the furnace and also to supply feed water in proportion to the demand for steam. The complete set includes the following: a starting motor, an auxiliary turbine, a combustion air fan, a boiler feed pump and a fuel oil pump. Of course, there are many other details that cannot be mentioned here.

The operating advantages of the steam turbine-electric locomotive as listed by the author include:

(a) Thermal efficiency from fuel to driving wheels more than double that of the conventional steam locomotive.

(b) Electric braking resulting in saving in brake shoes and tires, not only for the locomotive but for the entire train.

(c) High rates of acceleration and braking due to high adhesive weight.

(d) Capacity for 500 to 700 mile performance without stops for fuel or water.

(e) Elimination of corrosion and boiler scale by the use of distilled water in a closed system.

(f) Elimination of unbalanced reciprocating parts which set up destructive forces in the rails and road bed.

(g) Greater availability because of the construction of the boiler and the absence of reciprocating parts.

This locomotive has just been completed for the Union Pacific R.R. for their Chicago and Pacific Coast service.

It will haul a twelve car train of Pullman and passenger cars over this route without a helper. Its maximum speed is 125 m.p.h.

The new locomotive was designed and built by General Electric and Union Pacific engineers in collaboration with the Babcock and Wilcox Co. and the Bailey Meter Co.

NEW APPLICATIONS OF SULPHUR

By W. W. Duecker, in Mining and Metallurgy, November, 1938

Abstracted by F. G. Green, a.m.e.i.c.

Sulphur is one of the few comparatively cheap and water-insoluble elements having a low melting point. Its properties interesting to an engineer are cheapness, insolubility in water, resistance to most acids, stability at ordinary temperatures, low electrical and heat conductivity, ability to bond to various surfaces, fungicidal properties and the fact that it can be plasticized.

Once used as a lubricant for cooling hot running bearings sulphur has again come into use in free solution or loosely combined with animal, vegetable or mineral oils to produce cutting oils or lubricants for surfaces subjected to extremely high pressures.

Plasticized sulphur has been prepared by reacting sulphur or sulphur chloride with phenol, with turpentine, etc. The organic polysulphide "Thiokol" resembles rubber in many respects and finds use in the fabrication of gasoline hose and other oil resistant equipment. It may also be used to plasticize sulphur. This material can be used with suitable aggregates to make cements having most of the desirable physical properties of sulphur without its brittleness. These cements in combination with suitable brick or tile have been used in pickling tanks, acid tanks, electrolytic cells and on floors.

Editorial Comment...

A COMPARISON

It has become a habit of mankind to value things in terms of their relationship with others of the same or similar kinds. For instance, a suit priced at fifty dollars will be considered expensive by one who is accustomed to thirty dollar suits, and yet will seem cheap to the man who is in the habit of paying seventy-five dollars. It is almost impossible for the average citizen to work out absolute values, and consequently he is guided all through life by such comparative figures.

With this in mind, and in response to a request from Council, the Journal is printing in this issue a table prepared by the Committee on Membership and Management which shows the entrance and annual fees for the leading and comparable English and American national engineering societies. This information was gathered as part of the committee's comprehensive study of membership in the Institute.

It is interesting to find that The Engineering Institute of Canada has the lowest fees, both for entrance and per annum, of any of the twelve societies listed. This fact may come as a surprise to some members. As the available revenue per member has a definite bearing in Institute activities, a careful study of the table is recommended.

INSTITUTE PRIZES

For years the Institute has offered prizes in the form of medals, books and cash, for papers on engineering topics. In all there are twenty-two awards, all of which may be made annually. For some of the prizes the papers submitted must deal with a subject belonging to some specified branch of engineering, such as civil, electrical, mechanical, mining, chemical and metallurgical; for others there is no such restriction.

Several of the prizes bear the names of famous Canadian engineers in whose honour they were established. Their values run from substantial figures to modest amounts sufficient to start a young engineer in the collection of good books for his library. And yet in many cases the number of papers submitted has been surprisingly small.

For one award which carries a cash prize of one hundred dollars, only two papers were submitted last year. Another prize has not had a single paper for two years. Others have had only two or three entrants, whereas there should have been a dozen. In fact in every instance the number of competitors has been surprisingly and discouragingly low.

Our members—and particularly the younger men— fail to realize the educational and professional benefit which results from the systematic effort needed for the preparation of a worthwhile paper. The successful writer of course achieves a fitting distinction. But his less fortunate competitors have in other ways gained as much as he, because they have acquired increased facility in expressing themselves, in collecting and arranging their information, in thinking clearly on some definite engineering topic.

Council is desirous of stimulating interest in these competitions. It is felt that to encourage members to prepare and deliver papers is one of the main functions of the Institute, and this offer of prizes is made to afford this encouragement. In an effort to bring this subject effectively to the attention of members, a description of the prizes and the rules governing them are printed on page 191 of this issue of the Journal. It is hoped that readers will study them, and will submit papers which will add interest, enlarge the competition and perhaps contribute something substantial to the literature of the profession.

FINANCE

Immediately after the Annual General Meeting, it is the duty of the Finance Committee to give earnest consideration to the finances of the Institute for the coming year. In order to do this it is necessary to make an estimate of the probable income and from this estimate to examine the expenditures that can be properly undertaken to give the membership the best service possible.

During the depression years some depletion of the working capital was unavoidable. This was due to the financial stringency under which we were operating, a condition that affected every public and private body in Canada. Obviously this condition should not be prolonged for an indefinite time; accordingly, acting on the strong advice of former chairmen of the committee, a firm endeavour is being made this year to increase the liquid assets of the Institute.

The committee has assumed that the total income for 1939 will be comparable to that of last year, although a slightly smaller figure has been used in the budget. It is very desirable that this figure be at least met and if possible improved upon.

More than one-half of the income comes from membership fees, so that in order to satisfactorily administer the Institute, both Headquarters and the branches, it is essential that the members at large pay their fees promptly each year. Any arrears which accumulate are in the end very hard to liquidate, and during the period of their accumulation add greatly to the difficulties of those in charge of the financial affairs of the Institute.

Furthermore, the service which it is possible to render to members is in direct ratio to the funds available. Thus a shortage of funds often prevents the Finance Committee from recommending to Council many activities which could otherwise be undertaken and from which the members would receive a great deal of benefit, especially in the smaller branches.

In the budgeted expenditure this year cognizance has been taken of all known items of expense and amounts have been set aside for a reserve for maintenance and repairs on the Headquarters building, a reserve for depreciation of furniture and fixtures, a reserve for depreciation of the building, an item for contingencies, and a small surplus on the year's work.

It must be realized, of course, that these are estimated figures for budgeting purposes, but they have been made with a great deal of care and it is believed the programme can be lived up to. To ensure this, however, the committee is relying upon the membership to continue the support so heartily accorded during the past year, and, in view of the conditions just outlined, to do so with even greater interest and consideration. **F.N.**

LUNCHEON TO MEMBER OF DOMINION COUNCIL

Mr. P. Burke-Gaffney, of Winnipeg, visited the Headquarters of the Institute on March 11th, and a few of the officers, councillors and members had the privilege of lunching with him at noon of that day, at the University Club.

Vice-President Fred Newell was in the chair, and warmly welcomed the guest, explaining how pleased members of Council were to have the opportunity of entertaining an engineer from Manitoba who has been so constructively interested in the problems of the profession in that part of the Dominion. His visit afforded members of the Headquarters delegation which visited Winnipeg last October an opportunity to thank Mr. Burke-Gaffney for the assistance and hospitality which he had shown on that occasion.

In reply, Mr. Burke-Gaffney gave a very interesting and informative talk on present and future relationships between the provincial associations, the Dominion Council, and the Institute. Referring back to his college days in Ireland as the source of his inspiration, he gave an analogy of the situation in the various provinces in Canada as he saw it, that was a delight to hear. It not only graphically illustrated his ideas but pleased his listeners with its clear elucidation and its perfect rhetoric.

PRESIDENTIAL ACTIVITIES

On March 14th and 15th the President, in company with the General Secretary, attended the Annual Meeting of the Canadian Institute of Mining and Metallurgy at Quebec. At the luncheon on the 14th he presented the Leonard Medal to Mr. J. J. Denny, mill superintendent with the McIntyre Porcupine Mines Limited, for his paper, "The Prevention of Silicosis by Metallic Aluminum."

The President plans to visit every branch of the Institute during his term of office, and made a very satisfactory start on this ambitious programme at a luncheon meeting with the Quebec Branch on March 15th.

The second branch visited was Montreal. An informal dinner was held at the Windsor Hotel before the meeting at which almost fifty attended. At the meeting, the President outlined a portion of his programme for the year, with particular emphasis upon the work of the new committee which has been appointed to investigate and deal with the problems of the young engineer.

The President presided at the dinner given on March 17th, at the University Club, Montreal, to B. L. Thorne, M.E.I.C., of Calgary, the newly-elected President of the Canadian Institute of Mining and Metallurgy.

At the Council meeting of March 17th, held at Headquarters, President McKiel was in the chair.

B. L. Thorne, M.E.I.C.

COUNCIL ENTERTAINS PRESIDENT OF C.I.M.M.

A widely representative party assembled at the University Club, Montreal, on March 17th for an informal dinner in honour of B. L. Thorne, M.E.I.C., who has just been elected President of the Canadian Institute of Mining and Metallurgy for 1939. President McKiel was in the chair and was supported by an array of past-presidents, vice-presidents, members of council and guests, some twenty-two in all.

All present joined in hearty congratulations to Mr. Thorne on the well deserved distinction which he has received. Mr. Thorne's membership in both Institutes is of long standing, and the Calgary Branch of the E.I.C. owes a great deal to his activity and wise counsel. He is of course well known for his work in the west with the Department of Natural Resources of the Canadian Pacific Railway. It may be noted that recent developments in connection with the oil fields in Alberta have added greatly to the responsibilities of his position.

President McKiel took occasion to welcome Messrs. E. P. Muntz, M.E.I.C., of Hamilton, Past-President of the Ontario Association of Professional Engineers, and P. Burke-Gaffney, of Winnipeg, Past-President of the Association of Professional Engineers of Manitoba, who also represent their respective associations on the Dominion Council and were able to join the party.

CO-OPERATION IN HAMILTON

In a letter dated February 18th, 1939, the Hamilton Branch of The Engineering Institute of Canada invited a number of engineering and scientific associations to meet at a round table conference to consider a general co-operation for the purpose of enlarging the sphere of activity and usefulness of these various societies. The meeting was held in the Committee Room of the City Hall, Hamilton, on February 27th, 1939.

The following organizations were represented:

American Institute of Electrical Engineers, Toronto Section—D. W. Callander, A.M.E.I.C.

American Society of Mechanical Engineers, Ontario Section—Mr. O. H. Anderson.

American Society of Metals—J. R. Dunbar, A.M.E.I.C.

Association of Professional Engineers of Ontario—E. P. Muntz, M.E.I.C.

Canadian Westinghouse Company, Apprentices' Club—D. W. Callander, A.M.E.I.C.

Engineering Institute of Canada, Hamilton Branch—J. R. Dunbar A.M.E.I.C. and A. R. Hannaford, A.M.E.I.C.

First Field Squadron, R.C.E.—Major V. S. Thompson, A.M.E.I.C.

Hamilton Association for the Advancement of Literature, Art and Science—Dr. A. H. Wingfield A.M.E.I.C. and J. A. M. Galilee, Affil.E.I.C.

Hamilton Chemical Association—Mr. G. R. Smye and Mr. J. M. Morton

Hamilton Electric Club—Charles R. Chadwick.

Illuminating Engineers' Society—Mr. J. Osbaldeston.

Ontario Association of Architects, Hamilton Chapter—Mr. R. E. McDonnell.

Mr. J. R. Dunbar was elected Chairman of this meeting. He explained that the object of the conference was to discover if the allied societies were in favour of some form of co-operation which might be designed to eliminate the holding of meetings by two or more societies on the same evening, and the avoidance of engaging the same speaker at very close intervals. Also the possibility of some central bureau from which the representative of one of the allied societies might obtain information regarding the arrangements already made by the other societies. Also there might be an annual assembly and lecture.

Mr. E. P. Muntz gave a general outline of the scheme of a similar nature that is being used in the Toronto district, with very useful results. He also outlined work of this nature now being carried out in some centres in the United States.

A general discussion followed these points of information and the meeting was unanimous that there are possibilities of considerable benefit both to the societies and the public.

The following committee was appointed to gather information and formulate some definite plan for the proposed co-operation and report to a meeting to be arranged for some date in the near future, R. E. McDonnell, chairman; Charles R. Chadwick and A. R. Hannaford.

In closing the meeting Mr. Dunbar thanked the various delegates for their attendance.

A CANADIAN-BUILT FIGHTING PLANE

The first single seater fighter designed and built by Canadian engineers has just been delivered from the Canadian Car and Foundry Company's plant at Fort William. It was designed by Michael Gregor, M.E.I.C., the company's chief designer. With a 750 hp. engine, its top speed is 300 m.p.h. but the landing speed of 57 m.p.h. is unusually low for a plane of that type. It can climb to 10,000 feet in three minutes. The armament consists of two bombs and two synchronized machine guns.

ENTRANCE AND ANNUAL FEES OF VARIOUS ENGINEERING SOCIETIES

SOCIETY	Fellow		Member		Associate Member		Associate or Affiliate		Graduate or Junior		Student	
	Entrance	Annual	Entrance	Annual	Entrance	Annual	Entrance	Annual	Entrance	Annual	Entrance	Annual
Institution of Civil Engineers, British Isles, outside London..	—	—	$210.00	$21.00	$63.00	$13.00	$52.50	$25.00	No class		None	$ 7.50
London area..................	—	—	210.00	$31.50	$63.00	$18.35	$52.50	$25.00			None	$10.00
Institution of Electrical Engineers in Great Britain.........	—	—	$26.00	$21.00	$15.75	$15.75	$15.75	$21.00	—	$ 8.00 to $15.75	None	$ 5.25 to $10.50
Institution of Mechanical Engineers......................	—	—	$30.00	$20.00	$15.00	$15.00	$15.00	$15.00	$ 5.00	$ 7.50 to $15.00	None	$ 7.50 to $12.50
Institution of Mining and Metallurgy.....................	—	—	$26.00	$26.00	No class		$15.75	$15.75	No class		None	$ 5.25 to $ 8.00
Institution of Chemical Engineers resident United Kingdom.	—	—	$26.00	$26.00	$15.75	$15.75	No class		$ 5.75	$10.50	$ 2.50	$ 2.50 to $ 5.25
Institution of Structural Engineers, England, Scotland, Wales	—	—	$16.00	$21.00	$10.50	$13.00	No class		$ 5.25	$ 5.25 to $10.25	$ 2.50	$ 2.50 to $13.00
Institution of Engineers, Australia......................	—	—	$26.00	$26.00	$15.75	$15.75	$15.75	$15.75	$ 5.25	$ 8.00	None	$ 5.25
American Society of Mechanical Engineers..................	$30.00	$25.00	$25.00	$20.00	No class		$25.00	$20.00	$10.00	$10.00 to $20.00	None	$ 3.00
American Society of Civil Engineers......................	Contributions to permanent funds		$30.00	$20.00 $25.00 N.Y. dist.	$25.00	$20.00 $25.00 N.Y. dist.	$30.00	$20.00 $25.00 N.Y. dist.	$10.00	$10.00 $15.00 N.Y. dist.	$10.00	
American Institute of Mining and Metallurgical Engineers..	No class		$20.00	$15.00	No class		—	—	$10.00	$10.00 to $15.00	—	—
American Institute of Electrical Engineers..................	$20.00	$20.00	$15.00	$15.00	No class		$10.00	$10.00 to $15.00	No class		—	—
Engineering Institute of Canada	—	—	$10.00	$10.00 to $15.00	$10.00	$ 8.00 to $12.00	$10.00	$10.00	$ 5.00	$ 5.00 to $ 8.00	—	$ 1.00 to $ 3.00

NOTES:—
Qualifications for Fellow A.S.M.E. and A.I.E.E. are approximately the same as for Member E.I.C. and Member approximately the same as Associate Member E.I.C.
Fees include cost of monthly publication.
Higher rates shown for E.I.C. apply only to members of the Montreal Branch.

DISCUSSION ON WELDING IN SHIP CONSTRUCTION

(CONTINUED FROM PAGE 179)

The Author

Regarding Mr. Shearwood's remarks on corrosion in welded joints, I have not observed this to any appreciable extent so far in any welded vessels which have come under my observation, nor have I had any report from our Outport Surveyors which might suggest any unusual trouble in this respect. One would naturally look for some evidence of corrosion in materials which are, to some extent at least, under stress, but I have not seen anything worth commenting upon.

I thoroughly agree with Mr. Shearwood's view that high ductility is of more importance in welded structures than high ultimate strength.

It would perhaps have been better not to use such a drastic term in referring to a riveted ship as "shaking down," as this gives the impression of rather excessive slippage taking place in the joints, which, of course, is not the case. There have been cases, however, where the joints have actually slipped rather severely, and while this has not loosened or damaged the rivets to any serious extent, it has affected the caulking of the edges of the butt, which have had to be recaulked. In the case of a welded ship, while the joints are rigid and cannot slip in the same sense as in a riveted joint, there are other ways in which residual stresses can be relieved, such as slight buckling or readjustment of the plates, or even perhaps in slight permanent extension locally in highly stressed areas.

In reply to Mr. McMillan's discussion, there is no indication by failure or otherwise of the presence of excessive residual stresses in the joints of the *Cedros*.

Saving of weight may be the common argument for welded structures, but I am not so sure that this should be stressed too much. In fact, experience seems to indicate the desirability of increasing the scantlings of welded vessels rather than the reverse, even if only to obviate buckling which is accentuated by thin plating, and the wider frame spacing, where the frames are toed to the shell.

No trouble has arisen in regard to the accumulation of gases in the double bottom and side spaces of the Norwegian tanker mentioned by Mr. McMillan, and the tanks have been found in service to be remarkably tight, notwithstanding severe year-round service conditions on the Atlantic.

On the other hand the subject of sequence in welding is all important, and is one that must be left to be dealt with on each individual ship, as no fixed rules can be laid down; only experience can provide the guidance necessary to avoid the many pitfalls that beset the builder of welded ships.

ANNUAL MEETING SPEAKERS DISCUSS THE ENGINEER

THE ENGINEER FACES A NEW WORLD

Colonel Willard Chevalier, Vice-President, McGraw-Hill Publishing Company

Address delivered at Annual Banquet, February 14th, 1939

Mr. President, Your Excellencies, distinguished guests, ladies and gentlemen: Before addressing myself to the subject assigned me, I should like to give expression to the great pride I have in being your guest this evening, for yours is an organization of engineers second in dignity, standing and accomplishment to none on the American Continent, and I consider it a very important honour that you should have permitted me, an alien, to be with you and to participate in this splendid and auspicious occasion. I am particularly delighted to have the opportunity to meet their Excellencies because, for many years, I have been indebted to John Buchan for the books he has written, which I have read with keen interest.

"The engineer faces a new world!" There is nothing new in that, for man is always facing a new world. Change is the law of life. Now the task of the engineer may be stated very simply: it is to apply the findings of science to the solutions of social problems, but the solution of one social problem invariably leads to new social problems.

Once the great social problem was to overcome scarcity so as to provide man with enough to eat and enough clothes to put on his back. We have solved that problem so well that we have created an abundance, and we have an employment problem on our hands, and we cannot find work at which to put people. So the engineer is at once the author and the victim of one of these great problems in this changing world.

I should like to take my text from something Dr. Wallace said to us at luncheon to-day, "the need to foresee the impact of technical progress on economic and social institutions." This need is vital to-day and Dr. Wallace did well to stress it because new concepts of social responsibility are to-day behind most of the problems in this changing world, and unless we take account of these, we are not going to solve the problems which confront us.

Unless the engineer understands the social trends of economic functions, he is going to be a skilled craftsman, hawking his wares to the highest bidder, rather than an intellectual leader in the councils of his fellow men. If once the engineer ignores his social and economic functions, he abdicates his position as a professional man to become a craftsman. So Dr. Wallace did well to say that the engineer must have a serious sense of responsibility for the social implications of our time.

When I say this I do not mean that the engineer should usurp the place of the economist or social scientist any more than he should usurp the place of the chemist or physicist in the practice of his profession, but I do mean that he must recognize his responsibility. And what is it? It is to apply scientific progress to achieve social ends through economic means.

Every engineering problem is created by an effort to solve a social problem and to solve it by economic means, because only in that way can the engineer conserve the stability and consistent progress of society as a whole; unless he recognizes his social objectives and understands his economic needs, he cannot meet his responsibility. He will be to society what the carpenter and the stonemason are to the building, rather than what the architect is to the building. The engineer should be the architect of our society for he administers the fixed capital of the people: he takes their savings and pledged credit and invests them in new facilities that concern the community as a whole, producing new gadgets to add comfort and convenience in their homes, or building new agencies of transportation.

I want to talk on two points that come out of all that I have said. I refer to this specialization of function. It is really one of the two great problems that are harassing the engineer in this changing world. The first man had a very simple problem—he had only the energy that he could create in his own person—the energy that God had given him in his body, with which to earn his living, and he had just as good a living as he could create and we know that he survived by virtue of his own energy. He learned how to harness the lower animals and the first step in the long course to raise himself to a higher standard of living was then taken; then he discovered that the water in the rivers and streams ran down to find a lower level, and by a mysterious power could turn a wheel to create power and he multiplied his productivity in this way. Then he found the movement of the air created a wind and turned wheels and he multiplied his productivity again, and so it went for ages and ages and ages until "the day before yesterday," for it was only 150 years ago that the steam engine was made practical.

In the early days man's needs were very simple—people did almost everything, but to-day one man in Detroit is making one part of an automobile, while a man in Oshawa is making another part for the same automobile. This is specialization of power, and leads to one of the great problems—a balanced production of all things that man needs. After we succeed in solving that problem we have another, which is the administration of our capital funds and credit used to supplement it.

This does not mean that the engineer must become a banker or financier but specifically, in this changing world, he must be prepared to answer Dr. Wallace's question as to foresight so far as it is possible for him to do so.

No human being has the foresight to predict the effect of technical progress even for a few years hence. What man in 1900 expected that the 8,000 automobiles in the United States at that time would, a generation later, be increased to 28,000,000; what man, a generation ago, could foresee that to-day one out of every seven people in the United States would be employed in motor transport in some one of its many functions. What man can tell what it will be a generation hence; what will obsolete the motor vehicle, the radio, or the electric motor? That they will be rendered obsolete by the onward march of progress we are sure, but we cannot possibly foresee what the impact of technology will be a generation hence.

We have, however, a choice. We can, on the one hand, declare a moratorium on technical progress—we can lock or close up the patent office, lock up the research laboratories, because we do not know how to use the progress we have made.

The other solution is to recognize the fact that we must write off our capital investments more rapidly so that we can develop new things.

In other words, we can no longer afford to wear out things we once considered permanent—we must scrap them ruthlessly. We must change our attitude toward conservation of capital. Industry must change in accounting; finance must change in financial structure; government must change in its taxation practice. We must learn to maintain the flexibility of the entire capital fund and structure in order to adapt ourselves to this changing world.

This does not mean the engineer must leave his drawing board, but it is most essential that the leaders of the engineering profession recognize these trends and must guide others in the appreciation of them. Where there is no business the people perish, and where the leaders of a profession do not comprehend and adapt themselves to the changing trends that govern their functions, then the profession will perish with them.

THE PRACTICAL SIDE OF LIFE

Dr. R. C. Wallace, Principal of Queen's University

Address delivered at Luncheon on February 14th, 1939

Mr. Chairman, distinguished guests, members of The Engineering Institute of Canada, and friends, I have no misapprehensions as to why I am here to-day to speak to you. It so happens, as all of you are aware, that the people of Queen's are an extraordinary modest group of people—they never praise their own university. The fear was expressed at Headquarters that it would not be known that your new President, Dean McKiel, is a graduate of Queen's unless I came here to tell you. That is really my function to-day; the rest is padding to that main thesis. May I here express my real pleasure that my friend of another university is succeeded in this important office by Mr. McKiel from the Maritimes. In that way we feel Queen's has done something in engineering and that a contribution made from that background and the wide experience gained later will be of much benefit to the Institute.

I have suggested the thought of "The Practical Side of Life" simply because I knew that I was to address men who are concerned with the practical side of life as their life function, and for just a few minutes I want to deal with that aspect of life and its implications and repercussions. I am not an engineer but I have been associated enough with that profession to get some appreciation at least of the engineer's outlook and attitude in life, from the inside and not from the outside of the engineering profession.

Civilization could have advanced without the demand or desire to master nature. Indeed, in oriental countries, until the revision in Japan, it did so advance. Their plan in life was to adjust themselves to nature. Those of us who have seen or studied their plan must admit there are real values in that attitude towards life. We in this country seem to have an immediate and definite desire to adjust nature to ourselves. This note has come into the whole life of western people and it has come about so very rapidly that we have placed ourselves and our civilization in the hands of the adjusters, the scientist and the man who uses scientific knowledge, the engineer.

We have, by this means of developing nature, calculating nature, finding out nature and adjusting it to all our needs, placed outselves at the mercy of the scientist and the engineer in our present-day civilization; and from the material standpoint we have done so completely—what we eat, what we drink, how we are clothed, how we travel, how we enjoy ourselves. Civilization depends upon the ability and brains of the technical man with the scientific man at his elbow.

As an example of how invention has revolutionized our mode of living, take the motor car. How impossible it would be even to foresee some of the repercussions of the automobile in our modern civilization. It is used by its owners for as great a part of the summer as possible, and in the winter as well, and there is no question whatever that home values and the sense of home has gone down by comparison because the motor car has come up. The demand for homes as homes has become less for that reason. But there is an implication which I think would be the part of the engineer to foresee in connection with the motor cars, and it has come on us like an avalanche; that is the continuous and insistent demand of the electors for more and better roads throughout the whole country. During the last twenty years demands have been put on our legislatures, both federal and provincial, which they have been very ill able to afford.

A very large amount of money has been spent in the construction of highways in both western Canada and eastern Canada in a very short time, simply because of the motor car. Educational institutions have thereby suffered because it was said that the farmer and the man in outlying communities must have these roads built and consequently it had, in a democratic country, to be done. More than that, the railways, in a very significant way, indeed, realize fully how much it has meant to them. These are economic considerations which come immediately out of engineering projects, and my submission is that we may need to look a little farther ahead to see what economic relationship there may be in the long distance view rather than the short distance view in regard to some of our new enterprises.

The radio is another example, and as yet we are only beginning to understand the repercussions of the radio in our sociological life; how great it will be in the future we cannot tell, but it is already becoming the case that we prefer to sit in our homes and listen to the radio instead of going out to concerts or attend meetings, especially in bad weather. That applies to Sundays as well as week days. More than that, we will have to find out how far the supplying of good first class music over the radio is going to affect the developing of musical talent among our young men and women, who are musicians in their own right; how far the teacher in the school and in the college is going to be the master of the situation and use the radio simply as an instrument. Is it to be the main factor in education in the future ? We must realize the need to foresee the impact of technical progress on economic and social institutions. Let us say to ourselves, "Let us pause and see just what repercussions this enterprise and that project are going to make in our life and what effect they will have on our country as a whole," and then safeguard against them by the wisest type of policy. This is not alien to engineering thinking.

We do not want a civilization with such rapid developments that old things must be scrapped before they are used. We have not the financial ability to carry on a civilization of that kind. We must put the brakes on against the enthusiasm and ability of the scientist to use his new knowledge too rapidly to the extent that other things may suffer.

I well recall an interesting conversation which I had with a scientist, who said: "After all, the greatest things we do, even in our own field, are not done through technical knowledge, but through intuition—a sense, a feeling, a something that is not in our practical combination but in, what shall we say, our spiritual combination." I think if a well-known physicist can say that, any able engineer can say the same thing. The idea of the bridge for a certain place comes somehow as an inspiration to him, and then he gets it down on paper and builds up all the necessary scientific information that may be needed to make it safe and the right kind of bridge. The lines of the concrete highway, the great bridges, the large heating plants, the motor car, the aeroplane, all have become more beautiful. In all these things we are thinking of a sense of beauty that has nothing to do with the analysis of the engineer at all, but which the engineer is using and working into his whole plan because it is an essential part of his personality. We have come to realize that what we build is no less useful if it is beautiful. That is a practical side of life which meets our ultimate needs and satisfies the spiritual needs of life as well.

I think all of us feel the great demands the young people are making—they are so much heavier than in previous years. They are going to demand to co-operate in solving problems only partially connected with their own life, and we must get them to go out with that sense of appreciation and some knowledge of those other fields, which must play their part in their lives. If they are going to be successful in the real sense of the word, they cannot be successful in their own field alone. We must build solid practical foundations which must be supported and buttressed with other forces, which we cannot ask the other man to supply but must supply ourselves. We have to deal with wider aspects in our life and experience and personality which are practical in their real sense because they deal with the process of living.

It has been a great pleasure, Mr. Chairman, to have had the opportunity of having a word with you to-day and I thank you.

MEETING OF COUNCIL

A meeting of the Council was held at Headquarters on Friday, March 17th, 1939, at eight o'clock p.m.

There were present: President H. W. McKiel in the chair; Vice-Presidents E. V. Buchanan, H. O. Keay and F. Newell; Councillors W. F. M. Bryce, J. L. Busfield, A. Duperron, R. H. Findlay, W. R. Manock, H. Massue, B. R. Perry, J. A. Vance, E. Viens and E. B. Wardle; Secretary Emeritus R. J. Durley, General Secretary L. Austin Wright, and Mr. Louis Trudel, the newly appointed assistant to the General Secretary. Mr. E. P. Muntz, past-president of the Association of Professional Engineers of Ontario, was also present by invitation.

After discussion, the minutes of the meetings held on February 13th and 14th, 1939, were taken as read and confirmed with slight amendments to minutes 9411 and 9467. The President reported that, with Vice-President Dunsmore and Councillor MacNab, he had represented the Institute at the funeral of Mr. R. R. Murray, the Secretary-Treasurer of the Halifax Branch, who, with Mrs. Murray, had been lost in the recent tragic fire at Halifax. The President had acted as one of the pall-bearers, and he knew that the parents of both Mr. and Mrs. Murray had greatly appreciated the expressions of sympathy and the flowers which had been sent by the Institute.

On the motion of Mr. Findlay, seconded by Mr. Massue, the following resolution was unanimously passed:

> "It is with an appreciation of the great loss which has been sustained that the Council of The Engineering Institute of Canada records the death of Robert Roy Murray, who for many years has been an active member of the Halifax Branch, and who latterly, as secretary-treasurer of the branch, has rendered special service to his profession.
>
> "Council desires to express to the members of both Mr. Murray's family, and Mrs. Murray's family, its sincere sympathy with them in the great misfortune which has come upon them."

The Secretary reported, as regards the provincial legislation which had been sought by the architects, that their proposed Bill had failed to meet with approval at Quebec.

The membership of the Finance Committee and the Papers Committee were approved as follows, with one member yet to be appointed to the Papers Committee, representing eastern Ontario:

FINANCE COMMITTEE

F. Newell, M.E.I.C., *Chairman*

J. E. Armstrong, M.E.I.C.	G. A. Gaherty, M.E.I.C.
A. Duperron, M.E.I.C.	J. A. McCrory, M.E.I.C.

PAPERS COMMITTEE

J. A. Vance, A.M.E.I.C., *Chairman*

I. P. MacNab, M.E.I.C.	Maritime Provinces
H. W. Lea, A.M.E.I.C.	Quebec
W. E. Andrewes, A.M.E.I.C.	Western Ontario
I. M. Fraser, M.E.I.C.	Prairie Provinces
H. N. Macpherson, M.E.I.C.	British Columbia

The chairmen of other committees were appointed as follows, with a request that they submit the names of the other members of their committees for approval at the next meeting of Council:

Past-Presidents' Prize	R. DeL. French, M.E.I.C.
Gzowski Medal	A. O. Wolff, M.E.I.C.
Leonard Medal	E. Stansfield, M.E.I.C.
Plummer Medal	J. R. Donald, M.E.I.C.
Board of Examiners	C. J. Mackenzie, M.E.I.C.

Referring to the committee to be appointed to prepare a series of radio broadcasts on engineering subjects, it was resolved that Mr. Fraser S. Keith be asked to accept the chairmanship and to name the other members of the committee.

The President stated that since the last meeting of Council a great deal of thought had been given to the membership and duties of a committee on the welfare of the young engineer. The future of engineering in Canada depended upon the young engineer, and in his opinion nothing the Institute could do at the present time was more important than the consideration of the problems of these young engineers.

The membership of the committee, as now suggested, is as follows: Representing the Maritime provinces—Mr. C. A. Fowler, of Halifax, and Professor F. L. West, of Mount Allison University; from Quebec—Professor R. DeL. French, of McGill University, Mr. R. E. Heartz, assistant chief engineer of the Shawinigan Engineering Company, and Mr. Jacques Benoit, representing the younger French-speaking engineers; from Ontario—Mr. R. M. Smith, Deputy Minister of Highways, Professor D. S. Ellis, of Queen's University, Professor R. F. Legget, of the University of Toronto, and Vice-President Buchanan, who will act in co-operation with the chairman, Mr. H. F. Bennett, at London. For the western provinces, Vice-President Sauder had undertaken to canvass the western branches and have them name representatives. The President thought that the committee should not consist of more than ten or twelve members altogether, with a representation of both practising and teaching engineers.

The President having reported the very cordial welcome he had received at the recent Annual Meeting of the Canadian Institute of Mining and Metallurgy, it was unanimously resolved:

> "THAT this Council express to the Canadian Institute of Mining and Metallurgy its appreciation of the invitation which had been given to the President and General Secretary of The Engineering Institute of Canada to attend the Annual Meeting at Quebec, and further, that it would like to go on record, that it is in favour of promoting joint meetings wherever such meetings can be arranged to the advantage of either or both organizations."

The budget for the year 1939, as submitted by the Finance Committee, was accepted and approved.

Five resignations were accepted; the names of eleven members were removed from the list; two reinstatements were effected, and the names of two members were placed on the Life Membership List.

In reporting a request from one of the western branches for a refund by Headquarters of the travelling expenses of two speakers who had addressed the branch, the Finance Committee suggested the desirability of a definite policy regarding expenditures of this kind. Considerable discussion followed, as a result of which it was resolved to notify the various branches that in the future an estimate of expenses of this kind should be submitted to the Papers Committee in advance, the proportion, if any, for which the branch will be reimbursed to be decided by that committee. Vice-President Buchanan and the chairman of the Papers Committee drew attention to the difficulties experienced by the branches in the securing of speakers, and they were requested to present a report thereon at the next meeting of Council.

It was unanimously resolved that P. L. Pratley, M.E.I.C., be reappointed as the Institute's representative on the Main Committee of the Canadian Engineering Standards Association for the next three years.

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

ELECTIONS

Members	3
Assoc. Members	10
Juniors	5
Students admitted	14

TRANSFERS

Assoc. Member to Member	3
Junior to Assoc. Member	13
Student to Assoc. Member	2
Student to Junior	5

The Council rose at eleven-fifteen p.m.

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 isssue 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 PRIZE

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 Student or Junior in Zone C—The province of Quebec.
The Ernest Marceau Prize,—
for a French Student or Junior in Zone C—The province of Quebec.
The Martin Murphy Prize,—
in Zone D—The Maritime provinces.

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

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

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

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

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

G. O. Vogan, A.M.E.I.C., has been appointed by the Province of Quebec chief engineer of the National Electricity Syndicate which is in charge of the Provincial Government's enterprise in state power production. After graduating from Queen's University in 1917 Mr. Vogan entered the service of the Hydro-Electric Power Commission of Ontario, where he remained until 1928, when he joined the engineering staff of the Aluminum Company of Canada at Arvida, Que. He later became associated with the Beauharnois Construction Company at Beauharnois, Que., and in 1933 was made engineer in charge of the Noranda power development with Dr. F. A. Gaby, M.E.I.C., consulting engineer, Montreal. In 1932 Mr. Vogan was awarded the Gzowski Medal for his paper on "The Design of the Chute à Caron Diversion Canal."

C. J. DesBaillets, M.E.I.C., chief engineer of the Montreal Aqueduct Commission, has been elected Canadian President of the American Waterworks Association for the 1939-40 term. Born in Switzerland, he came to Canada in 1904 and served with the Shawinigan Water and Power Company, Montreal Light, Heat and Power Consolidated, American Locomotive Works, Canadian Westinghouse and Canada Pulp and Paper Company. After three years in Sherbrooke, Que., as manager and chief engineer of the Sherbrooke Public Works Department he entered the service of the City of Montreal in 1920 and the following year was appointed to his present post.

Dr. Charles Camsell, M.E.I.C., Deputy Minister of the Department of Mines and Resources, was elected president of the Canadian Geographical Society for the eleventh term at the annual meeting in Ottawa on February 24th.

Major-General A. G. L. McNaughton, M.E.I.C., was made a vice-president of the Canadian Geographical Society at the annual meeting.

Past-President J. M. R. Fairbairn returned to Montreal on March 26th after almost three months absence in England. He had several interviews with officers of the Institution of Civil Engineers, and the Institution of Mechanical Engineers, relative to the visit of their members to the engineering congress in New York next September, and particularly the arrangements for a post-congress tour through central Canada under the auspices of the Engineering Institute.

A. B. Normandin, M.E.I.C., of Quebec has recently been appointed chief engineer of the Hydraulic Service in the Department of Lands and Forests of the Province of Quebec. He was, for many years, assistant chief engineer in the same department. Mr. Normandin is a past chairman of the Quebec Branch and was on Council 1924 to 1929. He is a Councillor of the Corporation of Professional Engineers of Quebec.

Dr. A. Stansfield, M.E.I.C., emeritus professor of metallurgy, McGill University, and a Life Member of the Institute, has been elected a life member of the Canadian Institute of Mining and Metallurgy.

E. E. Eisenhauer, A.M.E.I.C., of the Department of Agriculture of Saskatchewan, was the speaker at the luncheon of the Westmount Rotary Club held March 11th.

R. B. McDunnough, A.M.E.I.C.. formerly general superintendent of the Quebec Power Company, is now assistant general manager of the company.

E. D. Gray-Donald, A.M.E.I.C., of the Quebec Power Company, has been promoted from the position of assistant general superintendent to that of general superintendent.

R. Dupuis, A.M.E.I.C., is now assistant general superintendent of the Quebec Power Company. After graduating from the University of Nancy, France, he returned to Canada and joined the Quebec Power Company as assistant superintendent of the power division. After serving in this capacity and as superintendent of the division he was appointed to his present position.

J. Saint Jacques, A.M.E.I.C., formerly office engineer in the Quebec Power Company, Quebec, has been made superintendent of the power division.

H. Beique, JR.E.I.C., has been appointed to the position of assistant superintendent of the power division of the Quebec Power Company. He graduated from McGill University in 1936 and entered the company's service in December, 1938.

Jules LeBlanc, A.M.E.I.C., has recently been appointed by the Government of the Province of Quebec, chief examiner of the Provincial Board of Electrical Examiners and head of the Department of Electrical Inspection. Mr. LeBlanc was graduated from the Ecole Polytechnique in 1928 with the degree of B.A.SC. and from the Massachusetts Institute of Technology in 1929 with the degree of B.SC. in electrical engineering. His experience in the electrical field includes seven years with the B.B. Electric Company Limited of Montreal in the design and construction of electric systems for public buildings and several months with the firm of Arthur Surveyer and Company, consulting engineers, in the valuation of distribution systems. At the time of his recent appointment Mr. LeBlanc was engineer with the Provincial Electricity Board of Quebec.

T. P. Strickland, M.E.I.C., has resigned his position of chief engineer of the Melbourne and Metropolitan Tramways Board, Melbourne, Australia, and is now in private practice as consulting engineer in that city.

E. S. Holloway, M.E.I.C., has been named assistant engineer on the National Electricity Syndicate, by the Quebec Government. He has had extensive experience in water power development, having conducted studies and investigations for Kerry and Chace Limited, Toronto, the Power Corporation of Canada in British Columbia, and later a reconnaissance of the storage possibilities of Grand Lake Victoria area of the Ottawa River and of the power possibilities in the St. François River.

N. L. Hartmann, A.M.E.I.C., has accepted a position with the Aircraft Division of the National Steel Car Corporation, Hamilton, Ont. Previous to this he was with the Hamilton Works of the Steel Company of Canada Ltd.

W. L. Thompson, A.M.E.I.C., who has been with the Bailey Meter Company, Montreal, since 1927, has been appointed as the firm's Toronto manager.

F. H. Hibbard, A.M.E.I.C., acting superintendent and chief engineer of the Quebec Central Railway Company, Sherbrooke, Que., has been appointed superintendent and chief engineer. He will have jurisdiction over all branches of operating service, including maintenance of way, motive power and car departments and highway motor coach services.

R. A. Logan, A.M.E.I.C., in the position of General Manager of the Irish National Air Lines (Aer Lingus Teoranta), has been residing in Eire since June 1st, 1938. Mr. Logan has had a very interesting career since his graduation from the Nova Scotia Technical College in 1911. In 1915 he was appointed aeroplane pilot and engineer in the Royal Flying Corps and became flight commander in 1917. Subsequently he was appointed officer in charge of the ground instructional section, Canadian Air Force, Camp Borden, and since September 21st, 1921, has held the rank of squadron leader (major). In 1922 he was engaged in special investigation of flying conditions in the Arctic regions with the Canadian Arctic Expedition of that year. Later he held the position of manager of the mapping division of the Fairchild Aerial Camera Corporation in New York.

R. R. Oulton, Jr.E.I.C., has accepted an engineering position with the Canadian Broadcasting Corporation and will be stationed at CBA, Sackville, N.B. Since graduating from the Nova Scotia Technical College in 1938, Mr. Oulton has been with the Engineering Service Company, Halifax.

Gerald N. Martin, Jr.E.I.C., now in England, has written an interesting letter to Headquarters. He is stationed at the Brimsdown Station of the North Metropolitan Power Supply Company. This plant has one of the highest, if not the highest, overall efficiency of any steam power plant in the world. The equipment consists of two 200,000 lb. per hour boilers, with steam pressure of 1,900 to 2,000 lb. and temperature of 930 deg. F.

A. D. Foulis, Jr.E.I.C., who for the past two years has been manager of the Nova Scotia Branch of the Canadian Fairbanks-Morse Company, has announced his resignation and his intention to open his own agency business with offices in Halifax.

W. G. Hamilton, Jr.E.I.C., who has been manager of the Avon Gold Mines Limited at Oldham, N.S., is now located at Prestea, Gold Coast Colony, West Africa, as mining engineer and assayer with Gold Coast Main Reef Limited. Mr. Hamilton graduated from the Nova Scotia Technical College in 1935, becoming connected with the Canadian Johns-Manville Company Limited at Asbestos, Que., and later with the Tashota Gold Fields Limited and the Mine Apprentice Project, Lacey Gold Mine, Chester Basin, N.S.

W. F. McMullen, S.E.I.C., of the engineering department of the General Electric Company, Peterborough, Ont., has taken a position with the sales department of the company in Toronto. Mr. McMullen, who graduated from the University of Toronto in 1935, has been an enthusiastic chairman of the Junior and Students' Branch in Peterborough for the past year.

A. O. Dufresne, M.E.I.C., director, Quebec Bureau of Mines, addressed the Advertising Club of Montreal on March 22nd on the subject of mining in Quebec.

VISITORS TO HEADQUARTERS

Charles L. Stevenson, S.E.I.C., Canadian Engineering and Contracting Company (Quebec), Arvida, on February 17th.

P. M. Sauder, M.E.I.C., Lethbridge, Alta., project manager of the Lethbridge Northern Irrigation District, on February 20th.

John B. Angel, S.E.I.C., director and general superintendent of United Nail and Foundry Company Limited, St. John's, Newfoundland, on February 25th.

E. D. Gray-Donald, A.M.E.I.C., general superintendent of the Quebec Power Company, Quebec, on February 27th.

H. I. Stevenson, S.E.I.C., Winnipeg, Man., on March 20th.

J. E. Goodman, A.M.E.I.C.. of Kingston, on March 20th.

R. W. McColough, M.E.I.C., chief engineer of the Department of Highways, Nova Scotia, visited Headquarters on March 24th and stayed just long enough to explain that he was flying that night to Vancouver as a guest of the Trans-Canada Air Lines on their special demonstration "sample" flight which had been arranged for several prominent citizens, preliminary to the inauguration of the regular service. S. J. Hungerford, Hon.M.E.I.C., chairman and president of the Canadian National Railways and president of the T.C.A., was among the party at the St. Hubert Airport prior to the take-off from there.

ERRATUM

On page 141 of the March issue of the Journal the name of the winner of the Leonard Medal appeared incorrectly. It should have been J. J. Denny.

Obituaries

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

Frank Percy Jones, Affil.E.I.C., died at his home in Montreal on February 27th. He was born on November 5th, 1870, at Brockville, Ont., where he received his early education. He later attended the Royal Military College for a time but left this institution to assist his father at Gananoque where his business was located. He entered the employ of the Canadian General Electric Company, and after working in the sales department for some time took a similar position with the Nova Scotia Steel and Coal Corporation. When he left this company he became associated with the Dominion Iron and Steel Company, in which he was successively a salesman, general sales agent and general manager. In 1909 he became manager of the newly-formed Canada Cement Company Limited. He was later made general manager and president.

During the war he was appointed to the Railway War Board and in 1917 became chairman of the War Trade Board. In 1926 his interest turned to the power development of the St. Lawrence between Lake St. Francis and Lake St. Louis. He was later made president of the Beauharnois Power Company but in 1929 resigned this position and assumed the position of president of the Consumers Glass Company, Montreal. He was engaged in this business at the time of his death.

Mr. Jones joined the Institute in 1910.

R. R. Murray, A.M.E.I.C. News of the tragic death of R. R. Murray of Halifax, Nova Scotia, comes as a great shock to his many friends and business associates. Both Mr. and Mrs. Murray lost their lives on the morning of March 2, in the Queen Hotel fire, in which some thirty people perished.

Born in Springhill, Nova Scotia, on May 13, 1892, he took an engineering course at Acadia University, and continued his professional training at the Nova Scotia Technical College, where he was the first graduate to receive two degrees, mechanical and electrical engineering, with the class of 1914.

R. R. Murray, A.M.E.I.C.

Immediately on graduation he took a position with the Canadian Westinghouse Company, but left to join the army at the outbreak of the Great War. He rendered distinguished service in France, was five times wounded, and was awarded the Military Cross with bar before retiring, disabled, in 1917.

After his discharge to civilian life, Mr. Murray became associated with the efforts of the government in the re-education of disabled soldiers and he was in charge of a training centre in Halifax at Borden Barracks. Later, as an engineer for the Department of Highways, he constructed sections of road throughout the province and for some time was in charge of the Mechanical Division of the Department.

In 1928 he became sales engineer and director of the firm of Wm. Stairs, Son and Morrow, Limited, a position which he held until his untimely death. Outside of business duties, he had many educational, professional, and military interests and at the time of his death was Lieutenant-Colonel commanding the 6th Divisional Engineers.

Mr. Murray joined The Engineering Institute of Canada as an Associate Member in 1920, and for the last ten years he had rendered valuable service as Secretary of the Halifax Branch.

Lieutenant-Colonel Murray was buried with full military honours. Among his pall-bearers were the President of the Institute and two past chairmen of the Halifax Branch.

assistant engineer of the construction department of western lines, Prince Albert, Sask. In 1915 he joined the C.O.R.C.C. with the rank of Major; he was promoted Lt.-Col. in October, 1916, and commanded a unit until demobilized in 1919. He was mentioned in despatches and awarded the D.S.O. in 1918. He returned to the Canadian Pacific Railway employ at the end of the war and was made assistant engineer in charge of the Lanigan Northeast Branch. From 1920 to 1922 he was chief engineer and superintendent of the Edmonton, Dunvegan and British Columbia Railway. The next three years he spent in charge of construction of Pier B-C in the port of Vancouver. Since 1934, when construction was discontinued, he had been assistant superintendent of the C.P.R. at Prince Albert.

Mr. Reid joined the Institute in 1908 as an Associate Member, transferring to Member in 1920.

T. H. Nicholson, A.M.E.I.C.

J. G. Reid, M.E.I.C.

Thomas Herbert Nicholson, A.M.E.I.C., died on February 23rd in Montreal. He was born in Dumfries, Scotland, on April 12, 1881, and received his education there. He came to Canada in 1904 and joined the staff of the Bell Telephone Company in Montreal. He remained here two years and then went to Boston as chief equipment inspector of the New England Telephone and Telegraph Company. He remained in this position until 1911 when he returned to the employ of the Bell Telephone Company in Montreal. In 1924 he went to Rio Janeiro, Brazil, as consulting engineer with the Brazilian Telephone Company. He was made vice-president and general manager of the Compania Nacional de Electricidad, which operated the principal electric light and power, telephone and tramway properties in Costa Rica. After a year in this position he returned to Montreal in 1931 and took over a new company, formed under Dominion charter at Montreal for the distribution through Canada, Newfoundland and the British West Indies of domestic electrical devices, known as the T. H. Nicholson Company Limited. He was engaged in this business at the time of his death.

Mr. Nicholson joined the Institute in 1922 as an Associate Member.

John Garnet Reid, M.E.I.C., died suddenly on the Canadian Pacific Railway train near Canwood, February 13th. He was born at Bruce Mines, Ontario, on May 13th, 1878, and was educated at the schools of Sault Ste. Marie and at Bishop Ridley's College at St. Catharines, Ont. From 1898 to 1902 he was rodman on the Canadian Northern Railway and the following year was leveller on the Manitoulin and North Shore Railway. In 1903 he began his connection with the Canadian Pacific Railway which lasted until his death. He first held the position of instrumentman on construction of western lines and after two years in this capacity he was made resident engineer. In 1908 he was promoted to

Wilfred Carey Risley, M.E.I.C., was born at Piermont, N.H., in 1877 and graduated from Dartmouth College in 1900. His service in Sydney with the engineering staff of the Dominion Steel and Coal Corporation and its predecessors dates from 1902. He became Assistant Field Engineer of the Steel Plant in 1904, was appointed Field Engineer in 1905 and remained in that position with the Steel Company until 1920 when he was made Superintendent of Maintenance for the collieries, railways, loading and discharging plants of the British Empire Steel Corporation, later the Dominion Steel and Coal Corporation, which position he held until his death.

Mr. Risley's work in Sydney extended, therefore, over a period of nearly forty years which covered most of the productive life of the Sydney Steel Plant and the construction work of the collieries and transportation auxiliaries in Cape Breton Island, on the mainland of Nova Scotia and on the St. Lawrence River.

Mr. Risley was known to his friends and colleagues as a thoroughly competent civil engineer of wide experience; a sound man, conscientious, careful, painstaking; loyal to those whose work he directed and to his employers. During his long career in Nova Scotia Mr. Risley grew steadily in the esteem of his colleagues as one never ostentatious of his knowledge but thoroughly to be relied upon when difficult work was to be done. His interests were in his work, his men, and in his family; in regard to all these he had the solid virtues of the good New England stock from which he came. While he was for so many years a citizen of Sydney who will be greatly missed, he always retained his love for his birthplace and for Dartmouth College, his Alma Mater.

Mr. Risley joined the Institute as a Member in 1924. He served as Councillor from the Cape Breton Branch in 1926 and 1927. He was also a member of the Mining Society of Nova Scotia.

Donald William Ross, M.E.I.C., died at his home 239 Kindersley Ave., Town of Mount Royal on March 3rd.

He was born in Montreal on January 26th, 1874. He received his education at the Montreal High School and the Massachusetts Institute of Technology.

He entered business first with the Baldwin Locomotive Works of Philadelphia. For some years he was with the Engineering staff of the Dominion Bridge Co., Lachine, and the Phoenix Bridge and Iron Works, Montreal. Some years later with the late Donald Church he formed the Church Ross Co., and constructed many large industrial projects throughout Eastern Canada.

At the time of his death Mr. Ross was president of the Donald W. Ross Co., of Montreal.

Mr. Ross joined the Canadian Society of Civil Engineers in 1901 as an Associate Member and was transferred to Member in 1920.

John Charles Stadler, A.M.E.I.C., lost his life on March 5th in an aeroplane crash, during a flight over the district north of Chicoutimi. He was returning from Lac-à-la-Croix where he had been making radio experiments for two days. He was accompanied by Messrs. A. Larivière, M.E.I.C., a Councillor of the Institute, Paul Tellier, President of the Saguenay Electric Company, and Captain Hervé St. Martin, a noted aviator. Messrs. Larivière and Tellier had been flown out by the same pilot, Oscar Therrien, in the same machine, a few hours earlier. Mr. Stadler was born at Shawinigan Falls, Que., on October 6th, 1906. He received his early education at Mount St. Louis College in Montreal, and was graduated from McGill in 1931 with the degree of B.Sc.

Upon graduation he entered the office of his father, John Stadler, M.E.I.C., a noted Canadian industrial engineer. He was later associated with the Quebec Electricity Commission as assistant secretary. In that capacity he was responsible for the link between the engineering and the secretarial offices.

In 1937 he joined the staff of the Canadian Broadcasting Corporation, later becoming manager of stations CBF and CBM in Montreal. In July, 1938, he was appointed executive assistant to Dr. A. Frigon, M.E.I.C., assistant general manager of the C.B.C., a position which he occupied at the time of his sudden death.

Mr. Stadler was widely known in amateur radio circles, having operated station VE2AP for over ten years. He had acquired the reputation of an expert in that branch. His early radio experience included a trip to Newfoundland, in 1932, with a government research expedition. In May, 1937, he was one of the North American representatives of the Independent Amateur Radio Union at the annual meeting of the International Radio Consulting Committee in Bucharest.

He possessed the physical, intellectual and moral characteristics of the well-balanced man. He was endowed with a pleasant personality and a natural distinction which made him outstanding. His death is a great loss to the Institute and to the profession and is particularly felt by the younger members.

The funeral took place in St. Leo's Church in Westmount on March 13th, and was attended by a large gathering which of itself was a tribute to a distinguished young engineer and a popular citizen.

Mr. Stadler joined the Institute in 1927 as a Student, and in 1937 was transferred to Associate Member. He contributed to the Quebec Branch an interesting paper on the C.B.C. radio stations, which subsequently appeared in the November, 1938, number of the Journal.

Joseph Charles Taché, M.E.I.C., died in Rimouski on March 7th, 1939. He was born on March 25th, 1850, in Rimouski, Que. He entered the Federal Ministry of Public Works in 1872 and served in this Department for over 40 years. During that period he was engaged in river and harbour works in the districts of Rimouski, Gaspe, Bonaventure and later in the Saguenay and Chicoutimi areas. From 1899 to 1902 he was in the Yukon as engineer in charge of river improvements and construction of roads and bridges.

Mr. Taché joined the Canadian Society of Civil Engineers in 1903 as a Member. In 1921, he was made a Life Member of the Institute.

Thomas Henry White, M.E.I.C., one of the original members of the Canadian Society of Civil Engineers, passed away at his home in Vancouver on March 20th. He was born in St. Thomas, Ont., on January 27th, 1848. He received his education there and was admitted to the Bar of Ontario at the age of twenty-one. He did not, however, follow the legal profession for long. In the same year he obtained his first position on the location and construction of the Canadian Southern Railway. Railroad expansion reached its height in those days and Mr. White became a leading factor in railway development in Canada during the following fifty years.

In rapid succession he advanced in his chosen profession, first in Ontario as assistant engineer with the Great Western Railway. His big chance came with the decision to link the Canadian provinces from coast to coast with a railroad. Mr White was appointed assistant engineer under Marcus Smith, in locating lines through the Canadian Rockies. His first work in British Columbia was of an exploratory nature, searching for a satisfactory pass through to the Pacific Coast. Many hardships were suffered by the field parties at that time investigating routes through the Chilcotin and Bella Coola passes. Mr. White was assistant to W. T. Jennings (who was subsequently one of the founders of

D. W. Ross, M.E.I.C.

J. C. Stadler, A.M.E.I.C.

T. H. White, M.E.I.C.

The Engineering Institute of Canada) in studies of locations on the Pacific Coast for the Canadian Pacific Railway.

Following the selection of the Fraser Canyon route for the new railroad, Mr. White was on location through the Fraser Valley in 1883. He ran the first survey through the canyon from North Bend through to Harrison Lake.

Subsequently he worked on locations for the new transcontinental railroad in Ontario and Quebec, but returned to British Columbia in 1888 to join Mr. H. J. Cambie for the preparation of evidence in connection with the Onderdonk Arbitration of 1888-89.

In 1895 Mr. White had his first connection with Sir Wm. MacKenzie and Sir Donald Mann, who were at that time commencing their railroad construction in the west, and Mr. White was selected to go to Manitoba in the following spring and survey the Lake Manitoba Railroad and Canal Company Line from Gladstone to Lake Winnipegosis. For the following many years Mr. White directed, in the west, the enterprises of these railroad builders.

He was chief engineer for the MacKenzie-Mann interests in the construction of their line through the Yellowhead Pass to the Pacific. His last big railroad job completed and the road opened in 1915, Mr. White remained to see the construction of the Canadian National Terminals in Vancouver and the completion of the Okanagan Branch Line in 1922, when he retired at the age of 74.

It is believed that Mr. White, prior to his death, was the oldest living member of the Institute. He was Councillor and on the Executive Committee of the Vancouver Branch during the period 1914 to 1918. He was not only a Life Member of the E.I.C. but also a Life Member of the Association of Professional Engineers of the Province of British Columbia.

ELECTIONS AND TRANSFERS

At the meeting of Council held on March 17th, 1939, the following elections and transfers were effected:

Members

Cooch, Harold Austin, B.A.Sc. (Univ. of Toronto), vice-president, Canadian Westinghouse Co. Ltd., Hamilton, Ont.

Nickle, Hugh Dickson, B.Sc. (Mech.), (Mass. Inst. Tech.), manager, service and erection dept., Combustion Engineering Corporation, Ltd., Montreal, Que.

McCaffrey, Walter Raymer, B.A.Sc. (Univ. of Toronto), secretary, Canadian Engineering Standards Association, Ottawa, Ont.

Associate Members

Barrie, Alexander Ogilvy, B.Sc. (Civil), (Queen's Univ.), executive engr., Public Works Department, Gold Coast, British West Africa.

Bishop, Edgar Richard, (Diplomas in elect'l. & mech'l. engrg., Univ. of So. Wales & Monmouth), dftsman., Canadian Westinghouse Co. Ltd., Hamilton, Ont.

Black, Robert, dftsman., engrg. dept., Canadian Industries Ltd., Montreal, Que.

Gaymer, John Edward Ivens, (Diploma, Faraday House, London, England), apparatus sales engr., Canadian General Electric Co. Ltd., Montreal, Que.

Hellstrom, Carl Axel, mech. engr., (Orebro Tekniska Gymnasium), supervision of constrn. & special dfting work, Public Utilities Commission, Port Arthur, Ont.

Jeffreys, Charles John, (London Polytechnic), asst. to res. engr., Powell River Company, Powell River, B.C.

Oliver, John Craig, B.A.Sc. (Univ. of B.C.), registrar, Association of Professional Engineers of British Columbia, Vancouver, B.C.

Lemieux, Charles, Diploma in Chemistry (Univ. of Nancy), managing director, Les Petroles de Quebec Inc., Quebec, Que.

Rowe, Hugh Miller, B.A.Sc. (Univ. of Toronto), inspecting engr., Dept. of Mines and Resources, Ottawa, Ont.

Self, Robert Harvey, B.A.Sc. (Univ. of Toronto), estimating and junior supt. for Bennett Pratt, gen. contractors, Toronto, Ont.

Juniors

Foote, Samuel David, B.A.Sc. (Univ. of Toronto), rodman, C.N.R. constrn. dept., Toronto, Ont.

Kerr, James Winslow, B.A.Sc. (Univ. of Toronto), correspondent, apparatus divn., Canadian Westinghouse Co. Ltd., Hamilton, Ont.

Marshall, James Lawrence, B.Sc. (E.E.), (Univ. of Man.), engr., transmitter dept., R.C.A. Victor Ltd., Montreal, Que.

Scroggie, George Nelson, B.Sc. (Civil), (Queen's Univ.), junior engr., Dept. of Public Works of Canada, London, Ont.

Smith, Maurice Howie, B.Sc. (E.E.), (Univ. of Man.), mechanic, Massey-Harris Co. Ltd., Toronto, Ont.

Transferred from the class of Associate Member to that of Member

Cousineau, Aimé, B.A.Sc., C.E. (Ecole Polytechnique, Montreal), B.S. (Sanitary Engrg.), (Harvard Univ.), city sanitary engr., and supt. of the divn. of sanitation of the Dept. of Health, Montreal, Que.

Holden, Otto, B.A.Sc. (Univ. of Toronto), chief hydraulic engr., Hydro-Electric Power Commission of Ontario, Toronto, Ont.

Nash, James Cundiff, B.A.Sc. (Univ. of Toronto), dftsman., transformer engrg. dept., Canadian Westinghouse Co. Ltd., Hamilton, Ont.

Transferred from the class of Junior to that of Associate Member

Andersen, Viggo, B.Sc. (Civil), (Royal Tech. Coll., Copenhagen), reinforced concrete designer, Eug. Guay Inc., consltg. engrs., Montreal, Que.

Benjamin, Archie, B.Sc. (E.E.), (McGill Univ.), engr., distribution engrg. divn., Montreal Light, Heat & Power Cons., Montreal, Que.

Bereskin, Abraham Isaac, B.Sc. (Civil), (Univ. of Man.), 1307 Portage Ave., Winnipeg, Man.

Gibbon, Hubert S. V., (McGill Univ.), field engr., Bell Telephone Company of Canada, Ottawa, Ont.

Hay, Edward Campbell, B.A.Sc. (Univ. of B.C.), sales engr., Canadian Westinghouse Co. Ltd., Regina, Sask.

Holgate, William Thomas, B.Sc. (E.E.), (Univ. of Alta.), sales engr., Canadian General Electric Co. Ltd., Toronto, Ont.

Johns, Charles Frederick, B.Sc. (Mount Allison Univ.), i/c engrg. dept., Enterprise Foundry Co. Ltd., Sackville, N.B.

Mills, Wilson Stuart, B.Sc. (Queen's Univ.), district mgr., Wallace & Tiernan, Ltd., Toronto, Ont.

Milne, James Ramsay Burt, supt. mtce., Spruce Falls Power & Paper Co., Kapuskasing, Ont.

Munro, David John Best, B.Sc. (McGill Univ.), supt. of equipment, Montreal Tramways Company, Montreal, Que.

Riva, Ronald Herrick, B.Sc. (Civil), (McGill Univ.), job engr., F. H. McGraw & Co. Inc., Rocky Hill, Conn.

Thwaites, Joseph Taylor, B.Sc. (Queen's Univ.), engr. on switchgear, Canadian Westinghouse Co. Ltd., Hamilton, Ont.

West, Thomas Macdonald, B.A.Sc. (Univ. of Toronto), sec. treas., i/c plant and research, J. & J. Taylor Safe Works Ltd., Toronto, Ont.

Transferred from the class of Student to that of Associate Member

Brumell, Orby Richard, B.Eng. (Mech.), (McGill Univ.), asst. engr., Dominion Oilcloth & Linoleum Company, Montreal, Que.

Cunningham, Harold Emberson, B.Sc. (Civil), (McGill Univ.), gear engr., Dominion Engineering Works Ltd., Montreal, Que.

Transferred from the class of Student to that of Junior

Cardin, Paul-Emile, B.A.Sc., C.E. (Ecole Polytechnique, Montreal), asst. divn. engr., Quebec Roads Dept., St. Anselme, Que.

Holder, Allan Scott, B.Sc. (N.S. Tech. Coll.), designing engr., Canadian Industries Limited, Shawinigan Falls, Que.

Ross, Arthur LeBreton, B.Eng. (Elec.), (McGill Univ.), elect'l. engr., Railway & Power Engineering Corporation, Toronto, Ont.

Ross, Henry Urquhart, B.Eng., M.Sc., (McGill Univ.), metallurgical engr., Algoma Steel Corporation, Ltd., Sault Ste. Marie, Ont.

Swartz, Joseph Norman, B.Eng., Ph.D. (McGill Univ.), technical control dept., Howard Smith Paper Mills, Cornwall, Ont.

Students Admitted

Bethel, Vincent Walter (Univ. of Man.), Scott, Sask.

Bourgeois, Claude, (Ecole Polytechnique, Montreal), 240 Milton St., Montreal, Que.

Brien, Francois, (Ecole Polytechnique, Montreal), 1152 Labelle St., Montreal, Que.

Crerar, Norman Stewart, B.Sc. (E.E.), (Univ. of Man.), 310 Pearl Ave., Peterborough, Ont.

Ford, John Franklin, (Univ. of Toronto), R.R. No. 4, Milton, Ont.

Gray, Laurence Frederick, B.A.Sc. (Univ. of B.C.), 102 Morrison Ave., Town of Mount Royal, Que.

Harrison, George Ernest, (Univ. of B.C.), 1248 Dallas Road, Victoria, B.C.

Hetherington, Wordsworth Lloyd, (Univ. of B.C.), 2720 Columbia St., Vancouver, B.C.

MacBride, James Malcolm, B.Sc. (Civil), (Univ. of N.B.), Woodstock, N.B.

Malon, Victor Peter, B.Sc. (E.E), (Univ. of Man.), 711 College Ave., Winnipeg, Man.

Nadeau, Yvon, (Ecole Polytechnique, Montreal), 1297 St. Christophe St., Montreal, Que.

Roue, John Edward, (N.S. Tech. Coll.), 84 Spring Garden Road, Halifax, N.S.

Rule, Russell A., (Univ. of Toronto), 100 Humbercrest Blvd., Toronto, Ont.

Sicotte, Jean, (Ecole Polytechnique, Montreal), 1906 Van Horne Ave., Outremont, Que.

News of the Branches

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

EDMONTON BRANCH

F. A. Brownie, a.m.e.i.c. - *Secretary-Treasurer*
J. W. Porteous, Jr.e.i.c., - *Branch News Editor*

The regular dinner and monthly meeting of the Edmonton Branch of the Engineering Institute of Canada was held on Tuesday, Jan. 24, at the Macdonald Hotel. W. E. Cornish, a.m.e.i.c., presided.

L. C. Charlesworth, m.e.i.c., Director of Water Resources for the Government of Alberta, addressed the meeting on "**Irrigation in Alberta.**" With the aid of slides Mr. Charlesworth described the Lethbridge Northern irrigation system, from the intake, through the storage lakes to the farm distribution system. The slides showed the possibility of home and garden beautification with the advent of irrigation. The speaker concluded his talk with the showing of coloured moving pictures of the entire system.

About 35 members enjoyed the very interesting paper.

At the regular dinner and meeting of the Edmonton Branch for February, Mr. C. W. Carry, of the engineering staff of the Standard Iron Works, presented a paper on **Hydraulic Regulating Gates.** This paper is one which was prepared by F. Newell, m.e.i.c., and chief engineer of the Dominion Bridge Company. A very fine set of slides was used to illustrate the paper and a good discussion resulted. Following the paper a short film was presented illustrating by means of hydraulic analogy the operation of Ferranti surge absorbers. This film was kindly loaned to the branch by the Edmonton office of the Northern Electric Company.

HALIFAX BRANCH

A. G. Mahon, a.m.e.i.c. - *Branch News Editor*

The February meeting of the Halifax Branch of The Engineering Institute of Canada was held in the St. Julien room of the Halifax Hotel, February 21st, 1939, with approximately thirty-five members in attendance. Chairman A. D. Nickerson, a.m.e.i.c., had charge of the meeting.

The guest speaker for the occasion was Mr. R. C. Weaver, Assistant Superintendent of the Plymouth Cordage Company, which has recently taken over the plant of the Consumers Cordage Company in Dartmouth. Mr. Weaver first spoke of the intention of his company to revamp the existing cordage plant for the continued manufacture of rope and like products with more up-to-date equipment. He next covered the production of cordage from the time the raw material was gathered to its utilization as a finished article. Mr. Weaver dealt with some of the engineering problems of his business and cited a number of interesting cases where very close requirements have to be met, such as the manufacture of cord cores for steel cables, the making of special tapered lines for yachts and drilling cables for oil wells. The address was illustrated by a thirty-five minute sound film showing the manufacture of cordage products in the Plymouth Company's main plant. Mr. Weaver's address was very interesting and instructive and was greatly appreciated by members of the Halifax Branch.

At the close of the meeting, Ira P. Macnab, m.e.i.c., gave a resumé of the annual general meeting of the Institute held at Ottawa, with a short account of the subjects of the principal speakers. Mr. Macnab, Otis Cox, a.m.e.i.c., and R. L. Dunsmore, a.m.e.i.c., represented the Halifax Branch at the Ottawa meeting. S. W. Gray, member of the Executive of the E.I.C., represented at the meeting The Association of Professional Engineers of Nova Scotia, in his capacity as President.

HAMILTON BRANCH

A. R. Hannaford, a.m.e.i.c. - *Secretary-Treasurer*
W. E. Brown, Jr.e.i.c. - - - *Branch News Editor*

The branch held the Annual Ladies' Evening Lecture on Monday, February 13th, in the Lecture Theatre, McMaster University.

We regret that such an excellent speaker as John A. Marsh, Esq., Member of Parliament for Hamilton West, could only be arranged for the evening before the opening of the Annual General Meeting at Ottawa.

In the absence of Chairman J. R. Dunbar, a.m.e.i.c., who had left for the Annual General Meeting, the chair was taken by V. S. Thompson, a.m.e.i.c., Vice-Chairman, who welcomed the ladies on this occasion arranged for them.

R. K. Palmer, m.e.i.c., introduced Mr. John A. March, paying tribute to him as a leading amateur astronomer and a member of the Royal Astronomical Society of Canada.

The speaker addressed the meeting on the subject entitled, **A Journey Through Space.**

He impressed on the gathering the thought that behind all the creations of the universe there was and is planned order.

Our own world and universe is only one of 3,200 known universes. The sun although continually burning its material up is at the same time attracting shooting stars and a large amount of stray or floating material that comes within the limits of the attraction of its surface. If we can consider the far off time at which the sun will have burnt out, then the earth will become a cold, waterless place like the moon, but possibly by that time man may have invented a means of keeping warm and obtaining water.

The address was illustrated by slides, many of which had been taken by Mr. Marsh, particularly interesting were those showing the sun flames and the corona, and the surface of the moon with the huge craters of extinct volcanoes.

The address was especially appropriate for the occasion and was greatly appreciated by the audience, numbering 76.

After the meeting the visiting ladies were the guests of the branch when they were entertained in the Science Library, where the management of the University kindly provided refreshments. Coffee was served by the wives of the Executive Committee.

LETHBRIDGE BRANCH

E. A. Lawrence, a.m.e.i.c. - *Secretary-Treasurer*

A joint dinner with the Association of Professional Engineers of Alberta was held on January 21st, 1939. An account of this appears on page 202 of this issue.

MONTREAL BRANCH

E. R. Smallhorn, a.m.e.i.c. - *Secretary-Treasurer*

Design and Construction of Domes was the subject of the paper presented before the branch on March 2nd by M. Cailloux, c.e. The design and construction of reinforced concrete domes were discussed with particular reference to the dome of St. Joseph's Shrine, Montreal. The paper was illustrated by a large number of slides. Mr. Cailloux is a graduate of Ecole Polytechnique and has had a wide experience in reinforced concrete work and is a partner of Associated Engineers Limited, Montreal. He made his subject a most interesting one to the audience. J. A. Lalonde, a.m.e.i.c., was chairman of the meeting.

A meeting of the Junior Section of the Branch was held on Monday night, March 6th. Dr. Andre Hone, Superintendent of Technical Control and Metallurgist at the

Shawinigan Falls plant of the Aluminum Company of Canada, addressed this meeting on the subject of **The Metallurgy and Engineering Aspects of Aluminum,** covering the mining of the ore in British Guiana, the casting, rolling, drawing, extruding, forging, and welding of aluminum, its properties and application and its more important alloys.

On March 9th J. A. Knight, M.E.I.C., addressed the Branch on **Calcium Chloride in Construction.** This paper described the use of calcium chloride in the building and maintenance of roads, its effect on concrete work and its use for ice control and refrigeration. Mr. Knight is a graduate of Toronto University and is now manager of Highways Engineering Service for Brunner, Mond Canada, Limited. H. S. VanScoyoc, M.E.I.C., was in the chair. Prior to the meeting a courtesy dinner was held at the Windsor Hotel.

C. G. Levy of the Canadian General Electric Company addressed the Branch on March 16th on the subject of **Unit Substations,** discussing factory built unit substations with special reference to primary networks. The branch was honoured by a visit from the President.

Prior to the meeting an informal dinner was held at the Windsor Hotel for President McKiel and for the speaker.

OTTAWA BRANCH

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

At the first noon luncheon at the Chateau Laurier of the Ottawa Branch for the 1939-1940 term, held on January 26, C. S. Parsons, Chief of the Division of Metallic Minerals of the Bureau of Mines, Department of Mines and Resources, was the guest speaker. Mr. Parsons spoke on **Metallurgical Testing and Research, and its Relation to the Development of Our Mining Industry.** J. H. Parkin, M.E.I.C., newly elected chairman of the branch, presided. Hon. Michael Dwyer, A.M.E.I.C., Nova Scotia Minister of Mines, was present and was introduced by the chairman.

Canadians may not be fully aware, stated Mr. Parsons, that Canada operates at Ottawa the largest and most completely equipped ore dressing and metallurgical laboratories in the world. The service which these laboratories have contributed in the way of research and experimentation with, and development of, ore treatment methods is one of the major factors in the development of the mining industry of Canada.

Only a small part of the investigations carried on at the laboratories originate within the Department itself, but come mostly from other government departments and organizations. The pressure of work, for instance, during the past five years has been such as to require an average of one complete investigation, including a typewritten report, to be made every three days.

It was these laboratories that developed the methods of treating the radium ores of the Great Bear Lake region a few years ago, Mr. Parsons said. With these ores the laboratories had to start "right from scratch" since methods in use in the Belgian Congo, the only other place where radium was processed, were a carefully guarded secret.

It has been too long accepted as axiomatic that Canada is a young and undeveloped country. "Our development years are slipping by more rapidly than our calendar years," said Mr. Parsons. While Canada still had much to learn from other countries, yet she could not afford to be dependent on them for her ideas and research. Many Canadian problems were peculiarly her own. That was particularly so in mining.

A series of slides was used by the speaker to illustrate various items of equipment and methods of investigation. One photomicrograph flashed upon the screen, for instance, showed a section of gold ore containing the gold in such small particles that it would take 8,500,000,000 of them to make one cent's worth.

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 January 12, 1939, to discuss the subject, **Where Does the Engineer Fit Into the Picture in a National Emergency?** The meeting took the form of an open discussion on the methods of employing to the best advantage the specialized training and ability of engineers both before and during a war. Many points in connection with this important problem were brought forward; the following resolutions were adopted by the meeting:

1. Resolved that committees of engineers from all professional societies be formed to study specialized defence problems even though they may be supplementary to existing work already being done by the Government.
2. (In connection with the survey of industry which the Government is already making.) Resolved that the survey of industry should be made by local committees including both engineers and manufacturers appointed by local manufacturers' associations at the request of the Government. Also that the Government advise the committees their probable requirements and consider placing trial orders of suitable war materials to assist in training personnel and checking the findings of the survey committees.
3. Resolved that the E.I.C. urge other branches to hold meetings similar to the one at Peterborough and that Headquarters appoint a committee to co-ordinate all ideas submitted.

At a meeting held on January 26, J. L. Clarke, M.E.I.C., Transmission and Foreign Wire Relations Engineer with the Bell Telephone Co. at Montreal, gave an address on **Trends in Electrical Communication.**

Mr. Clarke sketched the growth of the modern telephone system from its modest beginning in relatively simple isolated systems, to its present world-embracing state. Using slides and models, Mr. Clarke showed the vast improvements which have been made in telephone transmitters and receivers since the early telephone systems were started.

Mr. Clarke had previously presented this paper before the Montreal Branch of the Institute, and it has therefore already been reported in the Journal.

Mr. A. M. Doyle, Associate A.I.E.E., of the Canadian General Electric Co. at Toronto, addressed the Branch on **Lightning Protection for Transmission Systems** at a meeting held on February 9th.

Mr. Doyle devoted his talk to a discussion of the disturbances which may appear on transmission systems, and their effects on insulations and protective devices, and to the measures which can be taken which tend to reduce system outages.

Apart from dynamic overvoltages caused by dropping load, the overvoltages which may appear on transmission systems are:

1. Direct lightning strokes.
2. Induced lightning strokes.
3. Switching surges.
4. Arcing grounds.

Knowing something of the characteristics of the overvoltages, the problem becomes one of designing the transmission system so that no part of it is stressed beyond its demonstrated strength, and at the same time providing a sufficient margin above normal operating stresses to ensure reasonable freedom from outages. The difficulties in the problem lie mainly in the behaviour of insulations under lightning conditions, since the effects of the other overvoltages can be determined readily. Dynamic overvoltages must be given consideration only in the selection of certain protective devices as lightning arresters. Switching surges and arcing ground overvoltages are essentially of normal frequency character, and consequently normal frequency data are effective in designing for these voltages.

Lightning overvoltages vary so greatly in magnitude and wave shape that it is impossible to design a system which can be guaranteed entirely immune. However, by means of laboratory studies with wave shapes which simulate those encountered in service, considerable information has been obtained which is useful in predicting system performance.

Definite time is required to cause insulation breakdown, and the higher the applied voltage the shorter will be the time. Volt-time curves have been prepared to give the crest value of the voltage wave which causes breakdown in various items. Aided by these curves, it is possible to select the proper levels of insulation for the various parts of the system so that the requisite degree of protection is furnished.

On February 16, C. R. Whittemore, M.E.I.C., gave an address to the branch on **The Metallurgy of Metallic Arc Welding and Its Applications.** Mr. Whittemore is metallurgist for the Dominion Bridge Co. at Montreal. He is the author of many articles on welding, which have appeared in the Journal and in other publications.

Mr. Whittemore covered his subject in a very interesting and informative manner; at the conclusion of his talk he was given a hearty vote of thanks by the branch. The talk had previously been given before the Toronto Branch of the E.I.C., a resumé of it will be found in the January, 1938, issue of the Journal.

The annual Junior and Students Night was held on March 9, 1939. This meeting is one which is always looked forward to by the branch; the meeting this year upheld the high reputation established by the Juniors in previous years. A. J. Girdwood, Jr.E.I.C., the new Chairman of the Junior Section, introduced the speakers.

Mr. B. K. Scarlett was the first speaker, taking as his subject, **Radio Fundamentals.** His talk explained in a surprisingly simple manner the apparently intricate functions of a broadcasting station and of a modern radio receiver.

J. R. Dunn spoke on a complementary subject, **Radio Aids to Aerial Navigation.** He discussed the manner in which directional beams are sent out from modern airports, explained the functions of the "loop antenna," and told how planes can now make complete flights, including the take-off and landing, while flying blind, by means of modern radio equipment.

In closing the meeting, W. T. Fanjoy, A.M.E.I.C., Chairman of the branch, urged the speakers to enter their papers for the John Galbraith students' prize. Mr. Fanjoy reminded the meeting that this prize has on several occasions been awarded to a Peterborough Junior, including the last two years and the time a few years ago when Mr. Fanjoy himself won it.

ST. MAURICE VALLEY BRANCH

V. Jepsen, A.M.E.I.C. - *Secretary-Treasurer*

A dinner and the Annual Meeting of the Branch were held at the Cascade Inn, Shawinigan Falls, on February 23rd, 1939, under the chairmanship of H. J. Ward, A.M.E.I.C. There were 26 members present.

In opening the meeting the chairman, after thanking the members for the support they had given him during his term of office, spoke of the subject matter of the meetings held during the year, and asked that the members write to the Executive Committee giving their suggestions as to future subjects. He suggested that the members should attempt to arouse the interest of non-member engineers in the Institute, by bringing their friends to the meetings, etc., for the good of the branch. He expressed his thanks to the Secretary-Treasurer and to Prof. Keay, M.E.I.C., Vice-President, for their assistance during the year.

The Secretary-Treasurer read his report and financial statement, and moved their adoption. The motion was seconded by N. J. A. Vermette, A.M.E.I.C., and carried unanimously.

The Secretary-Treasurer read the report of the Nominating Committee, under the chairmanship of Mr. H. C. Keay, giving the personnel of the Executive Committee for the ensuing year, as compiled from the results of the recent ballot.

The Chairman congratulated the membership on their choice of the new Executive, and introduced the Chairman-elect, F. W. Bradshaw, A.M.E.I.C., of Grand'Mère, giving a brief resumé of his career.

Mr. Bradshaw congratulated the Chairman and the Secretary on their successful year. He stated that there had been six meetings in the year, with an average attendance of over fifty, although the resident membership was forty-six, and this in spite of the difficulties of transportation between the three towns in winter. He said that this activity of the branch showed efficient leadership, and also that it implied a potential membership much larger than the actual. He urged all to become membership-minded, and mentioned the various factors that make membership in the Institute worth while. He announced that Viggo Jepsen, A.M.E.I.C., had been appointed Secretary-Treasurer for the ensuing year. He thanked the members for entrusting him with the chairmanship and mentioned that he was fortunate in being assisted by the same Executive Committee as for the past year.

The Chairman promised Mr. Bradshaw his full support. He then asked Prof. Keay, Vice-President, to give his impression of the Annual General Meeting at Ottawa.

Prof. Keay spoke first of the Council meeting on Feb. 13th, at which the question of membership classifications was taken up. He said that the Council favoured the proposal to merge the classes of Associate Member and Member, but that the suggestion for establishing a class of Fellow had been deferred; also the question of reduction of the Council had been dropped. He then gave a brief resumé of the proceedings at the Annual Meeting.

The Chairman then called upon Mr. Champion, who expressed his gratitude to the members for electing him Vice-Chairman for the ensuing year, and offered to Prof. Keay the thanks of the gathering for his very entertaining talk.

The Chairman thanked those present for their support. He said that they had elected a good Executive for the coming year and asked the members to support them also. He wished success to Mr. Bradshaw.

The meeting adjourned at 9 p.m.

SASKATCHEWAN BRANCH

J. J. White, M.E.I.C. - *Secretary-Treasurer*

On January 20, 1939, the monthly dinner meeting of the branch was held jointly with The Association of Professional Engineers of the Province of Saskatchewan and the local section of the American Institute of Electrical Engineers in the Kitchener Hotel, Regina, when sixty persons were present.

The Chairman, R. W. Jickling, A.M.E.I.C., introduced the speaker of the evening, Mr. W. A. Osbourne, Vice-President of the Babcock-Wilcox and Goldie-McCulloch Company Limited of Galt, Ontario, who took for his subject the Babcock **Integral Furnace Boiler.**

After referring to the growth of pulverized-coal-firing during the past twenty years, Mr. Osbourne paid tribute to the pioneer work done in the cement industry and in some of the large utility plants in which engineers had the courage and foresight to undertake the installation of pulverized-coal-fired boilers at a time when there were still many problems to be worked out in connection with a new method of firing coal.

It was recalled that in the earlier installations it was soon discovered that furnace volumes which had been acceptable prior to that time for stoker firing were totally inadequate for pulverized fuel. It was also soon discovered that ordinary refractory materials in the furnace walls placed a definite limit on the heat release in B.T.U.'s per cu. ft. which could be considered as satisfactory in view of the furnace maintenance.

The later developments which have taken place in this method of firing have resulted from better knowledge of the disposition of boiler heating surfaces, with furnace cooling so as to avoid trouble from the ash in the coal and, finally, from the progress which has been made in the design and construction of coal pulverizers and pulverized coal burners.

One of the difficulties in applying the experience and knowledge gained in the larger utility plants to smaller industrial plants was that the necessity of having a comparatively large furnace volume with the conventional boiler placed above the furnace usually resulted in a unit requiring 50 feet head room or more. This usually meant that the replacement of obsolete boiler equipment would require, in addition to the new boiler equipment, a larger building to provide the necessary accommodation, with a consequent substantial increase in capital investment.

To meet the need for a steam generating unit which would incorporate the experience gained with pulverized-fuel-firing in the larger utility field and would, at the same time, prove efficient, reliable, and occupy a minimum of building space, the "Integral Furnace" boiler was put forward as a practical solution.

The one limiting feature in most plants where obsolete boiler equipment is to be removed is usually the head room available. In the "Integral Furnace" boiler, instead of having the boiler heating surface placed above the furnace, it is placed to the side of the furnace and at the same time the feature of having the furnace integral with the boiler itself eliminates the use of a number of headers and connections between the furnace waterwall cooling and the boiler.

The furnace floor consists of cast iron Bailey blocks, which are clamped to and carried on 3¼ in. tubes running underneath and placed on six in. centres. These blocks are accurately made and ground to gauge fit to suit the boiler tubes and, in addition to this, a heat conducting cement is placed between the block and the tube to insure high heat transfer.

This type of floor construction insures the maximum cooling of the ash as it falls on the floor, and reduces to a minimum the task of cleaning the ashes from the unit, which is usually done by an air hose or steam hose once per shift.

The sidewall and roof of the furnace are of Bailey stud construction consisting of 3¼ in. tubes on six in. centres with the space between the tubes taken up by studs which are electrically welded to the side of the tubes. Between these studs, after the tubes are put in place, is tamped a refractory cement which sets hard under the influence of furnace temperature.

From the boiler itself, the lecturer proceeded to deal with the subject of pulverized coal burner design, emphasizing the necessity for the proper proportioning of velocities in the primary air pipe and pointing out the limitations which were to be met in the range of capacity on pulverized-coal-fired burners.

After a short description of the principles of grinding coal, curves were shown to indicate the effect of grindability and fineness on pulverizer output and on the power required for pulverization and information was given in regard to the desired fineness for good combustion condition in various types of burners.

The automatic pulverizer feeder control greatly simplifies modern control of pulverized-coal-fired units, so that by the use of a damper on the primary air fan only, either manually or automatically controlled, the entire output of the unit can be controlled from one point.

The interest of the audience in the lecture was attested to by the discussion which followed. A hearty vote of thanks was proposed by E. W. Bull, M.E.I.C., and seconded by H. S. Carpenter, M.E.I.C.

SAULT STE. MARIE

O. A. Evans, Jr.E.I.C. - *Secretary-Treasurer*
N. C. Cowie, Jr.E.I.C. - *Branch News Editor*

On Feb. 24th, 1939, the Sault Ste. Marie Branch held its first general meeting for the current year, when 34 members and guests had dinner at the Windsor Hotel, Sault Ste. Marie. The Chairman of the branch, A. E. Pickering, M.E.I.C., occupied the chair.

The meeting took the form of a junior night when the ordinary business had been transacted. The Chairman transferred the chair to A. R. Clarkson, Jr.E.I.C., who organized the meeting. A short sing-song was held under the direction of Mr. Bruce Fleming. Following this Mr. Clarkson introduced the speakers of the evening, who were, A. H. Meldrum, Jr.E.I.C., whose topic was the **Basic Open Hearth Process of the Algoma Steel Corporation,** and Henry U. Ross, S.E.I.C., who spoke on **Beneficiation of Iron Ore.** Both talks were illustrated by slides.

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 2nd at Hart House, University of Toronto, Dr. A. E. Berry, M.E.I.C., in the chair, a large turnout of members enjoyed an informative talk by C. A. Robbins, District Engineer, Department of Highways, Toronto, on **"Highway Trends in Ontario."**

Mr. Robbins remarked that prior to 1917 all Ontario rural roads were under the control of the counties and townships and were paid for by assessment against property. In 1917 the first "King's Highway" was constructed with the province paying 80 per cent of the cost. To-day there are over 7,000 miles of King's Highways and 3,200 miles of secondary highways administered and wholly supported by the province. In addition to these, there are tourist roads, mining roads, and roads in suburban areas around Toronto and other cities which are subsidized to the extent of 50 per cent by the province.

In 1920 it was difficult for the Department of Highways to buy property for road beds. There were few cars on the roads, and farmers did not want roads cutting across their fields, so new roads had to stick to old rights of way. The result of this was that a high percentage of the mileage had to be held to speed limits of not over 30 miles per hour. This type of road cannot be expected to attract tourists in large numbers, and the tourist business is of outstanding importance to this province. The number of cars in Ontario is about 670,000; it has increased about five per cent each year since 1932. The number of tourists last year was eight million, bringing one hundred and sixty million dollars annually into Ontario. To preserve and increase this revenue, it is obviously good business for the province to make the road programme one of its major activities.

Practically all present roads are built up closely on each side of the right-of-way, hence widening involves enormous damage to property, and it is almost impossible to by-pass traffic satisfactorily on a busy road. Likewise, if it is attempted to make improvements to the grade and alignment of existing roads, the cost is out of proportion to the benefit derived. For these reasons a policy of building new roads on locations that will avoid built-up localities is the logical solution. The property will be acquired through expropriation proceedings, and it is planned to control all building for 150 feet each side of the road, so that grades and alignments may be chosen for engineering reasons. If desired any particular road might be made a "limited way." These new limited ways or roads for high speed through traffic will by-pass the towns, but will provide good entrances to and from the towns by cloverleaf intersections, or traffic circles, and where farms or other property have been divided by the road, some form of traffic light or tunnel will be provided so that the owner will be able to pass between the two parts of his property.

Both Chicago and New York have spent many millions on street widening programmes but did not get the expected improvement in traffic condition and have had to turn to limited ways. The new stretch of road between the Humber River and Browns Line is a local example of a limited way with no means of entrance from the sides in a length of four miles.

Just at the present time great interest is being taken in highway lighting. So far it is an interesting experiment.

The scenic aspect of road building is also the object of increasing attention. Tree planting, sodding of banks and control of erection of sign boards are all being practised, and on the new motor-ways a few wayside parks are being built.

Mr. Robbins showed a series of slides indicating how gravel roads are being improved, their dusty and undesirable features being overcome by the use of surfaces of bituminous material mixed on the road by graders, followed by rolling with a light roller. Other slides showed concrete roads of all types, some with lanes and boulevards between the lanes, to reduce the accidents at hill tops and crossings.

In closing a most interesting address, the speaker said that as regards safety, it always lay ultimately with the individual driver, that fifty miles per hour was a top limit for speed that was being increasingly mentioned, and that in Pennsylvania, where it was rigidly enforced, the accident toll had been cut in half since its adoption.

The following is a synopsis of an address by Colonel Willard Chevalier, New York, Vice-President McGraw Hill Publishing Co., editor and publisher of "Business Week," on **"The Hidden Spark Plugs of Industry,"** given on February 15th to a meeting of the Toronto Branch E.I.C. at the Royal York Hotel to which the members of the Affiliated Engineering and Allied Societies in Ontario received a special invitation.

The present day economic system was suffering more from "dirty spark plugs" than from any defect in the machine itself, Col. Chevalier declared.

"People to-day are wondering what is wrong with the world and the first thing they think of is to get a new machine, a new 'ism.' Do not run the old machine into the ditch and get a new model," he said. "Lift the hood and look for the trouble. It is not economical to scrap a perfectly good car just because the spark plugs have become fouled."

"Too much emotionalism, together with panic and narrow vision have let the spark plugs of industry become dirty," Col. Chevalier declared.

He compared the democratic economic machine to a motor car with six cylinders. Its gasoline was human energy and its spark plugs the incentives that keep industry going. These incentives, he said, were scientific research, low-cost power, salesmanship, labor, investment and management.

"Over in Germany," he added, "they are trying to make the world over with a one cylinder machine with only one incentive—fear. They just have that one spark plug and they certainly keep it hot. Before we, too, are forced into that one-cylinder economy, let us make sure the old democratic system has not outlived its usefulness."

The "isms" had nothing to offer America, the speaker asserted. "I can see nothing in Europe that has anything better to offer us than our democratic system, despite all its faults and imperfections," he said. "Communism and Fascism are both conditions that came out of the death throes of people in another and a different world whose standards and traditions are greatly different from ours."

Continuous discovery of new things through scientific research, the speaker said, was the most vital factor in the operation of a free and democratic economy.

VANCOUVER BRANCH

T. V. Berry - *Secretary-Treasurer*

The effectiveness of various types of **Highway Guard Rails** in preventing automobiles from leaving highways when out of control was demonstrated to the Vancouver Branch by a film prepared by the Missouri State Highway Commission.

The film was shown before nearly forty members of the branch on the evening of February 9th in the York Room of the Hotel Georgia. Officials of the Greater Vancouver Traffic and Safety Council, Provincial and City of Vancouver Traffic divisions and the Provincial Department of Public Works were present by invitation of the branch.

The film showed a series of twenty-four tests made on both cable and plate types of highway guard rails. Driverless cars weighing 5,100 pounds were given velocities of from thirty-one to thirty-four miles per hour by means of an inclined runway and the guard rails hit at the point of impact at an angle of twenty degrees. Fore and rear pictures as well as slow motion shots were taken of the impact in order to study the performance of each type of rail under impact and the resultant effect on the car.

In order to determine the most satisfactory type of guard rail the Missouri State Highway officials studied the following factors in each test.

1. Relative ability of the guard rail to divert the vehicle back on to the road.
2. Relative abruptness of stoppage of the vehicle, this factor being considered a measure of the relative safety of the passengers under such conditions.
3. Relative damage to the guard rail itself and the ease in repairing the rail after damage.
4. Relative damage to the vehicle.

It was the finding of the Commission that the plate type of guard rail was the more satisfactory and efficient, but as to the best type of plate rail the tests made were not conclusive.

The showing of this film was made possible by the courtesy of A. E. Foreman, M.E.I.C., consulting engineer, Vancouver, B.C., who made comments and read extracts from the Missouri State Highway Commission's report during the showing of the film. A very interesting discussion followed the exhibition of the film. A vote of thanks to Mr. Foreman was proposed by Major W. G. Swan, M.E.I.C., on behalf of the branch.

WINNIPEG BRANCH

J. Hoogstraten, A.M.E.I.C. - *Secretary-Treasurer*

At a joint regular meeting of the branch and the Association of Professional Engineers of Manitoba, held on February 2, 1939, Mr. S. S. Stevens, Radio Engineer, Trans-Canada Airlines, spoke on **Radio in Air Transportation.**

Navigation by radio has been perfected as a primary navigation instrument by the development of the radio range. The radio beam may be adjusted to any width, but is limited to about three degrees by the limitations imposed by the selective qualities of the human ear in distinguishing signal differences. Furthermore, a beam of width less than three degrees offers difficulties in definition by high speed planes travelling across the beam.

Teletype service provides all ground stations with weather sequence at all designated points in very fast time.

Developments for the future point to an ultra high frequency (600 megacycles) glide path to facilitate landings. Experimental work is carried on with a view to ultra high frequencies to avoid static, and ultra high frequency markers are already in use.

The Annual Meeting of the Winnipeg Branch was held in Theatre B, University of Manitoba, on Thursday, February 16, 1939. W. D. Hurst, A.M.E.I.C., retiring Chairman, presided.

Through the courtesy of the Imperial Oil Company, the members were entertained by two moving pictures, **Safari on Wheels** and **The Inside Story of Lubrication.**

The reports of the retiring chairman, the secretary-treasurer and standing committees were presented. Following a discussion on the financial position of the branch, it was recommended that the incoming executive circularize the membership for voluntary contributions.

Officers of the branch for the year 1939 are as follows: Chairman, J. W. Sanger, M.E.I.C.; Immediate Past Chairman, W. D. Hurst, A.M.E.I.C.; Vice-Chairman, H. L. Briggs, A.M.E.I.C.; Secretary-Treasurer, J. Hoogstraten, A.M.E.I.C.

Executive Committee: for two year term, D. N. Sharpe, M.E.I.C.; V. Michie, M.E.I.C.; one more year to serve: G. C. Davis, A.M.E.I.C.; V. H. Patriarche, A.M.E.I.C.; J. T. Rose, A.M.E.I.C.; Chairman Programme Committee: C. V. Antenbring, A.M.E.I.C.; Chairman Membership Committee: Adam Sandilands, A.M.E.I.C. A. J. Taunton, M.E.I.C., has one more year to serve as Councillor.

News of Other Societies

Items of interest regarding activities of other engineering societies or associations

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF SASKATCHEWAN

The Annual Meeting of The Association of Professional Engineers of the Province of Saskatchewan was held in the Writing Room of the Hotel Saskatchewan in the afternoon of February 17, 1939, at which fifty members were present.

Discussion mainly centred around the recent Co-operative Agreement between The Association of Professional Engineers of the Province of Saskatchewan and The Engineering Institute of Canada, which was reviewed by the Past-President, Mr. J. W. D. Farrell. He thought the agreement to be advantageous to both parties, especially so in view of the fact that it had eliminated the possibility of any confusion regarding control of all local activities.

The election resulted in the following officers:

President: I. M. Fraser, M.E.I.C.

Vice-President: P. C. Perry, M.E.I.C.

Councillors for a period of two years: R. J. Fyfe, A.M.E.I.C., A. M. Macgillivray, A.M.E.I.C.; J. McD. Patton, M.E.I.C.

Other officers to serve for another year on the Council are: R. W. Allen, M.E.I.C., S. R. Muirhead, M.E.I.C., R. A. McLellan, M.E.I.C., along with J. W. D. Farrell, M.E.I.C., Past-President.

The following were elected as a Nominating Committee for the ensuing year: C. J. McGavin, M.E.I.C., G. L. Mackenzie, M.E.I.C., L. F. Creighton, A.M.E.I.C.

In the evening, more than one hundred engineers and friends from all parts of Saskatchewan gathered in the private dining-room of the Hotel Saskatchewan for one of the most successful dinners in the history of the Association. This dinner was followed by variety entertainment arranged by H. A. Jones, Chairman of the Papers and Meetings Committee.

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF ALBERTA

At the district meeting of the Association of Professional Engineers of Alberta, held in Lethbridge on Saturday, January 21st, 1939, at the Marquis Hotel, presided over by Dr. J. O. G. Sanderson, geologist of Home Oils, Calgary, and president of the Association, it was decided to hold the annual meeting at a date to be fixed in the latter end of March.

A council meeting was held at 10 a.m., with J. T. Watson, A.M.E.I.C., City Manager, and Vice-President of the Association, in the chair. Association matters were discussed.

At 2.00 p.m., the district meeting of members was held under the chairmanship of Dr. Sanderson. Outside members present at this meeting were Professor Robb, M.E.I.C., Professor of Mechanical Engineering, University of Alberta, Edmonton; Professor W. E. Cornish, A.M.E.I.C., Assistant Professor of Electrical Engineering, University of Alberta; Robert Dingwall, M.E.I.C., Manager, Standard Iron Works, Edmonton; Charles Garnett, M.E.I.C., Managing Director of Gorman's Ltd., Edmonton; P. L. Debney, Assistant City Engineer, Edmonton, and Registrar of the Association; Howard McLean, Production Manager, Calgary Power Co., Calgary; and J. B. deHart, M.E.I.C., Instructor of Mining, School of Technology, Calgary.

The meeting closed with a joint dinner of the professional engineers and members of the local branch of The Engineering Institute of Canada under the chairmanship of R. F. P. Bowman, chairman of the Lethbridge Branch, E.I.C. The principal speaker was Dr. Sanderson, who addressed the meeting on matters pertaining to the Association. Mayor Elton was an invited guest.

Two solos by George Brown, Jr., and community singing formed part of the proceedings.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The one hundred and third meeting of the American Association for the Advancement of Science and associated societies was held at Richmond, Virginia, at which the Institute was represented by Fraser S. Keith, M.E.I.C.

In the promotion of science the Association has played a distinguished role for 90 years. Through its 15 sections and 166 associated societies it covers essentially the whole field of pure and applied science. Its membership of 19,000 extends throughout the world, and including that of its affiliated societies numbers nearly 1,000,000. There were over 5,000 registered at this convention. The sections include; Mathematics, Physics, Chemistry, Astronomy, Geology and Geography, Zoological Sciences, Botanical Sciences, Anthropology, Psychology, Social and Economic Sciences, Historical and Philological Sciences, Engineering, Medical Sciences, Agriculture, Education.

The Engineering Affiliated Societies are:

American Society of Mechanical Engineers.
American Institute of Mining and Metallurgical Engineers.
American Institute of Electrical Engineers.
American Society of Civil Engineers.
Illuminating Engineering Society.
American Society for Testing Materials.
American Ceramic Society.
Institute of Radio Engineers.
Society for Promotion of Engineering Education.
Institute of Aeronautical Sciences.
American Society of Heating and Ventilating Engineers.
American Society of Refrigerating Engineers.
Western Society of Engineers.
American Society of Photogrammetry.

The variety of the subjects represented by the 15 sections gives some idea of the field covered in the papers given at this convention, but it is more fully appreciated from the fact that during the convention there were delivered papers and addresses by different scientists to the amazing number of 1,723. It is impossible in a brief review to even mention the papers presented. In addition, there were social and entertainment features, excursions and out-of-town trips, visits to various plants, including extensive tobacco factories, one of which has an hourly production of 10,000,000 cigarettes and pays a daily federal tax of $240,000. Of outstanding interest to the visitor were the exhibits in the Mosque which was registration headquarters.

ONTARIO ASSOCIATION APPOINTS REGISTRAR

M. Barry Watson, A.M.E.I.C., has been appointed Registrar of the Association of Professional Engineers of Ontario, a position for which he is qualified by considerable experience as a councillor of the Association, and as an office-holder in the Toronto Branch of the Institute and in the Ontario branches of several other engineering societies.

Mr Barry Watson holds the degrees of C.E. and M.E. from the University of Toronto. During the war he served overseas in the Royal Engineers, transferring later to the Royal Flying Corps. Upon demobilization in 1919, he commenced practice as a consulting engineer, specializing in steam power plants and the mechanical and electrical equipment of buildings. From 1927 to 1931 he was a partner in the firm of Angus and Watson; since that time he has carried on his own consulting practice. In 1937 Major Watson was appointed Director of the Department of Military Studies in the University of Toronto.

The Ontario Association has been fortunate in obtaining the services of an engineer of such varied experience.

M. Barry Watson, A.M.E.I.C.

THE INSTITUTION OF ELECTRICAL ENGINEERS

The following letter is published in order that the maximum distribution can be given to the invitation which it contains. Members are requested to notify Headquarters if they plan to be in London at that time.

The Secretary,
The Engineering Institute of Canada.

Dear Sir,

On Tuesday evening, the 13th June, this year, there will be a Conversazione to overseas members of the Institution of Electrical Engineers followed by a reunion. The function will be held in this building, Savoy Place, Victoria Embankment.

In this connection the Overseas Activities Committee of the Institution desire me to say that they would very much welcome at this function the presence of any of the members of your Institute who may be here at the time. If, therefore, you would send me the names of any of such members, together with a note of their addresses while in this country, I should be most happy to send them cards of invitation in due course.

I am, dear Sir,
Yours faithfully,
P. F. Rowell,
Secretary.

The Institution of Electrical Engineers,
London, Eng., W.C., 2.

ANNUAL GENERAL MEETING OF THE CORPORATION OF PROFESSIONAL ENGINEERS OF QUEBEC

R. E. Jamieson, M.E.I.C., is elected President

The annual general meeting of the Corporation of Professional Engineers of the province of Quebec was held at the Headquarters of The Engineering Institute, Mansfield Street, on Saturday, March 25th. Dr. A. R. Decary, president of the Corporation, was in the chair, and about 100 members of the Corporation were present. A telegram was received from President H. W. McKiel, in which he expressed the Institute's desire to work with the Corporation in the promotion of the welfare of the profession, and its appreciation of the cordial relations which have always existed between the two bodies. Past-President J. B. Challies also sent greetings from New York. Mr. Hector Cimon, the Corporation's representative on the Dominion Council, spoke briefly concerning that Council's activities and the relations between the Council and the Corporation. Approval was voiced regarding the recent agreement concluded between the Association of Professional Engineers

R. E. Jamieson, M.E.I.C.

of Saskatchewan and The Engineering Institute. A progress report from the Corporation's committee on membership indicated that there is considerable field for expansion of the Corporation's activities. Discussion during the meeting showed that there is a desire on the part of the membership for an aggressive policy of professional development.

Announcement was made of the result of this year's elections to the council of the Corporation. Mr. Hector Cimon, M.E.I.C., was elected for the Quebec district, and Messrs. W. F. Drysdale, M.E.I.C., J. A. Kearns, A.M.E.I.C., and B. R. Perry, M.E.I.C., for the Montreal district.

At a meeting of the new Council, held at the conclusion of the general meeting, Dr. A. R. Decary tendered his resignation from Council, which was accepted with much regret. Dr. Decary has served continuously on Council, as president of the Corporation, since its organization in 1920, and its development has been in large measure due to his untiring efforts on its behalf. His place on the Council will be filled by Mr. Alex. Lariviere, M.E.I.C. Other retiring members of Council are Dr. O. O. Lefebvre, M.E.I.C., and Mr. J. M. Robertson, M.E.I.C., both of whom have given long and valued service.

The Council of the Corporation for the ensuing year consists of Messrs. Hector Cimon, W. F. Drysdale, R. E. Jamieson, J. A. Kearns, A. Lariviere, F. J. Leduc, A. B. Normandin, and B. R. Perry. Mr. R. E. Jamieson was elected president, Mr. A. B. Normandin vice-president, and Mr. J. A. Kearns secretary-treasurer.

Library Notes

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

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.

AERODROMES, Their Location, Operation and Design.

London, Sir Isaac Pitman; New York, Pitman Publishing Corp., 1938. 120 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.20.

This book contains an account of researches made by the Scientific Institute for Air Transport of the Stuttgart Technical College, into the technical and economic problems involved in the location, operation and design of airports. The researches not only discuss the airport as a technical and operating unit, but also its importance in the scheme of airways.

ELECTRICAL ENGINEERING, Vol. 1.

By W. T. Maccall. London, University Tutorial Press, 1938. 547 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, 15s.

This is the first of two volumes based on the author's "Continuous Current Electrical Engineering" and "Alternating Current Electrical Engineering." They are intended to provide a textbook for engineering colleges which will meet the requirements of the National Higher Certificate in England and of degree courses in universities.

EXPLOSIVES, MATCHES and FIREWORKS

By J. Reilly. New York, D. Van Nostrand Co., 1938. 172 pp., diagrs., charts, tables, 10 x 6 in., cloth, $3.00.

This volume forms a section of the second edition of Lunge and Keane's "Technical Methods of Chemical Analysis." It provides detailed methods for the analysis of the raw materials used in making explosives, matches and fireworks, and for analyzing and testing the finished products, and gives some information upon manufacturing methods.

FAN ENGINEERING

An Engineer's Handbook, ed. by R. D. Madison. 4 ed. Buffalo, N.Y., Buffalo Forge Co., 1938. 739 pp., illus., diagrs., charts, tables, 7 x 4 in., lea., $4.00.

This handbook presents information of use to designers and users of fans and air conditioning and ventilating apparatus. Section one, on the physics of air, discusses the properties of air, fluid flow, the flow of air in pipes and fans, and noise. Section two describes the uses of fans in air conditioning, drying and in boiler plants, and for removing dust. The final section contains performance tables, dimensions, etc., of fans and air conditioning equipment.

FINDING LIST for UNITED STATES PATENT, DESIGN, TRADE-MARK, REISSUE, LABEL, PRINT, and PLANT PATENT NUMBERS

By M. Randall and E. B. Watson. Berkeley, Calif., University of California Press, 1938. 31 pp., 9 x 5 in., paper, 35c.

This pamphlet is a handy guide to the location of any patent or trade mark. The various series of official publications in which they have appeared are listed and the numbers of the patents, etc., in each volume are stated, so that any patent may be readily found by number. A list of indexes is also included and many mistakes in numbering are corrected.

GEOLOGY, Principles and Processes

By W. H. Emmons, G. A. Thiel, C. R. Stauffer and I. S. Allison. 2 ed. New York and London, McGraw-Hill Book Co., 1939. 451 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.75.

This textbook is intended as a one-semester course for college students beginning the subject. It is intended to give the student some knowledge of the materials of the earth and of the processes that operate at the earth's surface and have operated in the past to form the earth. This edition has been revised, enlarged and rearranged.

INDUSTRIAL FABRICS

A Handbook for Engineers, Purchasing Agents and Salesmen. By G. B. Haven. 2 ed. rev. and enlarged. New York, Wellington Sears Co., 1938. 741 pp., illus., diagrs., charts, tables, 8 x 6 in., lea., $2.00.

This handbook aims to present information about physical properties of these fabrics which is commonly wanted by buyers and sellers. Starting with a description of the types of cotton, the manufacturing processes for cotton fibre, cotton yarn.

(An) Introduction to MODERN STATISTICAL METHODS

By P. R. Rider. New York, John Wiley & Sons, 1939. 220 pp., diagrs., charts, tables, 9 x 6 in., cloth, $2.75.

This textbook discusses and explains the most widely used of the methods developed by Professor R. A. Fisher, and illustrates their application by comparatively simple numerical examples. The fundamental concepts of statistics are developed in the earlier chapters, so that the work is suitable for a first course in the subject, as well as for those with some knowledge who wish insight into modern methods.

JAHRBUCH 1938 der DEUTSCHEN LUFTFAHRTFORSCHUNG unter Mitwirkung des Reichsluftfahrtministeriums und der Luftfahrtforschungsanstalten.

Sections paged separately, 50 rm. "Ergänzungsband," 403 pp., 24 rm. Munich and Berlin, R. Oldenbourg, 1938. Illus., diagrs., charts, tables, 12 x 8 in., cloth.

The first of these two large volumes provides an account of developments in aviation research during 1938, under the direction of the German Government and the various universities and technical colleges. The various investigations are presented in full. The supplementary volume contains the papers presented at the 1938 meeting of the Lilienthal Gesellschaft fur Luftfahrtforschung by German and foreign engineers. Those by foreign engineers are given in the original language, with a translation into German.

MANUAL FOR EXECUTIVES AND FOREMEN

By E. H. Schell and F. F. Gilmore. New York and London, McGraw-Hill Book Co., 1939. 185 pp., tables, 8 x 5 in., cloth, $2.00.

This manual gives step-by-step procedures for improving the departmental process, the workplace, the work, the attitude of employees and the control of quantity, quality, equipment and storage. The recommendations are very practical and the methods given have been tested and found effective.

THE MANUFACTURE OF PULP AND PAPER

Vol. 5. Prepared under the direction of the Joint Textbook Committee of the Paper Industry of the United States and Canada. 3 ed. New York and London, McGraw-Hill Book Co., 1939. Sections paged separately, illus., diagrs., charts, tables, 9 x 6 in., cloth, $6.50.

This well-known textbook, an official work of the paper industry of the United States and Canada, concludes the account of papermaking begun in volume four of the series. Papermaking machines, handmade papers, paper finishing, coated papers, paper testing and papermaking details are discussed clearly and practically. This edition has been thoroughly revised and several sections rewritten.

MECHANISM

By R. M. Keown and V. M. Faires. 4 ed. New York and London, McGraw-Hill Book Co., 1939. 282 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $2.75.

The motions of fundamental mechanisms and their combinations, including the manner of supporting and guiding machine parts, are presented for elementary study. Major topics covered include friction wheels, belts, cams, gearing, and theoretical discussion of velocities and accelerations. Numerous problems accompany each chapter.

METALLOGRAPHIC TECHNIQUE FOR STEEL

A series of three educational lectures on metallographic technique for steel, presented to members of the A.S.M. during the Nineteenth National Metal Congress and Exposition, Atlantic City, New Jersey, October 18-22, 1937.
By J. R. Vilella. Cleveland, American Society for Metals, 1938. 84 pp., illus., 9 x 6 in., cloth, $2.00.

The three lectures reprinted in this book cover respectively: the preparation of the specimen; etching methods; and photomicrography. The principal object is to acquaint the metallographer with the proper appearance of steel structure under varying conditions, and to demonstrate the differences between good and poor technique.

MODERN DEVELOPMENTS IN FLUID DYNAMICS

An Account of Theory and Experiment relating to Boundary Layers, Turbulent Motion and Wakes. 2 vols., ed. by S. Goldstein. Oxford, England, Clarendon Press; New York, Oxford University Press, 1938. 702 pp., illus., diagrs., charts, tables, 10 x 6 in., cloth, $16.00.

The purpose of this work is to present and summarize methods of experiment and development of theory in certain branches of hydronamics of special interest to aeronautical science. It discusses the laminar and turbulent flow of viscous fluids and the transfer of heat in such flow, as well as modern theories concerning it. Mathematical solutions of types of flow are given, and experimental methods are described. The book has been composed by the Fluid Motion Panel of the Aeronautical Research Committee, with the collaboration of several experts.

DIE MONTAGE VON STAHLBAUTEN

By E. Schellewald. Berlin, Julius Springer, 1938. 113 pp., illus., diagrs., charts, tables, 10 x 6 in., lea., 18.60 rm.

A practical and concise, but comprehensive, account of methods for erecting bridges and steel buildings. Contractors' equipment and the layout of erection plants are described, and the procedure for various types of work explained and illustrated by numerous photographs. A final chapter discusses costs.

DIE ORTSFESTEN ANLAGEN ELEKTRISCHER BAHNEN

By K. Sachs. Zurich and Leipzig, Orell Füssli Verlag, 1938. 321 pp., illus., diagrs., charts, tables, 11 x 8 in., cloth, 29 rm., 48 Swiss frs.

The construction of electric railways is presented with unusual detail in this valuable treatise, which is based upon familiarity with current practice throughout the world. Starting with the power station and its equipment, the author successively discusses transmission lines, substations, overhead and third-rail conductors, signal systems and car heating and lighting. The book is profusely illustrated with drawings and photographs.

PETROLEUM COMES OF AGE

By A. A. Lawrence. Tulse, Okla., Scott-Rice Co., 1938. 227 pp., illus., maps, 9 x 6 in., cloth, $2.25.

This volume gives an interesting account of the oil industry of the two Oil Creek regions tributary to the Allegheny River—one in New York, the other in Pennsylvania. Developments are traced from the earliest mention of oil in this region down to the year 1881, including some account of the technical changes in transportation and refining. A bibliography is included.

PHOTOGRAPHIC CHEMICALS AND SOLUTIONS

By J. I. Crabtree and G. E. Matthews. Boston, Mass., American Photographic Publishing Co., 1939. 360 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

The importance of certain solutions in photographic work makes a knowledge of the fundamental principles of their preparation and use valuable to the user. The purpose of this book is to supply such information, including the properties of the chemicals, the chemical reactions involved, and specific methods for handling both small and large quantities of chemicals.

PHYSICO CHEMICAL EXPERIMENTS

By R. Livingston. New York, Macmillan Co., 1939. 257 pp., diagrs., charts, tables, 9 x 6 in., cloth, $2.25.

A laboratory course in physical chemistry which is intended to illustrate the basic principles of the subject and, at the same time, to familiarize the student with the commoner types of apparatus and train him in the simpler techniques. In addition, the book contains a fairly extensive account of computing methods and of the theory of errors and measurements.

PLASTICS, Problems and Processes

By D. E. Mansperger and C. W. Pepper. Scranton, Pa., International Textbook Co., 1938. 187 pp., illus., diagrs., charts, tables, 9 x 6 in., lea., $2.50.

This book is intended for students in industrial art schools and amateurs who wish to work in plastics. It gives practical detailed instruction about tools for working plastics and methods of forming and finishing them. Working drawings and directions for making a large number of useful articles are provided. Appended are a list of trade names and makers, a directory of supply sources, a glossary and a bibliography.

PLASTIC WORKING OF METALS AND POWER-PRESS OPERATIONS

By E. V. Crane. 2 ed. New York, John Wiley & Sons, 1939. 450 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $5.00.

The characteristics common to the different groups of metal-working operations are discussed and a working theory established. Since all the operations described act to stress the metal beyond its elastic limit, the assembling and development of theoretical data on metal properties within this range constitute an important part of the book. Many useful tables are contained in an appendix, along with some thirty pages of explanation and description of various graphical computations.

PSYCHOLOGY FOR BUSINESS AND INDUSTRY

By H. Moore. New York and London, McGraw-Hill Book Co., 1939. 527 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

This book discusses practical business problems and calls attention to the contribution of psychology to their solution. The selection of employees and methods of testing fitness, training and promoting workers, accident prevention, fatigue, and psychological problems in advertising and selling are considered and constructive suggestions are made.

PUBLIC UTILITY REGULATION

By G. L. Wilson, J. M. Herring and R. B. Eutsler. New York and London, McGraw-Hill Book Co., 1938. 571 pp., tables, 9 x 6 in., cloth, $4.00.

An analysis of the nature, extent and problems of public utility regulation is presented. The authors first consider historical development and the emergence of the state public utility commission as the prevailing pattern of regulatory machinery. Federal government control is described and analyzed, and the issues of government versus private ownership are evaluated.

RAILWAYS TO-DAY. (The Pageant of Progress)

By J. W. Williamson. London and New York, Oxford University Press, 1938. 160 pp., illus., diagrs., maps, tables, 9 x 6 in., cloth, $1.50.

A concise yet comprehensive description of the modern railway, based upon British practice. The railway as an integrated whole is considered, the various parts, permanent way, structures, rolling stock, construction and maintenance methods, operation and control being considered. The book is well illustrated.

THE REFRIGERATING DATA BOOK

Vol. 1. Refrigerating Principles and Machinery. 4th ed. New York, American Society of Refrigerating Engineers, 1939. 527 pp. (Refrigerating Catalogue and List of A.S.R.E. Members Section, 134 pp.), illus., diagrs., charts, tables, 10 x 6 in., cloth, $4.00 in U.S.A., $4.50 in foreign countries.

This publication, the work of many experts, brings together all the essential information and numerical data on refrigeration and air conditioning. This edition has been thoroughly revised and many chapters rewritten, including those on compression and absorption systems, dry ice, fluid flow, insulation and small air conditioning machinery. An appendix gives a directory of equipment manufacturers and distributors, and a list of members of the Society.

ADDITIONS TO THE LIBRARY

PROCEEDINGS, TRANSACTIONS, ETC.

American Institute of Consulting Engineers:
Proceedings of the Annual Meeting, January 16, 1939.

American Institute of Steel Construction:
Proceedings, 16th Annual Convention, 1938.

Institution of Civil Engineers:
List of Members, 1939.

REPORTS, ETC.

British Rubber Publicity Association:
Field Transport of Cane on Steel and Rubber. January, 1939.

Canada Department of Mines and Resources Bureau of Mines:
Improving the Properties of Clays and Shales. Ottawa, 1938.

The Engineer:
Directory and Buyers Guide, 1939. London, 1939.

Edison Electric Institute:
Turbines, Condensers and Pumps, 1938.

National Harbours Board:
Annual Report for the year, 1938.

New Brunswick Electric Power Commission:
Annual Report for the year, 1938.

U.S. Department of the Interior Geological Survey: Geology of the Chitina Valley and Adjacent Area, Alaska; the Nushagak District Alaska (Bulletins 894, 903). Water Levels and Artesian Pressure in Observation Wells in the United States in 1937 (Water-Supply Paper 840).

TECHNICAL BOOKS

Civil Defence:
By C. W. Glovers. London, Chapman and Hall, 1938. 308 pp. illus., plates 9¾ x 6 in., cloth, 15s.

Peter Gillespie Teacher of Engineers:
An appreciation by C. R. Young, M.E.I.C., *Toronto, 1932. 53 pp., 12 x 9½ in., paper.*

International Electrotechnical Vocabulary.
London, International Electrotechnical Commission, 1938. 311 pp., 12 x 8½ in., cloth.

Modern Sewage Disposal:

Anniversary Book of the Federation of Sewage Works Associations. Ed. by L., Pearse. New York, Federation of Sewage Works Associations, 1938, 371 pp., illus., diagrs., charts, maps, tables, 10 x 7 in. cloth, $3.50.

A collection of thirty-two papers by specialists in various matters, which discuss modern methods of sewage treatment, questions of sewage research work, regional and national aspects of sewage disposal, and the problem of industrial wastes. Bibliographies accompany many of the papers. The volume contains much to interest the sanitary engineer.

Pocket-Book for Mechanical Engineers:
By David Allan Low. London, Longmans, Green, 1938. 778 pp., illus., diagrs., charts, 6½ x 4 in.

THE WATER TOWER

A house organ issued by Chicago Bridge & Iron Company and Horton Steel Works Limited, under the name of "The Water Tower," provides interesting information relative to the development in design of modern storage tanks for all purposes. The publication is profusely illustrated and in the March edition are featured many installations both in Canada and in the United States, among which are photographs taken during the assembling and after the completion of the 9-ft. diameter, 165-ft. penstock of the plant of the Great Lakes Power Co. Ltd. at Sault Ste. Marie, Ontario.

AGE HARDENABLE 5% NICKEL BRONZE CASTINGS

Bulletin No. 405, issued by Canadian Nickel Products Ltd., Toronto, and dealing with Nickel in the Brass Foundry, carries the caption, "Production and Properties of Age Hardenable 5% Nickel Bronze Castings." The bulletin deals with the properties of 88-5-5-2 nickel bronze—as cast, and of 88-5-5-2 nickel bronze—heat treated. It further deals with modifications of heat treatment, effect of impurities, and foundry practice.

This is one of a series of bulletins issued by the company and available upon request. The others issued to date are:

No. 302—Some Effects of Nickel on Bronze Foundry Mixtures.
No. 303—The Improvement of Bronze with Nickel.
No. 401—Casting Properties of Nickel Bronzes.
No. 402—Foundry Practice for Nickel Silver.
No. 403—Molding Sand Characteristics for Nickel Bronzes, Nickel Silvers and Monel.
No. 404—Production of Pressure Tight Castings in 30% Cupro-Nickel.
No. 501—Strength and Aging Characteristics of the Nickel Bronzes.
No. 502—Physical and Casting Properties of the Nickel Silvers.
No. 503—A Method for Study of Shrinkage and Its Distribution in Castings.

ASPHALT ROADS

Imperial Oil Limited are distributing a booklet entitled, "Imperial Asphalt and Low Cost Roads," which contains in condensed form short descriptions of low cost asphalt surfaces now in extensive use. A table setting forth the grade of asphalt and the working temperatures for specific uses is provided and is followed by the company's recommendation of construction methods for cold patching, surface treatments, blotter treatments, carpet coating, and mixed cold-laid surfaces.

WIRE ROPE ELECTRIC HOIST

A six-page bulletin is being distributed by the Yale & Towne Manufacturing Co., Philadelphia, Pa., containing descriptive specifications of the "Yale Cable King Wire Rope Electric Hoist," with numerous illustrations of various standard models and a table of capacities—lift and speeds—of standard hoists.

CHEMI-SEALED "TURQUOISE" PENCILS

The announcement on page 155 of the March, 1939, issue of The Engineering Journal regarding the four-page bulletin which is being distributed by the Eagle Pencil Co. of Toronto, and the sample pencils which are being offered by this company, omitted mention of the fact that these are the company's well-known "Turquoise" pencils.

The bulletin contains the report of the investigating Committee of Architects and Engineers of New York with descriptive information regarding the Eagle "Chemi-Sealed" "Turquoise" and "Verithin" coloured pencils.

WELDING ELECTRODE WALL CHART

A new wall chart, designated by the number CGEL-598, just made available by Canadian General Electric, illustrates G-E Arc-Welding Electrodes, describes their characteristics and the applications to which each is best suited. Types covered include heavily-coated electrodes for shielded arc welding of mild steel, heavily-coated electrodes for shielded arc welding of high-tensile steels, lightly-coated electrodes for arc welding of mild steel, and electrodes for miscellaneous applications. A handy table gives recommended current and arc voltage figures for each size and type of electrode.

INTERNATIONAL ACETYLENE ASSOCIATION PRESIDENT

At the annual meeting of the International Acetylene Association, held at Houston, Texas, on March 10th, H. P. Dolisie, general manager of the Canadian Liquid Air Company, Ltd., was elected president of the association for the 1939-40 term. That this honour has fallen to an executive of Canadian industry indicates the growing importance of Canada's contribution to technical research in the uses of acetylene as applied to the chemical, welding and allied industries, for which purpose the association was formed in 1898. Mr. Dolisie has been a director of the association for some time.

MINUTE SHAPES IN METALS AND PLASTICS

Shapes in every conceivable design and thinness are now being made in metals and plastics for numerous industries, architects, designers, instrument-makers, inventors and other scientific workers who have long needed such precise shapes in their line of work. Because of their accuracy, these shapes are also ideally adapted to the construction of scale-true models. The new process by which these shapes are made was developed by Precision Shapes, Inc., 230 Park Avenue, New York City.

"Precision Shapes," as they are termed, are of special significance in that they answer problems in design that have hitherto been impossible to achieve under the limited methods of extrusion, rolling or milling. With this new process the additional expense for dies is eliminated, with a resultant saving to the user. Another feature of this new process is that Precision Shapes can be made in any length up to 24 feet.

PENCIL DRAFTING CLOTH

Under the name Pencil-tex, the Frederick Post Company recently introduced a new Pencil drafting cloth which, it is claimed, may eliminate the use of ink in drafting rooms.

Of similar appearance to fine tracing cloth, Pencil-tex has a new and patented velvety surface with a remarkable affinity for pencils of all degrees of hardness. Post claims that even the hardest of hard pencils will leave a sharp, uniform, ink-dense line in its wake. This line intensification, together with a glass-like transparency, permits the production of a blue print with the sharp contrast of "prints" made from fine ink tracings. Prints made through Pencil-tex are completely without the characteristic fuzzy line and foggy unworkmanlike appearance of blue prints made from ordinary pencil drawings.

A novel sample kit is now being distributed to interested drafting supply users through the local Post dealers or the manufacturer who may be addressed at P.O. Box 803, Chicago, Illinois.

METER FOR MEASURING SHAFT-HORSEPOWER

Of interest to marine engineers, whether they be on passenger liners, ore carriers, tankers, or tugs, is the announcement of a new electric meter developed by General Electric engineers for giving accurate and instantaneous measurements of shaft-horsepower and horsepower-hours. With the new device, the engineer can check the performance of his propulsion equipment over a wide range of speeds, can compare the fuel consumption with horsepower-hours output under varying conditions, and, in general, can check the efficiencies of boilers and other equipment. Readings can be taken directly from the scale on the dial of the meter, thus eliminating the need for conversion formulas and tables.

ELECTRO-MATIC AIR FILTER

The Electro-Matic Air Filter, recently introduced by the American Air Filter Company Inc., Louisville, Ky., is a new development in which electrical precipitation has been combined with automatic air filtration to obtain the advantages of these two methods of cleaning air. This equipment is described in an eight-page pamphlet which may be obtained from Darling Brothers Ltd., Montreal, who represent this company in Canada.

In operation the front curtain of the Electro-Matic filter acts as a precleaner to remove the heavier dust particles and any bugs, butterflies, or scraps of material that might short circuit the ionizer or the collector plates in the rear curtain. Fine dust and smoke particles which escape the front curtain then pass through the ionizing unit in the centre of the filter where they receive a definite electrical charge. Upon entering the electrostatic field of the rear curtain these ionized dust particles are attracted to the charged plates where they are held securely in the oil film on the plates until removed in the oil bath.

The filter curtain is of a new design, which provides the necessary electrical insulation of the plates and a means for charging or grounding alternate plates in certain sections of the curtain. It meets the additional requirement of reverse direction of rotation so that the accumulation of dust and dirt on the front curtain is carried directly down into the reservoir where it is removed by the cleansing action of the oil bath, leaving the rear curtain clean and freshly oiled at all times.

The entire casing of the filter, as well as the front curtain, is thoroughly grounded. The ionizer is entirely enclosed within the filter and the rear curtain which is the only exposed part that carries an electrical charge, is protected by a heavy close-mesh grille which prevents accidental or intentional contact.

The Electro-Matic filter is made in standard sections of varying heights from five feet up to 13 feet. The power pack which furnishes the current for the ionizer and collector plates, is mounted directly on the filter casing and all internal electrical connections are made at the factory. Erection is only a matter of installing the sections and making the necessary external connections from filter drive and power pack to a 110-volt a/c lighting circuit.

9-INCH WORKSHOP LATHE

The South Bend Lathe Works, South Bend, Indiana, have published a new 32-page Catalogue, No. 46-B, announcing the new model 9-Inch Workshop Precision Lathe. The book contains more than 150 illustrations describing and showing the different types, important features, workmanship and application of this back-geared, screw cutting, metal working lathe. A copy of the catalogue will be mailed upon request.

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

NOTE:—Recently the Employment Department has had numerous requests and has not always been able to meet the requirements. Civils with three to five years experience, mechanicals, electricals, and mechanical draughtsmen are in demand.

IF YOU ARE INTERESTED, REGISTER IMMEDIATELY

Forms will be mailed upon request.

CHIEF ENGINEER, graduate civil engineer, for permanent position with railway in Newfoundland. Preference given to applicants having experience in maintenance of way work on railway in Canada. Apply giving full details of experience and salary requirements to Box No. 1849-V.

SALES ENGINEER, to handle specialties, particularly refractory cement. Prefer someone now handling other engineering specialties. Apply to Box No. 1851-V.

SALES ENGINEER. Experienced sales engineer for hydraulic press, turbines and allied equipment. Reply fully to Box No. 1852-V.

ELECTRICAL ENGINEER, wanted for inspection work. Permanent position. Preference given to man with experience in operation and maintenance of electrical machinery. In reply state age, experience record, educational status and salary expected, to Box No. 1858-V.

MECHANICAL ENGINEER, graduate in mechanical engineering, two or three years out of college, for a large industrial company in Montreal. Permanent position. Apply giving full particulars, and photograph, to Box No. 1860-V.

SALES ENGINEER, technical training, preferably a university graduate. For the sale of precious metal products, including platinum, gold and silver and their alloys. Twenty-eight to thirty-five years old with a chemical engineering or mining training. Straight salary. Apply to Box No. 1862-V.

SALESMEN. Large life insurance company has openings for two men, age 25-35. Married. Salary paid for servicing business plus commissions on all new business. Professional men have a high record of success in this business. Apply to Box No. 1864-V.

MECHANICAL ENGINEER, graduate, preferably five years experience in machine design, layouts, estimating, draughting, shop practice and general maintenance in good sized industrial plant. Working knowledge of steam and electricity. French language would be helpful. Must have initiative, ability to accept responsibility and work harmoniously with large organization. Give previous experience, age and fullest particulars. Apply to Box No. 1866-V.

DRAUGHTSMAN, experienced in pulp and paper work on machine design, layouts, estimating and general maintenance. Knowledge of Franch an advantage. Reply stating age, experience and full details. Apply to Box No. 1867-V.

CIVIL SERVICE OF CANADA VACANCIES

Comp. No. 28779. An Industrial Hygiene Engineer, for the Industrial Hygiene Division, Health Branch, Department of Pensions and National Health, Ottawa, at a salary of $3,120 per annum. *Duties:* To determine, under direction, the necessity of making specific studies of particular industrial conditions; to conduct surveys and supervise studies of factory conditions predisposing to occupational diseases; to prepare comprehensive reports of findings with recommendations for control of occupational disease hazards; to supervise the work of field and laboratory workers, and to perform other related work as required. Graduation in chemistry or chemical engineering and at least five years of practical professional experience in industrial chemistry, including experience in laboratory research work required.

Comp. No. 28780. A Senior Draughtsman (Mechanical) in the Naval Service Branch of the Dept. of National Defence, Ottawa, at a salary of $1,800 per annum. *Duties:* To do draughting work of a naval engineering office; to work up machinery and other layout plans from sketches or instructions; to lay down and develop the lines and plans of small vessels, to assist in drawing up specifications; to compute quantities and costs, and to perform other related works as required.

Application forms properly filled in must be filed with the Civil Service Commission, Ottawa, Ontario, *not later than April 20th, 1939.*

Full information will be found on List No. 753, regarding the above two vacancies.

SITUATIONS WANTED

INDUSTRIAL ENGINEER, B.Sc. (McGill), with fifteen years broad experience in general design and construction and in practically all departments of industrial design and operation, would consider responsible permanent position with progressive industrial concern. Apply to Box No. 492-W.

ELECTRICAL ENGINEER, B.Sc. Age 40. Married. Jr.E.I.C. Eight years experience in operation, maintenance and installation of electrical equipment in hydro-electric plants and sub-stations. Five years electrical maintenance and construction, motor windings, relays, meters, and all automatic equipment. Also experience on geological survey and highway construction. Best of references. Sober and reliable with ability to handle men. Available at once. Any location. Apply to Box No. 636-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, B.Sc. '29. Married. Experience includes building construction, hydro-electric development in South America, road construction and paper mill construction and maintenance. Desires permanent position with good prospects. Apply to Box No. 744-W.

CIVIL ENGINEER, B.Sc., A.M.E.I.C., R.P.E. Age 48. Twenty-five years construction experience on railways, highways, bridges, dams, flumes, pipe lines and buildings. Expert on earthworks and transportation. Location immaterial. Apply to Box No. 841-W.

MECHANICAL ENGINEER, Jr.E.I.C., technical graduate, bilingual, age 36, married. Experience includes five years with firm of consulting engineers, design of steam boiler plants, heating, ventilating and air conditioning. Seven years with large company on sales and design of heating systems, air conditioning, steam specialties, etc. Available on short notice. Apply to Box No. 850-W.

SALES ENGINEER, B.A.Sc., Jr.E.I.C. Age 29. Married. Presently employed. Five years experience in sales and field engineering seeks position with more future. Bilingual. Available on few weeks' notice. Apply to Box No. 1107-W.

CIVIL ENGINEER, A.M.E.I.C. Age 48. Married. Ten years municipal work. Five years highway construction, familiar with all types of paving. Presently with consulting engineers on municipal work, water supply, etc. Best of references. Available immediately. Further particulars on request. Apply to Box No. 1141-W.

CIVIL ENGINEER, A.M.E.I.C. Married. Experience of over 26 years. Surveys, railways, canals, highways, including location, construction, inspection, giving monthly and final estimates. Building locks, dams and all kinds of buildings. Experienced in steel and munitions work, on laboratory inspection of shells and gauges for same. Seeking for steady employment. Apply to Box No. 1168-W.

ELECTRICAL ENGINEER, B.Eng. (McGill '35). Four years experience design and estimates of substations, control and metering layouts, bus layouts, transformer layouts and fire protection, transmission lines. Hydraulic studies. Also knowledge of town planning, house design, reinforced concrete, water and sewer works, sidewalk and street design. Two years supervision. Interested in design of any description. Married. Age 24. Location immaterial. Available on reasonable notice. Apply to Box No. 1288-W.

CIVIL ENGINEER, B.Sc., A.M.E.I.C. Age 29, enthusiastic, competent, wishes new position. Four years experience in design, draughting, and estimating steel and concrete structures and bridges. Six months field work bridge erection, four years paper mill engineering-design of mill buildings and hydro plant, paper machine installation, heating and ventilating, heat recovery and economy, etc. Now available in Montreal. Apply to No. 1295-W.

MECHANICAL ENGINEER, B.A.Sc., (Toronto '34) Age 27. Recently completed the Alexander Hamilton Institute course in Modern Business. Thoroughly experienced in the heat treatment and selection of tool and die steels, with a wide knowledge of modern production methods. Also familiar with aircraft steels and tubing to British specifications. At present employed as sales representative for an English steel company. Desires position in the field of production control and/or procession or factory management. Complete information given upon request. Apply to Box No. 1348-W.

FIRE PROTECTION AND SAFETY ENGINEER, A.M.E.I.C., B.Sc. '24, (Mech. Engrg.). Age 35. Bilingual. Twelve years experience with insurance underwriters inspection bureau covering phases of field work. Thoroughly familiar with insurance requirements. Position desired industrial or other concern maintaining self insurance or relative departments. Location Montreal or vicinity preferred. Apply to Box No. 1395-W.

CIVIL ENGINEER, taking law degree in May. Perfectly bilingual. Worked for railway company, industrial company and on construction. Age 24. Would like work in time study or similar. Apply to Box No. 1428-W.

ELECTRICAL ENGINEER, B.Eng. (McGill '35), EL.Eng. M.EL.Eng. (Rensselaer '36), S.E.I.C. Single. Age 25. Experience includes planning and production work in large factory and two years electrical and mechanical engineering on temporary staff of National Research Council, Ottawa. Available at once. Apply to Box No. 1468-W.

CIVIL AND ELECTRICAL ENGINEER, B.A., B.A.Sc. '32. A.M.E.I.C. Age 32. Single. Bilingual. Presently employed. Thoroughly familiar with electricity and gas rates and their industrial and commercial applications. Experience also includes heating and lighting engineering. Interested in electrical contractors' and consulting engineers' work. Best references. Available on short notice. Apply to Box No. 1518-W.

MECHANICAL AND ELECTRICAL ENGINEER, graduate Toronto university; machinists and tool makers trade; lengthy designing experience, pumps, diesel engines, steam generating and distributing equipment, water turbines, steam control and power plant equipment, paper mill and heavy machinery. Fully conversant with mass production on shop methods; foundry practice; forged work; machine shop practice. Excellent experience in specification, research, and development duties. Have been consultant to sales engineering staff large national concern ten years. Employed but available in thirty days. Apply to Box No. 1699-W.

CIVIL ENGINEER, B.A.Sc. (Toronto '35), Jr.E.I.C. Age 26. Experience in highway layout and construction, concrete bridge construction, draughting, office work, and surveying. Further details on request. Good references. Available immediately. Location immaterial. Apply to Box 1832-W.

ELECTRICAL ENGINEER, B.Sc., (Manitoba '36), S.E.I.C. Practical and theoretical experience in radio. Have done experimental work. At present doing radio service work. Available at once. Apply to Box No. 1833-W.

CIVIL AND MECHANICAL ENGINEER, B.Sc., M.E.I.C, R.P.E., Military Service Lieut. C.E. Married, age 47. Twenty years experience in heavy manufacture, drafting, designing, estimating and production, also design manufacture and maintenance of buildings and machines, including transporting equipment (hoists, cranes, etc.), interested in plant works or production management. Available on short notice. Apply to Box 1853-W.

ELECTRICAL ENGINEER, A.M.E.I.C. Age 32. Married. At present employed in responsible commercial position, but desires change. Over sixteen years experience in electrical industry. Trained in English factory. Seven years resident in Canada. Apply to Box No. 1854-W.

SALES ENGINEER REPRESENTATIVE, B.A.Sc., C.E. Age 30. Contact in Northern Quebec mine belt. Interested in selling any kind of materials. Experience in heating and air conditioning. Speaks both English and French. Available at once. Apply to Box No. 1859-W.

CIVIL ENGINEER, B.Sc., S.E.I.C. Married. Six months surveying; mill site; water supply, power line location, earthwork, drainage, topographic. Have 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.

CHEMICAL ENGINEER, graduating Toronto '39. S.E.I.C. One and a half years general ore dressing laboratory work. One and a half years' general milling and assaying. Seeking a permanent position in chemical industry. Apply to Box No. 1867-W.

TECHNICALLY TRAINED EXECUTIVE, general experience covers organization and management in business and industrial fields; including sales, purchasing, productions, accounting and costing, also industrial surveys, reorganizations and amalgamations in the United States and Canada. B.Sc. degree in mechanical engineering. Married. Canadian. Apply to Box No. 1871-W.

MANUFACTURING EXECUTIVE, B.Sc. in mechanical engineering. Married. Canadian. Experienced in munitions manufacturing and other precision work. Apply to Box No. 1872-W.

SALES ENGINEER. Several years experience selling to industrial, mining and railroad organizations in Ontario and Quebec. B.Sc. in mech. engrg. Married. Canadian. Apply to Box No. 1873-W.

CHEMICAL ENGINEER, S.E.I.C., graduating this Spring. Has had experience with platinum, gold, etc. Two years in a biochemical research laboratory and a good knowledge of plumbing and electrical equipment, desires position either on production or in research. Apply to Box No. 1876-W.

PRELIMINARY NOTICE

of Application for Admission and for Transfer

March 20th, 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 May, 1939.

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 Counail.

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

ARCHAMBAULT—JULES, of Outremont, Que. Born at Montreal, Dec. 13th, 1900; Educ.: B.Sc., McGill Univ., 1926. R.P.E. of Que.; 1926-27, technical asst., Aluminum Co. of Canada, Arvida; 1927-29, engr., Duke-Price Power Co., Arvida; with the Bell Telephone Company of Canada as follows: 1929-34, engr., transmission and foreign wire relations, Montreal; 1934-35, special studies, eastern area manager's dept., Montreal; 1935-37, manager, with jurisdiction over towns of St. Hyacinthe, Granby, Sorel, Drummondville, etc.; 1937 to date, chief engr., Montreal Tramways Commission, Montreal.

References: R. H. Mather, A. Duperron, D. E. Blair, C. L. Dewar, M. DuBose.

BEVERLY—IRA WILLIAM, of 326 Waverley St., Winnipeg, Man. Born at Kettle Falls, Wash., April 16th, 1894; Educ.: B.Sc. (E.E.), McGill Univ., 1918; 1911-15 (summers), mining in Rossland, B.C.; 1916 (summer), gen. elect'l. work, Cons. Mining & Smelting Co. Ltd., Trail; 1919, factory course; 1920-21, sales engr., Sangamo & Wagner, Montreal and Toronto; 1921-23, opened and operated service dept., Wagner Electric Co., Toronto; 1923-24, sales engr., Toronto, 1924-32, sales engr., Western Canada, Sangamo, Wagner, and Lincoln Meter Companies; 1932 to date, western sales manager, Sangamo Company Limited, Winnipeg, Man.

References: G. H. Herriot, E. V. Caton, J. P. Fraser, R. H. Andrews, L. M. Hovey.

BRACKINREID—THOMAS WILLIAM, of Brockville, Ont. Born at Toronto, Ont., Nov. 2nd, 1891; Educ.: B.A.Sc., Univ. of Toronto, 1912; R.P.E. of Ont.; 1912-14, students' test course, 1914-17, constrn. dept., and 1917-24, sales engr., Winnipeg, for the Can. Gen. Elec. Co. Ltd.; 1925-36, gen. mgr., Port Arthur Public Utilities Port Arthur, Ont.; 1936 to date, gen. sales mgr. and gen. mgr., and at present, President, Phillips Electrical Works Ltd., Brockville.

References: J. H. Parkin, L. A. Wright, H. W. Lea, R. B. Chandler, F. C. Graham.

BOOZ—FREDERICK BERNARD, of Montreal, Que. Born at Toronto, Ont., July 26th, 1895; Educ.: B.A.Sc., (Univ. of Toronto), 1923; R.P.E. of Que.; 1912, dfting., roadway dept., City of Toronto; 1914, ap'tice., Margin Pump & Machine Co.; 1919-23, motor mechanic, Toronto; with the Horton Steel Works Ltd., as follows: 1923-26, gen. dfting., 1926-32, plant engr., 1932-33, field engr., and 1933 to date, sales engr.

References: C. H. Scheman, C. S. Boyd, A. W. F. McQueen, W. R. Manock, L. C. McMurtry, C. G. Moon.

CANNING—DOW VERNON, of 631 Gilmour St., Peterborough, Ont. Born at Brockville, Ont., June 29th, 1899; Educ.: B.Sc., McGill Univ., 1921; R.P.E. of Ont.; 1920 (4 mos.), Bailey Meter Co., Cleveland; with the Can. Gen. Elec. Co. Ltd., as follows: 1921-22, test course, 1922-31, switchboard engr., 1931 to date, chief design engr. on industrial control equipment.

References: G. R. Langley, E. R. Shirley, H. R. Sills, B. I. Burgess, W. T. Fanjoy.

CLIBBON—ARTHUR ROBERT CECIL, of 4966 Decarie Blvd., Montreal, Que. Born at Strood, Kent, England, Sept. 13th, 1897; Educ.: Montreal High School, 1910-14; 1914-16, junior dftsman., 1916-18, senior dftsman., Canadian Car & Foundry Co. Ltd.; 1918, R.F.C., and R.A.F.; 1919-21, designing dftsman., Canadian Car & Foundry Co. Ltd.; 1921, loaned by above company to Toronto Transportation Commission as designing dftsman., for rehabilitation of special track work; 1921 to date, designing dftsman., estimator and calculator, steam railway, street railway and industrial trackwork; also side frames, bolsters, journal boxes, wheels and misc. castings for Canadian Car & Foundry Co. Ltd., Montreal, Que.

References: W. McG. Gardner, R. Collins, C. R. Kinnear, G. Agar, P. Varley.

DALE—JAMES GRAHAM, of Edmonton, Alta. Born at Cranbrook, B.C., Jan. 7th, 1910; Educ.: B.Sc. (E.E.), Univ. of Alta., 1934; 1926, rodman and chainman, B.C. land survey; 1927-28, electrn. helper, Cons. Mining & Smelting Co.; also summer, 1929, and May, 1930, to Sept., 1931; 1934-36, inspr., and 1937 to date, installn. engr., Northwestern Utilities Ltd., Edmonton, Alta.

References: H. R. Webb, J. Garrett, E. Nelson, R. S. L. Wilson, W. E. Cornish.

DIBBLEE—JOHN, of 82 Old Mill Road, Toronto, Ont. Born at Woodstock, N.B., May 7th, 1894; Educ.: B.A.Sc., Univ. of Toronto, 1915. R.P.E. of Ont.; 1915 (June-Oct.), erection engr. of a small rotary converter substation at Georgetown for the Lambton-Guelph Rly.; 1915-16, demonstrator in hydraulics, Univ. of Toronto; 1916-17, res. engr. for Kerry & Chace; 1917-18, engr., station design section, 1918-26, district operating engr., eastern Ontario section, 1926-31, gen. supt., Niagara Falls District, 1931-37, asst. chief operating engr., and Nov., 1937, to date, asst. chief engr., Hydro-Electric Power Commission of Ontario.

References: T. H. Hogg, W. P. Dobson, O. Holden, D. Forgan, A. H. Hull.

DUCHENE—THEODORE FRANCIS, of 11 Belvedere Ave., Quebec, Que. Born at Quebec, Oct. 14th, 1915; Educ.: B.Sc. (Civil), Univ. of N.B., 1936; Oct., 1936, to date, employed by the Dominion Arsenal, testing of materials and ballistics, etc.

References: E. O. Turner, A. F. Baird, J. Stephens, B. H. Hagerman, D. S. Scott.

DYMENT—ARTHUR ELLIOTT, of Montreal, Que. Born at Toronto, Ont., May 4th, 1906; Educ.: B.A.Sc., Univ. of Toronto, 1929; 1929-30, efficiency engrg.; 1930-37, technical representative (explosives engrg.), and at present, manager, technical department, Canadian Industries Limited, Montreal, Que.

References: R. E. Heartz, I. R. Tait, L. deB. McCrady, H. C. Karn, G. Rinfret.

ED—KENNETH MERRILL, of Montreal, Que. Born at Moline, Ill., June 12th, 1907; Educ.: B.Sc. (Mining), N.S. Tech. Coll., 1929; 1927, flowage survey, International Paper Co.; 1928, prospecting party on iron ores; 1929-32, supt. and engr. on gen. constrn. and road work, Robert Ed Co. Ltd., Halifax, N.S.; 1932-34, mine engr., supt., Hants Gold Mines Ltd., Rawdon, N.S.; 1934-36, mine engr., mill supt., shift boss, mine capt., Montague Gold Mines Ltd., Montague, N.S.; 1936, asst. plant engr. at Beloeil, and at present, district technical representative, Canadian Industries Limited, Montreal, Que.

References: R. E. Heartz, H. W. McKiel, I. R. Tait, H. C. Karn, L. deB. McCrady, G. Rinfret.

FERRIER—JOHN ALEXANDER, of Windsor, Ont. Born at Renfrew, Ont., May 27th, 1909; Educ.: B.Sc. (Mech.), Queen's Univ., 1937; summers, 1935-36, and 1938 to date, with the Ford Motor Company, at present i/c automatic combustion control in power plant.

References: J. E. Porter, B. Candlish, L. M. Arkley, L. T. Rutledge, W. M. Mitchell.

FLEISCHMANN—ALBERT CHARLES, of 72 Bouthillier St., St. Johns, Que. Born at Lyon, France, July 8th, 1899; Educ.: 1914-22 (except 2½ years of war), Univ. of Cluny, France; Civil Engr., 1922; R.P.E. of Que.; 1923-25, dftsman. and designer, Baulne & Leonard; 1926-27, dftsman., U.P. Dye Works, New York; 1927, dftsman., Dominion Bridge Co.; with the City of Montreal, 1927-29, on concrete sewers, and 1929-30, on constrn. permits; 1930-33, private practice as consltg. engr. on reinforced concrete design; 1933-36, designer, on bridges and structures, A. Janin & Co.; 1936-39, Franco Canadian Dyers, St. Johns, Que., plant engr. in charge; at present, industrial engr. for the Provincial Bank of Canada, St. Johns, Que.

References: J. E. Carmel, O. O. Lefebvre, J. A. Beauchemin, J. A. Lalonde, E. Gruenig, L. J. Leroux, R. J. Mattson, E. Peden.

HARKNESS—ROBERT DICKSON, Colonel, R.C.C.S., D.S.O., M.C., of 4386 Montrose Ave., Westmount, Que. Born at Osaka, Japan, Dec. 23rd, 1892; Educ.: B.Sc., Queen's Univ., 1913; 1911-13, mfg. and installn. depts., Northern Electric & Mfg. Co.; with the Northern Electric Co. Ltd. as follows: 1914, cable sales dept., 1920, asst. cable sales mgr., 1925, district mgr., Winnipeg Branch, 1925, telephone contract mgr., 1928, gen. commercial mgr., 1933, asst. to the President, and 1938 to date, vice-president and general manager.

References: J. B. Challies, C. V. Christie, W. P. Wilgar, H. J. Vennes, J. S. Cameron.

HENDERSON—GORDON G., of Walkerville, Ont. Born at Midland, Ont., Nov. 6th, 1900; Educ.: B.A.Sc., Univ. of Toronto, 1924; 1923, inspr., Dept. of Highways Ontario; with the Canadian Bridge Company Ltd., as follows: 1924-26, dftsman., 1926-29, checker, 1929-32, asst. engr., preparing designs and estimates on various constrn. work, 1932 to date, sales engr. i/c of designing, estimating and contracting for various constrn. projects.

References: F. H. Kester, R. A. Spencer, C. M. Goodrich, P. E. Adams, H. J. A. Chambers, R. C. Leslie, T. H. Jenkins.

JEFFERY—CHARLIE CHANTLER, of Toronto, Ont. Born at Midland, Ont., Nov. 21st, 1888; Educ.: diploma in civil engrg., Univ. of Toronto, 1910; 1907-08, land surveying, New Ontario; 1908, asst. engr. on elevator constrn., Midland; with the Dept. of Public Works, Canada, as follows: 1909-10, asst. engr. (temp.), 1910-35, asst. engr. (permanent), 1935-36, acting senior asst. engr., August, 1936, to date, senior asst. engr., and acting district engr., when district engr. is absent. (1916-20, overseas. Acting Major, 5th Battn.)

References: E. L. Cousins, R. L. Hearn, W. B. Redfern, J. M. Fairbairn, L. A. Wright.

KOREEN—OLOF JOEL, of 315 Wolseley St., Port Arthur, Ont. Born at Ornskoldsvik, Angermanland, Sweden, July 13th, 1892; Educ.: 1908-12, Lulea Technical School. Private tuition in Naval Architecture; 1908-12, mach. shop ap'tice during summers, in Sweden; 1913-15, ap'tice in shipyard at Port Arthur; 1924-25, designing and detailing struct'l. steel for grain elevators, C. D. Howe & Co. Ltd.; 1917-19, detailing of all parts of a ship, and from 1919 to date (except eight mos., 1924-25), asst. to the naval architect, Port Arthur Shipbuilding Co. Ltd., work includes estimating, designing and ordering materials for all classes of boilers, heating, stationary and marine. All classes of boats, struct'l. steel for bldgs. and other structures; also pulp and paper machy. and mining machy.; preparing specifications and designing to the requirements of classification ship's hull, piping and aux. machy., etc.

References: E. L. Goodall, B. A. Culpeper, H. Os, G. Eriksen, F. C. Graham, R. B. Chandler, J. M. Fleming.

LAFERRIERE—ROSARIO AUREZ, of Ottawa, Ont. Born at Sorel, Que., Oct. 2nd, 1902; Educ.: B. A. Sc., Ecole Polytechnique, Montreal, 1928; R.P.E. of Que.; 1928-29, with the Trussed Concrete Steel Co.; 1929 to date, asst. engr., Dept. of Public Works of Canada, Ottawa, Ont.

References: K. M. Cameron, J. A. L. Dansereau, O. O. Lefebvre, L. V. Denis, G. H. Thurber, J. A. Vermette, F. G. Smith.

LANGMAN—JOHN NELSON, of Grimsby, Ont. Born at Aurora, Ont., Sept. 3rd, 1909; Educ.: B.Sc. Queen's Univ., 1932; with the Dept. of Highways of Ontario as follows: 1931 (summer), instr'man. i/c of party; 1932-34, inspr. and instr'man. on constrn. of concrete pavements, grading, bridge constrn. etc.; 1934-35, instr'man. i/c of constrn.; 1935-37, surveys branch, location engr.; 1937 to date, asst. divnl. engr., i/c of new Niagara Highway, Burlington to Fort Erie, constrn. and location.

References: G. F. Hanning, W. P. Wilgar, A. Hay, A. A. Smith, R. M. Smith, T. T. Irving.

MacDONALD—JOHN THOMSON, of 17 Strathallan Blvd., Toronto, Ont. Born at Toronto, Dec. 8th, 1912; Educ.: B.A.Sc. (Civil), Univ. of Toronto, 1936; with the Gair Company of Canada Ltd. as follows: 1936-37, i/c technical control laboratory, Dominion boxboard divn.; 1937, designing and dfting. during reconstrn. of Canadian Paperboard mill, asst. to res. engr.; 1937-38, dftiug., meter mtce., steam and elect'l. power reports, Toronto mill divn.; 1938 to date, asst. mech'l. supt., Toronto mill divn., planning layout, estimating and supervision of plant mtce.

References: J. C. Nutter, C. F. Morrison, C. R. Young, W. J. Smither, G. H. Tate.

MacMILLAN—DONALD CARTER, of 58 Lakeshore Blvd., Toronto, Ont. Born at Guelph, Ont., May 16th, 1915; Educ.: Grad., R.M.C., B.Sc., Queen's Univ., 1937; 1938-39, works officer during constrn. of a rifle range at Winona, Ont. At present, Lieut., R.C.E., Toronto, Ont.

References: W. P. Wilgar, H. H. Lawson, L. F. Grant, O. T. Macklem, G. G. M. Carr-Harris.

MACNAB—ARCHIBALD CAMERON, of 352 Hunter St. East, Hamilton, Ont. Born at Arnprior, Ont., Feb. 7th, 1909; Educ.: B.A.Sc., Univ. of Toronto, 1932; 1930-31 (summers), inspr., Chats Falls, Engrg. Board; 1932-34, foreman, worsted spinning, and 1934-38, asst. supt., worsted yarn mfg. section, i/c production and mtce., Dominion Woollens & Worsteds Ltd.; Feb., 1938, to date, plant supt. and engr., Donald Ropes & Wire Cloth Co., Hamilton, Ont.

References: R. E. Smythe, E. G. Wyckoff, W. A. T. Gilmour, A. R. Hannaford, C. H. Hutton.

McEACHERN—ARCHIBALD CALVIN, of Calgary, Alta. Born at Regina, Sask., March 22nd, 1912; Educ.: B.Eng. (Civil), Univ. of Sask., 1938; 1931 (summer), chainman, Smith & Phillips, Regina; 1934-36, dftsman. and instr'man, Dept. of Northern Development Ontario; 1936 (June-Sept.), dftsman. and instr'man, Phillips & Benner, Port Arthur; June, 1938, to date, transitman, Prairie Farm Rehabilitation, Calgary, Alta.

References: E. K. Phillips, W. L. Foss, C. J. Mackenzie, R. A. Spencer, W. E. Lovell, I. M. Fraser.

MILTON—CHARLES WILLIAM, of Humphrey Mills, N.B. Born at Albert Mines, N.B., May 22nd, 1892; Educ.: 1909-12, Mount Allison Univ.; R.P.E. of N.B.; 1912, rodman and leveller on prelim. and location; 1912-13, diamond drilling and mine surveying; 1913-15, rodman and leveller, right of way survey; 1915-16, instr'man., divn. engr's office, C.N.R., Truro; 1916-18, instr'man, and 1918 to date 1st asst., divn. engr's. office, C.N.R., Moncton. Gen. engrg., mtce. of way dept., office work, field work, bridge, track and bldg. constrn. (1930-33, engr., Town of Sunny Brae, sewerage and water installn.).

References: A. S. Gunn, F. O. Condon, V. C. Blackett, E. R. Evans, F. L. West, H. W. McKiel.

MITCHELL—OSBORNE, of Toronto, Ont. Born at London, England, June 2nd, 1902; Educ.: 1918-22, Northampton Polytechnic Institute; R.P.E. of Ont.; Student course, Ferranti Ltd., England, sandwich system arranged by college, 1920-21; 1923-25, elect'l. dftsman., 1925-26, elect'l. designing dftsman., H.E.P.C. of Ontario; 1926-30, asst. editor, 1930-35, editor, 1935-38, managing editor, "Electrical News and Engineering," also "Electrical Appliances and Supplies" and "Radio Trade Builder"; at present, secretary, Hydro-Electric Power Commission of Ontario, Toronto, Ont.

References: J. B. Challies, T. H. Hogg, O. Holden, W. P. Dobson, A. H. Hull.

MOTHERWELL—JAMES SHEARER, of Montreal, Que. Born at New Westminster, B.C., Jan. 10th, 1914; Educ.: B.A.Sc., Univ. of B.C., 1936; 1936 (two mos.), instructor in dfting., Univ. of B.C.; two years to date, in paper machy. drawing office, Dominion Engineering Co. Ltd., Lachine, Que.

References: H. G. Welsford, H. P. Archibald, H. F. G. Letson, C. E. Webb, J. McHugh.

MOXON—HENRY WILDING, of 4710 Decarie Blvd., Montreal, Que. Born at Liverpool, England, April 9th, 1910; Educ.: B.Sc. (E.E.), McGill Univ., 1930; summers, 1928-30, and 1933-34, asst. electrn., Chateau Lake Louise, C.P.R.; 1930-31 and 1932-33, test dept., C.G.E., Peterborough and Toronto; 1934-37, power house operator, Pacific Mills Ltd., Ocean Falls, B.C.; with the Can. Gen. Elec. Co. Ltd. as follows: 1931-32, switchgear engrg. dept., and 1937-39, switchgear engrg. dept., Peterborough, and at present asst. district engr., Montreal.

References: B. I. Burgess, W. T. Fanjoy, L. Jehu, C. E. Frost, I. S. Patterson.

PEERS—ARTHUR FRANCIS, of Quesnel, B.C. Born at London, England, Nov. 14th, 1898; Educ.: McGill Senior Matric., 1915; 1916-17, Royal Naval College, Sandhurst-Woolwich; 1917-18, part time training as midshipman; 1920-21, courses for rank of Lieut., retired from Royal Navy, 1922; 1927, promoted Lieut.-Commdr.; R.P.E. of B.C.; with the Dept. of Public Works of B.C. as follows: 1924-26, chainman and rodman; 1927, levelman, and res. engr. on constrn. Transprovincial Highway; 1928, instr'man., 1929-30, res. engr. on constrn., Nicomen Island Dykes; 1930-34, asst. district engr., North Cariboo District; 1935, res. engr., Quesnel Light & Water Co., Baker Creek hydro-electric development; 1934 to date, partner in firm, Fraser & Peers, mining and civil engrg., Quesnel, B.C.

References: E. Smith, H. L. Hayne, A. C. R. Yuill.

POLLOCK—FRANCIS JONES, of 2495 Lincoln Road, Windsor, Ont. Born at Almonte, Ont., Mar. 8th, 1896; Educ.: B.A.Sc., Univ. of Toronto, 1922; 1916-19, overseas, C.F.A., France and Belgium; 1920-22 (summers), military surveys, Dept. of National Defence; 1922-27, dftsman., and 1927 to date, engr. in charge tower and substation dept., dftsman., trans. towers, radio masts, substations, etc., and relative testing work, Canadian Bridge Company, Walkerville, Ont.

References: S. E. McGorman, C. G. R. Armstrong, T. H. Jenkins, R. C. Leslie.

SAINT-PIERRE—ROLAND, of Beauceville, Que. Born at South Stukely, Que., Jan. 5th, 1910; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1935; 1935-37, res. engr., and 1937 to date, divn. engr., Quebec Provincial Roads Dept.

References: A. Gratton, J. O. Martineau, P. P. Vinet, A. Frigon.

SCHIERBECK—JOERGEN, of 1506 Mackay St., Montreal, Que. Born at Copenhagen, Denmark, March 16th, 1913; Educ.: Senior Matric. 1933-34, Dalhousie Univ. (has credit for 13 out of 20 courses for B.Sc. degree); 1934-35, routine process testing, asphalt dept., Imperial Oil Limited, Halifax; 1935-36, with the Dominion Molasses Co., Halifax, maintaining mech. equipment of canning dept., etc.; 1936-37, with the Sylvania Industrial Corpn., testing in research dept., etc.; 1938 to date, technical sales work, servicing, etc., on water conditioning equipment, with C. K. McLeod, A.M.E.I.C.

References: R. L. Dunsmore, V. Jepsen, F. E. Wilhjelm, L. H. D. Sutherland, C. K. McLeod.

STE. MARIE—GASTON P., of 4251 Marcil Ave., Montreal, Que. Born at Montreal, Que., Feb. 20th, 1897; Educ.: 1915-30, correspondence schools and private professors; 1911-12, ap'tice., plumbing and heating trades; 1912-15, ap'tice and junior mechanic, 1915-17, journeyman and foreman mechanic, plumbing and heating and steam power plant, Garth Company; 1917-19, overseas; 1919-20, asst. to master mechanic, Tidewater Shipbuilders, Three Rivers; 1920-24, foreman, heating and steam power plant installn., Garth Company; 1924-26, supervisor and research work for oil burning equipment; 1927-31, designer and supervisor for heating and steam power plant, E. Lorne Wiggs, M.E.I.C., Consltg. Engr., Montreal; 1931-33, designer and supervisor for plumbing and heating, Raoul Gariepy, and E. A. Doucet, architects; July, 1933, to date, examiner and chief of service for Montreal district office, Pipe Mechanics' Act. Dept. of Labour, Quebec Provincial Govt., and also heating technician (promotion) as designer and supervisor, plumbing, heating, refrigeration, air conditioning and steam power plant for the Montreal Botanical Garden, Dept. of Labour, Quebec Prov. Govt. (not completed yet).

References: W. J. Armstrong, E. Darling, E. Cormier, H. C. Karn, G. L. Wiggs, R. M. Calvin.

TANTON—FREDERICK WILLIAM, of Drummondville, Que. Born at Charlottetown, P.E.I., Dec. 13th, 1897; Educ.: B.Sc. (E.E.), N.S. Tech. Coll., 1925; 1920 (summer), rodman and instr'man., Dept. of Public Works of N.S.; 1923-24 (summers) and part of 1925, district engr., Dept. of Public Works of P.E.I.; 1925-28, power house operator, Newfoundland Power and Paper Co., Deer Lake, Nfld.; 1928 to date, with the Southern Canada Power Company as follows: for six years relief operator at two of the company's power houses. Transferred to the system operating office, working directly under the operating supt., preparation of reports, incl. all statistics in connection with power generation and output; reports on and compilation of costs of various new work as covered by work orders; making sundry drawings, etc., as required in the field, etc.; in spring of 1938 was transferred (at own request) to the field force, and at present i/c of care and mtce. of protective system.

References: J. S. H. Wurtele, J. H. Trimmingham, F. A. Chisholm, P. T. Davies, G. M. Sutherland.

TURNBULL—ALLISON DEWAR, of 4392 Earnscliffe Ave., Montreal, Que. Born at Sydney, N.S., Sept. 24th, 1905; Educ.: B.Sc. (M.E.), N.S. Tech. Coll., 1928; 1927, elect'l. engr., Oxford Paper Co. Ltd., Murray, N.S.; 1928-29, engr., Dominion Steel Co. Ltd., Sydney, N.S.; with the Northern Electric Co. Ltd., as follows: 1929-30, service engr., 1930-33, service supervisor, 1933-35, operating supt., research product divn.; 1933 to date, lecturer on Faculty of Science, Sir George Williams College, Montreal; 1935 to date, asst. chief engr., Dominion Sound Equipment Ltd., Montreal.

References: G. H. Midgley, H. W. McKiel, F. L. West, H. J. Vennes.

VENART—CHARLES HERBERT SOMERVILLE, of 8744 Dante St., Chicago, Ill. Born at Londonderry, Northern Ireland, Nov. 17th, 1902; Educ.: His Majesty's Dockyard Schools; Kerr's Engrg. College, Belfast, Ireland; First Class B.O.T. Cert.; 1937-39, College of Science and Technology, Toronto; 1919-24, engr's. ap'tice, His Majesty's Dockyards, South Africa, Wales and Bermuda; 1924-25, operator and mechanic, Bermuda Electric Light Co.; 1925-26, junior engr., Furness Withy Steamship Co., New York; 1926-28, junior engr., and 1928-33, second engr., American Fruit Company, in complete charge of engine room, boiler room and personnel; 1934-35, chief engr. in charge of power, International Harvester Co. of Canada Ltd., incl. supervision of operation, mtce., heating, refrigeration, engrg. and installn. of new equipment, machy. and fuel tests, estimates, statistics, accounts; 1935, field engr., Carrier Engineering Corp., Washington, D.C. Entire supervision of installn. of refrigeration and air-conditioning machy. and equipment, estimating, balancing air quantities, alterations, etc.; 1936, consltg. engr., United States Dept. of Agriculture, engrg. and installn. of refrigerating and air-conditioning machy. and equipment at Mayaguez, Puerto Rico; 1936 to date, inspecting engr., boiler, pressure vessel and machy. inspection, Fidelity and Casualty Company, New York, N.Y.

References: A. Love, V. S. Thompson, W. Hollingworth, A. R. Hannaford, H. B. Stuart.

WALLACE—IVAN MORROW, of 693 Argyle Road, Windsor, Ont. Born at Port Perry, Ont., Oct. 4th, 1911; Educ.: B.A.Sc., Univ. of Toronto, 1934; 1934-37, instr'man. and dftsman., Dept. of Northern Development, Ontario; 1937 to date, dftsman., Canadian Bridge Company, Walkerville, Ont.

References: P. E. Adams, H. J. A. Chambers, T. F. Francis, C. R. Young, G. L. Wallace.

WILLIAMS—ROBERTS KITCHENER, of 206 Langley Ave., Toronto, Ont. Born at Toronto, Dec. 29th, 1899; Educ.: 1918-20, Univ. of Toronto; ex-mural study of numerous texts on industrial and management engrg.; Summer work: plant foreman, Canada Sand Lime Brick, Toronto; gen. plant work, Welland Steel Foundry, and Union Carbide Company; 1921-26, with Wm. Davies Co., Toronto, inside organization and gen. plant house installns. on refrigeration equipment, etc.; 1926-28, plant supt. of the Montreal plant, also plant layouts, etc., at the London plant, for the Canada Biscuit Co.; 1929-33, industrial engr., Sherman Engineering Corpn., New York, and latterly Canadian manager for this company; 1934-39, operating as an independent consultant, work included layout of new bldg. for New Method Laundry Co., Toronto, incl. spotting of all machines and steam pipe lines, and introduction of numerous mech'l. devices; contract to carry out practical engrg. work on numerous plants under supervision of R. J. Magor, National Steel Car Co.; also on the James Robertson plants at Montreal and Toronto, and the Gurney Foundry jobs at Toronto and St. Laurent; plant layout work with Service Station Equipment, Toronto; at present, installn. engr. with George S. May Co. Ltd., industrial engineers of Chicago, New York and Toronto.

References: R. L. Weldon, R. E. Smythe, L. A. Wright.

WILLIS—EDWIN AUBREY, of 170 Main St., Ottawa, Ont. Born at Bolton, Lancs., England, Dec. 16th, 1908; Educ.: Ontario Middle School Matric., also complete matric. of Univ. of London, England; 1922-25, Ottawa Technical School, graduating with Silver Medal and special prize for electricity; I.C.S. Diploma in Elec. Engrg., 1933; 1928-35, laboratory asst., responsible for repairing, cleaning of rotating standards, etc., and 1935 to date, electrician, Electricity and Gas Inspection Laboratory, National Research Building, Ottawa, Ont. (Directly responsible for operation and mtce. of storage batteries, motors, generators, switchboards, etc.)

References: H. A. Dupre, R. W. Guy, E. O. Way, B. G. Ballard, R. H. Field.

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

CARR-HARRIS—GORDON GRANT MACDONNELL, of Kingston, Ont. Born at Kingston, April 23rd, 1897; Educ.: 1915-16, R.M.C.; 1922-23, Cambridge Univ.; 1936-38, Cornell Univ., Master Mech'l. Engrg., 1938; 1913-16 (summers), mining surveys in N.B., geodetic boundary survey, Quebec-Maine, hydrometric survey, St. Lawrence River; 1916-27, ten years' service as a Royal Engineer Officer in the British Regular Army; 1927 (six mos.), instr'man., city engrg. dept., Vancouver; 1928-29-30 (summers), instr'man., Dept. of Highways Ontario; 1927-33, instructor in engrg., and from 1933 to date, asst. professor of engrg., and in full charge of the dept. of mech'l. engrg., Royal Military College, Kingston, Ont. (A.M. 1930).

References: H. H. Lawson, L. F. Grant, L. T. Rutledge, W. P. Wilgar, W. L. Malcolm.

GRAY-DONALD—ERCELDOUNE DONALD, of Quebec, Que. Born at Amoy, China, Dec. 29th, 1900; Educ.: B.Sc. (Elec.), McGill Univ., 1926. M.Sc., Laval Univ., Quebec, 1934; Summers, 1921-25, clerk of works, Govt. of Palestine, timekpr., Lockwood Greene & Co., student, Toronto Hydro-Electric System; 1926-27, ap'tice, Shawinigan Water & Power Co.; with the Quebec Power Company as follows: 1927-28, asst. engr., 1928-30, asst. supt., power divn., 1930-37, supt., power divn., i/c all operations of the power divn. of the company, comprising operation of hydro-electric power plants, trans. lines, substations and distribution system, also supervision of design and constrn. of additions and extensions; 1937-39, asst. gen. supt., supervision of all operating departments of the Quebec Power Company and the Quebec Railway Light & Power Co.; since January, 1939, gen. supt., with responsible charge of all operating depts. of Quebec Power Company, and the Quebec Railway Light & Power Co. This covers the power and gas divns., merchandising, new business, city tramways and bus systems, Montmorency Divn. Rly., car shops, garage, etc. (St. 1922, Jr. 1926, A.M. 1934).

References: R. B. McDunnough, P. S. Gregory, A. R. Decary, G. H. Cartwright, H. W. B. Swabey, C. V. Christie, J. Morse.

FAWKES—ARTHUR WALTER ELLSON, of 1022 Redland Ave., Moose Jaw, Sask. Born at London, England, Sept. 3rd, 1878; Grad. in civil engrg., College of Science and Technology, Edinburgh; 1903-06, engr. and surveyor, Vickers, England; 1907-08, res. engr., power developments, Town of Campbellford, Ont.; 1909-10, res. engr., City of Peterborough, Ont.; 1910-11, concrete bridge constrn., Milwaukee & St. Paul Rly.; 1911-13, engr. of constrn., City of Minneapolis; 1913-14, waterworks engr., Calgary; 1914-19, private consltg. practice, Calgary; 1920-21, municipal engr., Summerland, B.C.; 1921-24, advisory and constrn. engr., Board of Education, Hamilton, Ont.; 1924-28, city mgr. and city engr., Brandon, Man.; 1929-30, city commissioner, Moose Jaw, Sask.; 1935-36, appointed by order of Privy Council, Dom. Govt., Dominion Representative, bridges, highways and railway crossings; 1938 to date, city engr., Moose Jaw, Sask. (A.M. 1938).

References: W. L. McFaul, W. P. Brereton, C. J. McGavin, A. P. Linton, J. M. Patton, J. J. White, D. A. R. McCannel, C. Brakenridge.

FOR TRANSFER FROM THE CLASS OF JUNIOR

BRADDELL—EBERHARD SYLVESTER PATRICK, of 104 Chestnut St., Winnipeg, Man. Born at East Bay, Man., Dec. 16th, 1910; Educ.: B.Sc. (E.E.), Univ. of Man., 1932; B.A. (Economics and Eng. Lit.), 1936; summers, 1929, gen. mechanic on installn., C.P.R. Signals, Sask. and Alta.; 1930, asst. steel inspr., also i/c production, galvanizing dept., Manitoba Bridge & Iron Works Ltd.; with the Winnipeg Electric Co. as follows: 1931 (summer), engrg. asst. on electrolysis survey (underground testing, reporting), 1932-34, engrg. asst. on electrolysis survey (investigation and research), 1934-36, asst. distribution engr's dept. (testing, checking, inspection on constrn.); 1937 (Mar.-Apr.), dftsman., engrg. dept.; 1936 (Jan.-Oct.), asst., apparatus sales dept., English Electric Company of Canada Ltd., St. Catharines, Ont.; with the Northern Electric Co. Ltd., as follows: 1937 (Apr.-Dec.), sales engr., power apparatus divn., Montreal and Toronto; 1937 to date, power apparatus sales engr., respons. for preparation of tenders and quotations on recommended apparatus; also asst. specialist in associated depts., Winnipeg, Man. (St. 1931, Jr. 1937).

References: E. V. Caton, E. P. Fetherstonhaugh, J. W. Sanger, J. N. Finlayson, N. M. Hall, J. D. Peart, W. R. Bunting, C. T. Eyford.

FRASER—RALPH PERCY, of Ste 8 Allison Apts., Winnipeg, Man. Born at Winnipeg, Sept. 22nd, 1905; Educ.: B.Sc. (E.E.), Univ. of Man., 1931; 1924-29 (summers), trans. line survey, rodman and concrete inspr., Man. Power Co. and C.N.R.; 1930, testman, C.G.E., Peterborough; 1931-33, asst. instructor, elect'l. shop, Kelvin Technical High School, also instructor of electricity, evening classes; 1933-35, on occasional staff of Winnipeg Public School Board; with the Winnipeg Electric Co. as follows: 1935-36, floorman, substation operation dept., 1936, junior voltage inspr. and dftsman., 1936-37, senior voltage inspr., 1937 to date, asst. to distribution engr. (St. 1930, Jr. 1937).

References: E. V. Caton, C. T. Eyford, C. P. Haltalin, L. M. Hovey, T. C. Main.

HUGGINS—MARK WILLIAM, of 109 Wellington St., Kingston, Ont. Born at Toronto, Ont., Mar. 19th, 1911; Educ.: B.A.Sc., 1932, M.A.Sc., 1933, Univ. of Toronto, 1930-31 (summers), rodman, city of Toronto, field engr., Consumers Gas Co.; 1932-33, research asst., Univ. of Toronto; 1933-36, engr., E. P. Muntz Limited, Dundas, Ont., design and research, also estimating bridge and bldg. constrn.; 1936, engr. i/c design and erection of forms and falsework for Vernon Construction Co., Oakville, Ont.; 1937-38, detailing and designing, Dominion Bridge Company, Toronto; at present, lecturer, dept. of civil engrg., Queen's Univ., Kingston, Ont. (Jr. 1935).

References: C. R. Young, E. P. Muntz, W. H. M. Laughlin, G. G. Powell, D. C. Tennant.

MOLONEY—JAMES GRANT, of Toronto, Ont. Born at London, Ont., June 1st, 1908; Educ.: B.Sc. (Civil), Tri-State College, Indiana, 1935; R.P.E. of Ont.; 1925-27, Erie Construction Co., gen. dfting., estimating, quantity survey, cost keeping, etc.; 1927-28, engrg. divn., Metropolitan Stores, bldg. survey, planning, constrn., supervision and reinforced concrete detailing; 1928-31, Watt & Blackwell, architects, gen. struct'l. dfting. and detailing, supervision of constrn., location survey work; 1931, with the City Gas Co., London, property surveys, etc.; 1931-35, constrn. engr., Putherbough Constrn. Co. ; 1935-36, employed jointly by Col. M. M. Dillon, A.M.E.I.C., London, Ont., designing, detailing, rein. concrete bldgs. and bridges, etc., and as ass. to Major S. W. Archibald, M.E.I.C., on municipal surveys, water-lot and drainage surveys; 1936-38, chief designing engr., Dominion Road Machinery Co., Goderich, Ont., design and supervision of constrn. of gen. lines of road bldg. equipment; developed, designed and constructed first continuous asphalt plant in Canada; soil investigations and asphalt inspection; at present, Editor, "The Canadian Engineer," Toronto, Ont. (Jr. 1936).

References: S. W. Archibald, M. M. Dillon, H. A. McKay, J. Ferguson, J. M. Breen.

FOR TRANSFER FROM THE CLASS OF STUDENT

BENTLEY—KENNETH EARL, of Dartmouth, N.S. Born at Billtown, N.S., Sept. 27th, 1912; Educ.: B.Sc. (Civil), N.S. Tech. Coll., 1934; with the Imperial Oil Company, at the Imperoyal Refinery, as follows: 1934, asphalt lab., 1935, dftsman., 1935-36, gen. lab., shift work, tests, etc., 1936-37, dftsman., 1937-38, engrg. estimator, 1938, mtce. engr., and at present, engrg. inspr. (St. 1934).

References: R. L. Dunsmore, C. Scrymgeour, G. W. Christie, A. D. Nickerson, S. Ball, A. Sutherland.

BLAIR—JAMES, of 107 10th Ave. N.E., Calgary, Alta. Born at Gainsborough, Sask., Mar. 24th, 1909; Educ.: 1933, completed third year of civil engrg. course, Univ. of Alta.: accepted as candidate to write an engrg. report for admission to the Assn. of Prof. Engrs. of Alta. This thesis is required of all graduate engrs. also; Capt., R.C.E.; Member, Military Engrs. Assn.; 1927-28, rodman, C.N.R.; 1929-30, dftsman., Ghost River dam, Foundation Co.; 1930-33, dftsman., instr'man., field engr., on Glenmore dam constrn.; 1933-39, asst. refinery engr., and plant engr., Imperial Oil Refinery, Calgary, Alta.; direction of approximately 175 mech'l. staff members in mtce. and new constrn. plus approval of all design for this mech'l dept. (St. 1931).

References: R. S. L. Wilson, J. J. Hanna, R. W. Dunlop, J. H. Wood, B. W. Snyder.

BURKE—JOHN ABEL, of La Tuque, Que. Born at Wetaskiwin, Alta., May 28th, 1912; Educ.: B.Sc. (E.E.), 1934, B.Sc. (C.E.), 1937, Univ. of Alta.; 1928-33 (summers), with Alta. Govt. Telephones; 1934-36 (summers), rodman, instr'man., Alberta Highway Dept.; 1935, asst. instructor, Lethbridge Technical School; 1937-38, field engr., at Three Rivers terminal station for Shawinigan Engineering Co. Ltd.; 1938 to date, field engr., St. Maurice Power Corporation, La Tuque, Que. (St. 1934).

References: J. B. Challies, R. E. Heartz, G. R. Rinfret, P. M. Sauder, R. S. L. Wilson, H. R. Webb.

DUPUY—RENE, of Baie Comeau, Que. Born at Montreal, June 14th, 1911; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1935; R. P. E. of Que.; 1931-35 (summers), surveys for Quebec Streams Commission; 1935 (July-Dec.), res. engr. on road constrn. for Quebec Dept. of Highways; 1936-37, struct'l. and arch'l. design-dftsman., with the Ontario Paper Co. Ltd., now the Quebec North Shore Paper Co.; 1938 to date, with the same company as asst. to the mtce. engr. (St. 1936).

References: M. H. Jones, P. G. Gauthier, W. G. Reekie, D. Anderson, A. J Cunningham, L. E. Schlemm, A. Babin.

HARE—WILLIAM LESTER, of 1283 Mount Royal Ave. East, Montreal, Que. Born at Ottawa, Ont., Dec. 4th, 1910; Educ.: B.Sc. (Mech.), Queen's Univ., 1935; 1935-37, instructor, mech. engrg., Queen's Univ.; 1937 to date, junior engr., central engrg. dept., Dominion Rubber Co., Montreal, Que. (St. 1935).

References: G. J. Smith, L. T. Rutledge, T. M. Moran, R. Ford.

MACLEOD—DOUGLAS NORMAN, of Montreal, Que. Born at Weyburn, Sask., Oct. 22nd, 1911; Educ.: B. Eng. (Elec.), McGill Univ., 1935; R.P.E. of Que.; 1928-37, telegrapher, lining up and maintaining telegraph and telephone circuits, and from 1937 to date, supervision of installn. of communication equipment, eastern lines. C.P.R. Communications Dept. (St. 1936).

References: C. V. Christie, E. Brown, H. J. Vennes, R. E. Jamieson, R. DeL. French.

REIKIE—MATTHEW KER THOMSON, of Flin Flon, Man. Born at Kaslo, B.C., Oct. 13th, 1911; Educ.: B.Sc. (Chem.), Univ. of Alta., 1932; 1930-31 (summers), dftsman. on survey party, Alta. highways, tester in refinery, helper in zinc cottrells, Trail, B.C.; with the Hudson Bay Mining and Smelting Co. Ltd., as follows: 1932-34, research chemist, 1934, supt., zinc roasting and leaching, 1934-36, supt., zinc tank house and casting, 1936-38, supt., zinc research, Jan. 1939, to date, asst. supt., plant research dept. (St. 1932).

References: R. S. L. Wilson, W. E. Cornish, H. R. Webb, L. R. Thomson, C. A. Robb.

WHITELEY—ERIC, of 575 Weller St., Peterborough, Ont. Born at Sheffield, England, July 23rd, 1911; Educ.: B.A.Sc., Univ. of Toronto, 1937; 1937-38, student engr., 1938 to date, asst. engr., AC-DC design section, Can. Gen. Elec. Co. Ltd., Peterborough, Ont. (St. 1937).

References: H. R. Sills, B. Ottewell, G. R. Langley, B. I. Burgess, A. B. Gates.

COMING MEETINGS

American Water Works Association—Fifty-Ninth Annual Convention. June 11-15, at Atlantic City Auditorium, Atlantic City, N.J. Secretary, H. E. Jordan, 29 West 39th St., N.Y.

American Water Works Association—Canadian Section—April 12-14, at Royal York Hotel, Toronto, Ont. Secretary-treasurer, Dr. A. E. Berry, Ont. Department of Health, Parliament Buildings, Toronto.

Canadian Electrical Association—Forty-Ninth Annual Convention at The Pines Hotel, Digby, N.S., June 21-24, 1939.

Edison Electric Institute—Seventh Annual Convention, Waldorf-Astoria Hotel, New York, N.Y., June 6, 7 and 8, 1939.

Internationaler Kongress fur Wohnungswesen und Stadtebau, Stockholm, July 8-15, 1939.

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THE ENGINEERING JOURNAL

VOLUME 22 | MAY 1939 | NUMBER 5

"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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PRESIDENTIAL REMARKS OF 1918

(FROM THE FIRST NUMBER OF THE JOURNAL)

"THAT THE first issue of our monthly Journal should report the first general professional meeting of the Society can hardly be regarded as a coincidence but we may certainly hope that it may prove an omen of increasing success and a broadening field of usefulness for the new Engineering Institute of Canada. The change in name, with all that it involves, the holding of professional meetings in various provinces and the publication of a journal are the concrete results of the recommendations made by the Committee on Society Affairs which have led to such important alterations and additions to our by-laws. The change in name implies the attempt to unite all engineers into one society, no matter to what branch of the profession they may belong. The Journal will afford us all a means of being better informed on the activities of the Society, and keeping our members more closely in touch with each other

"Our new development may be ambitious but it contains great possibilities. In spite of the terrible times through which we are passing, the results, so far, are most encouraging. This Journal is the commencement of another effort to carry out our programme and let us all wish it success, and endeavour to promote its success by every means in our power".

MAY 1939

Twenty-one years ago on April 25th, 1918, a bill was approved authorizing the change of name from "The Canadian Society of Civil Engineers" to "The Engineering Institute of Canada," and a few days later the first number of "The Engineering Journal" was issued. I think it may be stated confidently that both these important steps in the development of the Institute have justified themselves in the years that have elapsed.

In almost every way the Journal has met our expectations and amply fulfilled the purposes set forth in the inaugural programme that "all that pertains to the doings of the Institute will receive full and free discussion. In it, our activities, our aims and our expectations may find expression." That this programme has been so successfully carried out is undoubtedly due to the wise and able conduct of the Journal by its first editor, his able successor, and the supervision and support given by all those members of the various committees who have devoted time and endeavour to it.

The importance and value of The Engineering Institute to its membership and to the engineering profession does not consist, principally, in the grading of its membership or in deciding who may be admitted to practise engineering. Its most important functions are:

The establishment and maintenance of a high code of professional ethics.

The holding of meetings for the presentation of papers and the discussions of subjects of professional interest and the recording of achievements of members of the profession.

The opportunity for widening acquaintanceships, for facilitating co-operation, for promoting the advancement of juniors, for developing an atmosphere of friendliness wherein a man may "seek freely and confidently what aid, comfort and advice from his equals and his betters he may at that moment stand in need of."

These are the great purposes of an engineering institute and these are the purposes which have been promoted with increasing success during the years this Institute has been in existence. With a well tried and tested organization, a loyal membership and a journal to direct and record its activities, I think we can look forward to the next twenty-one years with a great deal of confidence and satisfaction.

President, 1918

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THE THOUSAND ISLANDS INTERNATIONAL BRIDGE

CONSTRUCTION OF THE SUPERSTRUCTURE OF THE CANADIAN SECTION

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AND
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Paper presented before the Border Cities Branch of The Engineering Institute of Canada, March 17th, 1939

SUMMARY—A description of the contractor's work in constructing and erecting the Canadian section of the Thousand Islands International Bridge. This series of structures is 3,330 ft. long, and includes a 600 ft. two-span continuous truss bridge, a 348 ft. two-hinged arch, a 750 ft. suspension bridge, and the necessary approaches.

The Thousand Islands International Bridge, crossing the St. Lawrence River in the heart of the Thousand Islands region, consists of a series of bridge structures carrying a twenty-two foot roadway and two sidewalks between Ivy Lea, Ontario, and Collins Landing, New York, and connecting the highways of Canada with the highways of the United States. It is not only a thoroughfare between the two countries through one of the beauty spots of this continent, but a means as well for the public to reach the two large islands adjacent to the international boundary.

This project is separated into three distinct divisions. The American crossing is entirely in the United States, spanning the main American channel and connecting the American mainland to Wellesley island, which island lies between the mainland and the rift.

The International Rift Bridge, as its name implies, connects the two countries by spanning the international border over a channel about 80 ft. wide called the "Rift," and separating Wellesley island from Hills island. The structure over the International Rift is a 90 ft. rigid frame of reinforced concrete construction. This bridge is faced with stone cut from rock formations near the site.

The American crossing is 4,500 ft. long and consists of a suspension bridge with 800 ft. main span and 150 ft. underclearance, and plate girder approaches.

The Canadian crossing is entirely in Canada, connecting Hills island, Constance island, Georgina island and the Canadian mainland. Its length is 3,330 ft. and it includes a 600 ft. two-span continuous truss bridge, a 348 ft. two-hinged arch, a suspension bridge with 750 ft. main span and 120 ft. under-clearance, and plate girder approaches. There are also continuous plate girder viaducts over Constance island between the continuous span and the arch span, and over Georgina island between the arch span and the suspension span. Not more than one of these structures can be seen from most observation points, as the islands are heavily wooded, therefore each structure appears as a separate unit. The whole crossing is shown in Figs. 1 and 2.

The total length of bridge structures and connecting roadways on these islands, is about eight and one-half miles.

The Canadian Crossing

Probably the most important features of this crossing, from a contractor's viewpoint, are the following:

(a) The varied types of structures, each requiring its own construction methods.

(b) The location of the structure, which required all material and equipment to be shipped to the site by water, and the men carried daily to the job in boats.

(c) The rocky shore and property restrictions, which prevented the use of docks on the islands and on the mainland for handling and storing of material and equipment. To overcome this difficulty a storage yard was constructed near the east end of Constance island by sinking two scows. The material stored in this yard was transported on small scows to the bridge as required.

(d) Unusual winter conditions, an ice-blocked river, and difficulty in moving materials.

Fig. 1—Canadian Section of Thousand Islands Bridge (looking South), showing Canadian mainland in Foreground

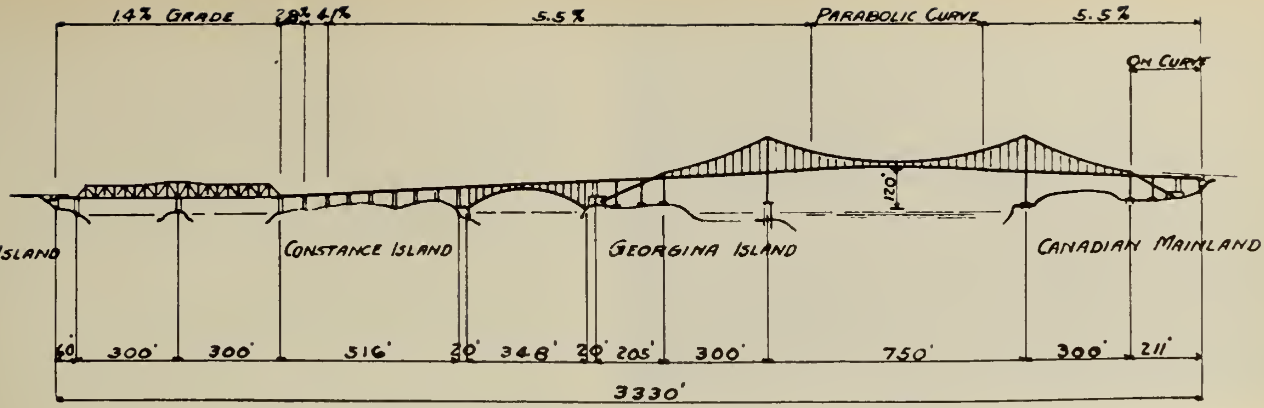

Fig. 2—Diagram of Canadian Section, Thousand Islands Bridge

The structures were erected in approximately the following order:

1. Continuous span and south approach.
2. Viaduct over Constance island.
3. Towers.
4. Cables.
5. Arch span.
6. Viaduct over Georgina island.
7. North approach.
8. Completion of suspension span.

The Continuous Truss Bridge

The south span of this bridge was erected on falsework. The piles and timber framing were cut from the trees removed from the highway right-of-way on Hills island. The river bed is rock and boulders; therefore each pile was fitted into a welded steel point and then driven to a firm bearing on the rock or between the boulders. An erection crane of the whirley type was used for erecting both falsework and steel. For erecting the falsework and floor steel of the south span, the crane was mounted on a scow; for erecting the remainder of the span it was placed on the bridge floor. This crane used ballast for stability, and proved very efficient throughout the job.

Fig. 3—Erection of North Span, Continuous Truss Bridge

The north span was erected with the crane on the deck as shown in Fig. 3. The span was cantilevered out 120 ft. from the centre pier, the next 120 ft. was supported on falsework, and the final 60 ft. cantilevered until landed on the north pier. Jacking facilities were provided on the falsework to insure proper alignment and to avoid overstressing of truss members.

As this span was designed to be continuous over three supports it seemed desirable to check the reactions after the steel was erected. Since assumptions regarding elastic behaviour of truss members have to be made in design, it seemed that the same assumptions might well be used in field work; therefore calculations were made for the vertical distance necessary to move one end of the bridge to give zero stress in the top chord over the centre pier. The span was completely riveted except for the splices in each centre section of top chord; these were left bolted. The elevations of the end and centre bearings were checked, then one end was jacked the calculated distance to give zero stress in the centre section of top chord. The bolted connections were now examined, the bolts were easily removed, the holes fair and the finished surfaces just in contact, all as calculated. These connections were then riveted at zero stress, and the bridge lowered to its original position.

Arch Span

The arch ribs were fabricated in eight sections, each six feet deep and weighing from 10 to 13 tons. The sections were lengthened an amount equal to the computed shortening due to dead load thrust, and all lengths and bevels were carefully checked with tapes calibrated against a certified tape and corrected for temperature. The four sections in each half rib were assembled on skids in the shop, offsets from the horizontal checked, and field connections reamed.

The arch shoes, weighing about three tons apiece, were of welded construction. After welding the shoes were stress-relieved by annealing.

The arch ribs and the bracing between the ribs were erected as shown in Fig. 4 by cantilevering out from both ends, using cable tie backs passing over temporary bents. The anchorages for these tie backs were of steel placed in the rock. The beams used in these anchorages were concreted in, but the parts of the anchor bars passing through the rock were boxed in so that they would be free to move. The tie backs were made from suspender cables and as these cables had been cut to length and socketed before shipment to site, links and pins were used to connect the pieces of various lengths. The load from each rib was carried by four cables. The final tie back assembly was connected to the third rib section; temporary cables connecting to the main tie back at the bent were used for holding up the first, second and third sections. Each of these temporary cables was released as soon as the next one was connected up. The bents supporting the tie backs were bents fabricated

Fig. 4—Erection of Arch Ribs

Fig. 5—Arch Span

for the permanent arch construction, temporarily erected on timber cribbing.

The steel for both ribs and rib bracing, about 200 tons, was loaded on one scow at Kingston and transported directly to the site. The steel was so loaded that each piece was erected direct from the scow without re-handling, and placed with a crane of the same type as that used on the continuous span. This crane, with a 96 ft. boom, was mounted on a scow. To secure greater stability the scow was lashed between two other scows, one of which carried the steel, then all three were moved to the place required for each lift and anchored with mooring lines attached to anchorages on the islands.

Three complete sections were erected on the north end, and four on the south end, then the final section of each rib was erected leaving about one and one-quarter feet between the sections at the centre of span.

The final closure was made by lowering the bents supporting the tie backs, two hydraulic jacks being used under each bent. The top flange connections were made as the upper parts of the ribs came in contact, and the remainder of the splice connected when the webs came to a good bearing. The splices were completely bolted on a Saturday noon, then on Monday morning final jacking was completed and the tie backs removed.

Fig. 6—Erection of North Approach Viaduct Suspension Span

After completion of the arch ribs the crane was lifted to the viaduct deck and the bents and floor steel erected. Calculations had been made for stresses in the ribs for each position of the crane so that at no time was any part of the structure overstressed. The completed structure is shown in Fig. 5.

Viaducts

The south approach and viaduct over Constance and Georgina islands were erected from the bridge deck with the cranes that erected the continuous and arch spans. For the 516 ft. viaduct over Constance island a guy derrick on the south shore of the island was used to handle the material from the scow to the erecting crane.

Erection of the north approach viaduct presented several interesting problems. This part of the structure extends from the cable bent to the north abutment and is on a curve located over very uneven ground. The only feasible way to get the steel to the site was by scow to a position as near as possible to the rocky shore line at the north tower and from there move it to its location with erection equipment. A falsework viaduct was built between the tower and cable bent; and the tower, cable bent and cable erected as described later, before the viaduct steelwork was available. The crane and traveller used for erecting the tower and cable bent, and a guy derrick located on the anchor pier, were used for erecting the approach steel. The steel was picked off the scows and swung around onto the falsework, with the traveller on the top of the tower, from here it was moved along the falsework track to the crane located near the cable bent; then it was distributed along the site by the crane and guy derrick. This movement of steel required great care in handling as it not only had to be swung around the tower, but both steel and equipment had to clear the main cables, trolley cables and cable bent. After the steel was distributed it was easily placed with the crane and guy derrick.

Towers

The south tower of the suspension bridge (No. 17) is located on a shoal surrounded by deep water, and the bottom section of this tower was erected with one of the whirley type cranes mounted on a scow.

The north tower (No. 18) is located on the Canadian mainland where the rocks rise abruptly from the river. With some difficulty a timber bent was placed at the water's edge and a platform carried back from this bent to the base of the tower. On this platform was placed the crane that had erected the continuous span. This crane erected the lower section of tower and also handled material from the scow for the remainder of the tower.

Except for the lower sections each tower was erected with a traveller that moved vertically up the tower as the work progressed. The traveller consisted of a crane with a 55 ft. boom mounted on a platform which cantilevered from the tower legs. The load line from the crane ran to a hoist located on the ground below. The platform and crane were raised by a line from the same hoist passing over a bracket connected to the top of the last tower steel erected. The platform was constructed to accommodate itself to the batter of the tower legs. Upon completion of the towers the travellers were left in their final position for later use in erecting cables, deck material and handling the steel for the north approach.

The cable bents were erected with the cranes that erected the lower sections of the towers. The crane at Pier 18 was moved around the tower on to the falsework viaduct extending from Pier 18 to Pier 19, and the crane at Tower 17 was removed from the scow onto cribbing near the south shore of Georgina island, where it

Fig. 7—Anchorage Assembly

was used to erect the cable bent and later to handle the reels for strand erection.

Cables

Each cable is composed of thirty-seven 1¼ in. prestressed bridge strands. These strands were laid in the shape of a hexagon, and after all dead loads were on the bridge, the cables were made circular by the use of cedar fillers that fit on the sides of the hexagon. Wrapping the cable with No. 9 soft galvanized wire followed immediately after placing the fillers.

Each strand is made up of 43 galvanized wires and has an area of .9761 sq. in. The wires in the outer lay are full length, while an occasional brazed splice was used in the inner wires.

The physical characteristics of the strands, as shown by tests made with specimens cut from the prestressed cables, are as follows:

Ultimate Strength, 210,000 - 222,000 lb. per strand.
Yield Point, 145,000 - 150,000 lb. per strand.
Modulus of Elasticity, 25,000,000 lb. per sq. in.

The office work on these cables included the following items:

1. Computing the approximate length of each strand so that the wire mills could start manufacturing wire.
2. Calculating dimensions under full dead load, using the bridge outline, clearance, etc., as shown on the engineers' drawings. These dimensions included overall length, location of towers, cable bents, splay points, and suspender ropes.
3. Calculating the form which the cable should take on erection, under no dead load except its own weight. From these figures the position of the bottom strands at a temperature of 50 deg. F. was calculated. As these bottom strands were to be used as pilot strands in the field, and be accurately set, the computations included the making of charts showing the sag variations in the side and centre spans caused by changes of temperature, and by varying positions of the top of the towers and cable bents.
4. Calculating deflection of towers due to cranes and trolleys and variation of tower deflection during erection of strands.

The cables were erected without the use of catwalks. Trolley cables carrying travelling cages were erected between towers and between cable bents and towers. These cages were light but of sufficient strength to carry men and material such as cable bands. The trolley cables were 1⅛ in. dia. for the side spans and one inch for the centre span.

The load from the cage greatly affected the form which these small trolley cables took. The tension in the cables and their length changed considerably as the cage moved from point to point on the main cables. These changes were provided for by hand-operated winches located at the base of the main towers.

The strands were marked with the theoretical positions of the centre lines of towers and cable bents at the time of prestressing and measuring. When first erected, the two pilot strands, one on each side of bridge, were positioned with these marks coinciding with the actual centre lines of both towers and cable bents. Observations were made at daybreak taking note of the various sags in centre span, side spans and back stays; also the position of the centre lines of the towers and cable bents. From the aforementioned charts the necessary corrections were interpolated, and during the day the pilot strands were reset accordingly.

The next morning at daybreak the pilot strands were again observed in the same manner, and then during the day they were given their final adjustment and securely clamped in position at the towers and cable bents and checked at the anchorage to prevent any motions that could not easily be detected.

The other strands in the bottom layer were next placed in position, and at daybreak the day following they were adjusted to the pilot cables. As this part of the work had to be done with all strands at an even temperature to secure accurate results and as the sun was affecting the strands before the adjustments were completed, the bottom layer was checked and readjusted the next suitable morning at daybreak. When the final adjustment of the bottom layer was complete the whole layer was securely clamped to the towers and cable bents to ensure there would not be any movement at these points.

Fig. 8—Machine Wrapping the Cable

After the bottom layer had been adjusted, the succeeding layers of strands were erected and adjusted using the bottom layer as a guide.

The adjustment of these strands is rather a heartbreaking job as it must be done under ideal conditions; that is, the atmosphere must be quite still and motionless and the sun must not be shining. To make the adjustments at daybreak it was necessary to have everyone taking part at their stations about four o'clock in the morning. It was found that it was useless to make adjustments later than 45 minutes after the sun rose as the heat from the sun would affect the strands on the east side to such an extent that within a half-hour each outer strand would sag about two inches below its neighbour. Later, when everyone had become accustomed to his respective job, the adjustment of the strands was done starting at midnight.

The method of anchoring the strands was developed by Dr. Holton D. Robinson and was used in this bridge for the first time. It worked out very well, was very simple to connect and has a very delicate adjustment.

In this new anchorage form each of the thirty-seven 1¼ in. strands composing the suspension span cable is separately and adjustably connected to a projecting end of one of 37 round steel bars, 2⅜ in. in dia., and independently embedded in the anchorage concrete. Set in hexagonal configuration to match the strand arrangement, the bars converge as they go from the anchorage to meet the strands. Each strand terminates in a cast steel socket, which is externally threaded, opposite hand, and the upper end of each bar is upset and threaded. An internally threaded

Fig. 9—Erection Second Girder, First Girder Connected, Suspension Bridge

sleeve, turned by wrench, serves for connection and adjustment between the anchor bar and the strand socket. (See Fig. 7.)

The strands were erected by the use of a pulling cable attached to an engine located close to one anchorage on the Canadian mainland, the pulling cable was passed over rotating drums attached to the cable bents and main towers and connected to the end of one strand located at the southern anchorage on the island. The strand was on the reel upon which it was shipped and the reel in turn was mounted in a brake frame which was designed so that the reel was held to keep about 3,000 lb. tension in the strand during the unreeling process.

Telephones were installed and all orders were given from the anchorage points. When everything was in readiness the engine on the mainland would pull the strand over the rotating drums against the action of the brake. When the strand reached the other side it was immediately attached to the anchorage and the pulling cable sent back. In the meantime the strand end had been taken off the reel at the south end and connected to its anchorage, the empty reel in the brake frame being replaced by a reel containing the next cable to be placed.

After all the strands were in position, the cable bands and suspenders were erected. This work was done from the travelling cages.

The final operation was the cable wrapping. To ensure tightness of the wrapping wire this operation did not start until nearly all the dead load was on the bridge. An air-operated three spool wrapping machine was used. The wire was delivered to the site in coils, and there reeled on the spools. The men worked on a platform that rolled on the cables, as shown in Fig. 8. Wrapping at the cable bands and other places inaccessible to the wrapping machine was done by hand.

Suspended Spans

The stiffening girders and floor steel for the centre span and for that part of the south side span over the water were erected by a hoisting frame working on the main cables, the steel being handled direct from scows below. (See Fig. 9.) This hoist frame was moved as required with the travelling cage. The cage would be moved directly under the frame, the trolley ropes tightened with the winches until the frame was supported by the cage, then it was moved to the next location and in reverse order lowered to the main cables.

The south panel of the south arm was erected with the crane on the deck of the viaduct, and the entire north arm was erected with the crane on the falsework below. The girders were erected in such order that at no time did the deflections of the tops of the towers exceed the calculated permissible limits.

After all the dead load was on the suspended spans, the stiffening girders were braced to the cables at the centre of the main span, and eight sets of diagonal stays, connecting four points on each main span cable with the ends of the stiffening girder, were erected. This bracing is to prevent any undulations or wave motions in the floor which might be caused by a heavy wind striking the underside of the floor.

Roadways

The roadways on the suspension and continuous spans are of armoured concrete construction, using I-Beam-Lok $4\frac{1}{4}$ in. thick filled with concrete. The roadways on the arch and viaduct spans are the conventional reinforced concrete slab 8 in. thick.

The concrete for the walks and eight inch slab was cast in forms, but the concrete for the armoured floors was dumped onto the I-Beam-Lok and vibrated to approximate level, the I-Beam-Lok acting both as form and as screed. (See Fig. 10.)

Fig. 10—Erecting I-Beam-Lok Flooring, Suspension Bridge

The entire bridge project was built under the direction of The Thousand Islands Bridge Authority, and designed by Robinson and Steinman, Consulting Engineers, New York. Monsarrat and Pratley, Consulting Engineers, Montreal, were retained as associate engineers.

The contract for the entire superstructure of the Canadian Section was awarded to The Canadian Bridge Company, Limited, on April 30th, 1937. The erection of the steelwork was done under the supervision of Mr. F. W. Parr, Erection Superintendent. The bridge was ready for traffic and opened on August 18th, 1938, although some of the operations, such as cable wrapping and painting, were not completed until late in September, 1938.

STEPS IN THE DESIGN OF A BUSH TRANSPORT AEROPLANE

RICHARD YOUNG

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Paper presented before the Niagara Peninsula Branch of The Engineering Institute of Canada, November 18, 1938

SUMMARY — In working out the design for a new type of aeroplane a great variety of considerations must be taken into account. The paper discusses briefly the way in which the necessary particulars are decided so as to meet the specified requirements for performance and safety.

Fig. 1—Fleet Model 50-K with Pontoons

This aircraft was planned by Mr. W. J. Sanderson, President of Fleet Aircraft, Ltd., after many years of close contact with commercial operators in the Canadian North Country. The opinions of many pilots were considered and the general specifications of the machine were laid down as follows:

1. It should be capable of carrying freight and passengers.
2. Carrying capacity to be 2,000 lb. payload, with a range of 300 miles.
3. Should be a biplane to combine rigidity of structure with minimum overall dimensions.
4. The power to be two engines of approximately 330 hp. each.
5. The machine must function equally well on pontoons, skis or wheels.

From this point on, the design and development of this aircraft, known as the Fleet Model 50-K Transport, may be divided into five principal steps:

1. General arrangement.
2. Structural analysis.
3. Drawings.
4. Construction.
5. Flight tests.

In beginning the general arrangement, we start with the horsepower, which has already been specified as 660 hp. total. From previous experience with existing aircraft, it is known that the desired performance as to take-off and climb can be obtained with a power loading of 12 to 13 lb. per hp. which gives a gross weight of about 8,000 lb. Further, it is known from previous designs in this general class that the empty weight of the aircraft will be approximately 60 per cent of the gross weight when equipped with floats, or about 5,000 lb. This leaves a disposable load of 3,000 lb. For a seaplane of this type, a cruising speed of 125 m.p.h. is considered reasonable. Then from the specified range of 300 miles, we compute the time required as 2.4 hours, adding 45 minutes for reserve, and figuring the fuel consumption at 65 per cent of full power to be .5 lb. per hp. hr., we get 645 lb. of fuel. Adding 90 lb. of oil and 170 lb. for the pilot, we get 905 lb. This leaves 2,095 lb. for payload, which is in good agreement with the original specifications. Having established the gross weight, we consider the aerofoil, or wing section to be used. A section known as the Clark-Y is selected because of its good lifting ability, good climbing efficiency and fairly high speed efficiency, but chiefly because it has been used previously on many aircraft and found to be very dependable. That is, it is not subject to premature stalling or loss of lift at low speed caused by interference with air flow from other parts of the machine. This consideration is important, because the engines must be mounted in the wings.

From wind tunnel data and actual flight tests on this aerofoil, we know that its maximum lift coefficient is such that it will lift about 15 lb. per sq. ft. of wing area at 60 m.p.h. airspeed. Considering 60 m.p.h. a reasonable landing speed for an aircraft of this size, we arrive at approximately 525 sq. ft. for the total wing area.

Since an aspect ratio of six is considered good practice, we get a wing chord or width of seven feet and span of about 45 ft. after allowing for curved wing tips, width of fuselage and so on. The areas of the tail surfaces and control surfaces are determined as percentages of the wing area taken from previous aircraft of known characteristics. The areas of the vertical fins and rudders are computed as a percentage of the total projected side area of the entire machine. Although there are methods of computing the proper tail surface areas for good stability and control, a finer shading of desirable characteristics can be gained from direct comparison of previous designs having these qualities. In laying out the fuselage, the pilots' cockpit is placed in the nose to insure good vision, with a cabin aft large enough to accommodate a maximum of ten passengers. Nearly all freight to be carried will be such that less space will be required than for the accommodation of an equal weight of passengers.

Assuming that the centre of gravity of the aircraft empty will be near the centre of gravity of the payload, we locate this point and place the tail surfaces about 20 ft. aft. This is about 2.8 times the length of the wing chord, which has been found a good ratio for satisfactory stability.

We now place the engines in the upper wings, just far enough outboard to allow reasonable clearance between the propeller tips and the side of the fuselage. The upper wing is selected for the engine location in order to keep the propellers far out of the spray from the floats and to allow the attaching members for the pontoons to be as short as possible, in order to reduce weight and air resistance. (See Fig. 1.)

After conferring with the float manufacturers, it was found that a float could be built with an integral streamlined pedestal by which it might be attached to the lower wing. This would eliminate all struts and brace wires in the float gear, resulting in reduced air resistance and an improvement in appearance.

The fuselage need only be about six feet deep to accommodate passengers, while the upper wing must be about seven feet above the lower, or about equal to the wing chord. Therefore, the upper wings are attached directly to the upper corners of the fuselage. The lower wings are attached to the lower corners of the fuselage and sloped steeply downward and outward to a point directly below the engines, at which point the floats are attached. This serves to reduce the height of the float pedestals and, also, to increase the wing gap. From this point, the lower wings are sloped upward at an angle of 10 degrees to the horizontal for good clearance of docks and other objects. To provide good gap at the wing tips, the upper wings are sloped upward at an angle of five degrees. This sloping of wings, or dihedral angle, serves also to increase lateral stability and up to a value of 10 degrees has no measurable effect on lift or efficiency. (See Fig. 2.)

At this point we make a preliminary weight and balance estimate by taking weights of all parts and items, estimating those which are yet unknown, and locate the centre of gravity. From previous experience and tests on known aircraft, we know that the centre of gravity should be at a point not less than 15 per cent and not more than 30 per cent of the wing chord measured from the leading edge. Also, we are striving to keep the centre of gravity of the empty aircraft as near as possible to the centre of gravity of the freight load, so that there will be a minimum change of balance between the empty and loaded conditions.

Soon we find that by placing the upper wing directly above the lower, and moving the engines back as close to the front spar as practical, the desired balance condition is obtained. This unstaggered wing arrangement also places the main structural members of the lower wing in the right fore and aft location for good mounting of the floats.

All through the planning of this general arrangement and the weight and balance estimation, we are considering materials and methods of construction. By now, we have decided upon welded steel tubing for the fuselage frame, with aluminum alloy fairing strips and fabric covering. For the wings we have selected wooden spars, aluminum alloy ribs and fabric covering. These selections are made because strong, light and durable structures are required, which may be easily repaired with ordinary tools under adverse conditions.

For the upper stub wings, which carry the engines, and the lower stub wings carrying the pontoons, aluminum alloy monocoque construction is chosen. This construction is used here because it is desired to have these structures metal covered, and by stressing the metal skin, reduction and elimination of some internal structure member may result. The fixed tail surfaces are also all metal monocoque construction in the interest of light weight and good strength and stiffness.

Having tentatively established the general arrangement and methods of construction, a stress analysis is made to determine the actual size and nature of all members. The first step in a structural analysis consists of computing all the external loadings on wings, tail surfaces and landing gears. These loadings are the expected loads through a series of flight and landing conditions, which are laid down in the Air Worthiness Requirements issued by the Department of Transport at Ottawa.

One of the most important of these conditions is the up-gust case at 1½ times normal high speed. The aircraft is considered to be fully loaded and flying at 1½ times maximum speed in still air and encountering an up-gust of 25 ft. per sec. at right angles to the line of flight. This gust is a mass of rising air having a vertical velocity as great as any gust an aircraft would ever be expected to encounter. The transit of the aircraft from still air into the gust is assumed to be instantaneous. The aircraft in still air has a total air load on the wings equal to the weight of the aircraft, but after entering the gust the angle of attack of the wings is increased by the angle whose tangent is the gust velocity divided by the velocity of the aircraft. Since the lift coefficient of the wing is directly proportional to the angle of attack, the new lift may be computed from published wind tunnel data on the airfoil and the airspeed. This new lift, which will be of the order of five times the normal lift, will be resisted by inertia forces from all the masses in the aircraft.

There are several other flight cases including a down-gust case and several cases carrying arbitrary factors.

The tail surfaces and control surfaces are designed principally for loadings derived from arbitrary formulae involving some fixed characteristics of the aircraft.

The landing gear is designed for various specified landing conditions, which, for the seaplane, involve investigation of forces on the aircraft when encountering waves of specified form at a given velocity and rate of descent.

For the wheel and ski landing gear, the loadings are derived from certain specified landing cases involving landing speed, altitude, rate of descent and shock absorber characteristics.

For each of these flight and landing conditions, the regulations specify a factor of safety by which the structure must withstand its load. In most cases this is an ultimate factor of two. That is, the structure must withstand without complete failure two times the load estimated for any particular case of stress.

From this point the entire structure, or at least that portion of the structure directly affected in each case, is analyzed to obtain the loads in the members. This analysis may be mathematical or graphical, and the loads in the members are all tabulated so that the maximum load for each member may be readily selected. In the case of the fuselage frame, for example, as many as nine different loads are computed for each member in order to be sure which is the governing case for that particular member.

After the maximum load in a given member is known, its size may be readily determined from its method of support and the material of which it is made.

The alloy steel specified for use in this aircraft is a chrome-molybdenum steel, known as S.A.E. 4130X, which in the normalized state has a minimum ultimate tensile strength of 95,000 lb. per sq. in., and may be heat treated to 180,000 lb. per sq. inch.

The aluminum alloy employed is designated as 17-ST by the Aluminum Company of Canada, and has a minimum ultimate tensile strength of 55,000 lb. per sq. in. This material may be purchased in the annealed state known as 17-SO. In this condition, it is quite soft and workable, and after forming may be heat treated to obtain full strength.

The heat treatment of this series of aluminum alloys is rather interesting in that it consists of two operations, namely, solution heat treatment followed by a precipitation process. For solution heat treatment, the material is heated to 920 deg. F. and quenched in water, oil or air. About thirty minutes after quenching, the precipitation process takes place spontaneously at ordinary room temperatures, and at the end of twelve hours is practically complete, although the process actually continues for approximately four days.

For some processes, riveting in particular, this material is worked after quenching, since at this time it is practically as soft as in the annealed state. The ageing process then continues spontaneously bringing the strength up to the required amount.

At the same time as the stress analysis is started, layouts are made of the main assemblies on which control mechanism, details of structural fittings and members are worked out. Contour drawings are also made of curved surfaces of the machine, such as wing tips, curved portions of the fuselage and fairing.

From these layouts, assembly drawings and details naturally follow. Each drawing is then checked by the chief draftsman and signed by the structural engineer for compliance with the stress analysis.

After the drawings of each major assembly are completed, two drawing lists and a bill of material are made up. A master drawing list consisting of drawing numbers in numerical order and a group drawing list, which is actually a parts list of all parts to be manufactured, are prepared, as well as a list of all materials and standard parts to be purchased.

Upon completion of all drawings and stress analysis, a print of each, together with a copy of the master drawing list, is sent to the Department of Transport, Ottawa, to be checked and approved by the Department engineers.

As soon as the first drawings can be released, work is started on assembly jigs for the major components and tools and forming blocks for the parts are made. In many cases, jigs are made from original layouts in order to save time.

At several points during construction of the first aircraft, temporary set-ups were made to check alignment, operation of control systems, etc. When all the parts were finished, a final assembly was made, followed by a thorough inspection, before flight tests were started. After inspections were completed ground tests were made on the engines, and after a few adjustments the aircraft was ready for taxiing tests. These tests were carried out in winter with very little snow and were consequently made on wheels. The machine was allowed to run along just below flying speed to determine the action of controls and landing gear. Then short flights were made with the wheels just off the ground, followed immediately by landing without leaving the field. By this time enough was known of the characteristics of the aircraft to make a regular flight. The first flight was made by Mr. Sanderson during which all the controls were checked for effectiveness and the general balance was observed. After several preliminary flights a series of quantitative and qualitative tests were begun. First the machine was tested for speed by flying with full load over a measured course. The course is 10,060 feet long and the flights were made as near to the ground as obstructions would permit. This is to insure that the flight path will be as near to level as possible. Two trips were made each way and the time checked with a stop watch. From these figures the speed for each trip was computed and the average taken as the true speed. This was done at full throttle and at several lower settings. During each run the revolutions per minute and manifold pressure of each engine were recorded as well as the indicated air-speed.

The landing speed was measured by flying the machine over the course at the lowest possible flying speed and the measured speed compared with the indicated air speed. The correction for instrument error thus found was applied to the lowest consistent indicated air-speed at the instant of contact on landing.

The time and distance required for take-off in still air were recorded as well as time to climb to all altitudes up to service ceiling, which is that altitude at which the rate of climb falls below 100 ft. per minute.

The qualitative tests were conducted by loading the ballast well forward so that the centre of gravity was moved to the forward limit. This limit was reached when there was just sufficient elevator control left to pull the tail down to landing position. The rearward limit of the center of gravity was found by moving the ballast aft until the longitudinal stability was unsatisfactory.

In checking longitudinal stability the engines are run at cruising speed and the tail plane adjusted so there is no load on the elevator control. Then if recovery from dives and climbs is automatic without undue oscillation, the aircraft is stable.

The directional stability was also checked at the aft centre of gravity limit by making "flat" or "rudder" turns to see if the aircraft would return to a straight flight path. Following these tests, the machine was submitted to the Department of Transport for official flight trials. Having already examined the drawings and stress analysis on this design, the department engineers now make a detailed inspection of the aircraft to check its conformity to drawings, non-structural requirements and standards of workmanship. After this very thorough inspection a series of flight trials were made by the Department's test pilot. These trials include performance tests, stability tests and investigation of general handling and behaviour qualities.

The requirements were all satisfactorily met after several hours of test flying, when the aircraft was given a commercial license and the right to justify its existence by earning its own living in regular transportation.

The following were the test results:—

	Landplane	Seaplane
Maximum speed	149 m.p.h.	148 m.p.h.
Cruising speed	130 m.p.h.	129 m.p.h.
Landing speed	61 m.p.h.	61 m.p.h.
Rate of climb	950 ft. min.	900 ft./min.
Service ceiling	15,000 ft.	14,500 ft.
Single engine ceiling	4,000 ft.	3,800 ft.
Maximum useful load	3,811 lb.	3,436 lb.

Fig. 2—Fleet Model 50-K with Wheel Landing Gear

Discussion

The following notes cover the principal points raised during the discussion, and the author's replies

What are the principal stresses on the crankshaft?

The principal stresses on the crankshaft are due to torque, arising mainly in sudden change of engine speed. Tension is insignificant, while the stress induced by the gyroscopic action in change of direction is small in proportion but must be considered.

What is monocoque construction?

The true monocoque construction is that in which the shell of the structure is self-supporting. In aircraft manufacture it is applied to that construction in which the skin is designed to carry part of the load; such as certain shearing stresses in the wings.

How is ice removed?

The best equipment for eliminating ice consists of a rubber bag on the leading edge of wings, which is divided into longitudinal compartments. By inflating and depressing adjacent compartments, the ice is loosened. This removes the majority of the ice formed while flying in a storm.

The ice on the propeller is very dangerous due to the danger of unbalancing. At present the usual method of overcoming this is the use of a slinger. This is simply a cylinder on the crankshaft, through which alcohol or a brine solution is thrown out by centrifugal force onto the blades, thereby preventing the formation of ice.

What paints were used?

On the wings a "dope" is used. This is similar to lacquer but not pliable or elastic, and is really a deposit of celluloid on the surface. Usually two coats of clear "dope," two or more coats of the same vehicle with an aluminum base to keep out the ultra-violet rays which are destructive to the fabric, are applied. On the better jobs a pigment "dope" is used which may be polished and waxed. On metallic surfaces one coat of chromate primer and two coats of synthetic enamel vehicle are used.

What provision is made for heating the engine in the north country?

There is no good solution yet. The usual method is to drain the oil and heat, or to place a tent over the engine and use a stove for heating purposes. Many present planes have heat exchangers by which the oil may be heated without draining.

How is the fabric tightened?

The fabric is actually attached quite loose and the "dope" shrinks it until taut.

What is the use of variable pitch for the propeller?

The variable pitch propeller is to obtain greater power in take-offs. For a fixed pitch propeller the motor revolves at much lower r.p.m. than that of which it is capable, thus losing power. By varying the pitch, the engine speed is fixed by a governor at constant r.p.m., and the pitch of propeller varied hydraulically for speed, thus maximum engine power can be obtained in take-offs and climbing.

What precautions are taken to prevent shifting cargo?

The centre of gravity of the plane is at the centre of the payload space. Therefore considerable variation can occur without serious trouble. Of course fittings are supplied for lashing the load in place. In answer to an inquiry about transporting livestock, it was stated that the method used is to chloroform and tie the animals down.

Why is lubricant in radial motors not collected in the lower cylinders?

The cylinder skirts extend into crankcase. With a force feed system, only seepage and spray enters the crankcase. This collects in the sump at the bottom, from which it is pumped back into the system. Practically all radial motors have a dry sump system.

How often must motors be overhauled?

This depends on the treatment of the motor by the pilot, but a new motor only requires complete overhauling after over 400 to 600 hours. The probable life of the motor is around 2,000 hours.

What is the difference in take-off and landing with wheels, pontoons, and skis?

For the Fleet Aircraft's new freighter, under full load, a distance of 600 ft. is required for take-off and landing. For pontoons a slightly longer distance is required. For skis, conditions vary so greatly due to the condition of the snow, whether dry, wet, drifted, or whether it is bare ice, that no definite lengths can be given. It is very interesting to note here that the minimum flying speed under full load for this craft is 60 m.p.h. and while empty is 53 m.p.h.

Will swivel wheels be used to enable landing in cross winds?

No. It would appear not. Higher landing speeds and tricycle landing gears are overcoming these difficulties.

What are the functions of bonding straps?

These are part of a system of bonding the metallic structure, thereby keeping all parts of the structure of similar potential. Otherwise there is a slight danger that if two adjacent parts were of opposite potential, a spark might be produced in bridging the gap. The main reason is, however, that the structure is used as the antenna of the radio set, and thus must be bonded to eliminate noise.

What part will the autogyro and the rocket ship play in the future of aviation?

The autogyro is much less efficient than an ordinary craft, since a given wing section has but one speed of maximum efficiency. On these craft the long blades can have but one point of maximum efficiency in their entire span.

As for rocket ships, they are entirely feasible, but many great problems have yet to be surmounted.

THE SANDCASTING OF CRANKSHAFTS

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SUMMARY—The author describes the technique and equipment employed in a foundry making steel castings for automobile crankshafts on a mass-production basis at the rate of 400 crankshafts per day.

At the outset the writer would like to point out that the object of this paper is not to discuss the relative merits of the cast crankshaft and the forged crankshaft, but rather to outline the methods used by a prominent automobile manufacturer to produce a casting as nearly perfect as can be expected in the light of present day knowledge. A good many of the features mentioned in the following discussion are applicable only to the particular job. The scheme is, however, an excellent example of modern technique in sandcasting.

In the foundry under consideration the original layout called for 400 crankshafts per day of 16 hours. Since material was gathered for this paper, the time factor has been reduced considerably. This, together with the fact that, for a casting that is roughly 27 in. long, the maximum allowance is only 30 mils, will give an idea of the accuracy and efficiency with which each operation in the construction of the mould must be performed. When we consider that the casting is produced from a mould composed of sixteen separate units, each unit or core forming a short length of the shaft, a further appreciation of the accuracy required will be obtained.

It is the construction of the mould rather than the actual casting that provides the subject matter for this paper. A brief description of the completed mould will be a help in understanding the various operations taking place in the construction and assembly of its component parts.

Fig. 1—Crankshaft Cluster

In order to make the best use of core material and also to cast as many shafts as possible at one pouring, the mould is made square in section, each quadrant constituting a mould for one crankshaft. Each of these four individual moulds is fed from a common sprue running down the centre of the complete mould. The casting therefore comes from the mould as a cluster of four crankshafts as shown in Fig. 1. In the illustration the runner-head, sprue, gates

*The John Galbraith Prize is one of the Institute Zone Prizes made available annually to Student and Junior members.

and risers are all clearly visible. It will be noted that welts appear on the flanges and journals of the casting. These mark the divisions between the individual cores of the mould, and a study of their location shows how much of the shafts each core forms. Each core is numbered, core No. 1 forming the main journal at the bottom and core No. 16 the runner-head, risers and some of the gates at the upper end. It might be mentioned here that if any flaw should develop in the casting, the faulty core can be readily located by counting the welts between the flaw and either end.

The sand used in making the cores is of two kinds, bank sand and sharp sand. The bank sand contains bonding materials such as aluminum and ferric oxide, which help to prevent sagging of the core prior to baking. It also tends to give the core a smooth finish. On the other hand, the sharp sand contains practically no bonding material but due to the round condition of its grains is in itself a natural vent. It has the further function of resisting the erosive action of the hot metal.

These two sands alone have insufficient resistance to the scouring action of the molten metal when pouring, so, to improve the mix in this respect, a silica flour, which is about 90 per cent pure silica, is added.

The only additional materials used in the mix are the bonding materials. These consist of raw linseed oil and a

Fig. 2—Turn-table, core boxes, core plates

cereal binder which is a corn product. Raw linseed oil itself is the essential bonding material for the sand when baked. Recently vegetable oil mixtures, less expensive than straight linseed oil, have been used successfully. However, in order to hold the shape of the core perfect from the time it is drawn from the box in which it is made to the time it is placed in the oven, the cereal binder must be used, its starch-like properties producing the required result in the green or unbaked state.

These materials mixed in the proper proportions form the main or body cores. There are, however, two additional cores that must have extra mechanical strength and extra resistance to the erosive action of the hot metal. These are the small locator and strainer cores. The former dovetail into adjacent body cores to line them up. They could also be called dowels. The strainer core is placed in the runner-head to prevent any slag or other foreign matter from being carried into the mould. A special mix is used in making these cores. It is made up from the same materials but contains a much larger percentage of the silica flour and binders.

All the sand used in this process is stored in bins in the basement of the foundry. It naturally contains a certain amount of objectionable moisture, particularly the bank sand. To drive off this moisture the sand is passed through a gas-heated kiln type drier, to which it is delivered by an elevator. After drying the sand is stored in hoppers. The two kinds of sand are allotted to separate hoppers, a third hopper containing the silica flour.

Fig. 3—Finishing conveyor. Baking oven (discharge end)

The milling action in the mixer breaks down the grain while the flow carries the mixture out through a small vent in the floor on to a belt conveyor beneath. From this point practically all transportation is carried out by conveyors, the only exception being the transfer of the cores from conveyor to conveyor by hand after they have been completed and during the finishing operations.

From the mixer the core materials are taken to a point at the rear of a sand slinger. Here the special mix is diverted to a hopper from which it can be taken either to a small bench where the locator cores and strainer cores are made, or to a box in the centre of the turntable where the body cores are made. The regular mix is picked up by a vertical conveyor that dumps it into a tank above, and which feeds the slinger.

The turntable, shown in Fig. 2, rotates in a counterclockwise direction past the operators and under the slinger, which is free to rotate so that it can be swung back out of the way when not in use. In the slinger head is a 16 in. impeller operated by a 15 hp. motor located at the back of the arm. Approximately 1.1 qts. of sand per sec. are projected into the boxes.

It will be appreciated that sand travelling at this rate would have considerable abrasive effect and would gradually wear the inside of the core box. In view of the exact dimensions that must be maintained, such a condition would be extremely objectionable. It is, however, easily avoided by placing a loose layer of sand in the bottom of each box before it passes under the slinger.

Altogether twelve distinct operations are performed at the turntable:

1. The box is first cleaned with a spray of kerosene and linseed oil and dried with an air hose.

2. Special sand is rammed down into the points of boxes 4, 5, 10 and 11 with a stick. To indicate what is meant by these core points, it should be pointed out that the con-

Fig. 4—Finished cores

necting rod journals are not solid and therefore the cores adjacent to those forming these sections of the crankshafts have points about $2\frac{1}{2}$ in. long which project into them, providing what are termed "lightener" holes in the journals. These projections, or points, must of necessity be more rugged than the rest of the core, hence the use of the special mix.

Fig. 5—Finishing conveyor (left), storage reel (right)

Included in operation No. 2 is the placing of the loose sand in the bottom of the box.

3. The next operation is to place wires in the body of the core points, and here extreme care must be taken to ensure that the wire is central. It is about $2\frac{5}{8}$ in. long, of which $1\frac{5}{8}$ in. is in the point, the remainder being ultimately covered by the body of the core. These wires are, of course, to increase the mechanical strength of the points.

4-5-6. The next three operations include the filling of the box under the slinger and the peening and ramming to ensure that all corners are sharp and fine.

7. When the box comes from the rammer, there should be from $\frac{3}{8}$ in. to $\frac{1}{2}$ in. of surplus sand to be removed from the top. This may appear simple enough, but if the precision required is borne in mind, this operation, and

Fig. 6—Completed mould mounted on pouring reel

particularly the next, assume considerable importance. This operation is called the "rough off" and is performed with a flat steel bar with a bevelled edge.

8. This is the finishing strike off and is likewise performed with a flat steel bar. In this case, however, the tool is bevelled on both edges and must be continually checked with a gauge to make certain that its edge is straight. The movement of the bar in this operation must be at right angles to that in the rough off to avoid the possibility of any bump being left by the rough-off tool. It is only by paying close attention to the finishing strike off that the foundry man can hold the overall dimensions of the crankshaft to the machine shop limits.

9. A cast iron core plate is now placed on top of the box, or in other words, on the back of the core. These core plates are clearly shown in Fig. 2. They must be of very rigid construction since the slightest warping will spoil any core placed on them, hence the ribbed reinforcing.

10. The core box and plate are turned over by means of a machine fitted with a set of clamps and a vibrator.

11. With the core resting on the plate, the clamps are removed, the vibrator is turned on and the box is drawn off the core with a hand lever, leaving the core resting on its plate.

12. The final operation is the removal of the core and plate to the oven by hand, the oven being but a few steps from the turntable.

As mentioned before, the locator and strainer cores are made on a small bench close to the turntable. The locator cores are moulded in a 50 gauge box, that is to say, 50 cores are made in one draw, while the strainer cores are made in a 10 gauge box.

Fig. 7—Casting coming from smoke hood and vibrator ready to be removed for breakup

All cores are carried by hand to the oven and placed on the trays of a vertical conveyor that carries them up through the oven. The conveyor is a continuous one, moving very slowly. It takes 45 minutes for the core to reach the baking zone, $2\frac{1}{2}$ hours for it to pass through it, and 45 minutes to cool to a point where it can be removed by hand at the discharge end. The baking temperature is 400-420 deg. F. and must be regulated very carefully since an overbaked core will crumble very easily, and an underbaked or green core will tend to give off a considerable volume of gas when pouring, tending to cause blow-holes.

As the cores are removed from the oven they are placed on another conveyor, shown in Fig. 3, the arrows indicating the direction of motion. The cores are carried on through the finishing department.

The initial operation in the finishing department is the gauging and inspection of all cores. Any that are out of true or that have been damaged are scrapped immediately. The rest are carried on to operators who apply a special core wash to their face. The principal constituent of this wash is again silica and it is used on all surfaces coming directly in contact with the molten metal. A brush is used to apply it to all core points, the rest of the surfaces being sprayed.

After being treated with the core wash the cores pass through a small oven where gas flames are played on the sprayed surface, drying it and leaving it covered with a

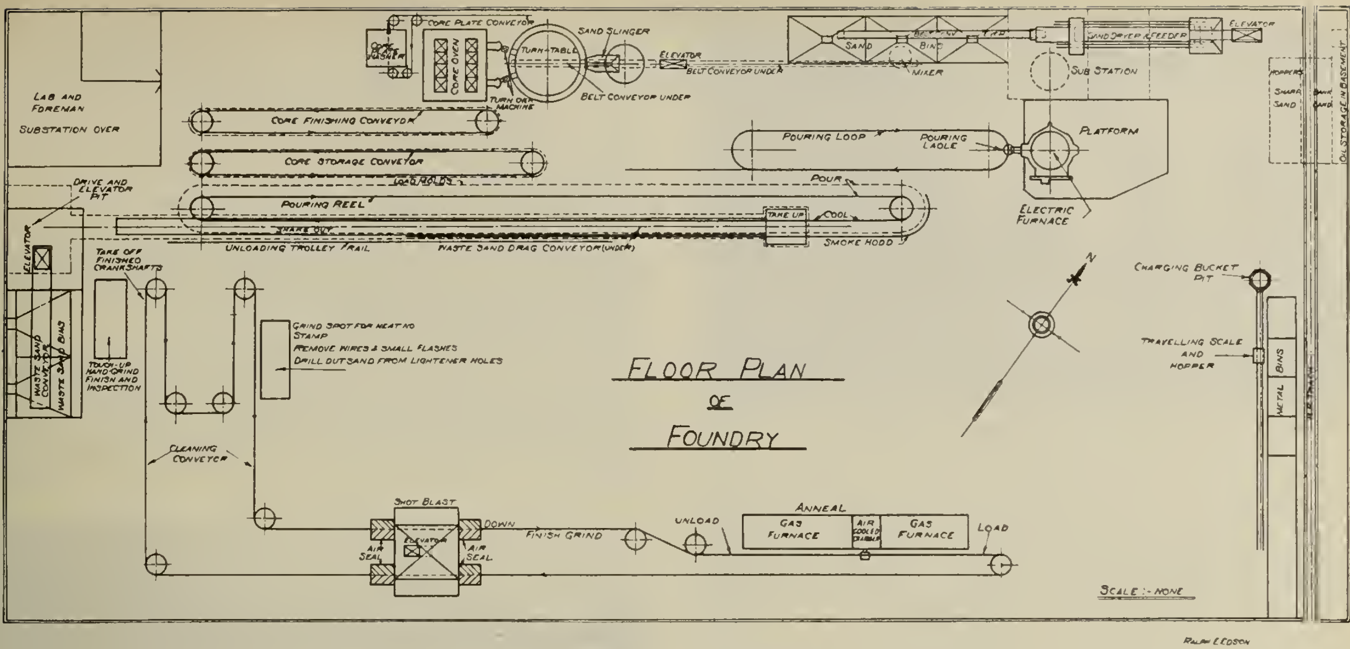

Fig. 8—Floor plan of foundry showing sequence of operations

fine white film. After they are cool they are subjected to a final inspection, particular attention being paid to the core points to make sure that none of the stiffening wires project to be fused into the casting.

Typical examples of the finished cores are shown in Fig. 4. The cores chosen were Nos. 2 and 16, which form the lower main journal and the risers respectively.

Each core has its own number moulded into its side so that when the cores are transferred to the storage reel, Fig. 5, they are filed in numerical order, starting with No. 1 at the top. This facilitates the stacking when the completed mould is being piled. The actual stacking takes place on the pouring reel, Fig. 6. The cores are piled at the far end, clamped as they move towards the foreground, and are ready for pouring when the completed mould reaches the near end.

An oval track runs from the back of the furnace (see Fig. 8), to the pouring reel, carrying the pouring ladle between the two. The metal is tapped from the furnace at a temperature of 2800 deg. F., while the actual pouring temperature should be close to 2650 deg. F. Since the fluidity of the metal at lower temperatures is poor and any higher temperature would result in a coarser crystalline structure in the casting, the temperature is constantly checked with an optical pyrometer.

In order to reduce shrinkage to a minimum during the period of solidification, the mould has, as has been noted before, been provided with risers, shrink gates, and a special sprue to act as feeders while the metal passes from the liquid to the solid state. At the bottom of the runner-head is located the strainer core below which a small trough carries the metal to the sprue, which runs from the top of the casting to the gates in core No. 1, a distance of about 30 inches. There are gates located in cores Nos. 1, 6, 7, 8, 9 and 15. These not only form runners from the sprue to the separate shafts, but also act as feeders or reservoirs by keeping plenty of hot metal to that portion of the casting already poured.

The sprue resembles a funnel somewhat in shape, its area at core No. 7 being almost double what it is at core No. 1. When the mould is poured the mass of metal at the top of the sprue holds its heat considerably longer than that at the bottom, thus when solidification sets in there is a head of molten metal that is forcing itself down, resulting in a uniform peening of the whole casting.

After pouring, the mould passes under a smoke hood where it remains for several hours to ensure uniform cooling. If properly cooled the heat treat operation is much more effective in rendering the casting easy to machine.

Just before the cluster is removed from the conveyor, it is attached to a vibrator, by the aid of which and the judicious use of a crow bar, most of the burnt sand is removed and falls on to an endless belt beneath the floor that removes it to a point where it can be conveniently disposed of.

Figure 7 shows the clusters just prior to being removed for the break-up and cleaning operations. The break-up is performed with a special crow bar, by means of which the individual shafts are broken away from the sprue and the gates and risers removed. Thereafter the crankshafts are hung singly on a continuous conveyor that carries them through the cleaning department, through a shot-blast, and on to the heat treatment. A further trip through the shot-blast is necessary to remove any scale resulting from the heat treatment. After this final operation, the crankshaft is ready for the machine shop.

Reference should be made to Fig. 8, in which is shown a floor plan of the foundry in which the various operations are carried out. From this sketch the sequence of those operations can readily be followed and the manner in which every detail is co-ordinated better appreciated.

A PHOTOELASTIC INVESTIGATION OF STRESS CONDITIONS
IN AN END BLOCK OF THE BORDEN BRIDGE AT CEEPEE, SASKATCHEWAN

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Awarded the H. N. Ruttan Prize for 1938*

SUMMARY—Describes an investigation made to determine how closely the designed distribution of the steel in the end block of a reinforced concrete bowstring arch was in correspondence with the actual lines of stress ascertained by loading a bakelite model.

The stress analysis of a bowstring arch is based on the assumption that the horizontal tie is fastened to the ends of the arch by hinges. In the Borden Bridge at Ceepee, Saskatchewan,[1] the designer, Dean C. J. Mackenzie, M.E.I.C., used a tie made up of steel rods encased in concrete, with the ends of the tie steel anchored in the end blocks. The tie, arch and end block were poured as one solid joint. The problem of designing and arranging the steel in this detail could not be easily solved by purely analytical methods, consequently a photoelastic investigation was undertaken for the purpose of checking the design.

This paper presents details of the study made. While the work was primarily undertaken in order to obtain a qualitative solution of the stress distribution, quantitative results were obtained which are of interest and value.

Photoelasticity

The basis of photoelastic stress analysis lies in the property of double refraction possessed by isotropic materials under stress. When plane polarized light is passed through a stressed point in such material, it breaks up into two rays which vibrate in the directions of the principal stresses and travel at different velocities. The two rays emerge with a phase difference which is proportioned to the difference between the two principal stresses at the point and to the thickness of the material. If these rays are analyzed by combining them into co-planar waves, interference can take place and will result in the colours of the spectrum if white light is used as a source, or in light and dark bands in the case of monochromatic light.

Fig. 1—The Polariscope, from left to right—lamp housing, polarizer, plano-convex lens, quarter-wave plate, plano-convex lens set so that rays strike model normally, another similar lens, quarter-wave plate, and analyzer

Using plane polarized light also results in a dark band, called an isoclinic, whenever the directions of the principal stresses are parallel and perpendicular to the plane of polarization. This effect is eliminated by the use of crossed quarter-wave plates which cause a resultant circular ray to pass through the stressed material.

The values of the stress differences represented by the isochromatics, or bands of colour, may be evaluated by means of a test beam, in which an exact analytical solution of the stresses can be made.

Since the isochromatics give only the value of the principal stress differences, and since the problem under consideration is one of internal stresses, an auxiliary method must be employed to solve for the separate stresses. In this investigation Filon's method of graphical integration was used.

Fig. 2—Loading frame and model used to study the end block

The Polariscope

Figure 1 shows the optical system used. The source of white light is a 6-volt, 18 amp., ribbon-filament lamp. To obtain polarized light the new material "polaroid," a product of Polaroid Corporation, was used. It was found advantageous when compared with ordinary Nicol prisms, in that it simplified the optical systems, obviated the necessity of cooling the light, and could be rotated without an accompanying loss in polarization.

The remainder of the polariscope consists of two quarter-wave plates, placed as shown, and three plano-convex lenses, arranged so that light strikes the model normally. The method of colour compensation was not used, which further simplified the apparatus.

In making photographs of the isochromatics, an ordinary camera and film were used, the pictures being taken directly from the screen. Photographs were taken only as a matter of interest and were not used in the solution.

The Model

In computing the dimensions of the model the principles of similitude had to be considered. To obtain distortion in the model similar to that in the structure, it is necessary that their geometrical figures be similar, and that the relative rigidities of the members of the model be proportional to those in the structure.

The difficulty of applying loads to an exact model of the bowstring arch was overcome by making the model in the form of a triangle or "A" frame, Fig. 2, with the diagonals tangent to the arch at its theoretical hinge. The load could then be applied through a pin at the top of the frame giving direct stress in the diagonal, which would result in the same vertical and horizontal forces as would be given by the arch meeting the hinge at the same angle.

The model was made of Bakelite C-25 from a 7 by 12 by ¼ in. sheet supplied by Bakelite Corporation. One annealing proved sufficient to remove practically all initial strain.

*The H. N. Ruttan Prize is one of the Institute Zone Prizes made available annually to Student and Junior members.

[1] The Engineering Journal, Vol. 20, Nos. 5 and 10, May, 1937, pp. 229-42 and Oct. (discussion), pp. 777-80.

The design of the model was based on arch No. 4 of the Borden Bridge, which has a span of 201 ft. 6 in. between centres of end blocks and a rise of 40 ft. 2½ in. to the centre of the arch at the crown. In determining the rigidity or stiffness of the tie and arch in the structure, it was assumed that the sway bracing and floor system offer no resistance to bending in a vertical plane. The length of the arch is then given by the arch axis, and that of the tie by the distance between the centres of end blocks. The arch and tie are of constant cross-section throughout so that the moment of inertia of each is also constant. The end blocks were proportioned to the linear scale derived from the dimensions of the tie. The two end blocks, Fig. 2, are not identical, since two different sizes were used in the actual structure.

It was originally intended to use bearings under the end blocks which would give a bearing surface proportional to that in the structure. This, however, caused considerable difficulty in sketching the isoclinics, which came out as blurred areas near the support instead of lines. A small roller, of approximately 1/64 in. dia. was therefore used for the support bearing.

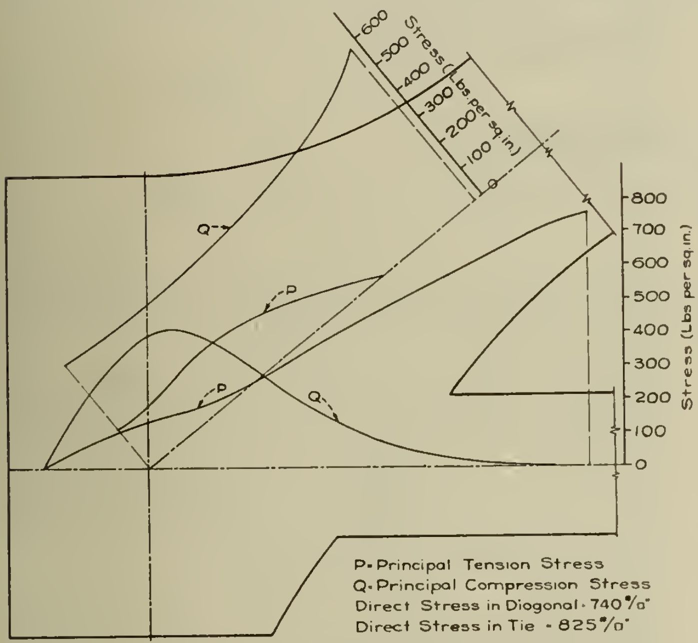

Fig. 3—Variation in principal stresses along axis of arch and tie

Using a roller caused higher concentration of stress at the base than was actually realized, but the effect on the stresses in the interior of the block was considered negligible for the purposes of this work. It was necessary, however, to keep the stresses as low as possible. A load of 73 lb. at the loading pin proved satisfactory.

Procedure

Figure 4 shows the model in the loading frame. The end block to be studied was placed in the path of the polarized ray and stressed. The image was projected on a special screen so arranged that the isochromatics and isoclinics could be sketched without intercepting the light rays.

After the isochromatics resulting from the load of 73 lb. had been sketched and labelled, the quarter-wave plates were removed and the isoclinics plotted for every five degrees of rotation. The resulting sketch then gave the isochromatics and the parameter and location of the isoclinics. From the isoclinics sufficient stress trajectories were constructed to enable the solution of separate stresses at the required points.

In order to obtain a general picture of the stress conditions, it was thought sufficient to find the separate stresses at points along the horizontal tie and vertical lines through the centre of the block, and along the gravity axis of the diagonal. Each of the two principal stresses was determined by integration along its stress line. The algebraic difference between the two values thus found should be equal to the stress value of the observed isochromatic at the point. This afforded a check on the accuracy of the work.

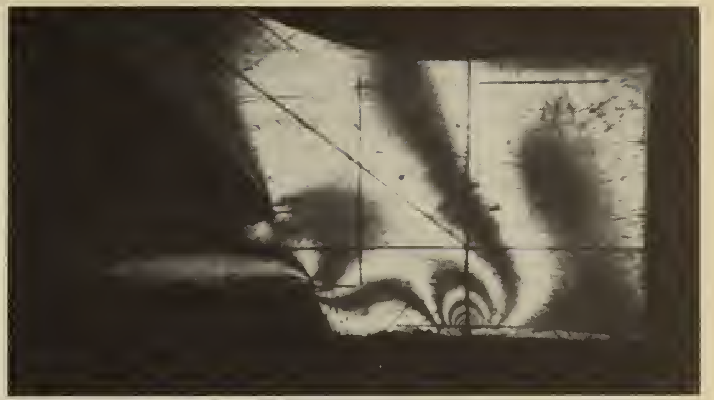

Fig. 4—Isochromatics in one of the end blocks resulting from a load of 73 lb. at the loading pin

Results and Discussion

Figure 3 shows graphically the principal stresses along the lines indicated above, together with the direct stresses in the diagonal and tie.

A line of principal stress represents the directions of the principal stresses. Since the planes of these stresses are free from shear and since the principal stresses are the maximum stresses, it would be logical to place reinforcing steel along the stress line in order to obtain the most effective use of the material. It is, therefore, interesting to compare the stress lines with the position of the main steel in the end block as constructed.

Figure 5 compares the position of the main reinforcing steel as placed with the lines of principal stress and maximum shear. In considering the arch steel it must be noted that the main reinforcing consists of a row of eight bars at top and bottom. The steel in the central portion of the arch section as shown is to stiffen the arch over the length where there is no sway bracing.

Considering the horizontal tie first, it appears that the placement of the upper three rows of steel is in accordance with the position indicated by the stress lines. The steel crosses the block diagonally and is turned upward to provide sufficient anchorage. The bottom row, which is carried

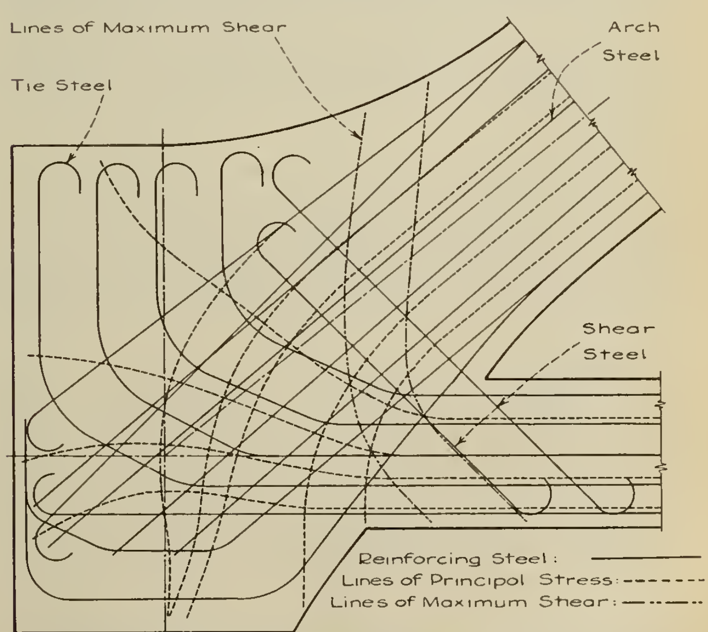

Fig. 5—Comparison of reinforcing steel as placed and lines of principal stress and maximum shear

straight through the block, corresponds to the position of the stress line originating in the same locality. The remaining tie steel could also have been carried straight through as indicated by its stress line. It was actually made to turn upward near the centre of the end block and then anchored at the top.

The arch steel was all carried through at approximately the same angle as the arch axis and then anchored in a plane perpendicular to the plane of the paper. The stress lines would suggest that the steel should be turned downward, just after it enters the end block, and meet the base at right angles. For a support detail as used in the actual structure, the stress lines corresponding to the three upper rows of steel would meet the base at right angles and be distributed over the width of the support instead of converging to a point as shown in the figure. The lower steel would be turned down similarly and anchored near the base, inside the vertical centre line through the support.

The shear steel was placed as shown and inclined at 45 deg. to the horizontal. The lines of maximum shear are at 45 deg. to the directions of the principal stresses and will take the form indicated. In the arch section, therefore, the inclination of the shear line is about 83 deg. to the horizontal.

In conclusion, it may be said that the actual design approaches very closely the true location of the steel as indicated by the stress lines, although the investigation would indicate possibly a slight modification in the placement of the arch steel. It is, of course, realized that practical considerations might prohibit any alteration in the adopted arrangement.

BUSINESS AND GOVERNMENT

WILLIAM L. BATT,
President SKF Industries, Philadelphia, Pa.
President of the International Committee of Scientific Management.

Address delivered before the Montreal Branch of The Engineering Institute of Canada, March 30, 1939

The term scientific management is not a high sounding phrase without substance and meaning—it is a clear declaration of the ideals and methods which should characterize intelligent management. Certainly it is not bounded by political or geographical limits and so it is entirely reasonable that—even in these troubled days—an International Committee for Scientific Management should be peacefully and harmoniously meeting and working together on the non-controversial problems of wise management.

Never before has a disturbed and uncertain world so vitally needed the dispassionate approach of sound management methods in politics as well as in business and government. This matter of the attitude of business and government toward each other in my own country may seem quite strange and incomprehensible to you here in Canada. I can well understand that you may wonder whether it is really serious or not. I can assure you that it is.

The reason is quite simple. It is to be found in the fact that increasing numbers of our people are dissatisfied. We have ten million unemployed; thirty million of our citizens have incomes which are too low; young men of employable age, in great numbers, cannot obtain work. This dissatisfaction causes a great uneasiness. Under such circumstances people demand action, and we find government concerning itself with the affairs of business in an endeavour to right conditions.

It is true generally that a contented citizen is the result of good industrial management. Therefore, industrial management and scientific management become of national concern. In an earlier day scientific management concerned itself with tools and methods, and even to-day the organized profession of management through the world seems to me to be concerning itself primarily with the techniques of management.

This is essential material but, at least for the United States, its final value is not determined until it is subjected to the new standards which are being set up by a new questioner—and these new questions are not asked by management, but by society—by government as the vocal agency of society, and management is on the defensive. How well it is able to justify itself may well determine the very form of industry, private enterprise and management itself.

In my opinion it is not too much to say that these forms of society have never been more gravely challenged than to-day. Because of that, the attitude which business takes toward government, the answers it supplies to the questions which government asks, were never so vitally significant as to-day. For the day is fast disappearing when business can with safety thumb its nose at government.

For us in the United States it is no longer wise to rest one's hope on the assumption that a change in administration is enough to right affairs and bring the good old days back again. Wise management is recognizing that something fundamentally different is happening; that new standards for its evaluation are being set up; and that government as never before proposes to interest itself in what business does and why it does it.

If an engineer attempted to plot a curve of our government and business, using years as the one element and new pieces of business legislation as the other, the result would be a startling shape. The Inter-State Commerce Act of 1887—Sherman Anti-Trust Act of 1890—were the first major pieces of business legislation. The Federal Trade Commission and the Federal Reserve Act in 1914 followed twenty-five years later.

Direct election of senators and the Income Tax Amendment were the first steps in a changing social consciousness. What might have happened to us because of these changes, had war not intervened, we do not know. The post-war recovery period delayed the inevitable process and probably accentuated its eventual progress, but after a lapse of another similar period, what do we find ? Like a machine gun blast—N.R.A.—T.V.A.—Robinson—Patman—Securities and Exchange Commission; Wagner Labor Act—Social Security Act—Hours and Wages—and numbers of laws of lesser apparent significance but with the same general objective. At this session of Congress, business is faced with the critical scrutiny of T.N.E.C.; with the possibility of some form of Federal Licensing Act of which the proposed Borah-O'Mahoney Bill may or may not be a pattern; and with numerous other bills proposing to do something affecting business.

What is to be the further shape of this fifty year curve whose leisurely form has so radically changed in these few last years ? The answer cannot be given alone by management, but it will be vitally influenced by what management does. And, as never before, the public at large will decide whether or not that answer is acceptable. In many quarters this is an unpopular conclusion, but I believe it to be true and believe we have to make the best of it.

What, therefore, is the outstanding problem of all management if it is not to win and hold public goodwill? The public in the widest possible sense of its interest is customer—employee—stockholder. But all of these have curiously conflicting and overlapping interests.

The CUSTOMER wants lowest prices and highest quality, but he is the public, an employee and a stockholder, therefore he has a vital interest in sound enterprise. There are in the United States 66 million life insurance policyholders and 44 million savings bank depositors. You can't separate the interests of the customer, the employee and the stockholder in these affairs.

The EMPLOYEE has an immediate interest in wages, hours and working conditions, but if he is wise he is also interested in whether or not the enterprise is sound because he is the customer and stockholder.

The PUBLIC, in its capacity as citizen and tax collector, must be reasonable. Finally the STOCKHOLDER; he can have the most only when these other interests are satisfied. While it is vitally essential that he be satisfied in order to maintain an ample flow of capital he is not now and never again will be in a position to demand. The stockholders' day of "the public be damned" is definitely over.

There is a vivid lesson in the testimony of Ex-Governor Murphy where he refers to the great automobile labour strike in his state. He said that the automobile manufacturers did not want force to be used. They said that their employees were their customers and therefore their goodwill was highly valued. If we admit these interests in what business does—is it not natural that government should be called in as arbiter? Apparently more people have had more faith in it than in us who represent business. A pressing problem of management to-day is to restore that faith! The way is not easy; there are no rabbits in the hat. Speeches like this won't do it. Nor will indiscriminate expressions of disgust for Washington and its legislative children do it.

But there are things which management *can* do which will help. Let us review briefly what they are.

1. Enlarge recognition that management is a profession of service and not alone of profit.

Vannevar Bush said, "One of the most encouraging signs of the times is the gradual emergence in our day of the truly professional men of business. Scattered, not organized, with no sign of professional trappings, they are none the less possessed of a high mission which needs only formulation and recognition in order that they may constitute a new and strong profession."

2. A more persistent and determined purpose to see the side of labour, remembering that labour wants primarily stable employment and security.

3. A greater willingness to meet government half way. I must dwell on this because it is an unpopular suggestion in the United States and many of us here may also resent it.

We see unfair competition of government. Restrictive labour legislation and appointments by government that indicate bias against us. Continued disparagement of business and what it has accomplished. We feel that government gives only lip service to the principles of free enterprise. We are conscious of lack of impartiality; government is policeman, judge and jury, with emphasis on policeman. Business men to-day are afraid to take a chance. These are some of the reasons business distrusts government. But one who attempts to walk the middle of the road may still urge that business shall be dispassionate in recognizing that more can be gained by working with government than against it, in the present temper of the public mind. And I should add that, in my limited experience with the attempt, it has been rather satisfactory. I have found most of the men who make up government, anxious for much the same things that I am—we frequently differ on the means, but I have found them at least as willing to listen and fairly question, as are my friends in the field of business.

It is actually embarrassing sometimes to talk to our representatives in Congress. Most of them are anxious for straight facts and honest opinions, which we sometimes find to be rather surprising. We in business have done a poor job in this area of public opinion. If you want an interesting experiment, find the opportunity for a good talk with your Parliamentary representative.

If business does not voluntarily work with government, it will be forced to do so.

4. Business must be a better neighbour in the community. Absentee management has not helped labour problems. I refer to plants which may be part of a larger organization whose head office is in another city. The community in which the plant is located does not like to know that the plant is really run from some other city.

A generation ago bigness in the community was a source of pride—because the biggest figure usually did most. So far as the smaller community to-day is concerned, bigness all too frequently means absentee management and unsympathetic policies. This is usually not intentional and not difficult to correct.

These are only some of the highlights of the problems which face management to-day. In an increasing measure wise management is attempting to meet them. Let me read the Creed for Management adopted at the International Management Congress last year and widely circulated since:

We who are responsible for the management of business in supplying the needs of the public for goods and services and who recognize our obligations to stockholders and employees, believe:

THAT we should constantly seek to provide better values at lower costs so that more of our people can enjoy more of the world's goods.

THAT we should strive to develop the efficiency of industry so as to earn a fair return for the investing public and provide the highest possible reward for the productivity of labour.

THAT we should stimulate the genius of science and utilize the methods of research to improve old products and create new ones so as to continuously provide new fields of employment for the present and the coming generations.

THAT management should encourage fair trade practices in business which, whether effected by competition or co-operation, will be so shaped as to be for the best interest of our customers and of society as a whole.

THAT it is management's duty to be alert to its own shortcomings, to the need for improvement, and to new requirements of society, while always recognizing the responsibility of its trusteeship.

THAT business in this country has never been what it could be and never what it yet will be.

THAT business, labour, government and agriculture working hand in hand can provide jobs and the opportunity for all to work for security without loss of our liberty and rights as free men.

How much better that the adoption of such principles should be voluntary instead of through the inefficient force of law. For masses of men and women in every country want more, and one way or the other, they will try to get it. If business and government in their present forms fail them, be sure that they will try something else.

If we are agreed on the desirability of the democratic form of government and the maintenance of the system of free enterprise, it has never before been so imperative that business and government shall try to understand and support each other.

I believe that a majority of business is willing to go far to meet fair government.

Abstracts of Current Literature

Contributed articles based on current periodicals, papers and events

RECENT DEVELOPMENTS IN BEARING METALS

By H. L. Evans and S. T. Harrison in Chemistry and Industry, February 11, 1939

Abstracted by F. G. Green, A.M.E.I.C.

Failures in bearing metals used for high duty service in internal combustion engines may be classified in three general types: fatigue cracking, wiping or in extreme cases seizing, and corrosion. Of these fatigue cracking is probably the most to be feared. Once thought to be due to bearing flexure, it has now been established that thin, steel-backed bearings suffer less from fatigue cracking than the older type, due to the fact that the increased flexibility of the thin bearing results in the load being spread over a greater area. Modifications in the composition of the alloys used alter fatigue strength but the value can be assessed only in tests. Wiping is due to puncturing the film of lubricant, with the consequent development of high temperature and incipient welding on a microscopic scale. Alloys which are highly conformable reduce the danger of seizure when "running in," the high spots being more readily reduced and a true surface obtained. The addition of wetting agents to the lubricating oil assists in preventing puncturing of the film, but care must be taken that they are not corrosive to the bearing metal. Tin-base and lead-base alloys containing tin do not give the trouble that cadmium and copper-lead alloys do, particularly in motor car engines. The development of highly refined oils has been partly responsible for some of the trouble, due to the removal of natural corrosion inhibitors during refining.

The fatigue resistance imparted to tin-base alloys by cadmium is greatest at temperatures below 150 deg. C. Tests of tin-base alloys containing cadmium in modern aircraft engines have been disappointing. The addition of three to four per cent silver, however, has been accompanied by good results in the reduction of fatigue cracking.

Lead-base alloys used as thin linings on rigid backings have recently come into use at the expense of tin-base alloys in the automobile industry. No corrosion troubles have been experienced as long as the tin content was over three per cent but alloys of lead with alkali metals were found exceedingly susceptible to corrosion when oil temperatures were high.

Two cadmium alloys have survived extended tests: cadmium-nickel and cadmium-copper-silver alloys. As a result of bearing tests cadmium alloys are said to have three times the life of other white metals as far as cracking is concerned, but they are subject to corrosion if vegetable or compounded oils are used as lubricants. Reduction of corrosion can be effected by coating the bearings with indium.

The use of copper-lead alloys containing 30 to 40 per cent lead and small additions of tin, nickel or silver give easily deformable material able to adjust itself to variations in shaft alignment. Development of lead-bronze bearings has probably been retarded chiefly by the problem of obtaining reproducible and suitable microstructure in regular production, but powder metallurgy may offer a way out of the difficulty.

Steel-backed bearings of pure silver have recently been adopted in the U.S. by aircraft engine makers and possess high fatigue resistance, melting point, and corrosion resistance. The running-in of these bearings is, however, a critical operation. Plating with lead or additions to the oil of compounds to form silver sulphide and so increase wetability of the surface tends to facilitate running-in.

MERCHANT ROLLING MILLS

Paper presented before the Montreal Branch of The Engineering Institute of Canada, December 8, 1938

By Warren Worthington

Abstracted by P. E. Poitras, M.E.I.C.

A merchant mill may be defined as a rolling mill designed for rolling rounds, squares, flats, small size angles, and other special shapes. Its importance to the steel industry can be gauged by the fact that 6,000,000 tons, or about 16 per cent of the total finished steel production of the U.S.A. and Canada was rolled on merchant type mills in 1937.

The original type of merchant mill was reversible and comprised two rolls high held in two rigid frames making a roll stand. The billet was reduced in section by being passed back and forth between the rolls, which were driven by a reversible motor. The output of such a mill was comparatively small.

The addition of a third roll in the stand, and making all three rolls continuously driven, increased the production by allowing the bars to pass alternately between the bottom and middle rolls and between the middle and top rolls. (Fig. 1.) Further improvements were made by the addition of other stands of three and two rolls high to form a finishing train.

There are many different layouts of merchant mills, varying from each other in the number of roll stands and the relation of the stands to one another. No standard layout has been developed because each mill has to be built to meet certain conditions—such as cost of mill, sections to be rolled, annual tonnage required, etc.

The layout best adapted to the Steel Company of Canada's requirements at Montreal is the "Belgian" type mill

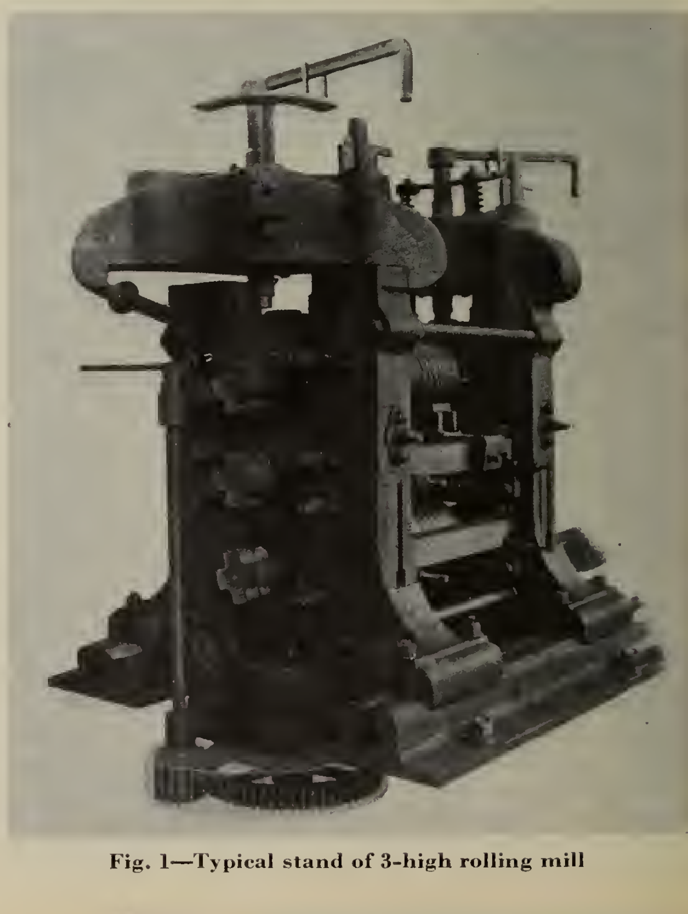

Fig. 1—Typical stand of 3-high rolling mill

(Fig. 2) where the roughing stand is separated from the finishing train—each being driven at a different speed by its own motor drive. In this case the roughing stand has three-high 18 in. dia. rolls and is located 50 ft. in advance of the finishing train; it is driven by a 2,000 hp. synchronous

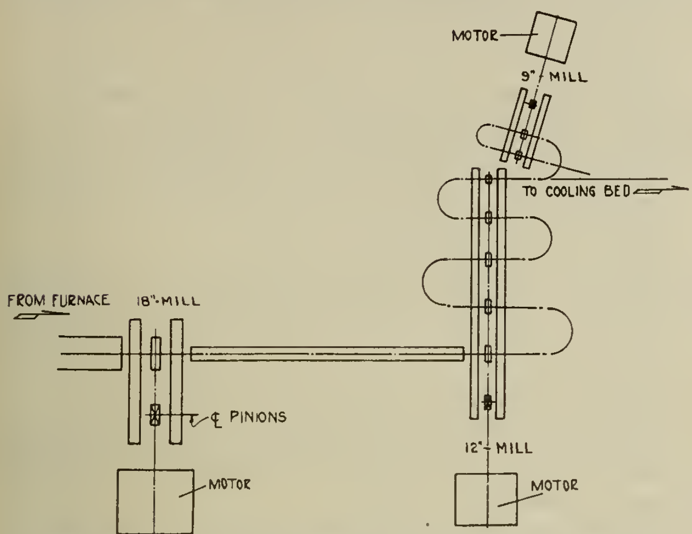

Fig. 2—Layout of merchant mill, showing roughing stand and finishing train

motor, to which is directly coupled a 1,250 kw. D.C. generator which supplies current to the 1,250 hp. D.C. 200/280 r.p.m. motor driving the finishing train of five stands of 12 in. dia. rolls and to the 400 hp. D.C. 240/480 r.p.m. motor driving two stands of 9 in. dia. rolls.

The material to be rolled is heated in the form of billets or slabs in a continuous heating furnace, which is oil fired. The dimensions of the furnace inside the brickwork are 17 ft. in width by approximately 37 ft. in length. The furnace is end-charged at one end and side-discharged at the other end. It is divided into a heating and a soaking zone, each having eight high pressure steam atomizing oil burners.

On leaving the furnace the hot billets pass through a hot shear and are cut into required lengths, thence to a runout table straight through to the roughing stand, where the section is reduced in one, three, or five passes, after which the bar is conveyed to the first stand of the finishing train on a roller table which may be adjusted in line with any particular delivery pass of the 18 in. mill and any particular entering pass of the 12 in. mill first stand.

The handling of the bars in a mill of this type is simplified by the use of repeaters or cast iron troughs which automatically lead the bar leaving one stand into the next stand. Repeaters are usually installed on the hot bed side of the mill only, as the sections coming from the passes on this side are usually oval or diamonds (Fig. 3). On the furnace side of the mill the usual practice is, when the section is small in size, for the tongsman to catch the front end of the piece as it comes from the stand, and to enter it in the next stand before it is entirely out of the first one, which operation is called looping. When the section is too heavy for the tongsman to bend in this manner, the entire bar is allowed to run out on the floor and the back end is picked up by the tongsman to be put in the next stand.

After the bar has been rolled through the finish pass, it is delivered at a speed of from 600 to 1,000 ft. per min. to either a hot bed or into a coiler—depending on the customer's requirements. The hot bed built by the Steel Company of Canada is 150 ft. long and 15 ft. wide. It is of the sawtooth lift and carry type, which transfers the bars from one side of the bed to the other by the action of alternate movable and stationary grid bars. The moving grids lift the bars off the stationary grids and carry them toward the runout table and then deposit them on the stationary grids again, moving the section a few inches at a time; this procedure is repeated again and again until the bars, which have by this time become cool, are delivered to the runout conveyor, which carries them to the shear for cutting into commercial lengths.

The 12 in. - 9 in. mill has a maximum capacity of 2 in. rounds and squares, and 4 in. flats. Larger rounds and squares up to 4 in., and flats up to 12 in. angles and channels are rolled on a mill having 18 in. dia. rolls.

On the line of the 18 in. dia. tandem rougher for the 12 in. mill, and driven by the 2,000 hp. synchronous motor, there has been connected a three-stand three rolls high 18 in. mill.

A billet for the 18 in. mill is delivered to the 12 in. - 9 in. roughing table from the continuous furnace, and from that point is moved parallel to itself by a heavy chain transfer table, onto the cast iron plate floor in front of the 18 in. mill. Four rows of floor rollers, located five feet apart and chain driven through a gear speed-reducing set by a 20 hp. motor, are installed to facilitate the handling of the heavy bars.

The section coming from the finishing stand of the 18 in. mill is delivered to a roller table which conveys it to a mechanical cooling bed. The cooling bed is 70 ft. long by 22 ft. wide from the centre line of run-in table to the centre line of run-out table.

When reaching the bed, the bar is pushed off the run-in table by a sliding pusher which moves on the horizontal plane. The bar is then transferred across the bed, a few inches at a time, by the repeated action of a set of movable grids. Finally the cooled bar reaches the cold run-out table, to be conveyed to the shear for cutting into commercial lengths.

The above two mills were built on the site occupied by three old merchant mills; each mill was steam-engine driven and operated separately with its own heating furnaces, cooling bed, shearing equipment, etc. The difficulty of meeting the tolerances required by modern practice and

Fig. 3—12 in. Mill finishing train, showing repeaters in place

the inability to ship straight bars from the cooling beds, as well as the long lengths now called for in reinforced concrete designs, necessitated a complete rearrangement of the old layout.

The new layout will give the following results:

1. Heating costs reduced to a minimum.
2. Flexibility with regard to the varied list of sections rolled and to the manner in which they are rolled, such as: full length run-out; hand looping; mechanical looping.
3. Operating costs reduced to a minimum.
4. Close tolerance limits in size and straightness of bars.

CONSOLIDATED MILLS INSTALL MODERN STEAM PLANTS

By S. W. Andrews in Pulp and Paper Magazine of Canada, December, 1938

Abstracted by H. O. Keay, M.E.I.C.

Considerable interest has been aroused among paper mill engineers and operators by this article in which are described very fully the details of the new steam plant installations at the Belgo and the Wayagamack mills of the Consolidated Paper Corporation, Limited.

At both the Belgo and Wayagamack plants are installed electric steam generators of normal rated capacities of 65,000 kw. and 35,000 kw., respectively, operating on secondary power derived from the nearby power plants of the Shawinigan Water and Power Company. Until within recent months, this secondary power has been sufficiently continuous to enable both mills to obtain the greater part of the steam requirements from this source.

As demands for primary power have generally increased, the withdrawals of power from the steam generator supply have become more frequent, more prolonged and of greater magnitude. Moreover, as shown by a typical 24-hour diagram of power supply available for electric steam generators, these withdrawals of secondary power, coupled with inevitable fluctuations in paper and pulp mill steam demands, were sufficiently sudden to overtax the ability of the existing fuel-fired steam boilers to hold the load satisfactorily, hence the decision to install modern steam plants.

While the plans of both steam plants call for the ultimate use of steam at 650 lb. per sq. in. gauge pressure and 725 deg. F. temperature through back-pressure, bleeder-type turbines, it is the intention to operate these boilers initially at pressures corresponding to the old units, thus avoiding the necessity for extensive changes in piping and auxiliaries until the demand for supplementary power is more urgent.

Steam Capacity

At the Belgo plant the design contemplates supplying sufficient process steam, within the best efficiency range, for a daily production of 665 tons of newsprint and the generation of as much by-product electric power as may be economically possible. Corresponding capacity at the Wayagamack plant is based upon a daily production of

200 tons of newsprint.
217 tons of Kraft pulp.
117 tons of Kraft paper.

At both mills, steam at 30 lb. per sq. in. gauge pressure is used for drying, heating and general mill purposes. The Belgo mill uses 125 lb. gauge pressure in the pulp mill and Wayagamack uses 135 lb.

The ultimate Belgo installation will consist of three 150,000 lb. per hr. pulverized-fuel-fired boilers and two 7,500 kw. turbo-generators. At Wayagamack the boiler installation will consist of three 120,000 lb. per hr. similar units and two 5,000 kw. turbo-generators. The initial installation, however, consists of two of the three boiler units planned for both Belgo and Wayagamack. It should be mentioned that at the Wayagamack mill, approximately 46,000 lb. of steam per hr. are delivered to the intermediate pressure header from black liquor recovery furnace boilers, thus taking care of a part of the steam requirements.

Buildings

Boiler house construction is of brick and steel, with concrete floors, sills and coping, Haydite roof slabs, steel sash, and tar and gravel roof. Doorways have been provided at grade level for the passage of equipment, and a light hoist has been installed for handling material to the upper levels through hatchways in the floors. Building and machinery foundations are of reinforced concrete. Pulverizer foundations were isolated from the soil and adjacent structures by means of a two-inch thickness of compressed corkboard.

Steam Generating Units

Each steam generator and its auxiliaries form an individual unit consisting of a Babcock and Wilcox integral-furnace type boiler, air preheater, two pulverizers, two feeders, two coal scales, forced draft fan, induced draft fan, control panel, necessary piping, duct work and accessories.

Each boiler has one 54-in. welded steam drum and one 42-in. welded bottom drum. There are 763 tubes in the Belgo boilers and 676 tubes in the Wayagamack boilers. First pass tubes are $3\frac{1}{4}$ in. in dia. and those in the second and third passes are $2\frac{1}{2}$ in. in dia. Furnaces have complete water cooling in all walls, the floor tubes being protected by cast iron Bailey blocks.

The rate of heat release in the furnace at maximum rating is approximately 25,000 B.T.U. per cu. ft. per hr. Each furnace is equipped with four B. and W. forced-draft circular burners, all located in the front wall, with one pulverizer supplying each two burners. Burner control is by means of secondary air dampers and coal valve.

Air preheaters of the tubular type are located at the side of and adjacent to the boilers. The heaters at Belgo have a transfer surface of 15,690 sq. ft. and those at Wayagamack 11,730 sq. ft. each.

The forced-draft fans at Belgo have a capacity of 193,000 lb. of air per hour at a pressure of 8.3 in. of water. At Wayagamack the capacity is 153,000 lb. of air per hr. at the same pressure.

The induced-draft fans at Belgo have a capacity of 211,000 lb. per hr. at a pressure of 7.2 in. of water and a temperature of 400 deg. F. Those at Wayagamack have a capacity of 168,000 lb. per hr. at a pressure of 7.0 in. of water and a temperature of 400 deg. F. Control of induced-draft fans is obtained by means of a hydraulic coupling between the fan and the squirrel-cage induction type driving motor.

The pulverizers, located in front of the boilers on the ground floor directly beneath the individual coal bunker outlets, are B. and W. type B. Each pulverizer at Belgo is guaranteed to have a capacity of 7,500 lb. per hr. of coal with 14 per cent moisture. The corresponding capacity of each pulverizer at Wayagamack is 5,650 lb. per hr. Warm air is piped from the secondary air duct to the inlet of the pulverizer fans and exhausted through the pulverizer to the burners at a controlled temperature of 150 deg. F.

The combustion control system is of the Bailey air-operated type, in which the supply of fuel and air to the furnaces is automatically regulated.

The article is profusely illustrated with drawings showing the general arrangement of both plants, together with half-tone cuts of equipment details. These installations are considered to be the most modern and complete of any in pulp and paper mills up to the present time.

THE BUCKLING OF SIMPLE COLUMNS AND FLAT PLATES

By F. R. Shanley in Aircraft Engineering, January, 1939

Abstracted by L. M. Nesbitt

This paper was prepared for the benefit of engineers and students who have not had the time to become familiar with recent developments in the theories of structural stability and their applications. Emphasis is placed on the mechanical aspects of the problem rather than the mathematical, the former approach being necessary for a clear undertanding of what happens when a structure buckles.

Section A deals with free buckling in the sense that the free development of wrinkles or waves in a member is not restrained by the presence of a more stable member which shares the load. Beginning with a discussion of the classical Euler equation for columns, the author points out that the resistance to buckling is really a matter of bending stiffness and illustrates this basic principle by showing how the

Euler equation can be extended into the short column range by taking into account the reduction in bending stiffness which follows the reduction in E beyond the elastic limit. The relation between the basic Euler equation and the theoretical buckling formulae for flat plates under edge compression and shear is explained by dividing the plates into strip elements which are considered to act as columns.

Shearing stresses themselves do not cause buckling; in fact, they have little significance except as a convenient means of defining the stress condition. They are equivalent to a combination of tensile and compressive stresses acting at 45 deg. to the direction of shear, and it is this compressive component that tends to buckle thin panels under shear loading, such as the webs of plate girders and Wagner beams. The tensile stress condition in the so-called "diagonal tension field" which parallels the wrinkle pattern is sometimes thought to cause the wrinkles, but actually retards their formation.

Test results are not always in good agreement with theory, mainly because small eccentricities and local deformations have a relatively large effect in thin walled structures. Owing to the scattered nature of the test results, it is customary to use conservative values in design, as much as 40 per cent below the theoretical, while it is sometimes advisable to make a few check tests when experimental data seem to be lacking. On the other hand, buckling may not become apparent until the theoretical buckling stress has been exceeded owing to a division of load between members having different buckling stresses. This leads to a discussion of restrained buckling under Section B.

The principle is illustrated by a pair of columns with different buckling strengths which are loaded together in a test machine. If the deflections are kept equal as the load is applied, the weaker member will refuse to take any more load after its buckling load has been reached, but it will not buckle immediately, owing to the presence of the stronger member. If the distribution of load is kept constant, however, the buckling load of the weaker member must determine the failing load of the combination. Thus, in attempting to predict the behaviour of any member subject to buckling, one of the first points to settle is whether the deflection or the load distribution remains constant. In the former case, some larger or stronger members usually act to restrain the buckling.

The principle of restrained buckling has many useful applications. It is particularly useful in understanding the behaviour of sheet-stiffener combinations, of plate girders with shear-resistant or tension-field webs, of sections such as channels whose less stable elements tend to buckle first, and also in deciding how tests should be made.

The extension of theory and tests into the plastic range and the prediction of loads at which buckling will cause permanent set to occur are promising fields for future developments.

The paper is well illustrated and a list of references is included.

GERMANY'S OIL POSITION

Petroleum Press Service, February 17, 1939

Abstracted by A. A. Swinnerton, A.M.E.I.C.

Detailed information regarding German oil requirements and the extent to which they are being met by domestic production is difficult to obtain owing to incomplete statistics, but the following survey is of interest because of the close connection between petroleum and world politics.

Several factors combined to bring about an increase in Germany's output of liquid fuels in 1938. Increased production in crude oil, benzol, alcohol, and motor fuel by hydrogenation of coal, added some 375,000 tons to the output of liquid fuels, bringing the total for 1938 to 2,355,000 tons.

This increase in production was accompanied by a further increase in consumption, due to expanding civil and military demands, and this increased consumption was far greater than the increase in production. While official figures are not available, it is estimated that the demand for liquid products in 1938 rose by about 1,160,000 tons (21 per cent) to about 6,630,000 tons. The difference between this increase and the expansion of domestic production had, therefore, to be made good by increased importations. Hence, from the standpoint of self-sufficiency, the oil position showed a marked deterioration in 1938.

The increase in the production of crude oil from 453,000 tons in 1937 to 552,000 tons in 1938 was chiefly due to the development of a new field near Hamburg, the remainder coming from the old established fields near Hanover. The production of benzol is estimated to have increased from 485,000 to 540,000 tons, and sales of alcohol increased from 205,000 to 225,000 tons. The chief item of domestic oil production is now synthetic gasoline, which in 1938 was about 1,150,000 tons.

The total consumption of motor fuel, which amounted to 3,154,000 tons in 1938, was 22 per cent greater than that of the previous year, and was probably due to increased military activity.

Gas oil and Diesel oil consumption amounted to 1,468,000 tons, an increase of 24 per cent over that of the preceding year. Apparently only about 10 per cent of Diesel requirements can be met by domestic sources, but kerosene requirements can apparently be filled by home production. However, the quantity required is relatively small. The consumption of lubricating oil amounted to about 565,000 tons, of which 180,000 tons was home-produced.

The development of mineral oil requirements and the proportion covered by domestic production is shown in the following table:

Requirements and Domestic Production
Germany—1938
1,000 tons (Metric)

	Requirements	Production	Percentage
Light motor fuels	3,154	1,935	61
Other spirits	200	....	..
Kerosene	110	90	82
Lubricants	565	180	32
Gas oil and Diesel oil	1,468	150	10
Gas oil and Diesel oil for bunkers*	229	....	..
Fuel oil for bunkers*	635	....	..
Crude oil and residues	266	....	..
Total	6,627	2,355	35.5

*For German shipping only.

Germany's total mineral oil requirements in 1938 reached the record figure of 6,627,000 metric tons. Of this quantity, domestic production was able to satisfy 35.5 per cent as compared to 36.2 per cent in 1937. But these figures exclude the large quantities of asphalt needed for road building and other purposes, which are obtained almost exclusively from imported materials; the inclusion of this material would bring up the total to well over 7,000,000 tons. Thus, Germany has surpassed France, and is now second only to the United Kingdom among European oil consumers.

It is not considered likely that the increase in German fuel requirements for 1939 will be in any way comparable to that of 1938, unless unforeseen political developments arise, but even so, it is hardly likely that any increase in domestic production will be enough to reduce appreciably the demand for imported supplies. It is apparently realized in Germany that they must depend on imports for the larger part of their liquid fuel requirements.

Editorial Comment...

GENTLEMEN - THEIR MAJESTIES!

King George VI and Queen Elizabeth will receive throughout Canada a heartfelt welcome, in which members of the Institute from coast to coast will join with enthusiasm.

The King will doubtless recall his voyage in 1912, when as a Naval Cadet on the *Cumberland* he visited Canadian ports after a cruise to the West Indies. Later, as his father's "ambassador," he travelled farther afield—his world tour in 1927 gave him a first-hand knowledge of the British Commonwealth such as few men possess. Now, as its reigning Monarch, and with his gracious Queen, he undertakes an arduous journey across this broad Dominion, and finds time to pay a brief visit to that great neighbouring country whose friendship we enjoy and value so highly.

We are proud to have the opportunity of presenting to the Sovereigns of the Empire, on behalf of the engineers of the Dominion, this assurance of loyalty and affection. May the cares of State weigh lightly on them during their absence from England, may their Canadian journey be one of complete enjoyment, and may they take away with them a sense of the love and loyalty to the Crown and to the Empire which is present everywhere in this fair Dominion.

THE JOURNAL COMES OF AGE

Attainment of the age of twenty-one is an event to be recorded. It is an important milestone in the life of man that marks—without precision—the end of youth and the beginning of manhood, the end of preparation and the beginning of performance, the end of freedom and the beginning of responsibility, both social and legal. With this issue the Journal reaches the twenty-first anniversary of its birthday, but none of these meanings can be attached to this event, because long ago in the hands of its earlier editors it accepted its responsibilities and attained its full stature. However, the occasion is not without significance, and attention is called to it for many reasons.

The past twenty-one years have been filled with events of great importance to the Institute. The files of the Journal record them all. Editorials, reports, letters, obituaries and photographs tell the story. We find controversy and criticism, co-operation and praise, new legislation, revision of by-laws and a host of items, all indicative of the constant struggle to clarify issues, and to enlarge the usefulness of the organization.

In all these matters the Journal has been the mouthpiece, the mirror and the record. It, too, has had its struggles. The success of the first editor in surmounting the many difficulties of establishing a new publication was a real achievement. It was a serious undertaking and placed untold hours of extra work on shoulders which must have been loaded almost to capacity, even without it. A perusal of the early numbers gives some indication of the size of the task, and the success of the effort. To the present editor the record is an inspiration.

The editorial page of May, 1918, shows many names prominent in the history of the Institute. The original Board of Management was: President, H. H. Vaughan; Vice-President, J. M. R. Fairbairn; Councillors: Ernest Brown, Walter J. Francis, R. A. Ross, H. R. Safford, Arthur Surveyer; Editor and Manager, Fraser S. Keith; Associate Editors: C. M. Arnold, Calgary; Frederick B. Brown, Montreal; J. B. Challies, Ottawa; A. G. Dalzell, Vancouver; J. N. deStein, Regina; Geo. L. Guy, Winnipeg; A. W. Haddow, Edmonton; Geo. Hogarth, Toronto; W. Lefebvre, Quebec; E. G. Marriott, Victoria.

The first editorial was short and to the point. Much of what it says is equally true to-day. It is worthy of being read again and therefore is reproduced herewith.

"The Journal's Inaugural

"Your faith that some day an intercommunicating medium would be provided, devoted to the welfare of the Institute and its members, assumes realization in the appearance of this, the first issue of The Journal of the Engineering Institute of Canada.

"It is yours.

"With you rests the decision as to its future, as to how far it shall be nourished and grow and wax strong in the likeness of the mental and moral qualities of the members of this Institute, for you are its sponsors and its guardians, even its progenitors. Until it has thrown off the swaddling clothes of its infancy, you will, like good parents, be not unduly critical of your own offspring.

"Just how human it may become will be determined by the amount of active co-operative interest you take in it. Here, all that pertains to the doings of the Institute, will receive full and free discussion. In it, our activities, our aims and our expectations may find expression."

This year the Journal has undergone notable changes. These, however, follow the original plan since they are designed to attain more completely the earliest objective —the establishing of a medium "devoted to the welfare of the Institute." Let us hope that such development will continue during the next twenty-one years, and that in that time many things will come to pass that will permit the Journal to further enlarge its usefulness to the Institute and broaden its services to the profession.

THE YOUNG ENGINEER

With the purpose of determining in what way The Engineering Institute can best serve the younger members of the profession, particularly during their period of training and apprenticeship, Council has set up a committee. It is expected that this committee under its competent chairman will consider the subject from several angles, among which will probably be the training of the young man entering the profession; the period when the young engineer is acquiring his experience and so attaining professional status, and his relationship to engineering societies and organizations.

Investigations of a similar nature have been under way in the United States for some time. These have been sponsored by the "Founder Societies" and have been carried out largely by the Engineers' Council for Professional Development. Already these investigations have shown the advisability of certain changes in training and method of admission to the profession and have indicated how the various societies can be of further assistance to their younger members. Similar investigations are in progress in Great Britain.

The period immediately following graduation would seem to be one in which organized engineering can be of greatest assistance to the young man. It is now that he must correlate the theory of his previous training with the practical requirements of his particular work. In many cases these requirements are highly technical and often rapidly changing. Wise advice during this period of adjustment may be of the greatest benefit. Here the Institute in co-operation with other technical bodies and with industry should be able to render a service of real value. At this time also the appreciation of the proper standards of ethical practice must be developed in the young man's mind. He should further be made conscious of his duties as a citizen, one who has been specially trained to be of service to the community and the nation. These latter phases of the young engineer's orientation to his profession would seem to be particularly the province of engineering societies, and in Canada of The Engineering Institute especially.

Obviously the Institute can only assist the young engineer if it can interest him in its plans and convince him that it can be of help. It becomes necessary, therefore, as a basic requirement, of any scheme of assistance, that The Engineering Institute and its activities become of greater interest to the younger men. Hence the relationship of the Institute to its younger members requires consideration.

Since the future of the profession in Canada depends completely on these young men now in college or just graduated this matter of assistance to them is of fundamental importance. Anything that can be done to aid them to get established in their chosen profession, to see that in this establishment the proper viewpoint and perspective are acquired will be not only of great value to the men themselves but will be a service to the profession and to the country as a whole. This is a proper and vital field of investigation and activity for The Engineering Institute and every effort should be made to supply the committee with all assistance and data necessary.

H. W. McK.

PRESIDENTIAL ACTIVITIES

The May meeting of Council will take place in Hamilton on Saturday, May 27, at 10 a.m. Following the usual custom, past officers, councillors and chairmen of the branch as well as the chairmen of nearby branches will be invited to attend. President McKiel will be in the chair.

The President will visit the following branches: May 26, Niagara Peninsula—Annual Meeting; 29, Hamilton; 30, London; 31, Border Cities.

INTERNATIONAL ENGINEERING CONGRESS AT NEW YORK

For several months, committees have been working out details of what promises to be one of the most outstanding engineering congresses that has yet been convened in this part of the world. It embraces directly the membership of five great societies, and indirectly at least two more, and brings together the engineers of three countries The co-operating organizations are the Institution of Civil Engineers, the American Society of Civil Engineers, the Institution of Mechanical Engineers, the American Society of Mechanical Engineers and the Engineering Institute of Canada.

The meeting takes place in New York from Monday, September 4, to Friday, September 8. It will be operated in two sections—one for the civils and one for the mechanicals, although on at least three occasions both groups come together for a common function. It is expected that each group will have a registration of from a thousand to twelve hundred. The English advance registration already indicates that at least two hundred and fifty will make the trip.

The dates coincide with the World's Fair, and the programmes are arranged so there will be sufficient opportunity to see it, both in daytime and at night. In fact one of the principal meetings takes place right on the grounds. Special facilities to see certain engineering features will be at the disposal of the visitors.

The civil group makes Columbia University its centre. Wonderful accommodation for offices, meetings, living quarters and social events will be available. The university is on the height of land well away from the congested area, and yet is less than fifteen minutes by subway from Times Square. The exhibition grounds are more easily reached from here than from downtown and it is the coolest section of the city.

Excellent hotel accommodation for Canadian engineers is guaranteed. Institute members will be housed in hotels, apartments and dormitories of Columbia University, and at rates that are surprisingly low. Suites with sitting room, bath and kitchenette accommodating two or three people can be secured at four and five dollars a day. Single rooms are as low as two dollars per day, and all in excellent establishments in a beautiful neighbourhood.

The mechanical group makes the Pennsylvania Hotel its headquarters. All papers and meetings, except the joint functions, will be held there. It is planned that members of The Engineering Institute will make Columbia University their home, but they will be invited to attend any of the meetings of the mechanicals in which they are interested.

The professional papers are being prepared by outstanding engineers of all three countries, and cover a wide range of important subjects. The programme of social events will be unusually attractive, including receptions, tours, luncheons and a banquet in the Waldorf Astoria, at which outstanding speakers of national reputation and importance will be present.

This description is intended as a preliminary notice only. It is expected that minute details will be ready for publication in the June Journal, including the programme of professional papers, social events, news of the fair, rates for and description of living accommodation, and numerous other items that will round out a programme which provides something worthwhile for everybody.

It is suggested that members plan their vacation so they can take in this unique event. The combination of an international professional meeting, a world's fair and New York City should provide inspiration for hundreds of members of the Institute. Remember that good accommodation is guaranteed, and will be arranged for you by Headquarters on request, and that you will be fully informed of all necessary details within a month's time.

FELLOWSHIPS IN TRAFFIC ENGINEERING

The Bureau for Street Traffic Research of Yale University announces the availability, commencing September 26, 1939, of graduate fellowships in street and highway traffic engineering.

These fellowships are intended to provide a year's intensive training in traffic engineering practices for young graduates desirous of entering this field or for those who hold positions with organizations having authority and responsibility for traffic control.

The fellowships provide a stipend of $1,400 distributed in the following way, $800 for living expenses, $400 for tuition fees and $200 for field investigations.

The academic year extends from September 26, 1939, to June 1, 1940.

Bureau fellowships may be applied for by persons having the following qualifications:

(a) Applicants must be not more than thirty-five nor less than twenty-three years of age at the time of application;

(b) Applicants must have an engineering degree representing four years' work in an accredited college or university;

(c) Preference will be given to men who have had:

(1) From one to five years of practical experience in a public engineering or administrative organization where they engaged personally in some phase of Traffic Engineering;

(2) Exceptional grades during their college courses;

(3) In addition to their engineering courses, courses in Planning, Government, Public Administration, Economics, Public Speaking, Psychology, Sociology, Philosophy, Physiology, Mathematics, and Statistics.

Those desiring to make application for these Traffic Engineering fellowships must apply as follows:

(1) Apply to Mr. Maxwell Halsey, Associate Director of the Bureau for Street Traffic Research, Room 315, Strathcona Hall, Yale University, New Haven, Connecticut, for *Application Forms*. These will be sent by return mail.

(2) Application forms completely filled out and complied with must be returned with their enclosures to the Bureau offices not later than June 1, 1939, though earlier filing will be appreciated.

MEETING OF COUNCIL

A meeting of the Council was held at the Royal York Hotel, Toronto, Ontario, on Saturday, April 15, 1939, at ten o'clock a.m.

There were present: Vice-President E. V. Buchanan, of London, Ontario, in the chair; Past-President J. B. Challies (Montreal); Vice-Presidents R. L. Dunsmore (Halifax) and F. Newell (Montreal); Councillors J. L. Busfield (Montreal), R. H. Findlay (Montreal), A. B. Gates (Peterborough), O. Holden (Toronto), T. H. Jenkins (Border Cities), A. Lariviere (Quebec), H. A. Lumsden (Hamilton), W. R. Manock (Niagara Peninsula), A. U. Sanderson (Toronto), J. A. Vance (Woodstock), E. Viens (Ottawa), and the General Secretary. The following were also present by invitation: Past-Presidents J. M. R. Fairbairn, F. A. Gaby, A. J. Grant and C. H. Mitchell; Past Vice-President A. H. Harkness; Past Councillors J. W. R. Ambrose, W. E. Bonn, C. S. L. Hertzberg, E. G. Hewson, W. A. McLean, R. E. Smythe, J. J. Traill, J. G. R. Wainwright, C. R. Young and R. B. Young; Branch Chairmen H. F. Bennett (London), J. R. Dunbar (Hamilton), W. T. Fanjoy (Peterborough), H. W. Harkness (Kingston), and C. G. Moon (Niagara Peninsula); Dr. A. E. Berry, chairman; C. E. Sisson, past-chairman; A. O. Wolfe, member of executive, and J. J. Spence, secretary-treasurer of the Toronto Branch; W. P. Dobson, President, E. P. Muntz, immediate Past-President, and M. Barry Watson, Registrar, of the Association of Professional Engineers of Ontario; Professor Robert W. Angus, Hon.M.E.I.C., and A. L. Bishop, chairman of the Institute Nominating Committee. Vice-President Buchanan extended a cordial welcome to all councillors and guests.

The membership of various Institute committees, as submitted by the chairmen, was noted and approved.

The Secretary reported that Mr. Fraser S. Keith, after an interview with Mr. Gladstone Murray, had expressed his willingness to accept the chairmanship of the committee on engineering broadcasts. The membership of the committee was unanimously approved as follows: Fraser S. Keith, chairman; Past-President G. J. Desbarats, of Ottawa, and Mr. G. A. Gaherty, of Montreal, with power to add to their number.

Past-President Fairbairn reported on the interviews which he had in England with the secretaries and committees of the Institution of Civil Engineers and the Institution of Mechanical Engineers. The Institute's invitation for them to visit Canada was accepted with an expression of great appreciation, and the details of arrangements throughout the trip were left entirely with the Institute.

Dr. Fairbairn reported that the Mechanicals expected to have about one hundred and fifty in their party, and that the Civils would have from one hundred to one hundred and twenty-five. Both delegations would arrive in Boston on the same boat, and would go from there to New York by rail. After the visit in New York it was planned to have both groups reunited at Niagara Falls, and spend Monday, September 11, and Tuesday, the 12th, together at Niagara Falls, Hamilton and Toronto. The Mechanicals leave Toronto Wednesday morning for Detroit, and the Institute's programme for the Civils calls for them to leave Toronto Tuesday night for Ottawa, spending Wednesday in Ottawa, and Thursday in Montreal, sailing on Friday from Montreal.

Mr. H. F. Bennett reported on the committee which is being formed to investigate a programme of activity on behalf of the young engineer. Considerable discussion followed, and suggestions were made with regard to the membership and functioning of the committee, after which it was arranged that final decision on the matter should be left until the next meeting of Council.

On the recommendation of the Montreal Branch Executive Committee, it was unanimously resolved that Mr. H. J. Vennes be appointed councillor to replace Mr. J. B. D'Aeth, whose resignation had been accepted.

With regard to the work of the Papers Committee, Mr. Vance drew attention to the assistance which the branches could render to that committee by notifying the committee of branch members who were likely to travel and who would be able to address branches while doing so. The Papers Committee was endeavouring to arrange for an interchange of speakers and of papers. Discussion followed on the difficulty experienced by some of the smaller branches in paying travelling expenses of speakers.

Following the discussion which had taken place at the last meeting of Council, the General Secretary reported that Mr. P. L. Pratley, who is the Institute's representative on the Main Committee of the Canadian Engineering Standards Association, would also represent the Institute on the C.E.S.A. Executive Committee, of which he is also a member.

In presenting the financial statement for the month, Mr. Newell stressed the importance of the gradual formation of a general reserve fund, and pointed out that this had been kept in mind in the budget for 1939. This point should be considered by Council in dealing with any requests for additional appropriations not budgeted. Mr. Newell stated that collection of fees had so far been satisfactory, while expenditures up to date had been less than budgeted.

Ten resignations were accepted; the names of two members were removed from the list, and the names of three members were placed on the Life Membership list.

A letter was presented from Mr. G. A. Gaherty outlining briefly the problems which confront Canada in view of the present international situation, and suggesting that, as both by training and experience the engineer is best fitted to grapple with these problems, The Engineering Institute of Canada could perform a real service for Canada by interesting itself in the solution of these problems. After discussion it was suggested that the General Secretary should secure more information to be submitted to the next meeting of Council.

A letter was presented from Mr. I. C. Barltrop advising that as he had been moved to Vancouver, he desired to tender his resignation as councillor representing the Victoria Branch. Mr. Barltrop's resignation was accepted with regret, and, on the recommendation of the Victoria Branch, Mr. A. L. Carruthers was appointed councillor to represent the Victoria Branch until the next annual election.

The Secretary presented a letter from Councillor MacNab stating that the Halifax Branch had decided to sponsor a movement for the submission of papers by local students at the October meeting of the branch. Mr. MacNab asked whether Council would be willing to grant student memberships in the Institute to all engineering students submitting worthy papers. Following considerable discussion, it was unanimously resolved that the request of the Halifax Branch be granted, and that Mr. Bennett's committee on the young engineer be asked to formulate a set of rules governing the award of student memberships for the guidance of all branches.

Vice-President Buchanan stated that Mr. Dobson, the President of the Association of Professional Engineers of Ontario, had extended a very cordial invitation to members of council to be the guests of the Association at the quarterly meeting of their council on Saturday, April 22, 1939, at Peterborough. This invitation was received with appreciation.

The names of the newly elected officers of the Calgary and Toronto branches were noted.

Mr. Eric P. Muntz was appointed to represent the Institute at the Second Foreign Trade Conference of the Canadian Chamber of Commerce, to be held in Hamilton, Ontario, on May 8 and 9, 1939.

The secretary was instructed to express Council's concern and regret at the serious illness of Mr. C. C. Kirby, President of the Dominion Council of Professional Engineers.

It was decided that if possible the May meeting of Council should be held in Hamilton, Ontario, to coincide with the President's visit to that branch.

A number of applications for admission and for transfer were considered, and the following elections and transfers were effected:

ELECTIONS

Associate Members................................ 5
Junior.. 1

TRANSFERS

Associate Member to Member...................... 6
Junior to Associate Member....................... 3
Student to Associate Member...................... 2
Student to Junior.................................. 1

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

ELECTIONS AND TRANSFERS

At the meeting of Council held on April 15th, 1939, the following elections and transfers were effected:

Associate Members

Buchanan, Albert Millar, (Royal Tech. Coll., Glasgow), plant engr. and supt., Gartshore-Thomson Pipe and Foundry Co. Ltd., Hamilton, Ont.
Carry, Charles William, M.Sc. (C.E.), (Univ. of Man.), sales engr., Standard Iron Works, Edmonton, Alta.
Fraser, William Stanley, B.Sc. (E.E.), (Univ. of Man.), district engr., Canadian Westinghouse Co. Ltd., Calgary, Alta.
Groundwater, James Ross, plant engr., Bruck Silk Mills Ltd., Cowansville, Que.
Pearce, William, B.Sc. and Engr. of Mines (Mich. Coll. of Mines), 1674 McGrail Ave., Niagara Falls, Ont.

Junior

Wallender, Louis, B.A.Sc. (Univ. of Toronto), 397 Spadina Ave., Toronto, Ont.

Transferred from the class of Associate Member to that of Member

Chambers, Harold Joseph Ashbridge, M.A.Sc. (Univ. of Toronto), sales engr., Canadian Bridge Co. Ltd., Windsor, Ont.
Coke, Reginald Norman, B.Sc. (McGill Univ.), vice-chief engr., and gen. supt., Montreal Light, Heat and Power Cons., Montreal, Que.
Gardner, William McGregor, B.Sc. (McGill Univ.), supt. of constrn. and mtce., Montreal Tramways Company, Montreal, Que.
Holden, John Hastie, B.Sc. (McGill Univ.), mgr., Geo. W. Reed & Co. Ltd., Montreal, Que.
Leslie, Roy Campbell, M.A.Sc. (Univ. of Toronto), sales engr., Canadian Bridge Co. Ltd., Windsor, Ont.
Moes, Gerlacus, (Cert. in Engrg.), (Liverpool Univ.), gen. mgr., Hamilton Sterling Electrical Co. Ltd., Hamilton, Ont.

Transferred from the class of Junior to that of Associate Member

Cornish, Charles Rischman, B.A.Sc. (Civil), (Univ. of B.C.), asst. engr., engrg. and constrn. service, Dept. of Mines and Resources, Banff, Alta.
Harvie, Allin C., B.Sc. (Queen's Univ.), asst. works engr., The International Nickel Co. of Canada Ltd., Port Colborne, Ont.
Menzies, John Ross, B.A.Sc. (Civil), (Univ. of Toronto), district engr., public health engrg. divn., Dept. of Pensions and National Health, Montreal, Que.

Transferred from the class of Student to that of Associate Member

Granville, Francis Xavier, B.Sc. (C.E.), (N.S. Tech. Coll.), asst. engr., Dept. of Public Works and Highways, Charlottetown, P.E.I.
McCann, Edward Howard, B.Eng. (Mech.), (McGill), B.Sc. (Bus. & Eng. Administration), (Mass. Inst. Tech.), engr., Production Dept., Canadian Car and Foundry Co. Ltd., Fort William, Ont.

Transferred from the class of Student to that of Junior

Archibald, Manning Clifford, B.Sc. (E.E.), (N.S. Tech. Coll.), engr., Woodstock Public Utilities Commission, Woodstock, Ont.

Students Admitted

Brooks, Joseph Warren, (Queen's Univ.), 724 Dundas St., London, Ont.
Burbidge, George Wheelock, (Univ. of Man.), 161 Harvard Ave., Winnipeg, Man.
Farmer, Philip John, (Univ. of B.C.), 2307 Bellevue Ave., West Vancouver, B.C.
Kean, John David, (Univ. of Toronto), 408 Brock St. South, Whitby, Ont.
Kirkwood, J. Gordon, (Univ. of Mich.), 1481 Church St., Windsor, Ont.
Stephenson, Eric Paul, (N.S. Tech. Coll.) 38 Queen St., Halifax, N.S.
Vaughan, Robert P., (McGill Univ.), 1539 MacGregor St., Montreal, Que.

(Students at the University of Alberta)

Balderson, Kenneth Kincade, Box 114, University of Alberta, Edmonton, Alta.
Findlay, Stewart McIver, 10322-123rd St., Edmonton, Alta.
King, Wilbur A., 9622, 107th Ave., Edmonton, Alta.
Monaghan, Cecil, 11505-96th St., Edmonton, Alta.
Nelson, Alvin Clarence, 10415-97th Ave., Edmonton, Alta.
Pattenson, Charles Francis, 9011-112th St., Edmonton, Alta.
Pegler, William Arthur, University of Alberta, Edmonton, Alta.
Robinson, Eric Frank Vernon, 9831-104th St., Edmonton, Alta.
Slipp, John Gillespie, Box 59, University of Alberta, Edmonton, Alta.
Wray, Robert Houston, Irricana, Alta.

FROM THE JOURNAL OF TWENTY YEARS AGO

The Special Legislation Committee which drew up the "Model Act" upon which was based subsequent legislation for provincial registration of engineers throughout Canada, reading from left to right:A. Surveyer, M.E.I.C., Montreal, Secretary of the Committee; E. E. Brydone-Jack, M.E.I.C., Winnipeg, Man., R. J. Gibb, M.E.I.C., Edmonton, Alta., F. H. Peters, M.E.I.C., Calgary, Alta., R. F. Uniacke, M.E.I.C., Ottawa, Ont., E. R. Gray, M.E.I.C., Hamilton, Ont., A. R. Decary, M.E.I.C., Quebec, Que., N. L. Somers, A.M.E.I.C., Sault Ste. Marie, Ont., A. E. Foreman, M.E.I.C., Victoria, B.C., H. R. McKenzie, M.E.I.C., Regina, Sask., C. C. Kirby, M.E.I.C., Saint John, N.B., W. Chipman, M.E.I.C., Toronto, Ont., and in the foreground C. E. W. Dodwell, M.E.I.C., Halifax, Chairman of the Committee. A. G. Dalzell, A.M.E.I.C., Vancouver, was present at the early sessions of the Committee.

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

deGaspe Beaubien, M.E.I.C., was elected President of the Canadian Club of Montreal at the annual meeting on April 24. Mr. Beaubien, who is Treasurer of the Institute, has also been elected recently director of the Regent Knitting Mills Ltd.

Professor R. W. Angus, Hon.M.E.I.C., of the Faculty of Applied Science and Engineering of the University of Toronto, was made an honorary member of the Canadian Section of the American Water Works Association at its annual meeting which was held in Toronto, April 12 to 14.

C. C. Kirby, M.E.I.C., President of the Dominion Council, has been confined to his home for some time on account of illness and although he is making satisfactory progress it is not expected that he will be back at his office for a few weeks yet.

A. L. Bishop, M.E.I.C.,president of Coniagas Mines Limited, has been elected to the board of directors of the Consolidated Mining and Smelting Company of Canada Limited to fill the vacancy created by the death of J. J. Warren.

E. V. Buchanan, M.E.I.C., was presented with the Past Chairman's Certificate at the annual meeting of the Canadian Section of the American Water Works Association in recognition of his service during his term as Chairman in 1937-38.

L. P. Cousineau, A.M.E.I.C., has accepted a position with the National Syndicate of Electricity as assistant engineer on construction of power development on the Ottawa River in the County of Temiscaming. Mr. Cousineau graduated in civil engineering from the Ecole Polytechnique in 1936. He then spent a year in Paris at the Ecole Supérieure de Soudure Autogène from which he was graduated as a welding engineer in 1937. Prior to taking up his new position he was with the Marine Industries Limited, Sorel, Que., as welding superintendent.

C. L. Dewar, A.M.E.I.C., formerly superintendent of construction and plant engineering in the Eastern Division of the Bell Telephone Company, has been appointed chief engineer of the Eastern Area. He graduated from McGill University with the degree of B.Sc. in 1921 and the following year obtained his Master's degree. He entered the company's service in 1923 and between that time and 1930 successively held the positions of assistant field engineer, district plant engineer and engineer in the general engineering department. In 1930 he was made outside plant engineer of the Eastern Area and in 1935 outside plant and transmission engineer.

Curtis M. Dean, M.E.I.C., has been appointed refinery manager of the Caribbean Petroleum Company at San Lorenzo, Venezuela, S.A. Mr. Dean, who graduated from the University of British Columbia in 1923, has served the Shell Oil Company in various capacities since 1924 but a great deal of this time has been spent in the Martinez Refinery, Martinez, Calif., where he held the position of manager.

H. B. Howe, S.E.I.C., has accepted a position with the Montreal East Plant of the Canada Cement Company. A graduate of Queen's University in 1936 with the degree of B.Sc. in mechanical engineering, Mr. Howe has been employed as assistant mechanical engineer of the Johns-Manville Company at Asbestos, Que.

Major A. J. Lawrence, A.M.E.I.C., has been re-elected as president of the Caledonian Society of Montreal for the year 1939-40.

C. R. Whittemore, A.M.E.I.C., metallurgist of the Dominion Bridge Company, was elected Chairman of the Montreal Chapter of the American Society for Metals at the annual meeting held on April 24. Other members of the Institute elected to office were: **F. R. Barnsley**, A.M.E.I.C., Vice-Chairman, **R. A. Gurnham**, A.M.E.I.C., member of the executive committee.

R. K. Thoman, Jr.E.I.C., is now employed with the Canadian Vickers Company, Montreal. Mr. Thoman graduated from Queen's University in 1936 and was production manager of Remington Rand Limited, Hamilton, Ont., before accepting his present position.

Dan Anderson, A.M.E.I.C., the author of the paper, "The Baie Comeau Electrical Installation of the Quebec North Shore Paper Company," which was published in the April issue of the Journal, has been electrical superintendent of the company since 1938. In the capacity of electrical engineer he was responsible for the design and construction of the development prior to commencement of operation. Before that he was on the staff of H. S. Taylor, consulting engineer, for five years on paper mill work as electrical engineer. Early in 1929 he joined the staff of the Power Corporation of Canada Limited, where he was employed for seven years on power work, including design, estimates and appraisals. Mr. Anderson graduated from McGill in 1923.

VISITORS TO HEADQUARTERS

P. V. Fearon, technical director of the Equipment and Engineering Company Limited, London, England, on April 3.

Adolphe Clairmont, S.E.I.C., plant engineer of the Singer Sewing Machine Company in Thurso, Que., on April 15.

A. E. Gregoire, S.E.I.C., engineer on construction of winter roads to Chibougamau, Que., for the Department of Mines of the Province of Quebec, on April 17.

J. P. Henderson, A.M.E.I.C., astronomer of the Dominion Observatory, Ottawa, on April 10.

Wm. J. Ahearn, S.E.I.C., of Ottawa on April 11.

J. F. McDougall, A.M.E.I.C., of Edmonton, Alta., superintendent of buildings with McDougall and Secord Ltd., on April 26.

Obituaries

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

Mossom Burwell Bonnell, A.M.E.I.C., electrical patents examiner of the Dominion Government Patent Office, died in Ottawa on April 14. He was born at Bobcaygeon, Ont., September 16, 1880, and received his early education at Upper Canada College. After graduating from that institution he entered the School of Practical Science, University of Toronto and received the degree of B.A.Sc. in 1905. From 1905 to 1907 he served an apprenticeship with the Westinghouse Electric and Manufacturing Company in Pittsburgh, Pa., and in Peterborough, Ont. Following this he was made assistant engineer of the Riordon Pulp and Paper Company at Merritton, Ont. He remained in this position for three years and at the end of that time entered the service of the government as draughtsman in the Department of the Interior. The following year he was transferred to the Canadian Patent Office as examiner in charge of electrical apparatus.

Mr. Bonnell served overseas in the Third Field Company, Canadian Engineers, being invalided home in 1917. It was three years before he fully recovered.

In 1922 Mr. Bonnell joined the Institute.

John Francis Cassidy, A.M.E.I.C., died in Toronto on January 26, 1939. He was born in that city on September 2, 1884, and received his education at St. Michael's College and the Toronto Technical School. In 1903 he began his technical experience with the Canadian Pacific Railway in the mechanical department. After four years with this company he entered the employ of the National Transcontinental Railway for a year. He then accepted a position with the Canadian National Railway as assistant to the chief engineer and later assistant to the chief engineer of surveys. Between the years 1912 when he left the employ of the Canadian National Railway and 1919 when he entered the Department of Public Highways of Ontario he held the positions of assistant to the chief engineer of the Canadian Northern Electric Lines; draughtsman and assistant in the architectural and bridge department of the Canadian Northern Railway, Toronto; concrete inspector with the Maritime Dredging and Construction Company, and assistant engineer of the Toronto Harbour Improvements carried out by the Department of Public Works, Canada. He has since been connected with the Department of Public Highways of Ontario and located in Toronto.

Mr. Cassidy joined the Institute in 1918 as a Junior, transferring to the rank of Associate Member in 1920.

Lieut.-Col. Frederic Harcourt Emra, O.B.E., M.E.I.C., died at his home in Ottawa on April 11. He was born at Salisbury, England, on June 13, 1881. He attended Eaton House School at Aldeburgh and Bromsgrove School and matriculated into Oxford University. He received his technical training with C. H. Keefer and Company, construction engineers of Ottawa, and prior to the War filled various appointments on exploration, location and construction of the Grand Trunk Pacific Railway, Canadian Pacific Railway and the South Eastern and Chatham and Dover Railways, Eng. He was commissioned a lieutenant in the 1st Canadian Pioneer Battalion at Winnipeg and went to France with his unit. He was severely wounded, however, and was invalided to England. In 1917 he was promoted captain in the 2nd Battalion Canadian Railway Troops but when he was again invalided to England he was seconded to the Admiralty as technical adviser to the Director of Engineering Works, Department of Auxiliary Shipbuilding. During 1918 he was in charge of civil and mechanical engineering and was acting director of shipyards extensions from 1919 to 1920. For his services to the Admiralty he received the Order of the British Empire in 1921.

On his return to Canada, Col. Emra became senior partner of F. H. Emra and Partners, civil and mechanical engineers and surveyors, and continued in this position until his death.

Col. Emra joined the Institute in 1908 as a Student, transferring to Associate Member in 1912 and to full Member in 1919.

Sir Henry Japp, K.B.E., M.E.I.C., died in London on April 8. He was born at Montrose, Scotland, on June 6, 1869. He attended the Montrose Academy and later the University College, Dundee. From 1887 to 1892 he was apprenticed to the Caledon Engine Works, Dundee, and at the end of that period was awarded a Whitworth Exhibition and Medal. He then attended the Finsbury Technical Institute for a year. After working two years as draughtsman for Humphreys and Tennant, Deptford, he entered the firm of S. Pearson and Son Limited as assistant civil and mechanical engineer. After a year in this position he was made chief engineer and in 1898 engineer managing contracts. He held the latter post until 1904 when he came to New York as director and managing engineer of S. Pearson and Son Inc., New York. In 1914 he was made president of S. Pearson Son and Partners Canada Limited, and was located in Montreal. He returned to New York, however, to be with the British War Mission and in 1920 went to England where he was appointed chief engineer and works director of John Mowlem and Company Limited, the position which he held at the time of his death. Among the notable projects which he carried out were the Surrey Commercial Docks and Great Northern and City Railway, London; Pennsylvania East River Tunnels, New York; Prince of Wales Dock, Workington; King George V Graving Dock, Southampton; Dover Train Ferry Dock and Jetty and Power House Foundations for Ford Motor Works.

Sir Henry joined the Institute in 1914 and at the March, 1939, meeting of Council was made a Life Member.

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 February meeting of the Border Cities Branch of The Engineering Institute of Canada was held in Detroit as a joint meeting with the Detroit Section, American Society of Mechanical Engineers, on February 28th.

During the afternoon the members and ladies were entertained by an inspection tour through the pharmaceutical plant of Parke-Davis and Co. in Detroit, which took from 2 to 4 p.m. and was very educational. A biological motion picture was shown the visitors from 4.30 to 6 o'clock in the plant auditorium.

In the evening an informal dinner was held at the Intercollegiate Alumni Club located in the Penobscot Building. Seventy from the Border Cities Branch of The Engineering Institute of Canada were present at the dinner meeting to welcome the speaker, Mr. Harvey M. Merker, Superintendent of Manufacture, Parke-Davis and Co. Mr. Merker's subject was **Engineering Medicinally Speaking**, the address being illustrated by numerous samples of recent discoveries.

The speaker pointed out many of the interesting problems encountered in the manufacture of the many pharmaceutical products now available, including the development of the health producing vitamins and the most recent development "Vitamin K." During the development of any pharmaceutical product numerous experiments and tests are made on animals, to show the results obtained as a cure for a disease or as a body building product. Day by day the general public are growing more interested in the manufacture and development of the many new pharmaceutical products which are now on the market.

Mr. Merker's address was greatly appreciated.

The technical meeting adjourned at 10 p.m., and was followed by an "afterglow" meeting at which coffee was served. The meeting finished about 11 o'clock. The members and ladies of the Border Cities Branch of The Engineering Institute of Canada will long remember the very delightful afternoon and evening spent with the Detroit Section, American Society of Mechanical Engineers, acting as host.

The regular monthly dinner meeting of this branch was held on March 17 in the Prince Edward Hotel.

A large audience, including many visitors, were privileged to listen to a most interesting paper fully illustrated entitled, **The Thousand Islands Bridge—Canadian Section—Construction of the Super Structure.** This paper *in extenso* appears on page 216 of this issue of the Journal.

CALGARY BRANCH

B. W. Snyder, a.m.e.i.c. - *Secretary-Treasurer*

On February 2, 1939, H. J. McLean, a.m.e.i.c., presented a paper, **The Best Places in the West.** The paper was an analysis of the various agricultural districts in western Canada based on a detailed study of meteorological records, soil surveys, evaporation data, etc. Mr. McLean had prepared a map classifying into ten areas the central and southern portions of Saskatchewan and Alberta, according to their ability to support population. In concluding his paper, he stressed the need for scientific study before embarking on costly rehabilitation and irrigation projects.

On February 9 the members of the Branch were addressed by Mr. W. R. Foster, representative of the Kobe Corporation of California. Mr. Foster gave a talk illustrated by slides and charts on the subject of **Hydraulic Oil Well Pumping.** This paper was very interesting to the members in view of the recent extensive development in Turner Valley. A number of members of the Oil and Gas Association were present as guests at this meeting.

On March 2, Mr. Max Freedman, a member of the editorial staff of the "Edmonton Bulletin," gave an address on **The Rise of Dictators,** a subject of general interest to the members of the Branch and to the guests, including members of the Association of Professional Engineers of Alberta, the Canadian Institute of Mining and Metallurgy, the Canadian Institute of International Affairs and the Military Engineers Association. He traced the origins of dictators in Europe and showed that no democracy need fear the rise of dictatorship within its boundaries, providing that it retains its virility and resolutely maintains democratic institutions.

The annual meeting was held in the Palliser Hotel on Saturday, March 11, 1939. This was a luncheon meeting, convened at 1.00 p.m., and was well attended.

The chairmen of the various committees submitted their year-end reports.

H. J. McLean, a.m.e.i.c., who attended the Annual General Meeting of the Institute in Ottawa on February 14 and 15, described the proceedings at this meeting. He stated considerable interest was shown in the papers presented on water supplies and drought areas of Western Canada.

Officers for the ensuing year were elected as follows: Chairman, S. G. Coultis, m.e.i.c.; Vice-Chairman, James McMillan, a.m.e.i.c.; Secretary-Treasurer, B. W. Snyder, a.m.e.i.c.; Executive: J. B. DeHart, m.e.i.c., J. R. Wood, m.e.i.c., G. H. Patrick, a.m.e.i.c., E. W. Bowness, m.e.i.c.; Ex-Officio: J. Haddin, m.e.i.c., H. J. McLean, a.m.e.i.c.

The retiring chairman, Mr. E. W. Bowness, expressed the opinion that engineers should play a prominent part in public life, and in order to do this, they should be well informed, and therefore, the policy of having speakers address the branch on topics of general interest as well as purely technical matters, should be continued. This suggestion met with general approval.

EDMONTON BRANCH

F. A. Brownie, 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 Tuesday, March 21, 1939. At 6.00 p.m. about 45 members met at the City Power Plant to inspect the new boiler and 15,000 kw. Parsons turbo-generator. This generator is one of the largest of its kind in Canada. After the inspection the members moved on to the Macdonald Hotel for dinner.

After the dinner, R. G. Watson, a.m.e.i.c., Power Plant Superintendent, outlined the engineering problems leading up to the purchase and erection of the new equipment. The speaker then described in detail the various pieces of equipment from the boiler to the turbine and generator. At the close of the paper Mr. Watson answered a considerable number of questions.

Messrs. Darby, Couper, W. I. McFarland, a.m.e.i.c., and C. V. Weir, a.m.e.i.c., assisted in conducting the members around the plant.

HALIFAX BRANCH

L. C. Young, m.e.i.c. - *Secretary-Treasurer*
A. G. Mahon, a.m.e.i.c. - *Branch News Editor*

The April Meeting of the Halifax Branch was held in the Main Dining Room of the Halifax Hotel on April 20, with approximately sixty members and guests in attendance. The Branch Chairman, Allan D. Nickerson, a.m.e.i.c., introduced the speakers and guests.

Brigadier H. E. Boak, d.s.o., Officer Commanding Military District No. 6, spoke regarding the important place which engineers would hold in the service of this country in event of war. He also reviewed the past history of engineering and its relation to military activities through the ages.

The Meeting was favoured with the presence of Dean H. W. McKiel, President of the Institute, who took the opportunity to explain how the E.I.C. was undertaking the registration of engineers, chemists, and others technically qualified to co-operate with the Department of National Defence in the event of a military emergency. He also spoke regarding the need for revision in the present training of engineers and the problem of the absorption of the young engineer into the profession.

Colonel J. A. MacDonald and Mr. R. A. MacAlpine, both of Sydney, Nova Scotia, were heard in brief addresses during the evening.

A very fine and fitting tribute was paid to the memory of the late Colonel R. R. Murray, m.e.i.c., by C. A. Fowler, m.e.i.c. Colonel Murray lost his life in the recent Queen Hotel fire and, for a number of years, was Secretary of the Halifax Branch of the E.I.C.

Ira P. Macnab, m.e.i.c., outlined a plan for the presentation of student papers during the Fall Meeting, these papers to be competitive and to be presented by students of the Nova Scotia Technical College.

HAMILTON BRANCH

A. R. Hannaford, a.m.e.i.c. - *Secretary-Treasurer*
W. E. Brown, Jr.e.i.c. - *Branch News Editor*

The Hamilton Branch held the regular monthly meeting on March 16 in the Lecture Theatre, McMaster University.

Chairman J. R. Dunbar, a.m.e.i.c., presided. The speaker of the evening, Mr. W. W. Cushing, chief draftsman of the Hamilton Bridge Company and Registered Professional Engineer, British Columbia, was introduced by Mr. Russell Niblett, barrister and personal friend of the speaker.

Mr. Cushing gave a talk on the **Lions' Gate Bridge,** which now spans the First Narrows in Vancouver Harbour and has the longest single suspension span in the British Empire. A complete paper on this bridge will appear in an early number of the Journal.

At the conclusion of the talk, which had been illustrated with lantern slides, four reels of moving pictures were shown depicting the erection and all the major operations which had already been described.

W. Hollingworth, m.e.i.c., moved a very hearty vote of thanks to the speaker for this most interesting lecture and at his request Mrs. Cushing came to the front of the Lecture Theatre so that he might present, to her, on behalf of the members of the Hamilton Branch, a bouquet of spring flowers.

The members then adjourned for the usual coffee and sandwiches, the attendance being 95.

KINGSTON BRANCH

H. G. Conn, a.m.e.i.c. - *Secretary-Treasurer*

On January 19 Professor J. L. McDougall, Professor of Political Science, addressed the branch on **An Attempt to Define the Canadian Railway Problem.** A synopsis of his address follows.

Professor McDougall pointed out that the Canadian railway problem is not an operating problem and not even a problem of the recent depression, but a financial problem. This is the result of an inflexible organization meeting a decline in the demand for its services. On the whole, the railways show evidence of definitely declining business.

If the statistics showing amount of traffic per head of population were taken for the period 1877-1917 and projected to 1937 there would be indicated a freight traffic of 39.39 tons per head as against an actual figure of 8.27 tons.

The penalties of such a flattening curve of growth are: (1) Increased risk to new investment; (2) Probable fall in rate of earning on the existing investment; (3) Possible disclosure of weakness not previously apparent; (4) Difficulties in connection with promotions and pensions. In fact the curve may actually represent a relative retrogression. The figures in the accompanying table illustrate the extent of the decline.

Five year period ending	Passengers carried per head of population	Tons freight carried per head of population	Year	Gross earnings percent Nat. Income	
				Freight	Total
1879	1.46	1.72	1921	7.81	11.19
1884	1.93	2.86	1922	7.70	10.75
1889	2.32	3.53	1923	7.85	11.17
1894	2.76	4.40	1924	7.27	10.43
1899	2.71	5.10	1925	7.06	9.93
1904	3.69	7.60	1926	7.23	10.01
1909	4.75	9.46	1927	6.82	9.48
1914	5.58	12.15	1928	7.25	9.88
1919	5.60	13.89	1929	6.56	9.10
1923	5.40	13.07	1930	6.25	8.79
1928	4.42	12.77	1931	6.23	8.58
1933	2.71	9.15	1932	6.41	8.68
1937	1.87	7.50	1933	6.26	8.39
			1934	6.36	8.42
			1935	6.22	8.19
			1936	6.20	8.10
			1937	5.91	7.76

Motor car competition has been felt keenly, especially for short distance passenger travel and high value freight haulage, but the influence has been greatly overrated. Some more important factors contributing toward the present conditions are: (1) Spread of manufacturing, thus rendering part of the transportation cost avoidable; (2) End of construction cycle in the west; (3) Change in the nature of the economy, i.e., the gainfully employed do not produce so much tonnage per head.

As a possible solution of the problem the following suggestions were brought forward: (1) Withdrawal of many branch lines; (2) Increased flexibility of operation; (3) Frankly facing the losses already incurred; (4) Surveying and possibly reducing railway men's earnings; (5) Complete revision of present working rules.

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, Ont., March 30, 1939, at 6.45 p.m.

E. L. Goodall, A.M.E.I.C., the Branch Chairman, welcomed members and their guests, and introduced the speaker of the evening, D. Boyd, A.M.E.I.C., Manager of the Canadian Car and Foundry Company, Fort William.

Mr. Boyd spoke on **Welding.** He traced the process of welding back to its earliest beginnings. The first welding method known was the fire weld; at present several methods of welding are used such as thermit, oxy-acetylene, flash, shot, carbon metallic arc, and electric arc. Now 90 per cent of welding is done by the latter method. The speaker explained the importance of buying good welding rods and also warned against the use of cheap and improper welding equipment. He stressed the need of proper designing of welded joints and explained the necessity of proceeding with the welding of contacts in their proper sequence, contending that all failures of welded joints could be traced to faulty design or poor workmanship. Finally, he stated that welding is here to stay to serve mankind and predicted a great future for its use. A short discussion followed the address, with the following members taking part: S. E. Flook, M.E.I.C., P. E. Doncaster, M.E.I.C., E. L. Goodall, A.M.E.I.C., W. Bird, A.M.E.I.C., and K. A. Dunphy, M.E.I.C. A vote of thanks to the speaker was tendered by K. A. Dunphy, M.E.I.C., and seconded by G. H. Burbidge, M.E.I.C.

Mr. Doncaster gave a short report of the Annual Meeting at Ottawa. He stated that this was one of the most outstanding meetings of the Institute and gave a short resumé of the three days programme. He expressed his appreciation at being able to attend this meeting as a representative of the Lakehead Branch and also his pleasure at being elected a Councillor of the Institute. Discussion of Mr. Doncaster's report in detail will be resumed at the next meeting. Mr. J. M. Fleming, M.E.I.C., moved a vote of thanks to Mr. Doncaster for his fine report, seconded by H. G. O'Leary, A.M.E.I.C.

Thirty-six members and guests attended.

LONDON BRANCH

D. S. Scrymgeour, A.M.E.I.C. - *Secretary-Treasurer*
Jno. R. Rostron, A.M.E.I.C. - *Branch News Editor*

The regular monthly meeting was held on the 15th of March, 1939, in the Public Utilities Commission Board Room at the City Hall.

The speaker was Mr. Jean P. Carrière, A.M.E.I.C., and his subject, **Preliminary Investigations for Pile Structures and Foundations with Special Reference to Test Piling.**

The chair was taken by the Vice-Chairman of the branch, Major W. E. Andrewes, A.M.E.I.C., owing to the absence of our branch chairman, Mr. H. F. Bennett, on vacation.

The Chairman, in introducing the speaker, stated that Mr. Carrière, who had made a special study of this subject, is an assistant engineer in the Department of Public Works of Canada.

The speaker first dealt with the classification of piles under two heads, viz., "bearing" and "sheathing" piles. The former support direct loading and the latter are designed to resist lateral pressure.

Bearing piles may be of wood, cast iron, steel or concrete depending on the type of structure, the material into which they are to be driven, the stresses to which they are to be subjected, the amount of deterioration by natural forces and the permanency required. When no stratum of rock or solid material can be reached economically the resistance to penetration depends mainly on the friction between pile and soil and the resistance of the foot of the pile to penetration in the compressed soil.

Sheathing piles may be of wood, steel or concrete, dependent on the type of structure and the permanency required. The piles must be driven into the ground to such a depth that passive pressure developed will counterbalance or partly counterbalance the active pressure with the remainder of the lateral stresses being taken up by tie-rods or struts.

The characteristics of soils vary so much that it is impossible to develop empirical formulae for piling with any degree of accuracy and each job must be designed according to the characteristics of the soil into which the piles are to be driven.

It is therefore most important that all pilework designs be checked by the driving of test piles and that the behaviour of these be recorded in detail.

Mr. Carrière showed how the translation of the records was applied graphically and otherwise to the problem of the design of the permanent foundation.

Much discussion followed .the talk and it was evident that the interest of the members had been aroused.

A vote of thanks was proposed by E. V. Buchanan, M.E.I.C., seconded by J. A. Vance, A.M.E.I.C., and unanimously carried.

Twenty-four members and guests were present.

MONTREAL BRANCH

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

A meeting of the Junior Section was held on Monday, March 20, at which A. J. Groleau, Jr.E.I.C., spoke on Telephone Traffic Engineering for the Montreal Exchange. Slides and motion pictures illustrated the paper. Mr. Jose Valladares was chairman of the meeting.

On March 23, P. Ackerman, A.M.E.I.C., addressed the branch on the subject, **The Cause and Remedy of our Social-Economic Ills as Revealed by Engineering Research.** Mr. Ackerman, an electrical consultant of Montreal, read a paper on economics before the branch two years ago which also aroused considerable interest among the members. In 1921 and 1928 he was awarded the Gzowski Medal for papers on electrical subjects. In presenting his subject, Mr. Ackerman showed how the modern machine age creates the problem of an ever growing amount of superfluous labour. He suggested the solution would be found in the creation of a retired leisure class, supported by a national insurance scheme. A single income tax instead of the present many taxes would result in the elimination of the opportunist from politics by making all political positions honorary.

C. V. Christie, M.E.I.C., presided at the meeting.

W. L. Batt, President of the SKF Industries of Philadelphia, and President of the International Committee of Scientific Management, addressed the branch on the subject of **Business and Government** at the meeting on March 30. A written account of this address appears on page 230 of this issue. H. R. Wake, A.M.E.I.C., was the chairman of the meeting which was preceded by a courtesy dinner at the Windsor Hotel.

William M. Vermilye, Vice-President of the National City Bank of New York spoke before the branch on April 6. His subject, **The Development of Modern Aids to Business Management,** was presented in a most interesting manner. A courtesy dinner was held at the Windsor Hotel prior to the meeting.

On April 13, Prof. R. E. Jamieson, M.E.I.C., J. E. Armstrong, A.M.E.I.C., and F. C. Mechin, A.M.E.I.C., presented brief addresses on the subject of **Engineering Education.** A general discussion took place afterwards under the chairmanship of J. A. Kearns, A.M.E.I.C.

At the meeting on April 20, the paper, **The Cause and Remedy of our Social-Economic Ills as Revealed by Engineering Research,** by P. Ackerman, A.M.E.I.C., was discussed. Many of the members present when this paper was presented on March 23 requested a special meeting to discuss several aspects of the subject. This was the concluding meeting of the session. Refreshments were served after the meeting.

NIAGARA PENINSULA BRANCH

Geo. E. Griffith, A.M.E.I.C. - *Secretary-Treasurer*
J. G. Welsh, Jr.E.I.C. - *Branch News Editor*

One of the best attended meetings of the year was held on April 6, 1939, in the General Brock Hotel, Niagara Falls, Ontario. Vice-Chairman A. W. F. McQueen, M.E.I.C., presided. W. R. Manock, A.M.E.I.C., spoke briefly of the general Institute affairs, and of the final meeting of the Niagara Branch, following which he introduced the speaker of the evening, Dr. Saul Dushman, Assistant Director of the General Electric Company of Schenectady, N.Y. Through the medium of a talk and lantern slides, Dr. Dushman touched on a few of the **Modern Developments in the Electrical Field.**

He pointed out that only comparatively recently has industry entered the field of research. The General Electric Company was one of the first to realize the advantage and necessity of such work. In 1900, Dr. W. R. Whitney was appointed part time research worker, and from this humble beginning the extensive research organization has sprung.

At present each plant of the Company has its own Works Laboratory which is responsible for the work required at that plant, while at Schenectady in the main laboratory only pure research is carried on. In this organization, it has been found that in larger groups the interest in research is maintained at a high level, due largely to the interchanging of ideas. Also there is complete individual and departmental co-operation.

Dr. Dushman then mentioned a few of the recent developments. Through a study of the properties of monomolecular surfaces, a technique was evolved whereby it was possible to lay single layers of molecules on a glass or other polished surfaces. This found its application in the making of "invisible glass." If a thin layer of such a thickness and refractive index that light refracted from the glass back would be half a wave length from that reflected from the surface, then there would be no reflection. Such a surface can be produced by dissolving certain fatty acids in benzene, building successive layers on the glass, and then dissolving the objectionable constituents out. It is possible to produce such a structure that will give an efficiency of reflection of 90 per cent. Obviously this will be applicable in the manufacture of glass for meters and optical instruments.

Alnico then was described. This is a substance which may be magnetized so that it will pick up over fifty times its own weight of iron, and after suitable heat treatment this may increase to 1,000 times. At present this is finding a use in meters, motors, and numerous other devices.

Considerable work has been carried out on the study of lead-in wires for bulbs, x-ray tubes, etc. Formerly platinum was the only substance known which had the same coefficient of expansion as ordinary lime glass. As a result of this more recent work, it was found possible to produce several types of alloy wires which with the aid of heat treatment would give a coefficient of expansion curve similar to the different available types of glass.

A very interesting study of the welding arc was mentioned. Since the speed of sound varies with the temperature and density of the gas through which it is passing, and since the density of the gas in the arc was known, a device was set up which would measure the speed of sound through the welding arc. This made it possible to measure the temperature of the arc to within one per cent and for ordinary electrodes it was found to range between 4000 and 6000 deg. C.

Recent development and a few of the largest installations in the x-ray field were shown. Further recent work was referred to in a brief pictorial trip through the laboratory, following which the speaker answered a number of questions.

After a hearty vote of thanks to Dr. Dushman, proposed by A. S. Robertson, the meeting was adjourned.

OTTAWA BRANCH

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

The fundamentals of a new science, **Soil Mechanics,** were described at a noon luncheon, March 2, at the Chateau Laurier before the Ottawa branch of The Engineering Institute of Canada by J. W. Lucas, A.M.E.I.C., of the Physical Testing Division of the Testing Laboratories of the Department of Public Works. This new science is essentially the application of the older sciences of mechanics, mathematics, physics, hydraulics, geology and chemistry to the study of the behaviour of soils under foundations and engineering structures. It will have its greatest application in the erection of heavy engineering structures, buildings, bridges, dams, as well as in road construction in certain types of soil.

Chairman J. H. Parkin, M.E.I.C., expressed thanks to J. L. Rannie, M.E.I.C., chairman of the special committee on arrangements for the recent annual convention of the Institute held in Ottawa, for his work and the co-operation of those associated with him. Mr. Rannie in a brief speech referred to the fine work done by the ladies' committee under the chairmanship of Mrs. F. H. Peters. He also introduced the chairmen of the various special committees in charge of convention arrangements.

At the noon luncheon on March 16 Harold Ainsworth, senior illuminating engineer with the Civil Aviation Division of the Department of Transport, gave an address on **Aviation Lighting.** Mr. Ainsworth has been in charge of electrical power and lighting installation at departmental airports across Canada.

The modern airport with its smooth surfaced field must be lighted to be distinguishable at night. In addition to a rotating beacon—which also flashes a code—to assist in guiding the aviator to the field, the available area is marked with boundary units normally spaced 300 feet apart. Those at the sides of the field are clear while those at the ends of the runways are green. All obstructions in the vicinity are marked by red lights.

Along the edges of the hard surface of the runway itself "contact" lights, similar in color to the boundary lights, are placed approximately 165 feet apart, and are so designed that they do not protrude above the surface more than two inches. They may therefore be run over without damage. Provision is made for adjustment to the lights if the edges of the field become covered with snow.

For landing in fog, special instrumental equipment is required both on the ground and in the plane. When instrument landings are applied to commercial operation, the radio facilities will be supplemented with additional lighting equipment. Some airports are already equipped with a series of lighting units beyond the boundary of the airport, which rows of lights form the guiding approach to the landing strip. To date the subject of approach lighting systems, of which there is a variety, is still in the experimental stage.

One of the problems to be solved in the future appears to be the penetration of fog. When light strikes fog, it is dispersed by the fog particles and a ball of light occurs. This destroys any pattern that is made by various groupings of lights. Claims have been made for certain equipment, but as yet its effectiveness has not been proved.

Over two million feet or 400 miles of cables have been required for lighting the various aerodromes on the Trans-Canada Air route, stated Mr. Ainsworth. All boundary lights, contact lights and much obstruction lighting have to be fed by underground cable, including field lighting, when used within a radius of 2,000 feet from each aerodrome.

The Aesthetic Aspect of Bridge Building was the subject of a noon luncheon address on March 30 by W. E. McHugh, of the Ottawa Branch of the Dominion Bridge Company.

"During the past few years there has been a distinct change in the type of steel bridges that have been constructed, due in large measure to the general desire for structures of higher aesthetic value," stated Mr. McHugh. "Formerly in most cases minimum cost was a prime consideration and in some cases there were in ingenious minds insurmountable prejudices against certain designed features that precluded the use of types that carried more beautiful lines."

Electric arc welding and the oxy-acetylene torch have helped to bring about the change. In the old days bridges were designed on purely utilitarian lines and in isolated cases engineers endeavoured to embellish their work through the addition of decorative ornaments and detail, but now it is possible to obtain pleasing appearance in the lines of the main frame without the addition of superfluous material.

"The fundamental requisites for true beauty are honesty and sincerity," continued Mr. McHugh, "and where steel is the essential carrying element it is not necessary to hide it behind non-essential material."

Mr. McHugh showed a large number of slides illustrating the trend in the design of bridges during recent years.

PETERBOROUGH BRANCH

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

On March 23 Mr. A. K. Jordan addressed the last technical meeting of the season on the subject **The Uses of Aluminum in Industry.**

Mr. Jordan began with an historical sketch of aluminum production and the aluminum industry. This industry was started in Canada in 1899 with the construction of the Shawinigan Falls smelter, the first ingot being cast in 1901. This plant has been enlarged from time to time. In 1926 a plant was opened at Arvida. This plant was set up to make treated cryolite, carbon smelting blocks, to concentrate bauxite, and to make fluoride. All these were previously imported.

The Company now owns its own bauxite mines in British Guiana, where bauxite is mined from open pits. The bauxite is shipped from McKenzie on the Demerara River to Port Alfred on the Saguenay River, and transported from there to Arvida over the Aluminum Company's own railroad.

Plants are operated in Canada for the fabrication of aluminum in almost all its forms at Shawinigan Falls and at Toronto.

Electric power is the most important item in the smelting of aluminum. Over 12 per cent of the installed hydro-electric capacity of Canada is engaged in smelting aluminum.

The Canadian industry is not yet in a position to produce the strong alloys which are produced for the Canadian market in Great Britain. The industry employs about 5,000 people in Canada, and its annual production is valued at $23,000,000. Aluminum is the third most important Canadian base metal.

At the close of the talk the Chairman suggested that the meeting appoint a Nominating Committee for its next year's officers. It was moved by R. L. Dobbin, M.E.I.C., seconded by A. L. Killaly, A.M.E.I.C., and carried, that the Chairman and the two immediate Past Chairmen act as this committee.

It was announced that the annual branch business meeting would be held on May 3 in the Y.M.C.A., and would include a dinner and a short sports programme. It was also announced that the Association of Professional Engineers would hold a business meeting in Peterborough on Saturday, April 22.

SAULT STE. MARIE BRANCH

O. A. Evans, Jr.E.I.C. - *Secretary-Treasurer*
N. C. Cowie, Jr.E.I.C. - *Branch News Editor*

At the regular meeting of the branch held at the Windsor Hotel on March 24, twenty-four members and guests sat down to dinner. Chairman A. E. Pickering, M.E.I.C., presided. After a short business session J. W. Craig of the Canadian Refractories Ltd. addressed the branch on **Newest Refractories for the Steel Industry.** The speech was illustrated throughout with slides. Also present as guests were Major G. M. Carrie and Mr. Brydon of the Canadian Refractories Ltd.

TORONTO BRANCH

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

On March 2, 1939, the regular semi-monthly meeting of the branch was held at Hart House with Dr. A. E. Berry, M.E.I.C., in the chair. The branch was fortunate in securing J. A. Wilson, M.E.I.C., Controller of Civil Aviation, Ottawa, to address its members on **Aerial Transportation Developments in Canada.** The speaker opened his remarks by saying that Canada has gained more than other countries from the development of aviation due to the widespread terrain and scattered population, and also that more diversified technical knowledge is required for the pursuit of aviation than almost any other activity. At the end of the Great War military aviation languished and there were still no civil activities, although in 1915 Dr. Camsell, M.E.I.C., made inquiries regarding the use of flying boats for the geological surveys being conducted in the far north by the Dominion Government. In August, 1919, the first experimental forest patrols commenced in Canada, and they were well established by 1922. From these patrols the first photographic survey flights followed, and now more than a million square miles have been mapped from the air. The next to use planes to a considerable extent were the prospectors.

Intercity flying was practically non-existent, although in 1919 the first transcontinental flight in Canada was made in ten days.

Intercity travel in the United States was fostered by the passing of the Kelly Act in 1926, and practically dated from this time. In 1928 the Dominion Government started preliminary surveys for a transcontinental route and in March, 1929, Winnipeg, Calgary and Edmonton commenced an intercity service for mail only. In 1932, financial stringency caused the Dominion Government to eliminate this service but they continued the surveys for the selection of suitable sites for airports for a future transcontinental service. The Ontario sites were chosen in the portion of Northern Ontario known as the clay belt, due to the flat terrain and the less variable weather, and resulting steadier visibility than prevails in the vicinity of the Great Lakes. Many of these airports were constructed by the men in the Government labour camps and the speaker paid a tribute to the fine way the work was done. Timber cutting was done in the winter and clearing in the summer. Some were graded by hand labour but in 1936, when the camps were closed, mechanical graders were purchased, also ditching machines for placing the extensive tile drains required to keep a modern airport in good condition at all seasons of the year. In winter, the northern airports do not attempt to keep the snow cleared off the runways but instead the snow is packed down by tractor-drawn rollers which produce a fine hard surface for landings and take-offs.

At Malton and at the Island, Mr. Wilson declared that Toronto possessed two of the finest airports on the continent. The standard runway for all T.C.A. airports was 3,000 ft. long with the site chosen so that expansion to 5,000 ft. was a possibility at all key airports. The British Government standard was 4,500 ft. and all planes there are built to conform to this length. A standard airport must have three 3,000 ft. paved runways with lights, radio range for two-way conversation, and meteorological services. The lighting beacons give forth a one million candle power beam, which rotates six times per minute and have been seen up to a hundred miles distant. However, the flier's main dependence must be placed on the radio, because lights are only visible during good weather. Radio range or beam stations have been built at all landing fields with 3,000 ft. runways, and as thirty-six of these are already constructed, it means that there is a fully equipped landing field with all services, including teletype weather reports, every one hundred miles all across Canada. The radio equipment is connected to towers 150 ft. high using a counterpoise system of grounds and antennae, and the towers, due to their height, must be located some distance from the fields.

At regular intervals, the meteorologists release small hydrogen-filled balloons, and by observations with transits, get records of the direction and speed of the upper air at various elevations.

Trans Canada Airlines is a wholly owned subsidiary of the Canadian National Railways. Its main base is at Winnipeg for the transcontinental route. The equipment so far is the Lockheed 14, which can carry twelve passengers and 1,000 lb. of mail. The planes are capable of non-stop flights from Toronto to Winnipeg, or Winnipeg to Vancouver, and have a cruising speed of 220 mi. per hr. They are equipped with two seven hundred and fifty horsepower radial type motors which normally consume 60 gal. of gasoline per hr. The planes and equipment cost $130,000 each, and for cost purposes their depreciation is calculated at 25 per cent per annum. The planes fly at altitudes of 12,000 ft. when eastbound and 11,000 ft. when westbound.

The personnel has been selected largely from among the flyers of existing northern services. All have been given additional technical training including courses on the Link trainer for blind flying. All pilots are tested on the Link trainer every month, and receive a physical examination every six months. Flying time is limited to a stated number of hours each month. The attendants on planes are all girls known as stewardesses, who must all be registered nurses of a stated height and weight.

In advance of each flight, the wind velocity, cloud height and other data are studied and a definite "flight plan" is formulated. If this is changed later during flight, the change must be communicated by the pilot by radio to the ground stations.

WINNIPEG BRANCH

J. Hoogstraten, a.m.e.i.c. - *Secretary-Treasurer*

On March 2, a joint meeting of the A.P.E.M. and the Winnipeg Branch was addressed by Prof. J. H. Ellis, Dept. of Soils, University of Manitoba, on the subject of **Soils and Soil Conservation Problems.**

In the soil survey of Manitoba at present being carried on, the soil is examined along section lines about every one-quarter mile, and the results plotted to a scale of two inches to the mile on township plats. At present, nine million acres have been surveyed. The three major problems disclosed by the survey are drought, wind erosion and soil erosion.

The moisture content of the soil is not dependent on precipitation only, but is largely affected by the texture of the soil, the texture, in turn, being dependent to a large extent on the crops grown thereon.

Summer fallowing with the basin tripper and the construction of terraces and furrows along the contours are useful in preventing run-off.

In the drought areas, it is considered that dams and dugouts have not been used to obtain maximum benefit, and it is suggested that some drainage scheme used in conjunction with these may provide adequate supply of moisture to maintain small vegetable gardens even in the driest portions of the province.

Soil loss due to wind erosion begins from the time the land is broken unless the soil is maintained in an aggregate condition. Wind erosion removes the finer particles, leaving, in extreme conditions, the skeleton soil only, which is incapable of sustaining plant life. The approach to this problem is to reduce wind velocities by means of wind breaks and to increase the size of the aggregate by seeding to grass.

THE PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS

The Association held their annual dinner at the Cercle Universitaire de Montréal on April 24. President R. H. Macdonald was in the chair. Col. Wilfrid Bovey, Director of Extra-Mural Relations, McGill University, spoke on **The Buildings and the Spirit of Quebec.** Vice-President Newell attended as the representative of The Engineering Institute of Canada.

CANADIAN SECTION OF THE AMERICAN WATER WORKS WORKS ASSOCIATION

A very successful annual meeting of the section was held in Toronto from April 12 to 14 with a registration of 446. At this nineteenth annual meeting of the organization it was shown that the membership had grown to a total of 222.

Papers were read by: N. G. McDonald, a.m.e.i.c., **Waterworks Intakes; Valuation of Waterworks Systems in Canada** by J. B. Clark Keith, a.m.e.i.c; V. A. McKillop, a.m.e.i.c., **Some Phases of Public Relations for Water Works;** H. P. Stockwell, **Some Features in Water Coagulation.**

The officers for 1939-40 are: Past Chairman, A. B. Manson, m.e.i.c., Stratford, Ont.; Chairman, C. J. DesBaillets, m.e.i.c., Montreal; Trustees: R. J. Smith, Perth, Ont., G. H. Strickland, Windsor, Ont., F. G. Browne, Kirkland Lake, Ont., Wm. G. Storrie, m.e.i.c., Toronto, W. E. Robinson, Calgary, Alta., O. H. Scott, Belleville, Ont., Secretary-Treasurer, A. E. Berry, m.e.i.c., Toronto.

Library Notes

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

PROCEEDINGS, TRANSACTIONS, Etc.

American Society of Mechanical Engineers:
Transactions, Vol. 60, 1938.

Institution of Water Engineers:
Transactions, Vol. 43, 1938. (Bristol, England.)

REPORTS, Etc.

Canada Dept. of Labour: Investigation into an alleged combine in the manufacture and sale of paperboard shipping containers, 1939. Labour Legislation in Canada, 1938.

Canada Dept. of Mines and Resources: Report of the Department for the year ending March 31, 1938.

Canada Dept. of Mines and Resources Bureau of Mines: Gasoline Surveys for 1937 and 1938.

Canada Dominion Bureau of Statistics: Survey of Libraries in Canada, 1936-38.

Edison Electric Institute: Boilers, Superheaters, Economizers, Air Heaters, and Piping, 1938.

Electrochemical Society: The Electrolytic Formation of Azo Dyes; Plating on Aluminum; The Anodic Solution of Alloys; The Electrolytic Preparation of 5, 7, Di-iodo-8-quinolinol; The Electrochemical Reduction of Sugars; Electrochemical Experiments with Various Organic Acids; The Electrolytic Preparation of 2, 4-Dinitrobenzoic Acid from 2, 4-Dinitrotoluene; The Electrolytic Reduction of Benzoic Acid to Benzyl Alcohol; Porous Carbon Electrodes; The Electrochemical Reduction in Acid Solution of Para-Nitrophenetole; The Mechanism of the Kolbe Electrosynthesis and Allied Reactions; Amalgam Activities and Standard Electrode Potentials; The Electrodeposition of Nickel from Nickel Chloride Solutions.

New York, Port of:
Eighteenth Annual Report 1938.

Nova Scotia Power Commission:
Nineteenth Annual Report, 1938.

Ontario:
Mineral Production of Ontario in 1938.

Quebec:
Mineral Production, 1938.

U.S. Dept. of the Interior:
Geology and Ground-Water Resources of the Snake River Plain in Southeastern Idaho; Surface Water Supply of the United States, 1937, pt. 6 Missouri River Basin, pt. 7 Lower Mississippi River Basin, pt. 9 Colorado River Basin (Geological Survey Water-Supply Paper 774, 826, 827, 829).

University of Illinois Bulletin:
An Investigation of Rigid Frame Bridges, pt. 1 and 2.
The Effects of Errors or Variations in the Arbitrary Constants of Simultaneous Equations; A Survey of Sulphur Dioxide Pollution in Chicago and Vicinity; Fatigue Tests of Butt Welds in Structural Steel Plates.

TECHNICAL BOOKS, Etc.

THE APPLICATION OF TENSORS to the Analysis of Rotating Electrical Machinery, pts. 1-16:
By Gabriel Kron. Schenectady, N.Y., General Electric Review, 1938. 187 pp. figs. 11 by 8 in., cloth.

DESIGN OF INDUSTRIAL EXHAUST SYSTEMS
By J. L. Alden. New York, Industrial Press, 1939. 220 pp., illus., 8¾ by 5 in., cloth, $4.50.

This book discusses how to design, build or buy an exhaust system that will adequately and economically perform the functions required by law or prescribed by specialists in industrial hygiene. It covers exhaust ventilation, low-pressure pneumatic conveying, the design of hoods, piping and structural details, and the selection of dust separators and centrifugal exhaust fans.

DIRECT-CURRENT MACHINERY
By H. S. Bull. New York, John Wiley & Sons, 1939. 318 pp., illus., diagrs., charts, tables, 9 by 6 in., cloth, $3.00.

The arrangement of topics in this textbook has been made with a view toward better correlation with laboratory instruction. Otherwise the treatment is that customary to elementary books on the subject. Principles, descriptions, and characteristics of d.c. machines are discussed and a set of explanatory problems is included.

THE FUNDAMENTALS OF ELECTROMAGNETISM
By E. Geoffrey Cullwick. Cambridge, University Press, 1939. 352 pp., figs., 8¾ by 6 in., cloth, $5.50.

This book is a contribution to the present problem of restating the fundamentals of electricity and magnetism. The whole question of the meaning of the physical concepts is discussed and the fundamental theory is logically developed. The book synthesises the subject, from electrostatics through permanent magnets to electromagnetic waves; it gives all theory in a form which can be used either with orthodox units or the new m.k.s. practical units; and it contains many worked and unworked examples.

THE 1939 CALLENDAR STEAM TABLES
By G. S. Callendar and A. C. Egerton. London, Arnold, 1939. 66 pp., tables, 11 by 8 in., cloth, $4.50.

U.S. WORKS Progress Administration Bibliography of Aeronautics
Pts. 19 and 20 Control Surfaces and Slots and Flaps; Pts. 25 and 26 Air Navigation and Flight Instruments. New York, 1938-39. 10¾ by 8¼ in., paper.

NEW AND REVISED SPECIFICATIONS

American Institute of Electrical Engineers: Recommended Practice for Electrical Installations on Shipboard (No. 45, December, 1938); Test Code for Apparatus Noise Measurement (No. 520, March, 1939).

American Society for Testing Materials: Index to A.S.T.M. Standards and Tentative Standards, 1939.

Canadian Government Purchasing Standards Committee: Specification for Flannelette, Unbleached, Wide; Cotton Towelling, Huck, Bleached; Linen Towelling, Huck, Bleached; Cotton Towelling, Terry, Bleached; Cotton Drill, Unbleached; Cotton Drill, Bleached; Paper, Fine Writing and Ledger; Mechanical Rubber Goods.

U.S. Department of Commerce National Bureau of Standards: Building Materials and Structures Report BMS6 Survey of Roofing Materials in the Southeastern States; Report BMS10 Structural Properties of One of the "Keystone Beam Steel Floor" Constructions, sponsored by H. H. Robertson Co.; Report BMS11 Structural Properties of the Curren Fabrihome Corporation's "Fabrihome" Constructions for Walls and Partitions; Report BMS12 Structural Properties of "Steelox" Construction for Walls, Partitions, Floors, and Roofs, sponsored by Steel Buildings, Inc.; Report BMS13 Properties of some Fibre Building Boards of Current Manufacture; Report BMS14 Indentation and Recovery of Low-Cost Floor Coverings; Report BMS15 Structural Properties of "Wheeling Long-Span Steel Floor" Construction, sponsored by the Wheeling Corrugating Company.

JANUARY AND MARCH JOURNALS REQUIRED

Copies of the January and March, 1939 issues of The Engineering Journal are wanted by the Institute for binding and it would be appreciated if members would forward copies available to Headquarters at 2050 Mansfield Street, Montreal, Que.

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 J. M. Bryant, J. A. Correll and E. W. Johnson. 3 ed. New York and London, McGraw-Hill Book Co., 1939. 522 pp., diags., charts, tables, 9 x 6 in., cloth, $4.50.

The first six chapters of this revised edition discuss the theory of alternating-current circuits and the development of the equations applying to the various types of circuits. The remaining ten chapters consider the application of these principles to polyphase circuits and transmission lines. Transients and circuits containing magnetic materials are not treated in this volume. Problems accompany each chapter.

CHEMICAL INDUSTRIES
Edited by D. M. Newitt. New York, Chemical Publishing Co., 1939. 380 pp. and bibliography, 79 pp., illus., diagrs., charts, tables, 11 x 9 in., cardboard, $4.00.

This annual contains a collection of numerical data and information frequently wanted by those in the process industries, accompanied by directories of British manufacturers of supplies and equipment. 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, fine chemicals, conversion tables, books.

DEPRECIATION, Principles and Applications
By E. A. Saliers. 3 ed. New York, Ronald Press Co., 1939. 482 pp., charts, tables, 9 x 6 in., cloth, $5.00.

A summary and interpretation of approved present-day practice, this book considers all the aspects of business-management, operating, finance, and accounting—in their connection with depreciation and valuation, including actual methods of procedure. Problems are analyzed and the practical and legal aspects of various methods of treatment are discussed. Full tables of probable useful life and depreciation rates for hundreds of items are appended.

DIESEL ENGINES, Theory and Design

By H. E. Degler. Chicago, American Technical Society, 1939. 270 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $2.50.

A practical elementary text which uses only elementary mathematics, intended for evening-school classes and home study. Thermodynamics, fuels and combustion and testing are considered, together with the principles of design and the design of engine parts.

HIGH-SPEED COMBUSTION ENGINES. Design; Production; Tests. 10 ed. of the Gasoline Motor.

By P. M. Heldt. Nyack, N.Y., P. M. Heldt, 1939. 742 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $7.00.

Originally entitled "The Gasoline Motor," this treatise covers the design, production and testing of the gasoline engine in a comprehensive, practical manner. Theory and fundamentals are thoroughly explained and their application illustrated by numerous examples of modern engines. The book is intended as a textbook for students and a reference book for engineers. This edition has been thoroughly revised and largely rewritten. Many new illustrations have been added, and also chapters on carburetors and ignition equipment. Designers and constructors will find the work useful.

HOUSE CONSTRUCTION DETAILS

Compiled by N. L. Burbank. New York, Simmons-Boardman Publishing Corp., 1939. 317 pp., illus., diagrs., charts, tables, 11 x 9 in., cloth, $3.00.

This book contains a collection of information on the details of small building construction, photographs of finished work, tables, etc. The material is chiefly presented in drawings, with brief explanatory text, and is arranged in construction sequence. The volume is intended for use in trade schools and in the drafting room. Much of the material has appeared in the American Builder and the Building Age.

HYDRAULICS for Engineers and Engineering Students

By F. C. Lea. 6 ed. New York, Longmans, Green & Co., 1938. 757 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $6.75.

The opening chapters deal with the basic characteristics of fluids at rest and in motion. The several chapters following contain a detailed analysis of the flow of water over weirs, through orifices and pipes, and in open channels, as well as of gauging practice. A chapter on the impact of water on vanes is introductory to the description and analysis of water wheels, turbines, centrifugal and reciprocating pumps, and other hydraulic machines. Stream line motion and dynamical similarity are briefly discussed.

HIGHER MATHEMATICS

By R. S. Burington and C. C. Torrance. New York and London, McGraw-Hill Book Co., 1939. 844 pp., diagrs., charts, tables, 9 x 6 in., cloth, $5.00.

Designed primarily to meet the needs of students interested in the applications of mathematics to physics and engineering, the concepts presented have been developed with sufficient rigor to be suitable as well for students of pure mathematics. In the following topics the physical meanings of the various notations and relationships have been emphasized, with the help of numerous examples and exercises: advanced differential and integral calculus; differential equations; infinite series; functions of a complex variable; vector analysis; and the calculus of variations.

INCHLEY'S THEORY OF HEAT ENGINES

Edited and revised by H. W. Baker. New York and London, Longmans, Green & Co., 1938. 445 pp., diagrs., charts, tables, 9 x 6 in., cloth, $3.60.

Considerably changed from the original book, this new edition retains the author's idea "to give in a complete and concise form the thermodynamical principles of the subject." These principles, first the fundamental general ones and then the more specific applications, are considered respectively before the discussion of the particular devices treated: air compressors and motors, reciprocating steam engines, steam turbines, internal combustion engines, and mechanical refrigerators. Heat transfer, combustion, and test methods are also included.

MECANIQUE des FLUIDES APPLIQUÉE, 2 Vols.

By A. Tenot, with preface by A. Caquot. Paris, Dunod, 1939. Diagrs., charts, tables, 9 x 5 in., Vol. 1, 226 pp., 64 frs. bound; 56 frs. paper. Vol. 2, 147 pp., 50 frs. bound; 42 frs. paper.

These are the first two books of four which are to be devoted to presenting practical applications of the laws of fluid mechanics. A variety of problems met in the design of turbines, pumps and aircraft and in viscosimetry and lubrication, are worked out in numerical examples. These selected problems offer practical experience in applying theories to concrete cases.

PATENT TACTICS and LAW, rev. ed. of "Patents"

By R. S. Hoar. New York, Ronald Press Co., 1939. 315 pp., 9 x 6 in., cloth, $4.50.

This treatise on patent tactics contains an analysis and interpretation of enough of the patent law to enable an industrial executive or engineer to understand and co-operate with his patent attorney. Definitions, patentability, search procedure, litigation policies and maneuvres, and the organization of a patent department are all discussed in clear, non-technical language.

(Th PERCEPTION of LIGHT

By W. D. Wright. New York, Chemical Publishing Co., 1939. 100 pp., charts, diagrs., 8 x 5 in., cloth, $2.50.

A concise analysis of the visual phenomena of most importance to lighting engineers and others concerned with lighting problems. Special attention is paid to purely physiological investigations in this field. Among the topics considered are vision at low and high intensities, glare, and visual sensations.

POWER-FACTOR ECONOMICS

By P. L. Rogers. New York, John Wiley & Sons, 1939. 143 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $2.50.

The aim of this book is to answer the questions that arise when power factor is considered and to provide simple, accurate means for solving power-factor problems. The larger part of the book is devoted to industrial plants, but a section is also included on the distribution systems of public utilities. The data required for the solution of problems is included, and typical problems are solved as illustrations.

PRACTICAL HEAT

Ed. by T. Croft, revised by R. B. Purdy. 2 ed. New York and London, McGraw-Hill Book Co., 1939. 726 pp., illus., diagrs., charts, tables, 8 x 6 in., cloth, $5.00.

This book is intended to provide a textbook on heat which can be used by those with no mathematical equipment other than arithmetic. The fundamental laws of heat phenomena, the effects of heat and the properties of vapors are explained in the theoretical sections. These are followed by sections on the practical applications of heat phenomena in steam and internal-combustion powerplants, building heating and refrigeration. Numerous examples and problems are given. In this edition the practical sections have been thoroughly revised.

SOLS et FONDATIONS. (Collection Armand Colin No. 217)

By A. Mayer. Paris, Librairie Armand Colin, 1939. 201 pp., illus., diagrs., charts, tables, 7 x 5 in., paper, 15 frs.; bound, 17.50 frs.

A concise presentation of the present state of our knowledge of soil mechanics, by a prominent French investigator. Deep and shallow foundations, shafts, caissons, piles, sustaining walls and embankments are discussed. There is a brief bibliography.

The STONE INDUSTRIES

By O. Bowles. 2 ed. New York and London, McGraw-Hill Book Co., 1939. 519 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $5.00.

This is the only current book upon the stone industries as a whole. Both dimension stone and crushed and broken stone are included. The origin, properties, methods of preparation and uses of each variety are described. A bibliography is given for each chapter. The new edition contains the latest available statistics.

STREAM and CHANNEL FLOW (Hydraulic Graphs and Tables)

By E. E. Morgan, with a foreword by C. L. H. Humphreys. London, Chapman & Hall, 1938. 240 pp., tables, charts, 9 x 6 in., cloth, 25 s.

This volume contains a collection of graphs and tables prepared to facilitate calculations relating to the uniform flow of water in open channels and streams. The graphs and the greater part of the book are based on Manning's formula. A comparative study of various formulas is included. The tables are designed to enable problems of velocity and discharge to be solved quickly and simply. Their use is illustrated by numerous examples.

TENSOR ANALYSIS of NETWORKS

By G. Kron, New York, John Wiley & Sons, 1939. 635 pp., diagrs., charts, tables, 9 x 6 in., cloth, $7.50.

The subject matter of this volume presents a new method of approach to the analysis and synthesis of networks through the use of tensors and spinors. Although the book deals specifically with the organization of those sets of linear, algebraic equations occurring in the study of symmetrical active networks having lumped constant, it also constitutes an introduction to similar applications of tensor analysis in other engineering fields.

COMING MEETINGS

Affiliated Engineering and Allied Societies in Ontario—Joint Dinner Meeting, Thursday, May 18, 1939, Concert Hall, Royal York Hotel, Toronto, Ont. Speaker, I. I. Sikorsky, engineering manager, Sikorsky Aircraft Division of the United Aircraft Corporation, Bridgeport, Conn.

American Society for Testing Materials—Forty-second Annual Meeting, June 26-30, 1939, at Chalfonte-Haddon Hall, Atlantic City, N.J.

American Water Works Association—Fifty-Ninth Annual Convention. June 11-15, at Atlantic City Auditorium, Atlantic City, N.J. Secretary, H. E. Jordan, 29 West 39th St., N.Y.

Canadian Electrical Association—Forty-Ninth Annual Convention at The Pines Hotel, Digby, N.S., June 21-24, 1939.

Edison Electric Institute—Seventh Annual Convention, Waldorf-Astoria Hotel, New York, N.Y., June 6, 7 and 8, 1939.

Internationaler Kongress fur Wohnungswesen und Stadtebau, Stockholm, July 8-15, 1939.

BOOK REVIEW

The Canadian Railway Problem

By Lesslie R. Thomson, M.E.I.C., consulting engineer, Montreal. Macmillan Company, Toronto, 1938. 1080 pp., tab., 10¼ by 7 in., cloth, $12.50

Reviewed by C. R. YOUNG, M.E.I.C.*

Whoever lays hands on the physical outcome of Lesslie R. Thomson's five years of intensive labour in the field of railway economics cannot fail to feel the impact of its exhaustiveness and wealth of detail. Arrangement, tabulations, footnotes and cross-referencing are typical of the thoroughness and foresight that characterize the work of a trained engineer. Refuge is not sought in generalities. No less than 199 tables and 49 figures reinforce the text.

While establishment of the factual basis of the problem and consideration of the many plans advanced for its solution bulk largest in the work, much space is devoted to the author's conception of the factors necessarily involved in any adequate solution and to the presentation of his own recommended plan. In point of fact, the whole book is made to march in measured step towards the elucidation and advocacy of that plan. It is essentially an argument, meticulously supported and buttressed on all sides, even to the extent of setting up and demolishing counter-arguments.

Causes of the Railway Chaos

In the opinion of the author, the major cause of the predicament in which the railways of Canada now find themselves is the long-continued financial depression. He finds that there is much less redundant rail mileage than many persons think, particularly in view of the inescapable "strip economy" of this country. More mileage per capita is required where populous centres are separated by long distances than where they are closely spaced. In any event, an economic debacle such as that which cut the gross railway earnings for the period 1932-1934 to 54.1 per cent of what they were for 1927-1929 would have shaken even the strongest corporation.

It would be too much to say that no unsoundness of financial structure of the railway companies contributed to the chaos, and Mr. Thomson would be the last to say it. Certain conditions pertaining to the rail situation are unsound, irrespective of any depression. A debt per mile of road 78 per cent greater than that borne by Class I railways of the United States imposes a terrific handicap on rail transport in Canada. On the basis of normal accounting, but excluding unpaid interest on the Canadian Government Railways, which were constructed in fulfilment of national policy, the author finds that at no time since 1917 have all Canadian steam railways paid their way. At no time since its consolidation (with the exception of the years 1926 and 1928) has the Canadian National Railway System paid its operating expenses and fixed charges on the securities held by the public. It has paid nothing on loans and advances made by the Federal Government and nothing has, of course, been paid on any capital invested in the Canadian Government Railways.

Competition

There can be no doubt that our unhappy presence in the railway morass is largely due to the unbridled competition to which the railways gave their full energies between the years 1923 and 1931. On the basis of the author's tables, with which the text does not always agree, the funded debt of the Canadian National Railways represented by securities in the hands of the public rose in that period from $823 millions to $1,276 millions, while the debt to the Dominion Government rose from $1,114.2 millions to $1,363.8 millions. In the same period the debt of the Canadian Pacific Railway increased from $270.6 millions to $479.5 millions. Most of these vast additional obligations were incurred in order to maintain corporate position and prestige.

While the author properly observes that the railway woes do not arise in a determining degree from the competition of other forms of transport, it would be unwarranted to assume that this had not seriously affected the ability of the railways to make ends meet. The waterways of Canada are essentially free to the commerce of all nations. Motor transport has heretofore been required to pay only a small part of the capital charges that have been incurred in the provision of highways. In the whole of Canada the total provision for sinking funds amounts to only about 0.25 per cent of the cost of the highways provided. Ontario and Quebec make no formal allowance whatever for highway debt retirement. In the case of the former province, as is evident from the report of the Royal Commission on Transportation (Ontario), and the recently announced expenditures for the fiscal year 1939, the deficiency between highway revenue and highway expenditure made by the province itself, without interest, grew to approximately $138 millions in the 21 years ending March 31, 1939. The municipalities themselves, out of their own taxes, paid in the same period about $162 millions more for roads and streets than the amount fairly chargeable to them for non-motor use. The $300 millions of aid which has in this manner been extended to motor vehicles as a class supports commercial motor transport to an important degree in its competition with the railways and to that extent constitutes a virtual subsidy. For the whole of Canada it is probable that a sum of the order of half a billion dollars in excess of highway revenue has been devoted to the encouragement of motor traffic in the past 21 years.

Whatever improvement of operating efficiency may have accrued from the competition of the rails amongst themselves in other days, the author holds that competition of rail with rail is no longer necessary to secure that end. The struggle with other forms of transport and with the railroads of the United States serves to keep Canadian railway managements alert.

Excessive Labour Costs

The author definitely recognizes the extraordinary rigidity which attaches to the item of labour cost in railway operation. With wages and salaries constituting two-thirds of the total operating expenses and powerful labour unions dictating rates of pay and working rules that in certain cases border on the absurd, there is little that management has been able to do to compensate for declining traffic. A courageous national service was performed by Professor J. L. McDougall in recently pointing out the uncomfortable facts in some detail to the Committee of the Senate enquiring into the railway situation in Canada.

Remedies

The author leaves no doubt in the minds of his readers concerning the failure of the plan of compulsory co-operation introduced at the instigation of the Duff Commission. It does not appear that the actual savings have ever amounted to more than two millions per year, or one-third of the amount suggested by Sir Edward Beatty, who had no incentive to fix a high estimate for them. Of the various reasons for the failure of the plan, the most cogent is, to quote the late Hon. C. P. Fullerton, Chairman of the Board of Trustees of the Canadian National Railways, that "quicker progress could have been made had there been present in the officials of both railroads a greater measure of the will to co-operate." The reasons for the lack of desire are obvious. No assured community of interest could exist under a plan of this kind. There can be no substantial savings if the advantage goes largely to others rather than to the party making them.

Mr. Thomson evidently believes that, even at this late date, there is some possibility of public advantage accruing from the placing of certain parts of the Canadian National System in bankruptcy. With the perspective that time gives it now appears that the public interest would have been served had the Canadian Northern, the Grand Trunk and the Grand Trunk Pacific been allowed to go to the wall and emerge rehabilitated. But the political leaders of 1916 could not have foreseen the devastating depression that set in eleven years after the termination of the war nor the effects of it on the fortunes of the railways. Heavy as the public commitment was in 1916 or 1917, it formed but a trifling fraction of what it now is. In the hope that something might yet be salvaged from the wreckage, the author proposes that a Royal Commission be set up to inquire into the feasibility of bankruptcy for parts of the Canadian National Railways. Whether a step of this kind would hold out more than a forlorn hope is doubtful. So much has the government of this country become identified with the railway business and so many are the actual and implied responsibilities of its position that there appears to be small likelihood of bankruptcy proceedings now being found practicable.

Plan of Common Management

As a basis upon which to set up a prudent and sufficient railway policy, the author enunciates and discusses at some length twelve principles to which it should conform. He reaches the conclusion that the public interest would be best served by embarking on a plan of common management similar in many respects to that put before the Duff Commission by Mr. Gerard Ruel. In accordance with it the two great railway systems, without alteration in ownership or title to property, would be placed in the hands of a Board of Directors for operation and management in a manner calculated at once to serve the best interests of the country as a whole and to effect the greatest possible economies consistent with that object. The policy would be given a trial for a term of at least ten years and on the expiry of that period the Parliament of Canada could then, if it so desired, revert to a policy of competition or set up a railway monopoly.

Mr. Thomson's plan is obviously and frankly a tentative measure, which would afford an opportunity for determining the essential characteristics of the final solution. By adopting a plan of this kind the Government would avoid the irrevocability feature of unification, while at the same time it could elicit closer co-operation between the railways, could eliminate unnecessary duplication in service and new capital expenditures and could formulate a policy of debt reduction. Criticisms there would be and with the most obvious of these the author has effectively dealt.

Mr. Thomson will doubtless be charged with extreme rashness in attempting to grapple with a problem that has baffled governments and commissions, not to speak of individual students. In some instances his facts may be wrong and his judgment at fault, but, if so, he may speedily be set right by those in possession of the truth. There the onus lies. The people of this country have been saddled with a colossal railway obligation and the urgency for dealing with it rests ultimately upon the most thoughtful amongst the people themselves. We are particularly in the debt of the well-informed and competent engineer who has carried through the present study. Critics of democracy never tire in stressing the failure of the intelligent citizen to acquaint himself with the facts of public business and make known his views on public questions. In the long and arduous labours leading to the publication of this book, Mr. Thomson has performed with distinction the kind of task that engineers are forever being urged to undertake and rarely do.

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*Professor of Civil Engineering, University of Toronto.

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—A permanent executive position is open for a man with machine shop and tooling experience on rapid production work on bronze and iron castings. Bronze and iron foundry experience would be helpful, together with experience in handling men. Good opportunity for right man. Please give age, nationality, education, experience, salary required, to Box No. 1869-V.

NATIONAL RESEARCH COUNCIL VACANCIES

The National Research Council of Canada invites applications for a Junior Research Engineer to carry out research under direction in electrical engineering. Initial salary $2,100 to $2,700, depending on qualifications. Applicants must possess a degree in electrical engineering or electrical physics from a recognized university, preference granted to British subjects. They should possess aptitude and experience qualifying them to undertake research in electrical engineering. Applications and credentials should be forwarded to the Secretary-Treasurer, National Research Council, Ottawa, and should include a statement of age, race, nationality, academic accomplishments, training and experience, indicating in particular if the candidate has been associated with high voltage engineering. Applications should be received by June 1st, 1939.

The Associate Research Committee on Industrial Radiology announces a vacancy for a junior or assistant research physicist or engineer. Salary rate of $2,100 to $2,850. **Duties**—Under supervision to carry out tests and investigations of the strength of castings and other structural materials, etc. **Qualifications**—Graduation with high standing in physics or engineering from a recognized university, graduate training and research experience in related branches of physics or engineering. Applications should reach the Secretary, Associate Research Committee on Industrial Radiology, National Research Council, Ottawa, before June 1st, 1939, and should include a statement of the following information: Name in full, date and place of birth, marital status, nationality, racial origin, period of residence in Canada, academic degrees and honours, a certificate of standing from the registrar of the applicant's university, positions held or other information relevant to training and experience. Also a statement of physical fitness, a recent photograph, and the names and address of three persons to whom reference may be made.

SITUATIONS WANTED

INDUSTRIAL ENGINEER, B.Sc. (McGill), with fifteen years broad experience in general design and construction and in practically all departments of industrial design and operation, would consider responsible permanent position with progressive industrial concern. Apply to Box No. 492-W.

ELECTRICAL ENGINEER, B.Sc. Age 40. Married. Jr.E.I.C. Eight years experience in operation, maintenance and installation of electrical equipment in hydro-electric plants and sub-stations. Five years electrical maintenance and construction, motor windings, relays, meters, and all automatic equipment. Also experience on geological survey and highway construction. Best of references. Sober and reliable with ability to handle men. Available at once. Any location. Apply to Box No. 636-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.

ELECTRICAL ENGINEER, B.Sc., Jr.E.I.C. Eight months on installation of power and lighting equipment; three years as manager of sales and service dept. of an electrical firm; seven months as tester on power and radio equipment, one and a half years as inspector on electrical and power equipment. Interested in inspection or sales engineering. Available on short notice. Location immaterial. Apply to Box No. 740-W.

CIVIL ENGINEER, B.Sc., A.M.E.I.C., R.P.E. Age 48. Twenty-five years construction experience on railways, highways, bridges, dams, flumes, pipe lines and buildings. Expert on earthworks and transportation. Location immaterial. Apply to Box No. 841-W.

MECHANICAL ENGINEER, Jr.E.I.C., technical graduate, bilingual, age 36, married. Experience includes five years with firm of consulting engineers, design of steam boiler plants, heating, ventilating and air conditioning. Seven years with large company on sales and design of heating systems, air conditioning, steam specialties, etc. Available on short notice. Apply to Box No. 850-W.

SALES ENGINEER, B.A.Sc., Jr.E.I.C. Age 29. Married. Presently employed. Five years experience in sales and field engineering seeks position with more future. Bilingual. Available on few weeks' notice. Apply to Box No. 1107-W.

CIVIL ENGINEER, A.M.E.I.C. Age 48. Married. Ten years municipal work. Five years highway construction, familiar with all types of paving. Presently with consulting engineers on municipal work, water supply, etc. Best of references. Available immediately. Further particulars on request. Apply to Box No. 1141-W.

CIVIL ENGINEER, A.M.E.I.C. Married. Experience of over 26 years. Surveys, railways, canals, highways, including location, construction, inspection, giving monthly and final estimates. Building locks, dams and all kinds of buildings. Experienced in steel and munitions work, on laboratory inspection of shells and gauges for same. Seeking for steady employment. Apply to Box No. 1168-W.

ELECTRICAL ENGINEER, B.Eng. (McGill '35). Four years experience design and estimates of substations, control and metering layouts, bus layouts, transformer layouts and fire protection, transmission lines. Hydraulic studies. Also knowledge of town planning, house design, reinforced concrete, water and sewer works, sidewalk and street design. Two years supervision. Interested in design of any description. Married. Age 24. Location immaterial. Available on reasonable notice. Apply to Box No. 1288-W.

MECHANICAL ENGINEER, B.A.Sc., (Toronto '34) Age 27. Recently completed the Alexander Hamilton Institute course in Modern Business. Thoroughly experienced in the heat treatment and selection of tool and die steels, with a wide knowledge of modern production methods. Also familiar with aircraft steels and tubing to British specifications. At present employed as sales representative for an English steel company. Desires position in the field of production control and/or procession or factory management. Complete information given upon request. Apply to Box No. 1348-W.

FIRE PROTECTION AND SAFETY ENGINEER, A.M.E.I.C., B.Sc. '24, (Mech. Engrg.). Age 35. Bilingual. Twelve years experience with insurance underwriters inspection bureau covering phases of field work. Thoroughly familiar with insurance requirements. Position desired industrial or other concern maintaining self insurance or relative departments. Location Montreal or vicinity preferred. Apply to Box No. 1395-W.

CIVIL ENGINEER, taking law degree in May. Perfectly bilingual. Worked for railway company, industrial company and on construction. Age 24. Would like work in time study or similar. Apply to Box No. 1428-W.

ELECTRICAL ENGINEER, B.Eng. Elec. (McGill '35), M.Eng. Elec. (Rensselaer '36), S.E.I.C. Single. Age 25. Experience includes planning and production work in large factory and two years electrical and mechanical engineering on temporary staff of National Research Council, Ottawa. Available at once. Apply to Box No. 1468-W.

CIVIL AND ELECTRICAL ENGINEER, B.A., B.A.Sc. '32. A.M.E.I.C. Age 32. Single. Bilingual. Presently employed. Thoroughly familiar with electricity and gas rates and their industrial and commercial applications. Experience also includes heating and lighting engineering. Interested in electrical contractors' and consulting engineers' work. Best references. Available on short notice. Apply to Box No. 1518-W.

CIVIL ENGINEER, B.Sc. (Univ. N.B. '32), A.M.E.I.C., R.P.E., Dy.L.S. Age 33. Married. Experience: ten years surveys, mines, land, legal, railways, geological, appraisal, mine management, construction. At present in private practice in civil and mining engineering. Would consider employment in a foreign field. Apply to Box No. 1562-W.

MECHANICAL AND ELECTRICAL ENGINEER, graduate Toronto university; machinists and tool makers trade; lengthy designing experience, pumps, diesel engines, steam generating and distributing equipment, water turbines, steam control and power plant equipment, paper mill and heavy machinery. Fully conversant with mass production on shop methods; foundry practice; forged work; machine shop practice. Excellent experience in specification, research, and development duties. Have been consultant to sales engineering staff large national concern ten years. Employed but available in thirty days. Apply to Box No. 1699-W.

REFINERY ENGINEER, B.Sc. (E.E.), Man. '37. Experienced in supervising operations and maintenance of small refinery. 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.E., Jr.E.I.C., 28 years of age. Married. Desires position with reliable construction firm. Intends to make construction life work. Over five years experience on permanent highway construction, inspection, estimates and instrument work. Available on short notice. Apply to Box No. 1820-W.

SALES ENGINEER REPRESENTATIVE, B.A.Sc., C.E. Age 30. Contact in Northern Quebec mine belt. Interested in selling any kind of materials. Experience in heating and air conditioning. Speaks both English and French. Available at once. Apply to Box No. 1859-W.

CIVIL ENGINEER, B.Sc., S.E.I.C. Married. Six months surveying; mill site; water supply, power line location, earthwork, drainage, topographic. Have 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.

CHEMICAL ENGINEER, graduating Toronto '39. S.E.I.C. One and a half years general ore dressing laboratory work. One and a half years' general milling and assaying. Seeking a permanent position in chemical industry. Apply to Box No. 1867-W.

TECHNICALLY TRAINED EXECUTIVE, general experience covers organization and management in business and industrial fields; including sales, purchasing, productions, accounting and costing, also industrial surveys, reorganizations and amalgamations in the United States and Canada. B.Sc. degree in mechanical engineering. Married. Canadian. Apply to Box No. 1871-W.

MANUFACTURING EXECUTIVE, B.Sc. in mechanical engineering. Married. Canadian. Experienced in munitions manufacturing and other precision work. Apply to Box No. 1872-W.

SALES ENGINEER. Several years experience selling to industrial, mining and railroad organizations in Ontario and Quebec. B.Sc. in mech. engrg. Married. Canadian. Apply to Box No. 1873-W.

CHEMICAL ENGINEER, S.E.I.C., graduating this Spring. Has had experience with platinum, gold, etc. Two years in a biochemical research laboratory and a good knowledge of plumbing and electrical equipment, desires position either on production or in research. Apply to Box No. 1876-W.

INDUSTRIAL DESIGNER seeks position, part-time employment or commissions. University graduate, A.M.E.I.C., long architectural designing experience. Location Ottawa. Apply to Box No. 1878-W.

CIVIL ENGINEER, S.E.I.C., McGill, '39. Age 22. Consistently high scholastic standing. Ready to adapt himself to any kind of work promising future advancement. Experience includes maintenance work in an industrial plant, surface exploration for minerals in northern Quebec, surveying, mapping, and selling. Excellent references. Present residence, Montreal. Available June, 1939. Apply to Box No. 1881-W.

CIVIL ENGINEER, B.Sc. Age 27. Married. Four years experience in highway work, including instrument work on preliminary surveys and construction, estimating and inspection. Prefers position with construction firm. Available at once. Apply to Box No. 1883-W.

CIVIL AND STRUCTURAL ENGINEER, B.A.Sc. (Toronto), A.M.E.I.C. Three years experience in plant engineering work entailing mechanical and structural design and supervision. Also two years on construction work. Desires permanent position with industrial firm or consulting engineer. Apply to Box No. 1893-W.

CIVIL ENGINEER, A.M.E.I.C. Married. Ten years experience on railway location and construction. Twenty years on hydro-electric power and mill construction in executive capacity in charge of preliminary investigation, engineering, estimating, costs and purchasing. At present unengaged owing to the firm associated with discontinuing operations. Available at once. Apply to Box No. 1896-V.

FOR SALE

TRANSIT THEODOLITE, made by W. F. Stanley, London, with tripod and case. Designed for precise work on D.L.S. base lines and meridians and is fully equipped for solar and stellar observations. Available in Montreal. Price $200.

TRANSIT, made by H. Spencer & Son, Dublin. Tripod and case. Available in Montreal. Price $70. Apply to Box No. 35-S.

PRELIMINARY NOTICE

of Application for Admission and for Transfer

April 27th, 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 June, 1939.

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

BECK—EDWARD HERBERT, of 37 Argyle Ave., Ottawa, Ont. Born at Portsmouth, England, June 7, 1885; Educ.: Articled to the firm of E. R. Lester & Co., Govt. Contractors, Plymouth, England, 1899-1906; 1911-19, gen. contracting and engrg. as Edward H. Beck, and later as Beck & Poole, Gen. Contractors, Toronto; 1920-29, as follows: constrn. engr., Archibald & Holmes, Toronto; designing and sales engfr, quarry, gravel pit, crushing and screening equipment, Dominion Road Machinery Co. Ltd.; res. engr., Dominion Textile Co. blgs., Montmorency Falls, Que.; chief field engr., Aluminum Co. of Canada, Arvida, Que.; constrn. engr., Wayagamack Pulp & Paper Co., Three Rivers. Engr. in charge for Loblaw Groceterias Ltd., central warehouse constrn., Toronto; res. engr., Robert Simpson Co., Toronto extension and Montreal bldgs.; 1929-32, constrn. engr., full charge of erection, National Research Building, Ottawa; 1932-36, mgr. and supt., Ontario Ready Mix Concrete Ltd., Ottawa; 1936-38, supervising tunnel and sewer work, also constrn. and repairs to bridges and bldgs., City of Ottawa; at present, structural engr., National Research Council, Ottawa, i/c design and constrn. of New Laboratory Buildings, layout and services, etc.

References: E. Viens, W. F. M. Bryce, J. H. Parkin, J. M. Oxley, R. B. Young.

CARLYLE—E. J., of Montreal, Que. Born at Woodstock, Ont., Oct. 15, 1877; Educ.: B.Sc., McGill Univ., 1904; 1904-06, Anaconda Copper Co.; 1906-07, chemist, gen. smelter foreman, chief chemist, Cons. Arizona Smelting Co., Humboldt, Arizona; 1907-11, smelter supt., Kyshtim Corp. Ltd., Kyshtim, Russia; 1912-13, smelter supt., Famatina Corpn., Argentine Republic; 1914-17, smelter supt., and met. engr., Sissert Corpn., Russia; 1918-23, smelter supt., British American Nickel Co.; 1926-31, smelter supt., Northern Peru M. & S. Co., Peru; 1931 to date, secretary-treasurer, Canadian Institute of Mining and Metallurgy, Montreal, Que.

References: C. Camsell, J. B. Challies, G. E. Cole, C. V. Corless, F. W. Gray, H. M. Jaquays, S. C. Mifflen, F. D. Reid.

EDDY—HARRISON PRESCOTT, Jr., of Medfield, Mass. Born at Worcester, Mass., Feb. 17, 1895; Educ.: B.Sc., Mass. Inst. Tech., 1917; R.P.E. of New York, Ohio, New Jersey, Penns., Conn.; 1917-19, asst. naval constructor, U.S.N.R.F.; 1919-26, asst. engr., and from 1936 to date, partner in firm of Metcalf & Eddy, Boston, Mass., on design, investigation and supervision of constrn., of sewers drainage works, incinerators, etc.

References: J. M. R. Fairbairn, W. Storrie, C. B. Breed, F. A. Barbour, R. S. Weston.

HENDERSON—DUGALD CAMPBELL MACDONALD, of 53 Heath St. East, Toronto, Ont. Born at Aberdeen, Scotland, March 10, 1882; Educ.: 1898-1903, Robert Gordon College, Aberdeen; 1905-09, articled pupil, and 1909 (one year) as asst. engr., city engr's. office, Aberdeen; with the Works Dept., City of Toronto, as follows: 1910-13, leveller, dftsman., instr'man. and asst. engr., also on sewer design; 1913-20, asst. engr., sewer mtce.; 1920 to date, asst. engr., in charge of sewer mtce., and day labour constrn. (eastern half of city).

References: G. G. Powell, M. A. Stewart, W. R. Worthington, G. Phelps, W. Storrie.

LAING—WILLIAM LOWTHER, of 3562 Belmore Ave., Montreal, Que. Born at King's Norton, England, April 21, 1892; Educ.: Tullie House Technical School, Carlisle, 1907-12; Private study; 1907-12, mech'l. elect'l. ap'ticeship, Cowans Sheldon & Co., Carlisle, England; 1912-13, misc. mech. work, New York; 1913-15, crane erection supt., Toledo Bridge & Crane Co., Toledo, Ohio; 1915-17, crane erection supt., Pawling & Harnischfeger, Milwaukee, Wis.; 1917-19, overseas, Sapper, Can. Engrs.; 1919-21, dftsman, Sheppard Elec. Crane & Hoist Co., Montour Falls, N.Y.; 1921-24, service engr., Champion Engrg. Co., Kenton, Ohio; i/c of all erection and service, also designing crane machy., hydraulic gate hoists, and misc. machy.; 1924 to date, asst. engr., mech. dept., Dominion Bridge Co. Ltd., Montreal, Que., specialising on design of elect'l. cranes, etc.

References: F. P. Shearwood, F. Newell, R. S. Eadie, R. H. Findlay, G. H. Midgley, J. E. Openshaw, I. S. Patterson.

LILLIE—HERBERT, of Montreal, Que. Born at Buenos Aires, Argentine Republic, June 18, 1906; Educ.: 1924-28, Royal Technical College, Glasgow, Diploma, 1927, Associate, 1928; A.M. Inst. E.E., 1937; 1925-27, engrg. training during summers; 1928-29, asst. estimator, Harland Engrg. Co. Ltd., Alloa, Scotland; 1929-33, transformer and rectifier sales engr., Bruce Peebles & Co. Ltd., Edinburgh; 1933-36, tech. asst. to paper gear engr., Harland Engrg. Co. Ltd., London, England; 1936-37, contract engr., transformer dept., Bruce Peebles & Co. Ltd., Edinburgh; 1938 to date, transformer engr., Bepco Canada Ltd., Montreal.

References: R. A. Yapp, J. D. Chisholm, R. M. Morton, F. E. Regan, H. Fellows, A. G. Mahon.

MARGONINSKY—BRUNO ADOLF, of Montreal, Que. Born at Berlin, Germany, Nov. 27, 1903. Educ.: 1922-27, Technische Hochschule of Berlin (of University rank). Diploma in Engrg., 1927; Doctor of Engrg., 1932; 1927-30, with Renta Organizations Co. Ltd., reorganizing four plants; 1930, with Wolf, Netter & Jacobi Works, Berlin, reorganizing three plants; 1931, supt. of Deutsche Niles Works, Berlin; 1932-37, chief engr. of Hermann Meyer & Co., Berlin; at present, industrial consultant, vice-president of Allied Consultants Limited, Montreal, Que.

References: H. J. Roast, J. A. Kearns, E. A. Ryan, E. Kugel, S. S. Colle.

MacDONALD—WILLIAM ARTHUR, of 38 Lorway Ave., Sydney, N.S. Born at Glace Bay, N.S., Jan. 7th, 1906. Educ.: B.Sc. (Elec.), N.S. Tech. Coll., 1929; 1929-31, Northern Electric Co., automatic telephone equipment engrg. office, cable and rock divn.; 1931-34, part time employment with N.S. Dept. of Highways, instr'man., asst. engr., and i/c of survey crew; 1934-35, time study and methods study of shipping, Dominion Steel & Coal Co.; 1935 to date, asst. to Mr. E. L. Martheleur, mgr., Seaboard Power Corpn., and chief elect'l. engr., Dominion Steel & Coal Corpn., Sydney, N.S.

References: F. L. West, H. W. McKiel, S. C. Mifflen, F. W. Gray, J. A. Macleod.

MACPHERSON—GEORGE LUCAS, of Sarnia, Ont. Born at Markdale, Ont., Jan. 25, 1896. Educ.: B.A.Sc., Univ. of Toronto, 1920. Petroleum Engrg., Mass. Inst. Tech., 1930; 1920-22, sales engr., Canadian Service Co.; 1921-22, plant engr's. office, Durant Motors; 1922-26, dfting office, 1926-35, design divn., 1935-39, development dept. and design, and at present asst. chief engr., Imperial Oil Limited, Sarnia, Ont.

References: T. Montgomery, F. C. Mechin, R. L. Dunsmore, C. E. Carson, J. J. Hanna.

McPHERSON—ROSS CODY, of Edmonton, Alta. Born at Paris, Ont., June 10, 1909. Educ.: B.Sc. (E.E.), Univ. of Alta., 1932; R.P.E. of Alta.; 1928-29 (summers), lineman, MacGregor Constrn. Co.; 1930-31 (summers), rodman, city engr. dept.; 1932-33, inspr., Northwestern Utilities Ltd.; 1933-34, dftsman., Canadian Utilities Ltd.; 1934-date, engr. i/c design, installn., operation, and servicing of commercial and industrial gas installns., Northwestern Utilities Ltd.

References: J. Garrett, E. W. Bowness, E. Nelson, W. R. Mount, W. E. Cornish

NEIL—ALEXANDER STEWART, of 744 Crescent Road, Calgary, Alta.—Born at Little Cumbrae, Scotland, Jan. 9, 1882; Educ.: 1902-07, Glasgow Technical College; 1900-05, ap'ticeship (shops and drawing office), John Hastie & Co. Ltd., Greenock; 1905-07, dtfsman., Ferguson Bros., ship and dredge bldrs., Port Glasgow; 1907-08, asst. engr., John Paton Son & Co., Alloa, Scotland; 1908-13, chief dftsman., Port Glasgow Engrg. Works Ltd.; 1911-12, teacher, mach. drawing and design, Port Glasgow School (Affiliated to Glasgow Technical College); 1929 to date, engr., Precision Machine and Foundry Ltd., Calgary, Alta.

References: J. R. Wood, J. B. McMillan, J. S. Neil, M. W. Jennings, V. A. Newhall.

PLANT—WILLIAM ALBERT, of Smooth Rock Falls, Ont. Born at Norwood, Ont., Nov. 9, 1893; Educ.: I.C.S. Diplomas in Mech. Engrg., 1922, Elect'l. Engrg., 1925; 1909, machinist, W. P. Plant, Hastings, Ont.; 1912, machinist, Can. Gen. Elec. Co. Ltd., Peterborough; 1912-15, dftsman., Canadian Car & Foundry Co., Montreal; 1915-19, overseas, C.E.F.; with Mattagami Pulp & Paper Co. Ltd., Smooth Rock Falls, mill and organization acquired by Abitibi Power & Paper Co. in 1927; 1919, hydro-electric power house, chief operator; 1924, elect'l. supt. of mtce. and constrn.; 1927, mech'l. and elect'l. supt. of mtce. and constrn.; 1933, res. engr., engrg. in addition to above responsibilities, and at present, res. engr. i/c of design of improvements, mech'l. and elect'l. mtce. and constrn. in the organization of the Abitibi Power and Paper Company's 200 tons per day bleached sulphite pulp mill at Smooth Rock Falls.

References: E. L. Goodall, R. J. Askin, C. W. Boast, M. S. Madden, G. W. Holder.

SMITH—JOSEPH, of 3500 Walkley Ave., Montreal, Que. Born at Newmains, Lanarkshire, Scotland, April 1st, 1898; Educ.: 1914-17, and 1919-22, Royal Technical College, Glasgow; 1913-17, ap'tice, Sir Wm. Arrol Co., Glasgow; 1917-19, Lieut., R.A.F.; 1919-23, dftsman., Babcock-Wilcox, and Armstrong & Main, Glasgow, Scotland; 1923 to date, designer and estimator, Dominion Bridge Co. Ltd., Lachine, Que., on all types of electric cranes, hydraulic gates and handling equipment, grain car and material unloaders, log stackers and locomotive turntables, machy. for operating bascule, swing and vertical lift bridges; at present, asst. engr., mech. dept., i/c of design of cranes, gates, unloaders, machy. for moveable bridges, etc., under the mech. engr.

References: F. Newell, P. L. Pratley, R. S. Eadie, R. H. Findlay, I. S. Patterson, W. N. McGuinness, K. O. Whyte.

SMITH—MURRAY SUTHERLAND, of Halifax, N.S. Born at Halifax, June 14, 1910; Educ.: B.Sc. (Mech.), N.S. Tech. Coll., 1933; with the Royal Canadian Mounted Police, Marine Section, as follows: 1936-37, engineman (oiler), engaged in repair and mtce. of Diesel engines, and 1938 to date, engr. in charge of a watch on main and auxiliary engines and repairs, under chief engr's direction, in motorships.

References: S. Ball, A. Sutherland.

TAYLOR—WILLIAM EBIN, of Negritos, Peru. Born at Vernon, B.C., Aug. 19, 1913; Educ.: B.Sc., Queen's Univ., 1935; 1934 (summer), power house operation, H.E.P.C. of Ont.; 1935-37, elect'l. mtce., International Nickel Co. Ltd., Copper Cliff; 1937 to date, asst. to elect'l. supt., International Petroleum Company, Negritos, Peru.

References—L. T. Rutledge, D. M. Jemmett, A. Jackson, L. M. Arkley, R. B. Rapley.

TOMLINSON—CARL PERKINS, of Montreal, Que. Born at Danburn, Conn., June 6th, 1886; Educ.: Ph.B., Yale Univ., 1907; R.P.E., Conn.; Assoc. Member, A.S.C.E.; 1907, U.S. Reclamation Service, Fort Shaw, Mont.; 1907-08, Helena Power Trans. Co., Helena, Mont.; 1908-14, with Stone & Webster Engrg. Corpn., Boston; 1910-11, res. engr. at Hauser Lake, Mont.; 1911-12, asst. supt. of constrn., at Bellingham, Wash.; 1912-14, asst. supt. of constrn. at Falls Village, Conn.; 1914, vice-president and gen. mgr., Granger Mfg. Co., West Stockbridge, Mass., Boston, Mass.; 1920 to date, industrial engr., making reports on non-metallic materials, and at present, vice-president, McColl-Frontenac Oil Co. Ltd., Montreal, Que.

References: J. B. Challies, A. Surveyer, L. A. Wright, J. Morse, R. G. Swan.

WESTON—JOHN FILLMORE, of 61 Maple Ave., Shawinigan Falls, Que. Born at Tillsonburg, Ont., Oct. 28th, 1911; Educ.: B.A.Sc., Univ. of Toronto, 1934; Post-Graduate year in business administration at Univ. of Western Ontario; Summers—1931-32, Beaver Foundry and Furnace Works, Tillsonburg, design of street lamp standards and small portable boilers; 1933, Borden Milk Co., Tillsonburg, installn. of refrigeration equipment, etc.; 1935, Borden Milk Co., distribution of costs, appraisal of plant; 1937-38, Canadian Industries Ltd., Shawinigan Works, final constrn. costs for plant additions, equipment design and costs; June, 1938, to date, Aluminum Co. of Canada Ltd., Shawinigan Works, standard costs for fabricating dept., cost estimates for special orders, production control.

References: J. H. Johnson, T. A. Carter, A. G. M. L. Atwood, E. A. Allcut, R. E. Smythe, R. C. Wiren.

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

ANGELL—HENRY GERALD, of Cosham, Portsmouth, England. Born at Guildford, Surrey, England, Oct. 27, 1885; Educ.: Senior Cambridge Cert., 1901; Articled pupil in C.E., 1903-06; R.P.E. of Alta., 1921; 1910-36, with the C.P.R. as follows: 1910, dftsman., Montreal; 1910-15, asst. engr., Dept. of Natural Resources, on irrigation project i/c of parties on topog'l. surveys and constrn.; 1916-17, office engr. on above project; 1917-35, canal supt. i/c of the Bassano Divn. of above project; 1935-36, inspr. at Calgary; 1936-39, appointed Junior Officer with the Admiralty in London, and later transferred to H. M. Dockyard, Portsmouth, ranking as Engineering Assistant; Feb., 1939, appointed as "Superior Officer" with Admiralty, ranking as Assistant Civil Engineer of Barracks. (Jr., 1914, A.M., 1922.)

References: G. A. Gaherty, S. G. Porter, A. Griffen.

VANCE—JAMES ALFRED, of 288 Light St., Woodstock, Ont. Born in the County of Oxford, Ont., May 8, 1892; Educ.: 1911-14, Univ. of Toronto; R.P.E. of Ont.; 1908-11 (summers), workman and foreman i/c of erection of steel highway bridges, concrete foundations, etc.; 1911-14 (summers), supt. i/c of work-methods, falsework design, etc.; 1914 to date, operating as general contractor, on design and constrn. of steel and concrete highway bridges, also factory bldg. design and constrn., sewers, dams, misc. concrete and steel structures. (St. 1914, Jr. 1919, A.M. 1924.)

References: E. V. Buchanan, R. K. Palmer, C. Talbot, W. C. Miller, W. G. Ure.

FOR TRANSFER FROM THE CLASS OF JUNIOR

ACHESON—HARRY ROSS MACDOUGALL, of Kapuskasing, Ont. Born at Toronto, June 26th, 1907; Educ.: B.Sc., Univ. of Alta., 1929; R.P.E. of Alta.; 1926 (summer), rodman on constrn., Lacombe & Northwestern Rly.; Summers, 1927-28, and May, 1929, to Dec., 1930, instr'man. on constrn. and location in Sask., Alta. and B.C., for the C.P.R.; 1931-37, technical divn., Dept. of Lands and Mines, Prov. of Alta., on mathematical computations, examination of plans of survey, preparation of legal descriptions for leases, etc.; April, 1937, to date, Spruce Falls Power & Paper Co., as supply engr., mtce. dept., Kapuskasing Mill, responsible for specification and supply of spare parts and equipment for mtce. of mech'l. equipment. (St. 1926, Jr. 1934.)

References: H. J. MacLeod, W. E. Cornish, R. S. L. Wilson, G. H. N. Monkman, J. Dixon, F. K. Beach, J. R. B. Milne.

ADAMS—ERIC G., of 10 Grove St., New York, N.Y. Born at Hull, Que., May 3rd, 1907; Educ.: B.Sc., McGill Univ., 1929; two years Harvard Graduate School of Business Administration, M.B.A., 1931; passed exam. for N.Y. State Prof. Engrs. License, 1938; 1931-34, business research and advertising technical products, Cockfield Brown & Co., Montreal; 1935-36, preparing engrg. and economic reports in the office of asst. to the President, C.P.R.; 1936 to date, engr. with Coverdale & Colpitts, Consltg. Engrs., New York, preparing engineering and economic reports. (St. 1928, Jr. 1934.)

References: F. A. Gaby, G. A. Wallace, W. W. Colpitts, G. H. Burgess, R. E. Jamieson, L. K. Sillcox, L. R. Thomson.

AULD—JAMES ROBERTSON, of Montreal, Que. Born at Strathroy, Ont., April 20th, 1902; Educ.: B.A.Sc., Univ. of Toronto, 1927; one year, post-graduate, Union College, Schenectady; 1926, dftsman., General Motors Truck Co.; 1927-29, tester, General Electric Co., Schenectady; 1929-32, asst. to A.C. engr., Can. Gen. Elec. Co. Ltd., Peterborough; 1934 to date, elect'l. engr., Canadian Industries Ltd., Montreal, Que. (Jr. 1929.)

References: L. de B. McCrady, I. R. Tait, H. C. Karn, H. R. Sills.

GILES—B. H. DRUMMOND, of Montreal, Que. Born at Montreal, April 20, 1903; Educ.: B.Sc., McGill Univ., 1927; 1923-24, lab. asst., Candn. Laco Lamps; with Canadian SKF Co. Ltd. as follows: 1927-28, engr., Montreal; 1929-30, asst. chief engr., Toronto; 1932-33, chief engr., Toronto; 1932-38, district mgr., Montreal, and 1938 to date, vice-president, Montreal. (Jr. 1929.)

References: R. H. Findlay, H. B. Bowen, R. E. Heartz, J. B. Challies, W. F. Drysdale, W. I. Bishop.

McEWEN—MARKLAND NEIL, of Kenora, Ont. Born at Togo, Sask., March 23, 1911; Educ.: B.Sc. (C.E.), Univ. of Man., 1932; R.P.E. of Ont.; 1929, 1930 1932, rodman, C.P.R. constrn. dept.; with the Dept. of Northern Development as follows: 1932-33, dftsman., 1933-34, instr'man., 1934-35, res. engr., 1935-36, instr'-man.; with the Dept. of Highways of Ontario as follows: 1936-37, instr'man., gen. divn. work, Kenora; 1937-38, instr'man. on paving work, Kenora-Manitoba Boundary; 1938 to date, instr'man., Kenora Divn. (Jr. 1937.)

References—E. A. Kelly, F. Petursson, J. N. Finlayson, R. O. Paulsen, A. E. Macdonald, G. H. Herriot, S. C. Tackaberry.

SCHULTZ—CHARLES DAVIES, of Vancouver, B.C. Born at Vancouver, Oct. 26th, 1904; Educ.: B.A.Sc., Univ. of B.C., 1931; 1924-28 (summers), compass-man, topographer, timber estimator, instr'man., and 1931-36, forest engr., Forest Surveys Division, Govt. of British Columbia; 1936 to date, British Columbia Timber Commissioner to the British West Indies and the Caribbean Region. (St. 1928, Jr. 1932.)

References: C. T. Hamilton, W. H. Powell, A. L. Carruthers.

SEELY—WALLACE ERROL, of Siscoe, Que. Born at Saint John, N.B., March 19, 1906; Educ.: B.Sc. (Civil), Univ. of N.B., 1930; 1926 (summer), govt. surveying; 1928 (summer), compassman, timber survey, International Pulp & Paper Co.; 1929, concrete inspr., James McLaren Co., Buckingham; 1931, bldg. inspr., C.N.R.; 1931, pile inspr., Saint John Harbour Reconstrn.; 1937, field engr. i/c survey party, Ontario Paper Co., Comeau Baie, Que.; at present, miner at Siscoe Gold Mines, Siscoe, Que. (St. 1929, Jr. 1935.)

References—J. Stephens, E. O. Turner, P. G. Gauthier, A. F. Baird, A. R. Babbitt.

STRIOWSKI—JOHN BENJAMIN, of 675 Ingersoll St., Winnipeg, Man Born at Winnipeg, April 11, 1907; Educ.: B.Sc. (C.E.), Univ. of Man., 1929; Major and Minor completed for M.Sc. degree; 1926-27-28 (summers), axeman, chainman, rodman and instr'man., C.N.R.; 1929-30, demonstrator in civil engrg., Univ. of Man.; 1929 (summer) and 1930-31, structural designer, Northwestern Power Co. Ltd., Winnipeg; 1931-33, res. engr. on highway surveys and constrn., Dept. of Northern Development; 1934 (2 mos.), mineral claim surveys and dfting; 1935 (three mos.), levelman on township surveys, Manitoba Govt. Surveys Branch; 1935-37, structural and hydraulic designer, City of Winnipeg Engrg. Dept., and Greater Winnipeg Sanitary District; 1937-38, designing engr. for T. B. Borgford, consltg. engr., design and constrn. of water treatment plant; June, 1938, to date, structural designer, Cowin & Co., reinforced concrete engrs., Winnipeg, Man. (St. 1927, Jr. 1935.)

References: A. E. Macdonald, G. H. Herriot, J. L. Charles, C. V. Antenbring, T. C. Main, E. Gauer.

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References: R. E. Chadwick, F. G. Rutley, W. Griesbach, A. Gray, G. F. Layne, S. J. Fisher.

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References: J. G. Hall, J. L. Busfield, C. M. McKergow, E. Brown, F. A. Combe, H. D. Nickle.

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OPERATING EXPERIENCE WITH STEEL-TOWER TRANSMISSION LINES IN THE SAGUENAY DISTRICT

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Paper presented before the Saguenay Branch of The Engineering Institute of Canada at Arvida, Que., March 25th, 1938

Introduction

The object of this paper is the discussion of operating experience with several steel-tower transmission lines in the Saguenay District and of those physical and electrical features of designs which directly affect their performance.

In general, the remarks are confined to three lines serving industries in the Saguenay-Lake St. John area, as follows:

(a) Dolbeau line, by which Saguenay Transmission Company supplies power from the Isle Maligne hydro-electric generating station to the Dolbeau paper mill of Lake St. John Power and Paper Co., Ltd.

(b) Port Alfred line, supplying power from the same station to the Arvida works of the Aluminum Co. of Canada and to the Port Alfred paper mill of Consolidated Paper Corporation, etc.

(c) Alcoa line, supplying power from the Shipshaw No. 1 generating station of Alcoa Power Co. Ltd., to the Arvida Works and the Port Alfred line.

There is a fourth steel-tower line running from Isle Maligne to Quebec City but as it lies almost entirely outside the Saguenay area it will only be mentioned briefly. In addition, Price Bros. and Co. have what may be termed a steel-pole line, utilizing towers with limited and uniform sectional area.

General Features

The Dolbeau, Port Alfred and Alcoa lines are all double-circuit steel tower lines with a single ground wire and of the same general design. In fact, the Port Alfred and the Alcoa line towers are identical.

Location of the lines is indicated by Fig. 1. Note how they parallel the major axis of the Saguenay district.

Figure 2 is a photograph of a typical suspension tower on the Port Alfred line. Comparative data for the suspension towers used on the three lines are given in Table I. Note particularly that the Dolbeau line towers are of much lighter construction than the others.

A suspension tower of the Port Alfred line type was tested at the factory and met all requirements satisfactorily, including 60 per cent overload in a normal direction and 20 per cent overload in a parallel direction.

Footing details for the Dolbeau and Port Alfred towers are very similar. Fig. 3 illustrates both the grillage footing used in earth or muskeg and the method of anchorage used in the case of rock.

Heavier construction is necessary for the strain or anchor towers used at appreciable angles in the line and at strain positions. Figure 4 shows a typical strain tower on the Port Alfred line.

The general features of design for the various lines are set forth in Table II.

Insulation Levels

The Dolbeau line has the same insulation on both circuits. Although originally designed for 110 kv., one circuit has been very successfully operated at 140 kv. since early in 1932 and has been recently stepped up to 154 kv. The Port Alfred and Alcoa lines have been operated at the designed voltage; namely, 154 kv.

Figure 5 illustrates the clearances between hot conductors and tower steel on the Dolbeau line, indicating a minimum clearance of 2 ft. 5¼ in. under maximum side swing due to an 11 lb. wind. Figure 6 furnishes similar data for the Port Alfred line.

Insulation levels for the three lines are recorded in Table III. It will be observed, in every case, that the roof bushings constitute the weakest insulation. Hence, a majority of lightning flashovers might be expected to occur at the roof bushings.

Troubles Experienced During Operation

When any transmission line is placed in service and operated over a period of years, it is generally found that troubles experienced during operation arise from two distinct groups of causes. The first group, which is discussed in detail under the heading "Pitfalls to Avoid in Construction," comprises those defects in construction which are more or less automatically weeded out in the first few years of operation. The second group, discussed under the

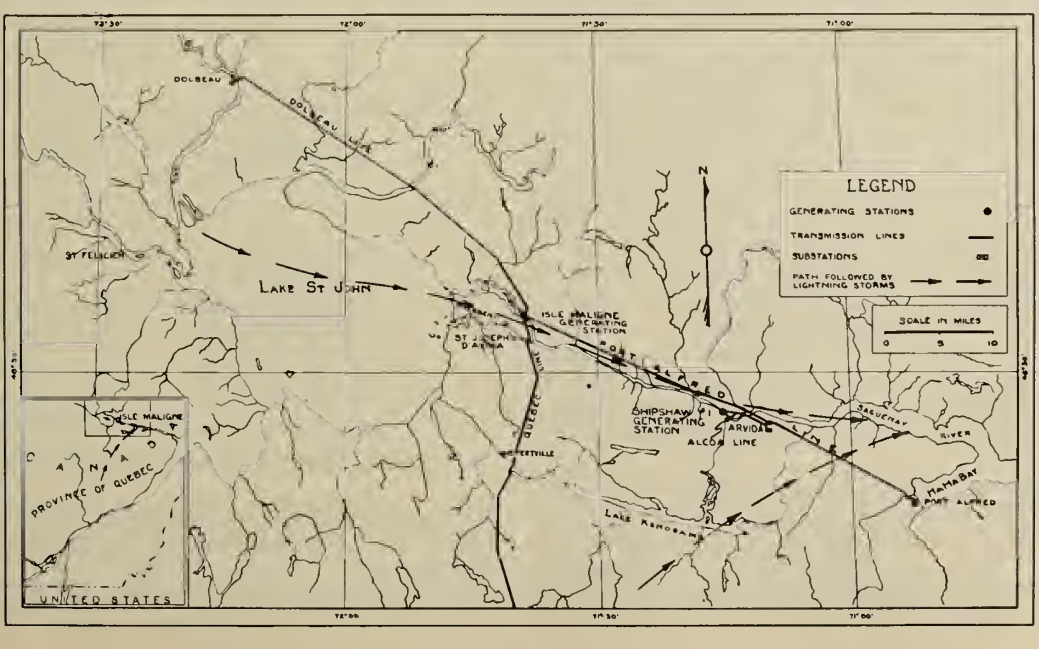

Fig. 1—Steel-tower transmission lines in Saguenay district and paths followed by lightning storms.

heading, "Material Failures," includes failures of conductors, insulators, tower members, etc.

Pitfalls to Avoid in Construction

Construction of a transmission line in rough country, poorly provided with roads, is always a serious undertaking, particularly if the construction men are working against time. Under such circumstances it is not only necessary that those responsible be fully informed as to methods to be employed but also that careful inspection of work be made. Otherwise, there is the risk of work being done in such manner that defects only come to light after several years' operation.

Fig. 2—Typical suspension tower used on Port Alfred line

Some of the pitfalls to be avoided in transmission line construction may be illustrated by reference to troubles experienced during the first few years' operation of the Dolbeau line. When construction of this line was undertaken a construction schedule was set up which could be readily met. However, prior to stringing of the conductors, it was found necessary to speed up the construction schedule in order to meet contract conditions. Moreover, after pulling out a considerable amount of cable, one of the worst sleet storms ever experienced in the district, which is mentioned later, covered everything with ice, fastening cable securely to the ground, etc. As a result, jointing of the power conductors and ground wire was carried out under very adverse conditions. Even sagging operations were affected because it was found very difficult to entirely clear the cables of ice.

It is generally considered that the ground wire with the assumed ice loading, at 32 deg. F., should have the same sag as the power conductor without ice and at 32 deg. F. That is, sagging should be done so that when an ice-loaded power conductor suddenly drops its loading of ice it will not come into contact with the loaded ground wire.

The foregoing is mentioned to emphasize the necessity for proper sagging of the ground wire. Under the difficult conditions at the time this work was done on the Dolbeau line a number of sections of the ground wire were left too slack.

As a result, the first few operating troubles on this line were due to top line conductors coming in contact with the ground wire in high winds, causing an interruption. The exact location, of course, could not be readily spotted but this class of trouble was cleared up by re-sagging the ground wire wherever it was low.

One or two cases of trouble were due to kinking of the ground wire as it was pulled out prior to stringing and eventual failure after it had been drawn up.

The conductor cables used on the three lines are of the well-known A.C.S.R. (aluminum cable steel-reinforced) construction—that is, an aluminum cable with a steel core, the aluminum furnishing the necessary conductivity and the steel adequate strength. As usual, the cables are manufactured in suitable lengths for handling and these lengths are spliced in the field. The steel core in the adjacent lengths is joined by a steel sleeve compressed over the core, in a portable hydraulic compressor. The aluminum strands are then joined by an aluminum sleeve, likewise compressed after being centred on the steel joint.

This type of joint, properly applied, has a most excellent service record everywhere. For instance, on the Port Alfred and Alcoa lines, with some 400 joints, not a single joint failure has ever occurred. The conductivity and mechanical strength of the joint are substantially equal to that of the cable itself.

Up to February, 1932, the Dolbeau line was operated with a very moderate load. About February 16th, load on one circuit of this line was increased from the previous average weekday value of approximately 45 amp. to approximately 150 amp. Some 22 days later, a compression joint failed. Examination of it revealed that not only was the steel sleeve badly off centre but the aluminum sleeve was compressed very little. As a result, the steel core was carrying practically the entire current as well as furnishing the mechanical strength.

Failure of a joint and rupture of the conductor is naturally an extremely serious matter, particularly if it occurs in winter and at a distance from maintenance headquarters, as valuable time is lost in getting men and repair material on the job. Consequently, following four more failures of a similar nature over the next five years, on both circuits of the Dolbeau line, every compression joint was carefully tested and examined during the summer of 1937. Joints which could be rendered satisfactory by additional compression were re-compressed; bad joints were replaced.

Compression joints were tested, winding a one-layer coil of No. 18 lamp cord over the length of the aluminum sleeve. When the coil was energized by two dry cells, it was possible to judge the position of the steel sleeve inside the aluminum sleeve to within approximately ½ in. by the use of a small pocket compass. Credit for the method should go, it is believed, to the Shawinigan Water and Power Co.

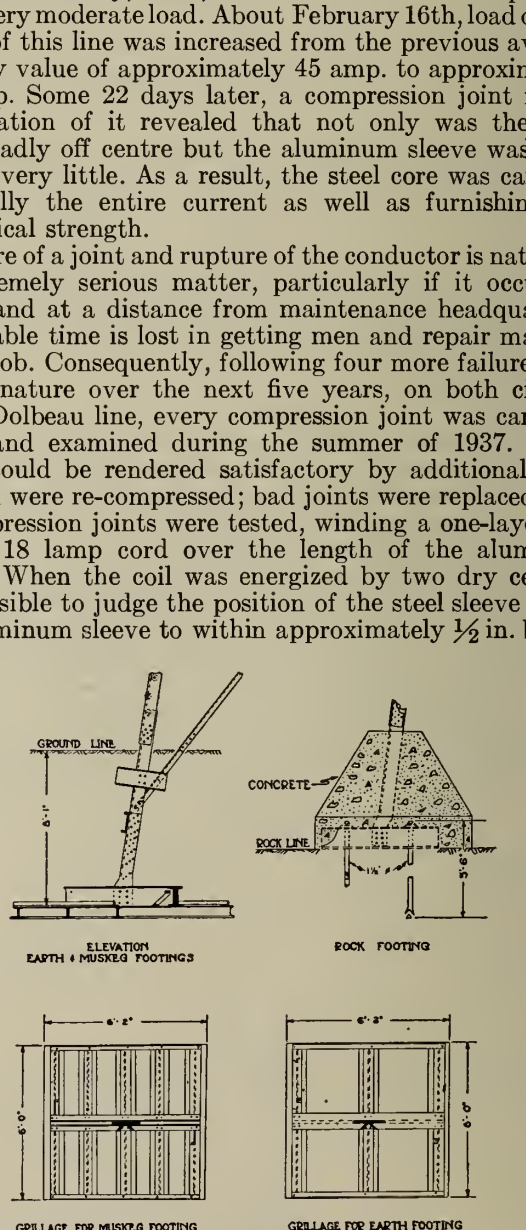

Fig. 3—Steel-tower footing details Port Alfred line

On week-ends when a circuit could be turned over to the maintenance crew, the inspector went from joint to joint

TABLE I

Physical Data for Standard Suspension Towers

Item	Dolbeau Line	Port Alfred Line	Alcoa Line
Dimension of Base. (At ground line)	21 ft. by 21 ft.	22 ft. by 22 ft.	Same as Port Alfred Line
Height to Bottom Cross-Arm. (Above ground)	54 ft.	58 ft.	
Over-All Height	79 ft.	90 ft.	
Type of Footing, in Earth or Muskeg	Steel Grillage	Steel Grillage	
Area of Footing Grillage, each of Four	12.25 sq. ft. (Gross)	36.0 sq. ft. (Gross)	
Depth of Backfill, over Grillage	8 ft. 7 in.	8 ft. 1 in.	
Type of Footing, on Rock	Anchor Bolts	Anchor Bolts and Concrete.	
Weight of Tower, Earth Footing	9,230 lb.	15,298 lb.	
Weight of Tower, Muskeg Footing	9,400 lb.	16,298 lb.	
Weight of Tower, Rock Footing	8,540 lb.	13,687 lb.	
Design Loading:			
I. Vertically Downward at Point of Conductor Support.	2,000 lb.	3,000 lb.	
II. Horizontally, Normal to Line	2,540 lb. at each of 7 Points of Conductor Support.	1,400 lb. at any broken Conductor: 2,800 lb. at each Unbroken Conductor.	
III. Horizontally, Parallel to Line	6,000 lb. at any one of 7 Points of Conductor Support.	8,000 lb. at any two Points of Conductor Support.	
IV. Wind	Allowed in II.	20 lb./sq. in. on 1½ exposed area.	
V. Dead Load of Tower	Allowed.	Allowed.	
Design	Combine I, 1¾ II, III, and V: or use twice I alone.	Combine all Loads and Design for 7,000 lb. Vertically Downward, Uncombined.	

TABLE II

General Features of Transmission Lines

Item	Dolbeau Line	Port Alfred Line	Alcoa Line
Length of Line	35.0 miles	39.4 miles	4.1 miles.
Width of Right-of-Way	100 ft.	300 ft.	175 ft.
No. of Standard Suspension Towers	219	223	19
No. of Strain and Semi-Strain Towers	35	51	7
No. of Special Strain Towers	3	6	0
Total No. of Towers	257	280	26
Average Span	720 ft.	750 ft.	870 ft.
Maximum Span	1,155 ft.	1,510 ft.	1,723 ft.
No. of Towers with Earth or Muskeg Footings	246	187	16
No. of Towers with Rock Footings	11	93	10
No. of Ground Wires	1	1	1
Ground Wire	½ in. 7 Strand Steel.	½ in. 7 Strand Steel.	½ in. 7 Strand Steel.
Conductor Cables	266,800 C.M., A.C.S.R...	477,000 C.M., A.C.S.R...	477,000 C.M., A.C.S.R.
Were Armour Rods used in Original Construction	No.	No.	Yes.
Design Loading	¾ in. Ice, 11 lb. Wind at 0 deg. F.	½ in. Ice, 8 lb. Wind at 0 deg. F.	½ in. Ice, 8 lb. Wind at 0 deg. F.
Maximum Conductor Tension	6,000 lb.	6,500 lb.	6,500 lb.
Ultimate Strength of Conductor Cables	11,250 lb.	19,250 lb.	19,250 lb.
Maximum Conductor Elevation above Sea Level	594 ft.	727 ft.	417 ft.
Minimum Conductor height above Ground	24 ft.	25 ft.	25 ft.
No. of Insulator Units per Suspension String	8	10	10
No. of Insulator Units per Strain String	10 (2 Strings in Parallel)	12	12
Size of Insulator Units	10 in. by 4¾ in.	10 in. by 5¾ in. I.M.—Arvida 10 in. by 5½ in. Arvida-Port Alfred.	10 in. by 5¾ in.
Minimum Mechanical Strength of Insulator Assembly	9,000 lb.	18,000 lb. I.M.—Arvida. 13,000 lb. Arvida-Port Alfred.	12,000 lb.
No. of Circuits	2	2	2
Designed Voltage	110 kv.	154 kv.	154 kv.
Communication Facilities	Wood-Pole Telephone Line.	Wood-Pole Telephone Line.	Wood-Pole Telephone Line.
Year Placed in Service	1927	1926	1931

in a conductor by means of a boatswain's chair after first testing the cable for strength. Other members of the crew carried out the necessary repairs.

All told, 336 compression joints were tested and 61 bad joints were detected.

At the same time a number of cases of broken individual strands due to damage caused by improper handling during construction were repaired.

Total cost of the repair work on 35 miles of double circuit line was about $2,025 of which approximately 65 per cent was chargeable to joint testing and repair or about $4 per joint tested.

Material Failures

Difficulties arising from failures of material during operation of the three lines under discussion have been of three classes:

1. Failures of tower members.
2. Failures of insulators.
3. Failures of conductors.

Failures of tower members have been substantially confined to the suspension towers on the Dolbeau line, although as mentioned later some have been encountered on the Port Alfred line towers. A considerable number of failures have occurred in member 27 shown in Fig. 8. It will be noted that brace 7 connects leg member 5 and member 27. The connection to leg member 5 is made sufficiently below the ground line to ensure enough earth cover to resist the horizontal component of the tension in member 7, which otherwise would cause bending in the tower leg, as tension in member 7 under full load is 3,500 lb. During the winter, heaving of the ground results in an upward thrust in member 7. The tower leg 5 being fixed, this thrust causes a negative bending in member 27. When this bending stress is sufficiently high rupture occurs at the bolt hole in member 27 as shown.

Fig. 4—Typical strain tower used on Port Alfred line

During the period 1933-6, inclusive, out of 1,752 total failures 193 or about 48 per year were of this type—that is, about 2.75 per cent per year. The winter of 1936-7 was very severe in that snow cover was practically absent till after early January. As a result, the rate went up to 6.6 per cent. The rate of failure for similar members on the Port Alfred line towers has been only a fraction of that on the Dolbeau line but a similar increase was noted as a result of the severe winter of 1936-7.

It is of interest that no failures of the above nature have occurred on towers located in sandy soil, all failures taking place in clay, loam and muskeg soils.

Several types of remedial measures have been tried but it is not yet possible to report on the outcome.

Failures of the suspension insulators used on the three transmission lines under discussion have been very infrequent. In 1930, a careful inspection of the Dolbeau line was made during which some 15,800 insulator units were tested. Only six defective insulators were found, after about three years of service. A similarly good record was found on the Port Alfred line where only seven insulators out of 22,000 were bad after four years' service.

It is noteworthy that up to the present no permanent outage has ever resulted from a defective insulator on these transmission lines.

No difficulty has been experienced with the post-type insulators used at switching and substations but several cases of trouble have been encountered with the terminal insulation in the form of outdoor apparatus and roof entrance bushings. This latter will be discussed in connection with lightning experience.

Several cases of conductor vibration have been observed on the Dolbeau and Port Alfred lines. In general, the frequency was approximately three vibrations per sec., amplitude of the order of one inch and distance between nodes approximately 10 ft. These cases were all noted at times when a very light breeze was blowing transversely to the line.

While vibration trouble has been practically negligible, a few cases of conductor strand failure have necessitated repairs. Remedial measures consisted of the application of armour rods at the points of conductor support where there was reason to believe vibration was responsible for fatigue breaks of strands. Some idea of the slight extent of the problem on the Port Alfred line, for instance, is afforded

TABLE III

Insulation Levels for Transmission Lines in Saguenay District

Item		Dolbeau Line	Port Alfred Line	Alcoa Line
60 Cycle Dry Flashover—	Roof Bushings	275 kv.	410 kv.	410 kv.
	Substation Post-Type Insulators	350	480	480
	Suspension Insulator Strings	420	560[1] 550[2]	563
60 Cycle Wet Flashover—	Roof Bushings	210 kv.	345	345
	Substation Post-Type Insulators	235	380	390
	Suspension Insulator Strings	330	400[1 2]	420
Impulse Flashovers ½ by 5 μ/s— Positive Wave[3]	Roof Bushings.			
	Substation Post-Type Insulators	768	1120	1120
	Suspension Insulator Strings		1274[1] 1251[2]	1300
Impulse Flashover 1½ by 40 μ/s— Positive Wave[4]	Roof Bushings	500	600	600
	Substation Post-Type Insulators	561	810	810
	Suspension Insulator Strings	685	940[1] 924[2]	960

[1]Isle Maligne-Arvida section.
[2]Arvida-Port Alfred section.
[3]Lightning wave reaches crest in ½ micro-second and drops to 50 per cent of crest value in 5 micro-seconds.
[4]Lightning wave reaches crest in 1½ micro-second and drops to 50 per cent of crest value in 40 micro-seconds.

by the fact that only 10 broken individual strands or wires were found when 948 conductor suspension clamps were opened at 158 towers in 1931.

The Alcoa line provided for armour rods in the initial design.

Those interested in a further consideration of conductor vibration are referred to the excellent paper by Mr. T. Varney which appeared in The Engineering Journal for September, 1936, entitled, "Evolution of the Modern Transmission Line."

TABLE IV

AVERAGE NUMBER OF LIGHTNING STORMS FOR 6 YEAR PERIOD 1932-37 INCLUSIVE

MONTH	As Reported By	
	Arvida	Isle Maligne
May	1.16	1.50
June	3.50	3.16
July	5.50	6.00
August	4.50	4.33
September	1.50	1.67
October	0.50	0.50
November	0.50	Data not available
Average no. per year	17.16	

SLEET STORMS

Serious sleet storms are of relatively rare occurrence in the Saguenay district. However, certain observations made during the course of the extremely heavy sleet conditions which prevailed from November 15th to 18th, 1927, may be of interest.

Snow, followed by a fine sleet and rain, which froze on contact, fell during the night of November 15th to 16th and built up a heavy ice deposit on communication and power lines. Strong winds occurred at intervals. Snow, with sleet and rain, during the 16th, 17th and the morning of the 18th, added to the ice.

On the Dolbeau transmission line, practically solid ice in a belt ¾ in. thick was noted on the 266,800 C.M. A.C.S.R. It occasioned no trouble except to delay construction, a considerable amount of cable having been strung out along the line, prior to sagging operations. A belt of ice ½ in. thick formed on the No. 6 A.C.S.R. telephone conductors but did no harm.

On the Port Alfred line, no ice formed on the power conductors as about 65,000 kw. were being transmitted over each circuit. However, a belt of ice ½ in. thick did form on the ½ in. dia. ground wire and caused one break in the 39.4 miles at, apparently, a place where the steel cable had been kinked in erection. Ice in a belt ¼ in.-⅜ in. thick formed around the No. 8 copperweld telephone wires on this line but no broken wires resulted.

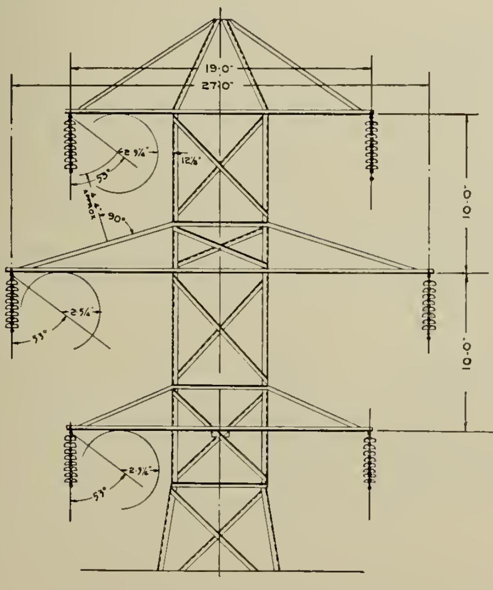

Fig. 5—Clearance between conductors and tower steel, Dolbeau line. Note—Angle assumed by insulator assembly is 53 deg. from the vertical under an 11 lb. wind and no ice, being 4 deg. 19 min. greater than 11 lb. and ¾ in. ice. Sparking distance in air between opposed sharp needle points, r.m.s. voltage values: 110 kv.—10.8 in.; 140 kv.—14.6 in.; 154 kv.—16.1 in.

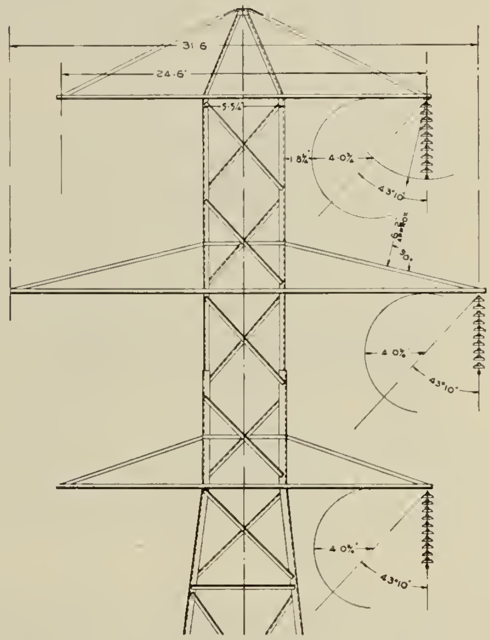

Fig. 6—Clearance between conductors and tower steel, Port Alfred line

Note—With 10 in. by 5¾ in. insulators: angle assumed by insulator assembly is 43 deg. 10 min. from the vertical under an 11 lb. wind and no ice, being 0 deg. 25 min. greater than at 11 lb. wind and ¾ in ice. With 10 in. by 5½ in. insulators: angle assumed by insulator assembly is 44 deg. 20 min. from the vertical under an 11 lb. wind and no ice, being 1 deg. 10 min. greater than at 11 lb. wind and ¾ in. ice. Sparking distance in air between opposed sharp needle points. r.m.s. voltage values 110 kv.—10.8 in.; 140 kv.—14.6 in.; 154 kv.—16.1 in.; 200 kv. 20.8 in.

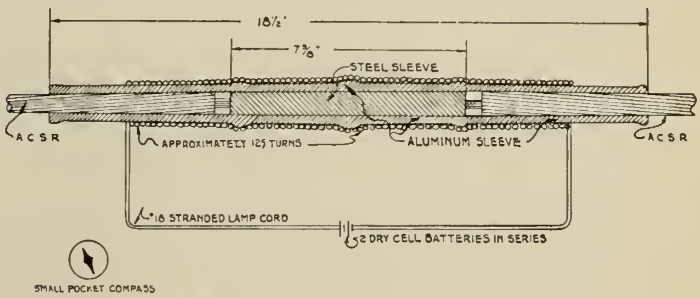

Fig. 7—Method of testing compression joints

Note—The joint is wound with one layer of No. 18 lamp cord forming a coil as shown above. This coil is then energized by two dry cell batteries in series. As the pocket compass, indicated above, is passed from one end of the joint to the other, the needle indicates the position of the steel core due to its being magnetized. Thus it is possible to judge the position of the steel core inside the aluminum sleeve to within approximately ½ in.

It will be noted that the loading assumed in the design of both the Dolbeau and Port Alfred lines was substantially reached, temperature, however, remaining higher than assumed.

Throughout the district the public telephone and other private telephone circuits were extensively damaged. The private telephone line paralleling the Quebec power line consisted of No. 9 B and S copper. Ice, in some sections near St. Bruno, reached a thickness slightly over ½ in.

LIGHTNING

One of the greatest enemies of successful transmission line operation is lightning. However, as the problem has become better understood, design of transmission lines has improved so that it is now possible to build substantially lightning proof lines.

Figure 1 illustrates the path followed by lightning storms in traversing the Saguenay district. The storms generally enter the district at the west and pass down the valley

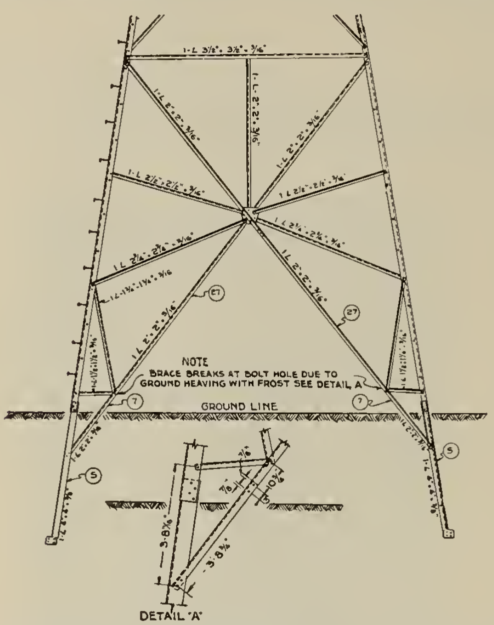

Fig. 8—Details of failures on Dolbeau line suspension towers

towards the St. Lawrence. A few storms pass over the Laurentians from the southwest and enter the Saguenay valley between Arvida and Port Alfred. It will thus be seen that the exposure of the transmission lines under discussion is moderately bad, in the case of any lightning storm entering the district by the usual route. Physically, as mentioned, the lines are rather badly exposed. However, the frequency of occurrence of lightning storms is not high, in the Saguenay valley, so the over-all exposure is moderate.

Table IV indicates the average monthly distribution of lightning storms for the six-year period, 1932-7, at Arvida and Isle Maligne. It will be observed there are about 17 lightning storms per year; the earliest occur in May, the latest in November. The maximum intensity of such storms is in July. After Table IV had been prepared, it was brought forcibly to the author's attention that lightning sometimes occurs much earlier in this district, as was demonstrated by the lightning storm at Chicoutimi and Arvida during the evening of March 22nd. A careful check of meteorological records showed thunderstorms had been recorded as follows:

In 10 years of record, at Mistassini, every month but February and November.

In 18 years of record, at Roberval, April to October, inclusive.

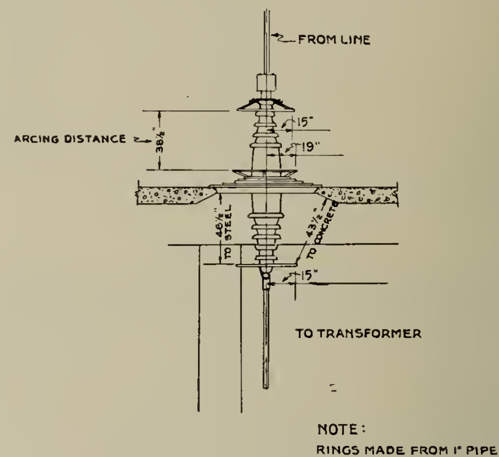

Fig. 9—Flashover protection used on 154 kv. roof bushings

In 19 years of record, at Chicoutimi, every month but January and February.

While the average number of lightning storms is about 17 per year, this figure increases to about 28 in bad years and decreases to 12 in good years. About one-third of these

TABLE V

Summary of Lightning Performance of Steel Tower Transmission Lines in Saguenay District 1931-37

Transmission Line	Type	Design Voltage	Operating Voltage	Item	1931	1932	1933	1934	1935	1936	1937	Average
Port Alfred[1]	2-Circuit Steel Tower.	154 Kv.	154 Kv.	Single Circuit Interruptions...	1	4	3	5	–	1	4	2.57
				Double Circuit Interruptions..	–	–	–	–	–	–	–	–
				Mileage....................	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4
				Single Circuit Interruptions/ 100 Miles Line[2]............	2.5	10.2	7.6	12.6	–	2.5	10.2	6.51
				Double Circuit Interruptions/ 100 Miles Line.............	–	–	–	–	–	–	–	–
Dolbeau Line[3]	2-Circuit Steel Tower.	110 Kv.	110/140Kv	Single Circuit Interruptions...	3	–	3	1	1	–	4	1.71
				Double Circuit Interruptions..	–	1	1	4	2	–	3	1.57
				Mileage....................	35	70	70	70	70	70	70	
				Single Circuit Interruptions/ 100 Miles Line.............	8.6	–	4.3	1.4	1.4	–	5.7	3.06
				Double Circuit Interruptions/ 100 Miles Line.............	–	1.4	1.4	5.7	2.9	–	8.6	2.86
Alcoa Line[4]...	2-Circuit Steel Tower.	154 Kv.	154 Kv.	Single Circuit Interruptions...	2	2	–	–	–	–	1	0.71
				Double Circuit Interruptions..	–	2	1	2	–	1	1	1.00
				Mileage....................	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2
				Single Circuit Interruptions/ 100 Miles Line.............	24.4	24.4	–	–	–	–	12.2	8.7
				Double Circuit Interruptions/ 100 Miles Line.............	–	24.4	12 2	24.4	–	12.2	12.2	12.20
No. of Lightning Storms..........					20	12	12	21	14	16	28	

Note:—

[1]Operated with single circuit from Isle Maligne to Arvida, since early part 1932. Treated as single circuit line throughout.
[2]Miles of single circuit. double circuit line with both circuits tied together without auto protection treated as single circuit.
[3]In 1931 only one O.C.B. at I.M. for red and green circuits. Since early part 1932 red circuit operated at 140 kv.
[4]One circuit of Alcoa Line operated at 69 kv. until 1933, but with 154 kv. insulation.

TABLE VI

Roof and Entrance Bushing Flashovers

LINE	No. of Flash-overs	No. of cases with permanent damage	Bushing years of service	Flashovers per 100 bushing years of service
Dolbeau	0	0	48	0
Port Alfred	8	2	144	5.6
Alcoa	9*	7	54	16.7

*Two flashovers simultaneously on each of 3 occasions. Three flashovers on 1 occasion.

storms are accompanied by so-called "forked lightning" and the remainder by so-called "sheet lightning."

Lightning experience with the steel-tower transmission lines in the Saguenay area has been quite good, as indicated by Table V. Performance of the different lines is not directly comparable, however, by reason of differences in switching arrangements. The figures of Table V include interruptions due to flashover of roof entrance and terminal bushings.

It will have been remarked the only form of protection against lightning provided in the case of these transmission lines is a single ground wire. How effective that is, we are not certain. However, Mr. A. E. Davison, transmission engineer of the Hydro-Electric Power Commission of Ontario, recently cited experience on a steel-tower line, of the usual double-circuit arrangement, initially provided with one circuit and no ground wire. The line, in the Thunder Bay district of Ontario, runs through a comparatively level, well wooded and rocky country where there are, on an average, 39 electric storms per year. Designed for 110 kv., it was provided with eight insulators in suspension strings, 10 in. disc and 5 in. spacing. With no ground wire, the yearly outages due to lightning were 7.6 per 100 circuit miles which was cut to 3.0 per 100 circuit miles when the ground wire was added.

As mentioned, each transmission line is provided with a single ground wire tied into substation and generating plant grounding systems. All power transformer banks are operated with solidly grounded neutrals. No data are available on tower footing resistance but it is believed to be moderately high, owing to the nature of the terrain crossed.

Roof Bushings

From Table III, it appears that the roof bushings are the weakest insulation, and a majority of lightning flashovers might be expected to occur there. However, this is not found to be the case, because most lightning surges occur some distance out on the line from the bushings and are sufficiently attenuated by the time the wave reaches the bushing that flashover does not ensue.

Table VI furnishes some idea of the bushing record to the end of 1937. All bushings, by the way, are oil filled.

It will be noted the Dolbeau line has been free from bushing flashovers while the Alcoa line has suffered 16.7 flashovers per 100 bushing years of service, a much more severe rate than the Port Alfred line with the same type of bushing. This is probably due to a somewhat greater exposure to direct lightning strokes of the roof bushings associated with the Alcoa line. As a result, arcing rings have been added to the bushings on the Alcoa line in order to prevent damage to the insulation structure of the bushings, and cause any flashover to take place at a chosen location, outside the station. Owing to the addition of the arcing rings, shown in Fig. 9, encouraging results have been obtained, although it is too early to say whether the problem has been entirely solved.

Service Interruptions

Comparative data on service interruptions arising only from troubles originating on the transmission lines proper are given in Table VII. Lightning is the most important single cause of trouble. It is to be noted, however, that troubles due to defects in construction when the line was built have been almost as important, in the case of the Dolbeau line. Poor sagging of ground wire and poorly-made compression joints, largely due to the previously-discussed adverse conditions existing during construction of this line, are responsible for this group of troubles.

TABLE VII

Average Service Interruptions per Year due to Trouble on Steel-Tower Transmission Lines 1931-37 inclusive

Line	Design Voltage	Operating Voltage	Nature of Interruption	Lightning	Wind	Mech-anical	Unknown	Total
Dolbeau Line	110 Kv.	110/140 Kv.	Single Circuit	1.00	1.57	0.29	0.57	3.43
			Double Circuit	2.00	0.86	0.43	0.29	3.58
Port Alfred Line*	154 Kv.	154 Kv.	Single Circuit	2.00	0.00	0.00	0.43	2.43
Alcoa Line	154 Kv.	154 Kv.	Single Circuit	0.43	0.00	0.00	0.00	0.43
			Double Circuit	0.71	0.00	0.00	0.00	0.71

*Operated as single circuit.

Summary

The general features and insulation levels of three double-circuit steel-tower transmission lines located in the Saguenay district have been presented.

Defects overlooked at the time of construction have been shown to play a very large part in subsequent operating troubles experienced on a particular line. In this connection may be mentioned improper sagging of ground wires, kinking of cables and poorly-made joints or splices in cables. It has been demonstrated how an excellent type of joint can be improperly applied and entail considerable future grief in operation.

Failures encountered on the steel towers themselves have been discussed. The excellent performance of the line insulation and the relative freedom from conductor fatigue troubles due to vibration have been noted. Brief mention has been made of remedial measures which can be applied for vibration difficulties.

Experience relative to sleet storms has been most satisfactory.

Although the steel-tower transmission lines in the Saguenay district have a moderate exposure as regards lightning storms, which average about 17 per year, operating experience has been quite good. The effect of a ground wire in reducing outages due to lightning has been discussed and experience data given for a steel-tower line in the Thunder Bay district of Ontario, showing a reduction from 7.6 outages per year to 3.0, per 100 circuit miles.

Operating experience with the 154 kv. roof bushings in respect of lightning flashovers has been only fair. Remedial measures under trial have been referred to briefly.

Finally, the operating records for the transmission lines, *per se*, have been analyzed, showing lightning to be the greatest single cause of service interruptions. Where good construction practice was followed and careful inspection applied, the lines in the Saguenay district have been almost completely free from interruptions due to any cause other than lightning.

THE ELECTRICAL PRODUCTION OF MUSICAL TONES

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SUMMARY—An outline of the physical basis of harmony on which in turn are based musical scales, is given, the discords produced in the tempered scale, due to natural harmonics and summation and difference tones being noted. In the electronic instruments musical tones can be generated as such in the first instance, or may be produced as a synthesis of pure tones; instruments embodying these principles are described briefly. A method of the synthesis of musical qualities is described.

In conclusion it is suggested that the possibility of removing the limitations of the traditional keyboard instruments gives an opportunity of abandoning the tempered scale in favour of the just scale.

We are dealing with a topic which lies partly in the realm of art, and partly in the realm of science; it is not clear where one ends and the other begins. If the question is debated as to wherein lies the superiority of Beethoven over Puccini, science can take no part. The problem is either too vague or too complicated to be dealt with on a precise basis. Physics cannot tell us why we find Beethoven particularly pleasurable but it can explain why an error made in transposing his music from one key to another would make it disagreeable.

Let us first look at the elementary facts of the physical basis of music. Music is an art; our response to it is psychological and emotional. Nevertheless, if as communication engineers we set out to produce, to transmit and to reproduce music, we are forced to translate the intangible into terms of the tangible.

There are three attributes which we recognize as essential in music: rhythm, melody, harmony. *Rhythm,* the maintenance and accenting of the time intervals at which sounds are produced, is the simplest and most obvious part of music, and is the chief characteristic of primitive music. *Melody* is the linking together of notes of different pitch and duration in a sequence which is pleasing, is harmonious, and is readily capable of being memorized. It is the attribute of music next in complexity to rhythm, and many modern types of music, e.g., the Persian, consist only of single notes played in sequence and in rhythm—the kind of music a man whistling and tapping his foot produces. The third attribute, *Harmony,* is inextricably bound up with melody in a very complicated fashion, and is the art and science of sounding two or more notes simultaneously, so that a pleasing effect is obtained, of greater richness, variety and interest than a single note can produce.

It is plain that music requires a fixed series of notes whose pitches, i.e., frequencies, are such that they give a pleasing effect when sounded in various sequences, and that they can be grouped in a number of ways and sounded simultaneously without offending the ear. What then are the physical realities back of such terms as 'pleasing', 'offending'? A melody sounds well when its component notes are those which sound well in harmony. This leads to the simple rule which has been universally recognized for at least thirty centuries as the fundamental basis of music:

Two notes sounded simultaneously are harmonious if the ratio of their frequencies can be expressed as the ratio of small integral numbers.

From this rule, we should expect that notes with the following frequency ratios would sound well, the degree of concord lessening as we go down the list:

$$\frac{1}{1}, \frac{2}{1}, \frac{3}{1}, \frac{4}{1}, \frac{5}{1}, \text{ etc.}$$

$$\frac{3}{2}, \frac{4}{3}, \frac{5}{3}, \frac{5}{4}, \text{ etc.}$$

The reason that the combination of two tones is harmonious when the tone frequencies have a simple numerical ratio has been a subject for conjecture since Pythagoras, who flourished about 700 B.C. In 1862 Helmholtz proposed the theory that with modifications is generally held to-day. It really explains, not why concords are pleasant, but why discords are unpleasant. The situation appears to be this: The normal human being gets pleasure from doing difficult things. It appears that listening to single note melodies is too simple and so we prefer to listen to complicated tone groups rather than single tones. At the same time if a number of notes are sounded simultaneously to form a single chord, there must be no spurious frequencies introduced which are objectionable. If two notes do not have a simple numerical ratio between their frequencies, then either the fundamentals or some harmonics of these will beat

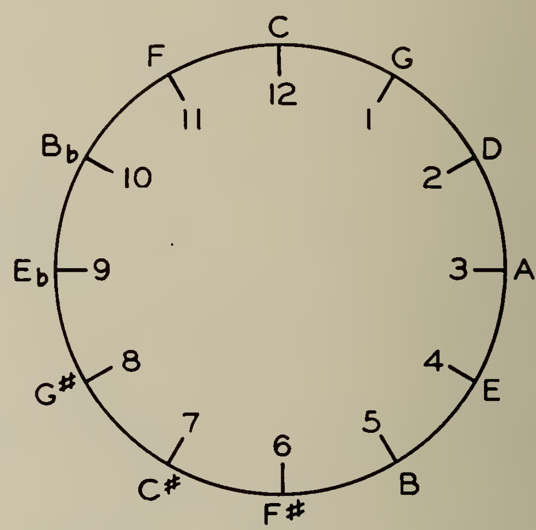


Fig. 1—The 12 semitones of the seven-note scale. Each note has the ratio 2:3 with the note after it and the ratio 3:2 with the note before it

together to form harsh low-frequency beat notes and the only notes between which tolerable concord exists are those combinations which do not produce such beat notes.

The simplest harmony exists between octaves, that is between two tones where one is 2, 4, 8, etc., times the other in frequency. This was the only harmony used by the Greeks. It is readily obtained in singing since men's and boys' voices are about one octave apart; in instrumental music the Greeks obtained it by inserting a bridge in their lyres one-third the distance along the strings. To us this kind of harmony sounds childish, flat, uninteresting. Later, music in Europe in the first or second century B.C., used the interval of the fifth which is C, G on our keyboard, a frequency ratio of 3:2. The fifth is the most important interval in modern music and stringed instruments and pipes as far back as the 5th century B.C. were tuned to the intervals C, F, G, C[1]. Early in the Christian era, a five-note scale became very common, both in Europe and Asia, and modern Scottish and Chinese music is frequently found in this scale, the notes on our keyboard being C, D, F, G, A. It will be found that many traditional melodies are played using only these notes, and that any tune restricted to these notes has a characteristic quality that we ordinarily associate with Scottish music. This scale appears to be very deeply rooted in our civilization, almost as deeply as our more common seven-note scale.

The question which naturally arises is: How did our musical scale develop and is there anything unique about it? If there were human beings on the planet Mars, for example, would they have developed the same scale we use or would it be something quite different? The answer is that they would probably have developed our modern musical scale, since it has a certain uniqueness that no other sequence of notes could have and it is an attempt to fit a musical notation to the inevitableness of arithmetic.

This scale arose simultaneously in many parts of Europe and Asia over a period of some centuries and the sort of process taking place must have been identical in each locality. There seems to be hardly any doubt that the development was as follows: A pipe or a string would be tuned to some note, say C, on our keyboard. At the dawn of musical appreciation the octave was added since it was early found that octave notes together give very pleasing concordance. Later, the fifth was added, that is G, and we then had a three-note scale: C, G, C^1. With the beginning of harmony it would soon be realized that whereas a single note melody could be made using any desired interval between the notes, as soon as two melodies are combined the notes in the scale have to be adjusted so that the two parts sound well together.

With a scale of C, G, C^1, the next logical development would be to add a string or a pipe which would sound as well with G as does C. This is again a fifth above G and is D on our scale. We now have four notes from which several harmonies can be obtained: CG, GD, CC^1. A later development of harmony also accepted GC^1 although this probably was not accepted at first. Another fifth above D gives A, and by following this process right up the scale, we find that the notes shown in Fig. 1 are obtained. Going up by a fifth twelve times brings us out again to our starting note C, seven octaves up. It is evident that when the early experimenters found they had again reached C they would consider that they had used all the natural notes and would be content with this scale of twelve tones. In other words, the modern musical scale is an inevitable result of the elementary equation in arithmetic:

$$12 \text{ fifths} = 7 \text{ octaves}$$

$$\left(\frac{3}{2}\right)^{12} = 2^7 \text{ approx.}$$

$$129.75 = 128 \text{ approx.}$$

It will be noticed that the five-note scale mentioned previously is obtained as any sequence of five fifths. While from the foregoing it is seen that a scale of 12 notes has been constructed, actually, according to a tradition going back possibly to 2000 B.C., a seven-note scale is used, the five additional notes being employed only as accidentals,—that is, for occasional effects,—or in order to permit music to be shifted in position on the keyboard,—that is, to be raised or lowered in pitch. Our seven-note scale is the scale which comes as second nature to everyone, whether he has any musical training or not; this is the familiar do, re, mi, fa, sol, la, ti, do. All music is written in this scale which in the key of C is represented by the white notes on the piano keyboard. It is seen that this seven-note scale goes up by unequal increments, and if we adopt the usual musical language, the intervals between the notes in ascending order are tone, tone, semi-tone, tone, tone, tone, semi-tone. When the black keys are added as well, then all the intervals become semi-tones.

A large number of scales have been constructed on the seven-note basis with five additional semi-tones in which the frequency intervals between the notes have been arranged according to a number of rules so as to give the nearest approach to exact harmony.

About the year 1700 the modern 'equally tempered' scale began to be adopted. It had been known for many centuries and was probably in use in China in 1000 B.C. This scale was proposed and became adopted because it has one great merit: it permits the player to shift from one key to another without any change in the intervals by which the scale progresses. There are twelve intervals in the musical scale and the equally tempered arrangement is this: that the frequency ratio of each note to the preceding one is the 12th root of two. It will be seen then that no matter in what position on the keyboard a piece of music is set, the effect and the harmony are precisely the same, the only difference being an overall change in pitch. The equally tempered scale has one fortunate property in that the interval of a fifth is almost exact. It is likely that one of the

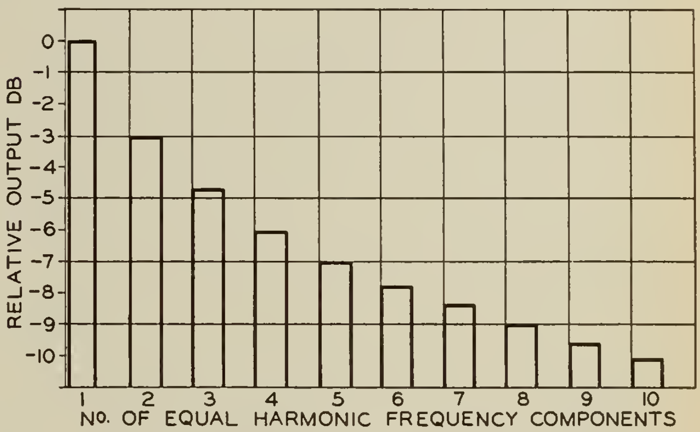


Fig. 2—Decrease of maximum output power of amplifiers due to a complex waveform consisting of equal harmonic components

contributing causes toward the adoption of this scale was the fact that, when the development of the piano had progressed through the stages of spinet, harpsichord, clavichord, and all the others, to the modern form, the difficulty of retuning the instrument for each key, which is necessary on the older scales and without which the harmonies are sufficiently inaccurate to be intolerable, made it imperative to devise an arrangement in which this retuning was not necessary.

The Greeks, although they used the seven-note scale, had no such device as a change of key since they did not employ harmony as we know it. They used, however, a change of mode, something which has almost disappeared from modern music. There were seven modes in Greek music and they were actually not simple changes in pitch of the whole of a piece of music but a change from one sequence of tones and semi-tones to another; in other words, there were seven different scales. Of these modes, two have remained: our major mode which is the usual scale C, D, E, F, G, A, B, and our minor mode which may for example be A, B, C, D, E, F, G. The Greeks attributed definite characteristics to each of their modes and this has been carried into our own music, so much that the expression, "in a minor key," is an accepted English phrase.

Another thing that has been carried into modern musical thought from the modes of the Greeks and more recently the keys of the mean-tone scale is the fiction which many musicians believe, that different keys on the equally tempered scale have characteristic qualities. This is not so. A change of key in the equally tempered scale results in nothing except a change of pitch. There is no change in the character of the music. This can be demonstrated beyond any question when it is pointed out that the key of F♯ major, six sharps, uses the identical notes of the key of G♭ major, six flats. Second order effects do, however, exist.

The equally tempered scale was not much used in England until about the year 1850 and was not generally used for some years afterwards. At the Exhibition of 1851, for example, it is said that not a single organ exhibited was in the equally tempered scale but that all were in the mean-tone scale. This seems to be rather a severe commentary on the English ear for harmony since the equally tempered scale had been adopted generally in Europe 150 years before, solely on the grounds that the mean-tone scale was intolerable except in the key of C.

The other scale which is of fundamental interest in music is the just scale or harmonic scale. This is a theoretically correct scale but suffers from the disability that it can only be played in one key. It consists of a series of notes whose frequencies are represented by the numbers 1, 9/8, 5/4, 4/3, 3/2, 5/3, 15/8, and 2. It will be seen that all these notes bear simple numerical relations to the key note and therefore this scale is very rich in exact harmonies. Unfortunately there occur in it three different sizes of intervals, one having a ratio of 9/8, one having a ratio of 10/9, and one having a ratio of 16/15, so that at present no keyboard instrument is tuned to this scale. There seems to be very little doubt, however, that when a violinist is playing unaccompanied by a keyboard instrument, he plays in this scale and measurements made by Helmholtz and others indicate that this is so. Table I gives a comparison of the frequencies of the notes in the harmonic or just scale and in the tempered scale. This shows two things: first, the divergence of the tempered scale from a theoretically correct scale, and second, the excellence of the harmonies occurring in the harmonic scale between fundamentals and harmonics. In the tempered scale no such fortunate relations exist, since the fundamental intervals are all different from the theoretical values. The harmonics are more and more divergent in notes occurring higher on the keyboard as we go up in frequency.

I have never heard a keyboard instrument played in the just scale but I think there is little doubt that it would give definitely a more pleasing effect than our usual tempered scale instruments. This would be particularly true on the organ where extremely complicated harmonies both of fundamental and harmonics are obtained. Helmholtz in 1850 commented on this and spoke of the extreme pleasure he got from playing a justly tuned instrument after playing on a tempered scale piano. Of an organ tuned in the tempered scale he said, "When the mixture stops are played in full chords, a hellish row must ensue and organists must submit to their fate." We still submit to our fate. The just scale gives almost exact harmonies, but cannot be played in more than one key without retuning; and the tempered scale can be played in all keys, but what should be harmonious relations between notes in the same octave produce perceptible discords. From Table II can be seen an even more important source of discord, particularly noticeable, as it was to Helmholtz, in organs. This is the fact that the 3rd, 5th, 6th, 7th, 10th and some of the higher harmonics of notes at the lower end of the keyboard do not duplicate notes on the upper end of the keyboard, but are noticeably out of tune with them. In the orchestra then, the 3rd, 5th, 6th, and 7th harmonics of the string basses must cause discord with the violins and woodwind, but the effect is not particularly noticeable, first because we are used to it, second because the instruments are all slightly out of tune in different ways, and third because the source of the discordant sounds is spread over a relatively large angle at the listeners' ear. In the pipe organ, the situation is definitely worse when the mixture stops are played. Mixture stops are those in which rows of pipes representing 2nd, 3rd, 4th, and even up to the 10th harmonic are coupled to the fundamental pipes being played, so clash is inevitable between the natural harmonics of the fundamental notes, which in many cases are very strong, and these synthetic harmonics, which lie strictly in the tempered scale. In the piano, the discord between the natural seventh harmonic and the tempered scale notes was early recognized as disagreeable, and to-day all pianos are so arranged that the seventh harmonic is largely suppressed; this is done also in organs and in the brass wind instruments. The oboe among the orchestra instruments is characterized by a strong seventh harmonic, and its harsh, penetrating quality may be largely due to the discords thereby produced. Two possibilities of remedying this situation theoretically are not open practically to the constructor of traditional musical instruments. The theoretical possibilities are: first, to suppress all natural harmonics and use only tempered ones, which is obviously not possible practically, except to some extent in the case of the pipe-organ; or second, to shift to the just scale, so that in most important instances the natural harmonics appear almost exactly on the scale. This results in the limitation of the instrument to a single key.

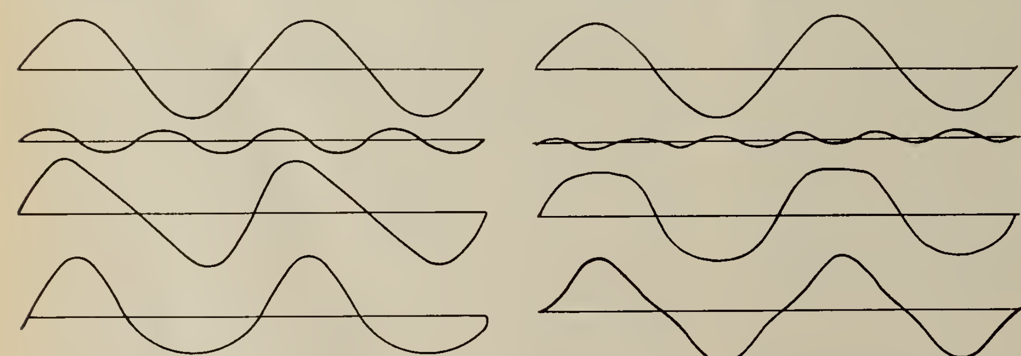
TABLE I

Comparison of Harmonic and Tempered Scale Intervals.

Note	Tempered Scale Frequency	Harmonic Scale Frequency	Harmonic Scale Harmonics of				
			C	G	D	F	A
C	1000	1000	1000	1031	985	1000	1042
C#	1059						
D	1125	1125	1125	1125	1125	....	1146
D#	1189						
E	1260	1250	1250	....	1266	.....	1250
F	1355	1333	1375	1312	....	1333	....
F#	1414						
G	1498	1500	1500	1500	.....	1500	1458
G#	1587						
A	1682	1667	....	1687	1687	1667	1667
A#	1782						
B	1888	1875	....	1875	....	....	1875
C	2000	2000	2000	2062	1969	2000	2083

By far the best answer to date has been supplied by Laurens Hammond in his electric organ. In this instrument, musical qualities are synthesized from pure sine waves, and all the frequencies used in the synthesis lie on the tempered scale. In other words, natural harmonics are entirely suppressed and tempered harmonics substituted. In no other instrument, to my knowledge, is this done, and while the results are not immediately perceptible to the lay ear, the characteristically harmonious effect of the Hammond organ that becomes apparent after some familiarity with it must be ascribed to this basic improvement.

There are two fundamentally different ways in which an electric instrument may be arranged to produce musical tones: the tone can be generated in the first instance as a complete wave of the desired



(a) (b)

Fig. 3—(a) Oscillograms showing the combination of a fundamental and a second harmonic in two different phases. (b) Oscillograms showing the combination of a fundamental and a third harmonic in two different phases

character, which is then amplified and reproduced; or it can be produced as the addition of a group of sine-wave frequencies lying in a harmonic series.

In the Hammond organ the latter arrangement is used. The tone-generator consists of 91 miniature tone wheels. These wheels are made of steel, and each has a sine-wave cut in the periphery. A single permanent-magnet pole-piece with a coil wound on it is used with each generator. All the generators are driven from a single synchronous motor with elaborate precautions taken to prevent frequency-modulation flutter. These consist of a damped low-pass mechanical filter in the main drive, and of a similar small section in the drive to each pair of tone wheels. The generator assembly consists of two groups of jack shafts, on each of which are mounted two tone wheels, separated in frequency by an integral number of octaves, and a gear and mechanical low pass filter. These two groups are driven by gears mounted on a main drive-shaft and one group lies on each side of it. It is evident that the limitations of motor speed, and of cutting exact numbers of teeth on gears and tone-wheels, will not permit an exactly precise duplication of the tempered scale. Compromises have been necessary, but they are of negligible importance. This could not be said of such departures from the just scale, if it were in use instead of the equally tempered scale. Note this point, however: if the just scale were used for this organ, no departures would be necessary, since all the frequencies bear simple fractional relations to each other. In the Hammond organ, the octave intervals are maintained precisely, this being the purpose of the small jack shafts, each with two tone-wheels mounted on it.

The output of each pick-up coil is passed through a bandpass filter to reduce it as nearly as possible to a sine-wave. In this instrument, provision is made to synthesize tones using a fundamental or 1st harmonic, the 2nd, 3rd, 4th, 5th, 6th and 8th harmonics, the sub-harmonic, or octave below the fundamental, and the sub-third, a fifth above the fundamental. From these nine partials pipe-organ voices can be imitated, in some cases perfectly, in all cases adequately, and this is true of most of the orchestra instruments. Obviously tones can be set up that are entirely new qualities, not produced by traditional instruments. It is evident that each generator output appears in a number of places on the keyboard. For instance, if we have a generator which is the fundamental frequency of middle C, it is the second harmonic of the C below, the fourth harmonic of the C below that, and the eighth harmonic of the C below that again. It is the sub-harmonic of the C above, the third harmonic of the F an octave and a fifth below, and the sixth harmonic of the F two octaves and a fifth below. It is the sub-third harmonic of the F below and the fifth harmonic of the G♯ two octaves and a third below.

Since a tone produced by the organ may include all nine partials each key carries an assembly of nine contact springs. The moving sides of these contacts connect to the generators, the stationary sides through the switching mechanism which selects the desired harmonics and adjusts their relative strengths to an amplifier contained in the console. The output from this amplifier is fed to as many power amplifier-tone cabinet units as may be necessary.

The relative amplitudes of the generator outputs are adjusted by sliding the pole-pieces. The output is adjusted to a curve rising steeply from the high-frequency end to the low-frequency end. Aside from the harmonic-suppression filters on each generator, no electrical filters are used. From the previous discussion on the tempered scale, it will be realized that the suppression of natural harmonics is of the greatest importance except in the top octave of the keyboard, where they fall outside the range of any of the generator fundamental frequencies. Accordingly no harmonic filters are employed on the top octave of generators, to permit the added brilliancy of an extended harmonic range.

The strength of each harmonic in a tone can be set in eight steps of three decibels each, or cut out entirely. Controls are provided so that four tones can be set up, two for each manual or keyboard, and can be brought in by pressing a button. In addition, a limited range of tones can be set for the pedals. Eighteen of the usual pipe-organ qualities are permanently adjusted, and nine may be used on each manual by pressing the appropriate switches at the left of the keyboard. The volume-control, operated by a foot-pedal, has a total range of 30 decibels. Figure 3 shows typical waveforms obtained by combining several harmonics with a fundamental.

A tremulant is provided by a motor-driven potentiometer, and the effect is variable by means of a manually operated potentiometer connected across it. An effect of great importance which is provided is the so-called "chorus effect". It is this that enables us to tell twenty violins playing in unison from one violin playing loudly, and it is particularly noticeable in the pipe-organ where frequently a great number of pipes of the same pitch may be sounded together. With a number of separate sources, it is inevitable that small frequency differences should occur and this, together with random and changing phase relations, are imitated in Hammond's organ by having for each generator representing a keyboard note, another generator slightly out of tune with it, whose output is quite low. This second set of generators can be connected at will by a control at the right of the keyboard.

The Hammond organ is widely accepted by musicians and is now in general use throughout the world. Among other electronic instruments that have been commercially exploited is the Everett Orgatron, an instrument that employs wind-blown reeds with electrostatic pick-ups. The reeds are in a sound-proof chamber, and different tone qualities are obtained by using different banks of reeds, and by shaping the response curve of the amplifier. This instrument gives the characteristic reed-organ quality. There are several pianos with electrostatic or electromagnetic pick-ups on the strings which are said to be extremely effective, since they permit the elimination of the sounding board, the bass can be enhanced at will, and a wide volume range can be obtained without the necessity of tremendous exertion by the performer, or of changing the quality of the sound produced.

TABLE II

Comparison of Scale of Equal Temperament with Hammond's "Tempered Harmonic" Scale.

Note	Tempered Scale Frequencies	Frequencies of Harmonics of Notes in Lower Octaves which appear in this Octave							
		2nd, 4th and 8th		3rd and 6th		5th		7th	
		Natural	Tempered	Natural	Tempered	Natural	Tempered	Natural	Tempered
C	1000	1000	1000	1001	1000	992	1000	985	1000
C♯	1059	1059	1059	1061	1059	1051	1059	1040	1059
D	1125	1125	1125	1124	1125	1114	1125	1102	1125
D♯	1189	1189	1189	1190	1189	1180	1189	1168	1189
E	1260	1260	1260	1262	1260	1250	1260	1237	1260
F	1335	1335	1335	1337	1335	1324	1335	1311	1335
F♯	1414	1414	1414	1416	1414	1406	1414	1389	1414
G	1498	1498	1498	1500	1498	1486	1498	1472	1498
G♯	1587	1587	1587	1589	1587	1575	1587	1559	1587
A	1682	1682	1682	1688	1682	1669	1682	1652	1682
A♯	1782	1782	1782	1784	1782	1767	1782	1750	1782
B	1888	1888	1888	1890	1888	1875	1888	1853	1888
C	2000	2000	2000	2003	2000	1984	2000	1969	2000

A number of organs using vacuum-tube oscillators have been produced commercially, some using a separate oscillator for each note, some using only twelve oscillators, one for each note in one octave, all the other notes being obtained as harmonics. There appear to be two objections to these instruments: first, the large number of vacuum-tubes involved—in the hundreds—and second, the difficulty of keeping them exactly in tune.

An instrument which is an outstanding example of the principle of the generation directly of a complex tone, instead of synthesis from harmonic components, is the Robb Wave Organ, designed by Morse Robb and constructed at Belleville, Ontario. This interesting and successful instrument consists of a console connected by a multi-conductor cable to the tone-generating unit, and the usual amplifiers and loudspeakers. The generator consists of twelve spindles, one for each note in the octave, each with a number of discs, and driven through belts and pulleys from a single motor. On these discs are cut the complex wave-forms which it is desired to reproduce, so that subject only to the limitations of the amplifier and loudspeaker equipment almost any tone can be accurately reproduced. A very large number of generator discs is required—one for each keyboard note, for each tone colour. The total number is substantially reduced, however, by using generators in the form of cylinders, not flat discs; a number of pick-ups are employed on each cylinder, at different points in the height of the waveform and different pick-ups and different combinations of pick-ups give wide variations in tone-quality. This organ is provided with a group of standard pipe-organ stops, the discs being cut from oscillograms made from acoustic pick-up from a pipe-organ. The Robb Wave Organ embodies a number of ingenious points in its design and must be regarded as a serious musical instrument.

The classical work on electrical musical instruments was carried out by Thaddeus Cahill, between the years 1895 and 1905. All the modern inventors have drawn largely on his work, which is explained and described exhaustively in five patent applications drawn up by him. Cahill appears to have been the first man to conceive the idea of the electrical production of musical tones. He produced several models of an instrument which he called the Telharmonium. To ship one of these instruments from his laboratory at Holyoke, Mass., to New York required forty railway cars; the instrument weighed over two hundred tons and cost upwards of a quarter of a million dollars! Cahill intended to use his Telharmonium to transmit music over telephone lines to subscribers; the plan finally fell through because of cross-talk into adjacent circuits.

Cahill clearly understood all the theoretical and practical problems involved in the electric organ; he outlines them in great detail, together with the extraordinarily ingenious features of his Telharmonium. Since, of course, he had neither vacuum-tube amplifiers nor modern loudspeakers, he had to generate relatively great amounts of power. He employed generators in the form of wound-rotor alternators and commutators (he used the word "rheotomes"). The bedplate of his main generator assembly was 60 ft. long. He understood and used low-pass and band-pass filters and matching networks of many configurations, and understood the impedance relations of his circuits and the importance of satisfactory transient characteristics, all these at a time when such knowledge was not general in any branch of communication engineering. Initially he used great multiple loudspeakers, made of vibrating magnets clamped to hardwood bars; later he used telephone receivers with conical horns. His Telharmonium provided much more complete facilities to the performer than has any electrical or acoustic organ before or since. He employed the methods both of tone synthesis from pure tones, and of the generation of complex tones. An article in 1906 in The Electrician states:

> It is evident that the constructional features of the electrical mechanism are exceedingly elaborate. It is believed, however, that the results obtained fully justify the means employed. There can be no doubt as to the absolute accuracy of the relative pitches of the various notes produced, nor as to the beauty and purity of the resultant music. Although the horn of the receiver resembles that of a phonograph, there is nothing about the music itself to suggest the phonograph, the harsh sounds and disagreeable overtones of which are entirely lacking. The quality of the sound is pure and sweet and the volume is such that the largest known auditorium can be served without the use of an excessive number of receivers, while the character and expression of the music is under the control of the musician to an extent not previously reached in any musical instrument.
>
> The question will naturally arise in the mind of the reader as to the practical use of this complicated and expensive apparatus. The plans of the inventor are to distribute music from a central station to hotels, restaurants, theatres and private homes. The remarkable purity and strength of the sounds produced electrically, enabling a few performers at a central station to produce orchestral music at a thousand places, strikes the imagination and it seems not improbable that at no distant day orchestral music for the dinner table will be as common in the homes of the people as it is now in the great hotels. Music of different sorts during the evening and slumber music during the small hours of the night coming to the listener by electricity from a central station, seem likely in a few months to be accomplished facts in one or more American cities.

The design of the transmission circuits of an electrical organ such as the Hammond presents a number of problems. The frequency range is from 32 to above 8,000 cycles, and the maximum output occurs at the lowest frequency. This involves the design of amplifiers and loudspeakers whose efficiency and power-handling capacity are unimpaired at 32 cycles. From the discussion on the tempered scale, it will be remembered that the suppression of natural harmonics in the amplifier-loudspeaker system is of the greatest importance. This requires careful design of the amplifier, and of the acoustic loading on the loudspeaker so that even at the lowest frequencies no break-up occurs.

Another point largely ignored in ordinary transmission systems that is of great importance in a system for the transmission of organ tones is that in a wave made up of a harmonic series with random phase relations, the peak value of the wave reaches a relatively high value for a given root-mean-square value. In other words, the power output capacity of the amplifier is largely reduced due to the waveform of the tone being transmitted. Fig. 2 shows the magnitude of this effect.

What significance can engineers draw from the facts that have been presented ? What of the future developments of the instrumentalities of music ? One possibility that is of overwhelming importance now appears: that is, to abandon the tempered scale in favor of the just scale. It has been seen what inaccuracies of harmony are inherent in the tempered scale. Its main virtue is its convenience—the facility it provides for changing key. The just scale must be retuned for each key, but is the ideal solution to the seven-note scale since it provides the largest number of exact harmonies possible. This makes its use impossible in the traditional keyboard instruments. The stringed instruments in the orchestra can readily play the just scale in any key, since the pitch can be continuously varied; the wind instruments can also by means of changing the length of the air column, with telescoping joints for small changes of pitch, and by using different instruments for large changes.

With the advent of electrical keyboard instruments a new era in music is initiated. It is now possible to tune such an instrument in the just scale, and to change key electrically by altering the frequency of the generating devices. From what has been said it will be apparent the resultant improvement in the harmoniousness of our music would be appreciable.

STREAM CONTROL IN RELATION TO DROUGHTS AND FLOODS

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SUMMARY—Precipitated moisture is evaporated, absorbed as soil moisture, or runs off. Distinguishing between the resulting effects in arid or humid watersheds the author briefly discusses stream control as affected by vegetal covering, character of soil, size of drainage basin, and by reservoirs and other remedial measures.

Every natural stream is the result of water from precipitation flowing to lower elevations, this flow being modified by evaporation, and local conditions such as topography, soil and vegetation. The development of successful stream control measures depends upon an understanding of the basic processes directly affecting stream flow.

What Happens to Precipitation?

Figure 1 illustrates the disposal of water coming to us in precipitation. When water falls on the earth's surface as rain or forms from melting snow, a part is evaporated directly from the surface on which it has fallen and a second part is absorbed by surface soil. The water absorbed by soil, or temporarily held in the soil near the surface where it is acted upon by surface influences, may be termed soil moisture. The third division is called initial run-off, being the water which runs off to join the streams draining the area being studied. Such water does not all continue in the stream, however, since there is a continual evaporation from the surface of every rivulet and stream. Some of the initial run-off is impounded in local ponds or lakes from which evaporation may be great. Another loss from the infant stream may be percolation into the ground.

Returning to the soil moisture, we will find that much of it is also evaporated. As the surface soil dries, capillarity brings water back to the surface. Then every growing plant or tree draws water from the area reached by its roots and vaporizes it from its leaves in the process of transpiration. (In this paper, transpiration will be considered as part of the evaporation.) That part of the soil moisture not used as above tends to continue its percolation and becomes ground water. A distinction should be made between ground water and soil moisture. For this paper, the term ground water will be used to describe water which has penetrated the earth to a zone beyond the natural surface influences. Ground water tends to move through the earth nearly parallel to the surface and appears as springs in surface depressions. When it is brought to the surface in any way, part will be evaporated and part may be added to the run-off. Water does not penetrate the ground to be lost. In humid districts, the ground is generally fully saturated a short distance below the surface and water can be taken into the ground only if quantities are also being removed. There may be a small movement of water away from certain areas through the ground and such water is thought of as deep seepage.

The central circle of Fig. 1 represents the disposal of water from a small area and a limited period, while the outer part of the chart represents average disposal for larger areas. A stream at any point represents the final run-off for the drainage basin, or watershed, above that point. With a definite area in mind, the final run-off represents the residue of precipitation after the requirements for evaporation and seepage are met. The amount lost in seepage from large drainage basins is usually very small.

The author suggests that the term run-off should be used only with a definite area in mind, and feels that the subject has been somewhat confused because of failure to do this. The area should preferably be a definite watershed or a group of watersheds, when the average of the group could be taken. Reports are available concerning run-off studies for plots of ground five feet square. Certainly the results would differ greatly from the results of a study of the run-off of the great river drainage basin in which the plots are located. Run-off studies of small areas may give misleading information when applied in a general sense.

With the exception of deep seepage loss, all of the processes illustrated in Fig. 1 are likely to be found in any watershed, but the percentages of precipitation affected vary greatly with different conditions of climate, topography soil and vegetation.

On the open plains of western Canada, a large drainage basin does not lose more than two per cent of its precipitation through run-off. Deep seepage does not occur in appreciable quantities and at least 98 per cent of the precipitation is returned to the atmosphere in evaporation. But on the eastern side of the continent, streams from a large drainage area may take away 40 or 50 per cent of the precipitation and only 50 or 60 per cent is accounted for in evaporation. Generally the percentages change with the size of a watershed, this being particularly true of the semi-arid areas, where a small tributary watershed may show ten per cent run-off, ten per cent seepage and 80 per cent evaporation, while the large basin of which the small one is a part, may show two per cent run-off, no seepage and 98 per cent evaporation.

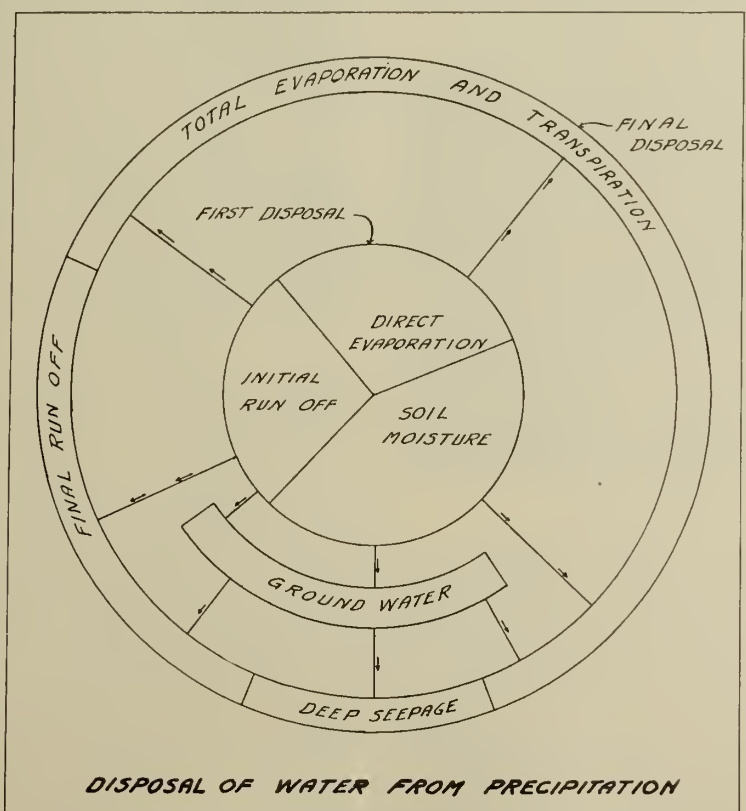

Fig. 1

Relationship between Evaporation and Precipitation

The total annual evaporation from a given area, or the amount which would be evaporated if the water were available, may be called the *evaporation requirements* of that area. The relationship between precipitation and evaporation should be the main factor in the classification of an area in regard to its aridity or humidity. In this paper, areas referred to as arid or semi-arid, are those in which precipitation is less than the evaporation requirements and areas referred to as moist or humid are those in which precipitation exceeds evaporation.

The author does not know of any general attempt to fix the annual evaporation requirements for extensive areas but some information is available. Professor E. F. Chandler[1], Dean of Engineering, University of North Dakota, has estimated this at 20 in. for rolling prairie areas of the north-central United States. The author believes that this figure would apply to much of the Canadian prairie.

Some books on hydrology, such as those by Meyer[2] and Mead[3], give data to aid the close estimation of evaporation from an open water surface or from different types of land surfaces in any locality. Probably the best method of estimating the evaporation requirements of any area is to begin with the evaporation from water surfaces and estimate for other surfaces by comparison. The area and types of surface in the watershed must be known or intelligently estimated. For a simple illustration, suppose that the watershed is estimated as follows:

300 sq. mi. water surface, evaporation..........	24 inches
300 sq. mi. cultivated land, evaporation........	18 "
300 sq. mi. wooded area, evaporation...........	12 "

Then the average evaporation requirements for the watershed would be 18 in. If the annual precipitation for the area is found to be 20 in. we may call the area moist and the run-off will approximately equal two inches of water over the drainage basin. If the annual precipitation is found to be 16 in., our imaginary watershed would be classed as semi-arid and run-off would be very light and probably uncertain.

If an estimate of the evaporation requirements can be made, the resulting classification will be of more value than a classification on the basis of precipitation alone. In northern Canada, there are areas with annual precipitation less than 15 in. which are definitely moist and yield a good run-off, while areas in the southwestern United States with annual precipitation in excess of 20 in. are definitely semi-arid.

Effects of Topography and Soil

Rugged topography and steep slopes favour a quick run-off and even in semi-arid areas may produce some floods when precipitation comes suddenly. Such topography tends to increase the effects of aridity as water is lost quickly after a storm. Porous soils such as sand and gravel tend to temporarily impound water and yield it for a more regular flow of stream. Cultivated fields, where slopes are not excessive, and wooded surfaces tend to absorb water. The former yields it later chiefly to evaporation and the latter yields it to evaporation and sustained flow of stream. Frozen ground, bare rock or hard packed bare ground do not absorb much moisture, and tend to produce quick run-off. In regard to floods, the shape of the watershed is important, a long narrow area being less subject to floods, while a round or fan-shaped basin with tributary streams converging near one point is likely to be troublesome.

Measurements of Stream Flow

The total run-off of a stream, for a given time, may be expressed as depth over drainage basin, or as the total amount of water, in cubic feet, gallons, or acre-feet, taken away by the streams. The flood stage is usually expressed as cubic feet per second passing the gauging station. In connection with floods, it is customary to divide the flood stage in second-feet by the number of square miles in the drainage basin above the control point, giving second-feet per square mile. This figure gives the flood-producing tendency of the watershed, but for comparisons to analyze the effect of certain conditions, watersheds of approximately the same area should be considered. Other things being similar, a small watershed shows a higher flood stage (in second-feet per square mile) than a large one.

The flood stage expressed in second-feet per square mile may not always indicate the damaging effect of a flood. Often it is the difference between the extreme stage and the average or normal which causes damage, but, in the study of factors causing flood discharge, the second-feet per square mile measurement of the flood stage is the only means we have for describing it. Floods are frequently described by reference to the height on a particular gauge. This allows comparison with previous floods at the same point but is of no value in comparing one stream with another. It should be noted that flooding of areas may be due to obstructions in streams rather than excessive flow.

Difference Between Streams in Arid and Humid Districts

In arid or semi-arid areas, run-off will be very light. A heavy rain, even of short duration, often brings water faster than the soil can absorb it. At such times a surface flow starts even though there is little soil moisture or ground water. On the other hand, very porous soil may allow percolation before surface influence acts and the water reappears in springs from which it joins the streams. Snow or rain coming on frozen ground is not likely to be absorbed and part of it becomes run-off.

A noticeable characteristic of the semi-arid stream is that run-off, expressed as depth over drainage basin, is greater from small areas than large. The only probable exception to this rule is an area of very porous soil, but even with this type of soil, the water is usually evaporated when it comes to the surface, and springs add little to the run-off. The tendency for the small semi-arid area to produce greater run-off than the larger may be seen in the Surface Water Supply Reports of the Dominion Water Power and Hydrometric Bureau. These reports show the average run-off for the Qu'Appelle River at Tantallon (drainage area 20,600 sq. mi.) for the ten years ending September 30th, 1929, to be 0.148 in. For the same period, a tributary stream, the Moose Jaw creek (drainage area 1,960 sq. mi.), had a run-off of 0.373 in. The Moose Jaw creek drains an area more arid than the average for the Qu'Appelle basin and the increased run-off for the Moose Jaw creek is due entirely to the smaller size of the drainage basin.

For Canada and the northern United States, dependable run-off from semi-arid districts comes only from the fall and winter precipitation. For several years, the author has used a chart for estimating run-off from the Canadian prairie, made from the plotting of a large number of run-off figures and taking into consideration fall and winter precipitation as well as the size of the watershed. This chart has been published previously[4] and is reproduced here (Fig. 2). It is believed that a chart of this kind will be useful to anyone having to estimate run-off in semi-arid areas in the northern United States and Canada.

It is not suggested that estimating of this nature should replace stream flow gauging and use of such records. In fact, this study shows clearly that more stream gauging work should be done, but it will be necessary for some time yet for engineers to supplement available records by estimates. Often the measurements of one control point on a large watershed are used as a guide for estimating run-off at any point on that watershed. Such a practice is misleading, because the run-off measurements of a stream draining a large area do not properly reflect the characteristics of the smaller tributary basins when they are studied as such. It is realized that acceptance of this principle will add to the difficulties of those who have charge of the administrative control of our streams, but the need for the full utilization of our waters is so great that these difficulties will have to be met and overcome. Ultimately it will be found that we have more water available for use in the small local water conservation projects than our records indicate.

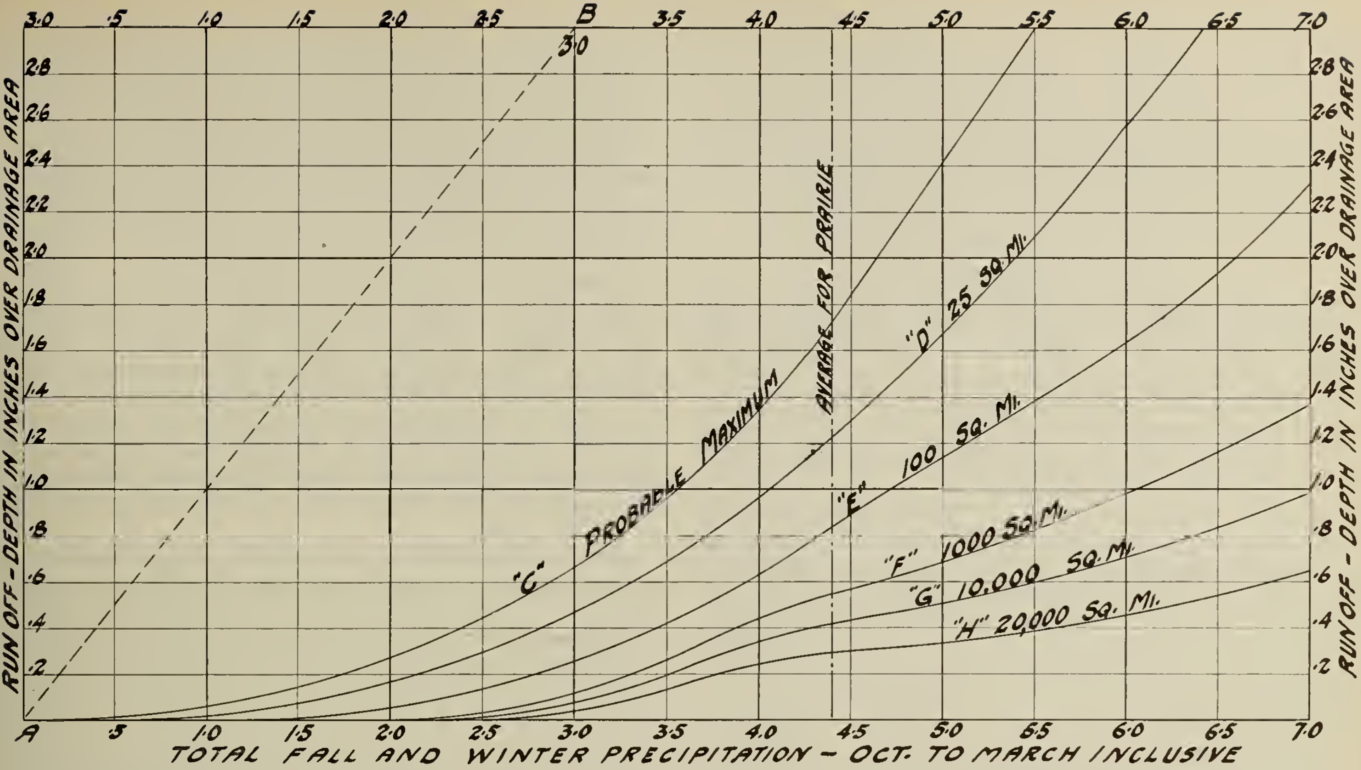

Fig. 2—Run-off from Canadian prairie, Regina, Sask., January, 1933. C, D and E will apply to rolling prairie or hills, clay soils and quick melting of snow. F, G and H will apply to watersheds consisting of part level and part rolling prairie, average soil and temperatures

Small basin floods are the result of a combination of the local factors such as topography and soil, and the climatic factors. As the drainage basin increases in size the behaviour of the stream becomes more the result of climatic conditions, and local factors become of less importance.

As an example of a stream draining a semi-arid area (according to the author's classification) we may take the Souris river with a drainage basin of 23,400 sq. mi. in southwestern Manitoba, southeastern Saskatchewan and the northern part of North Dakota. Average annual precipitation varies from about 14 in. in the western part of the basin to 18 in. in the eastern part. Taking Professor Chandler's estimate of 20 in. for evaporation requirements, we would expect definite moisture deficiencies. In some areas there is almost a total lack of ground water. Run-off is primarily the result of fall and winter precipitation. For the ten-year period ending September 30, 1929, the open water measurements indicated an average annual run-off of 0.177 in. over the drainage basin. The small winter flow of the streams would not greatly affect the result for this size of drainage area, and we may safely assume that the total would be under two-tenths of an inch.

The maximum flood during the period of observation occurred in April, 1916, and equalled 0.260 sec.-ft. per sq. mi.

An example of a moist watershed is that drained by the Winnipeg river, only a few hundred miles from the Souris river. Above the gauging station at Minaki, Ont., the river drains an area of 27,200 sq. mi. This includes the Lake of the Woods, Rainy Lake and numerous small bodies of water making an unusually large percentage of water surface. The land areas are largely wooded. Average annual precipitation is about 24 in. and evaporation requirements are certainly under 20 in. For the same period referred to in connection with the Souris river, annual run-off for the Winnipeg river averaged 6.88 in. over the drainage basin. If 24 in. is correct for average precipitation for the period, evaporation would be about 17 in. and this is supported by data available concerning evaporation from open water within the drainage area. It will be seen that no form of artificial control could appreciably affect the average run-off in this case and it will always be considerable when precipitation exceeds evaporation.

The maximum observed flood at Minaki is two second-feet per square mile or almost eight times as great as that for the Souris river.

Even for streams with drainage basins between 1,000 and 5,000 sq. mi., the climatic factor dwarfs all others in connection with flood discharge. The highest we know for this size of watershed in the Canadian prairie is approximately five second-feet per square mile. The Miami river at Dayton, Ohio (drainage area: 2,450 sq. mi.), had a flood stage estimated at 100 sec.-ft. per sq. mi. in April, 1913, and a number of the New England streams with drainage basins in excess of 1,000 sq. mi. had stages as high during the 1927 floods. Thus, streams in humid districts have flood stages twenty times as great as any we know for the Canadian prairie, in spite of any regulation which may be brought about by forest cover for part of the drainage basin.

The definite relationship between climatic conditions and floods has been clearly explained for western Ontario by Dr. Patterson,[5] and for the Ohio valley by Holzman and Clark-Hofstad[6].

In connection with the Thames and Grand rivers of western Ontario, it is interesting to note that the extremes have occurred in different years on the two adjoining watersheds though local conditions are similar[7].

Objectives in Stream Control

The author certainly does not wish to reduce the importance of conservation schemes affecting our streams, but rather wishes to rally support for every sound proposal.

Even with the recognition that climate is uncontrollable and that stream behaviour is primarily the result of climatic conditions, there still remains room for a great deal of control or regulation by man.

In arid or semi-arid areas, stream control will consist primarily in the conservation of water to make it available for periods of extreme lack. This will include supplies for rural homes, stock water, irrigation, recreational centres and municipal needs. Such conservation work may include the checking of floods which prove troublesome even though of small volume compared with humid area streams, and also measure to increase the low water flow.

In humid districts, some degree of drought may occur at times and stream control may alleviate distress from that source. Flood control may be the dominant problem, and in connection with measures for that purpose, navigation may be improved and power development aided.

Control Through Changes in Cultivation, and Vegetal Covering

Streams are affected to some extent by our use of the land from which they derive their flow. Any action which tends to increase average evaporation will decrease average run-off, and the speeding up of run-off is likely to adversely affect the later low water flow. It should be borne in mind, however, that storage reservoirs are of no use in stream control when full and that absorbing surfaces cannot function as such after being saturated.

Very wide divergence of opinion exists upon the effect of deforestation, cultivation, and drainage. We know that trees reduce evaporation from the ground and water surfaces, but yield water to the air through transpiration and evaporation from their branches and foliage. The net result as compared with cultivated fields cannot be definitely determined, but experts in this field consider that trees decrease total evaporation. There should then be a greater average flow from a forest area than from cultivated fields with similar climatic conditions, and this conclusion is strongly supported by a study of stream flow records. The reduction in evaporation and increase in run-off will be more pronounced in those areas where there is a long winter season, at which time the trees are dormant but check evaporation. In spite of the popular ideas concerning the matter, the author is convinced that the clearing of fairly level upland forest areas and placing them under cultivation does not increase flood tendencies, but does decrease the low water flow. However, with the settlement of a naturally forested country, there is a clearing of obstructions in some waterways which quickens the run-off and leads to more flood trouble along parts of some streams. It is also true that clearing of forests from areas of rugged topography is likely to increase the flood tendency of local streams draining them. After carefully reviewing the evidence available the author would estimate the evaporation from the various types of surfaces, compared with that from open water as follows:

Open shallow water	100 per cent
Cultivated fields	60 to 90 per cent
Uncultivated open plains	45 to 75 "
Forest	40 to 60 "
Bare rock or impervious hilly ground without vegetation	20 to 50 "

Because of the effects outlined above we may expect the following results of changes in cultivation and cover. These results will usually be evident only in comparatively small drainage basins, as the large basins do not have the same type of change throughout.

Alteration	*Effect*
Wild, open prairie placed under cultivation.	Slight decrease in run-off shown in both maximum and minimum flow.
Open prairie covered with tree growth.	Some increase in total run-off shown chiefly in low water flow.
Forest area cleared, cultivated and drained.	Decided decrease in low water flow. Slight increase in flood tendency. Total average flow decreased.
Forest area to barren hills.	Decided increase in flood tendency and decrease in low water flow.

The results are so indefinite that effect on streams will not often prove to be an important factor in deciding upon the use of any land. Appreciable changes in flood tendencies for other than small hilly basins can hardly be gained through forestation, but improvement of low water flow (usually very important) may be practicable in some cases.

Engineers and climatologists, who have given careful study to the question, are almost unanimous in stating that deforestation has not appreciably affected the flood tendencies of our principal streams and that reforestation or afforestation cannot be considered a practicable method of flood reduction.

Control of Erosion

Methods of cultivation and types of vegetal covering maintained are probably the important factors in erosion or erosion control on any watershed. Storage reservoirs may quickly fill and channels may be blocked where erosion is excessive. A comprehensive review of this phase of the question is contained in the United States Department of Agriculture Bulletin No. 1430, Financial Limitation in the Employment of Forest Cover in Protecting Reservoirs, by W. W. Ashe.

Everyone interested in the best utilization of our streams should support soil conservation work. We must, however, recognize definite limitations to man's effect on geological processes. Checking of erosion on small tributary streams may have no appreciable effect on the large systems which they join, or the effect in the main streams will be very small. No matter how much soil is added to swift flowing mountain streams, the water from them has definite silt carrying capacity when it reaches the slower moving stream and the excess is deposited at some intervening point. This is well explained for the Mississippi River in the 1927 report of Major-Gen. Jadwin, Chief of Engineers, United States Army, in which it is stated that "The silt carried by the Mississippi in its alluvial valley is not determined by that contributed from the various lesser tributaries of its main branches, but is the balance remaining of the load which has been picked up and deposited many times." The building up of the alluvial valley is, of course, a geological process started long before the advent of man. Other engineers with long acquaintance with the Mississippi have stated that not more than one or two per cent of the silt carried by that river is due to man's activity.

Numerous instances may be found of improvement in erosion conditions through changes in cultural methods and the vegetal covering of watersheds. Such improvement will conserve land, avoid excessive silting and generally improve the streams.

The U.S. Forest Service[8] report the use of forests by a large number of municipalities and water companies for the protection of municipal supplies in the northeastern states and the Ohio valley. In such cases, erosion control, sanitary improvement and increased low water flow would be the important results obtained.

The use of forestry in connection with stream control supports the opinion of those best qualified to advise, *i.e.*, that forest and other vegetal cover helps in erosion control, improves the regularity of streams of small drainage basins (particularly increasing low water flow) but does not affect major floods.

The Place of Reservoirs in Stream Control

When all purposes of stream control are considered, it is probable that dams and reservoirs will be found to be the most common means used. Dams vary in size from a small earth structure impounding two or three acre-feet to a giant structure such as Boulder dam.

In semi-arid or arid regions, reservoirs will be the chief means of conserving water for the various uses listed above. As more water is available for use on smaller tributary streams of the semi-arid region, it is evident that conservation can be effected best through many small reservoirs rather than in large ones on the main streams. This, too, usually gives the greatest benefit to the population.

With some tree and hedge planting carried out in the form of shelter belts and snow traps near these small reservoirs, a concentration of moisture will be brought about. It is quite conceivable that the tree planting may bring about an increased flow of surface water to offset the amount stored in many places. A great deal of local benefit can be obtained with practically no adverse effect on the main streams. An important point is the need for considerable depth of water in each reservoir to allow for the large evaporation.

Irrigation is often provided by diversion dams and is probably one of the greatest blessings which engineering skill has brought to mankind, but its limitations should not be overlooked. There is not enough water available in North America to adequately meet the needs of the dry regions, and most of the large ventures which have been developed have turned out to be unsound financially.

We should not overlook the fact that an open reservoir in a semi-arid country is often inefficient, since the loss from evaporation may greatly exceed the amount available for use.

In connection with flood control, reservoirs must control a considerable percentage of the drainage basin above the point to be protected, and should be near it. The common belief that reservoirs can serve a number of purposes such as flood protection, power development, and water conservation is often found to be false, as reservoirs are capable of only a very limited use in addition to the primary purpose for which constructed[9].

Dams are constructed of earth, timber, rock and concrete, earth dams of several types meeting the need in most cases. A full treatment of earth dam construction is given in Justin's book, "Earth Dam Projects"[10]. Mr. C. J. McGavin, A.M.E.I.C., gives helpful suggestions for those developing small conservation projects in a booklet issued by the Department of Natural Resources, Province of Saskatchewan[11].

Examples of Use of Reservoirs in Stream Control

Water conservation through the use of small reservoirs has considerably increased during the past six or eight years in both Canada and the United States.

Work of this kind being carried out in the northern prairie States was described by Mr. Lewis A. Jones in a paper published in The Engineering Journal of April, 1935[12]. It is believed that this sort of work is still being carried on extensively in the United States though it does not receive great publicity.

The work in Canada has been greatly encouraged through the Prairie Farm Rehabilitation Act. The working of this Act was described by Dr. E. S. Archibald, Director of Experimental Farms, Dominion Department of Agriculture, and progress in water conservation by Mr. B. Russell. A.M.E.I.C., in The Engineering Journal of May, 1936[13].

In a radio address on November 23rd, 1937, Mr. W. L. Jacobson, Secretary, P.F.R.A., stated that "by the end of October this year, over 10,000 applications had been received for assistance in building dugouts, stockwatering dams and small irrigation schemes in the three prairie provinces including 1,550 from Manitoba, over 6,200 from Saskatchewan and nearly 2,300 from Alberta. At that time, over 4,200 of these applications had been authorized or approved for construction and nearly 2,800 had been completed or reported completed."

According to Lois Olson[14], a similar programme has been carried out in South Africa under which approximately 13,000 dams have been approved.

The author is convinced that this type of work is the most important water conservation which can be carried out at this time in the arid or semi-arid areas of this continent.

An informative history of irrigation development in western Canada with a description of the principal projects was given by S. G. Porter, M.E.I.C., in a paper presented at the semicentennial celebrations of The Engineering Institute of Canada[15].

For a concise history of the irrigation development of the United States, the reader is referred to the chapter by Ralph H. Brown in the book, "Our Natural Resources and Their Conservation," Part 2, Chapter 6[16].

An outstanding example of the use of reservoirs in flood control may be found in the work of the Miami Conservancy District[17] during the past sixteen years

A recent development is that of the Muskingum Conservancy District[18] covering a drainage basin of 8,038 sq. mi.

A more complex undertaking is that of the Tennessee Valley Authority where dams are designed to serve for flood control, navigation improvement and power development[19].

A fine example of stream control, which reduces floods and provides other benefits, is found in the work of the Quebec Streams Commission[20], [21]. To a large extent, natural storage has been utilized by the construction of dams at the outlet of lakes. Water is stored during flood or high water periods and released during low water stages of the stream. This has greatly aided hydro-electric development and otherwise improved the streams. Benefits are so tangible that good returns upon the investment are obtained from assessment on the facilities and property aided by the control work.

Some of the important streams improved in this way are the St. Maurice, the St. François, the Lièvre and the Gatineau.

The Use of Flood Walls, Levees and Dykes in River Control

Much flood control work is accomplished by means of flood walls, levees or dykes. In some cases, a city or other valuable area is protected by flood walls or levees.In other cases, the stream is confined between parallel lines of control works for a considerable distance. These methods are extensively used on large streams where it would not be feasible to regulate the flow by means of dams, because of the large volume of water which is involved and the lack of suitable sites for storage.

Many such streams in their natural state spread water out over wide valleys during flood, and thus gain greatly increased capacity for storage along their courses, as well as increased carrying capacity due to the flow through the valley outside of the stream channel itself. This is especially true of an aggrading stream flowing through an alluvial valley.

The outstanding example of the use of levees is on the lower Mississippi River[22]. There is now a total of about 2,000 miles of levees extending from Cape Girardeau to the Gulf. They are 15 to 30 ft. high and 150 to 300 ft. wide at the base with slopes well grassed or protected with revetment where required (Fig. 3).

The Illinois and other tributaries of the Mississippi also have considerable control work of this nature. In Canada, we have protection of about 125,000 acres in the Fraser valley by means of dykes, some of the work dating back to 1878. Similar work has been done on some of the western Ontario rivers. Part of the City of Brantford has had satisfactory protection by the use of dykes since 1894[24].

Channel Improvement and Floodways

On some of the larger rivers, it becomes unsafe or impossible to confine major floods to a channel at all similar to that followed by the stream during moderate stages. Again referring to the Mississippi for illustration, we find that after the 1927 flood, it was decided to resort to floodways and spillways. Under present plans, provision is made for a flood of 3,000,000 sec.-ft. but only about half of this would pass New Orleans in the original main channel. A large part of the flood would be carried through a floodway along the Atchafalaya river on the west side of the valley and a part diverted to the east above New Orleans through the Bonnet Carré spillways and Lake Pontchartrain (Fig. 3).

In some cases the dredging of sandbars, deepening and straightening of a stream will improve its flood carrying capacities. An even more daring undertaking is the shortening of a river by cut-offs where the natural channel has many bends. This has been done on the Mississippi at several points and appears to be working out satisfactorily. An interesting feature of the Mississippi work is the model

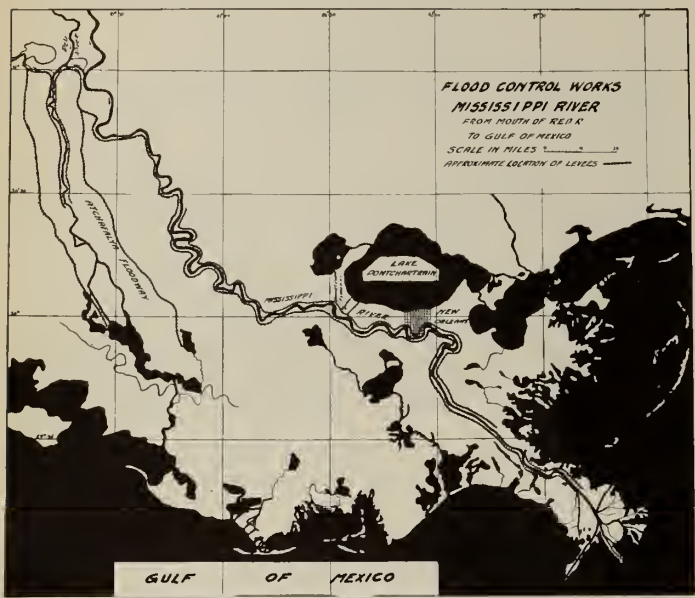

Fig. 3

of the river constructed near Vicksburg by United States Army engineers. This model is 1,100 ft. long and has been used to test out some of the proposed undertakings in advance of actual construction.

Hazen describes an interesting bypass or spillway on the Arakawa River at Tokio, Japan[25]. The river is controlled by a masonry dam above the city and excess flow is diverted through a flood channel 14 mi. long and 1,500 to 1,800 ft. wide. 104,000,000 cu. yd. of material were excavated and used for construction of dykes and for raising low lands.

Conclusion

A study of this nature impresses one with the great responsibility which rests upon the engineer who advises on stream control work. The failure of a dam may cause great loss of life and damage to property. The failure of a levee system may be less spectacular but even more devastating. An unsound irrigation scheme or navigation project not only wastes the money of the state, or other investor, but may bring heart-breaking misery to many individuals who expect to benefit from the project but encounter only personal failure.

The responsibility does not rest with the engineer alone. Every public official who has anything to do with matters of this kind should realize the trust imposed upon him. Then, too, every public-spirited citizen should familiarize himself with the facts concerning stream control proposals and work for safe and sound utilization of our surface waters.

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STRUCTURAL ALUMINUM

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Paper presented before the Montreal Branch of The Engineering Institute of Canada, November 21st, 1938

SUMMARY—Many of the aluminum alloys now used for structural work owe their strength to cold working or heat treatment. Their stress-strain curves are quite different from those of structural steel. These points among others must be borne in mind by designers. Examples are given of the saving in weight resulting from their use.

Unlike iron and copper, aluminum has not come to us through centuries of use, but is rather the product of modern technical skill and research. Metallic aluminum was first produced in 1825 but remained largely a chemical novelty until 1886 when the process for producing it in useful quantities was discovered. Following this the commercial development of the metal was very rapid and to-day we find it being produced in large quantities and entering into practically all of the fields open to other commercial metals, in addition to many new fields.

This paper will deal with only one of these many fields of use, the structural field, in which plates and shapes of this light metal are used primarily for the purpose of supporting loads. Pure aluminum is not suitable for such uses because it is too soft and weak. It was not until the strong alloys of aluminum were produced that aluminum could successfully be employed as a true structural material. These strong alloys of aluminum were introduced about 1912 and almost immediately found favour in the construction of aircraft. At the time of the World War the aircraft industry, of course, was given a tremendous impetus and the construction of metal planes was greatly developed. Following the war, engineers in other lines of construction began to interest themselves in the application of the strong aluminum alloys for all types of construction in which savings in dead weight could be readily translated into reduced operating costs. In 1929 the first mill was built for rolling structural shapes of aluminum, and to-day the aluminum alloy structural shapes and plates have definitely taken their place in the structural field.

There are available to-day more than a dozen commercial wrought alloys of aluminum, each adapted by virtue of its particular mechanical properties, to some field of usage. These, of course, are not all classed as structural alloys, although all of them have probably been employed in some degree as structural materials. For the purposes of this paper, the discussion will be restricted to four of the alloys which may be considered typical of the group. Table I shows the typical tensile properties of these four alloys, with annealed commercially pure aluminum (2S-O) listed for comparison. Commercially pure aluminum in its annealed state (2S-O) has a yield strength of only 5,000 lb. per sq. in. and an ultimate strength of only 13,000 lb. per sq. in. These values are far too low to be interesting to the structural engineer. To be sure, they can be raised considerably by cold rolling the material, but not enough to make the commercially pure metal classify as a structural material. By adding small amounts of alloying elements to commercially pure aluminum, the strength can be raised to values such as those shown for the four alloys in Table I.

Table I

TYPICAL PROPERTIES OF SOME ALUMINUM ALLOYS

All values, except elongation, in lb.-sq. in.

Alloy	Yield Strength*	Ultimate Strength	Elongation†
2S-O	5,000	13,000	45
52S-½H	29,000	37,000	14
53S-T	33,000	39,000	20
17S-T	37,000	60,000	22
27S-T	50,000	65,000	11

*Set—0.2 per cent.
†Per cent in 2 in. for ½ in. round specimen.

The first of these alloys, 52S-½H, is classed as a common alloy or unheat-treated alloy. It is supplied in several tempers starting with the annealed (O) temper, which is very soft, and continuing through the one-quarter hard (¼H), one-half hard (½H), three-quarter hard (¾H) and full hard (H) tempers, each with higher tensile and yield strengths than the preceding. These tempers are produced entirely by cold working the metal. The properties shown in Table I are for the ½H temper, which is probably the temper most frequently used in this alloy because it represents a reasonable compromise between forming ability, which decreases as the temper increases, and tensile strength, which increases as the temper increases. Cold-worked alloys such as 52S are not ordinarily produced in the form of structural shapes because it is impossible to cold work such shapes sufficiently to raise the strength to the desired level. Hence, for structural purposes, these alloys are supplied almost exclusively in the form of sheet and plate.

The last three alloys in Table I are of the heat-treated variety. The first of the group (53S-T) has unusually high resistance to corrosion and hence finds great favour in marine applications and other places where resistance to corrosion is of paramount importance. The second of the group (17S-T) is the oldest and perhaps the most commonly used of the structural alloys because it matches most nearly the properties of ordinary grade structural steel. The last alloy shown on Table I (27S-T) is the strongest of the aluminum alloys that are produced in the form of structural shapes and is used primarily where extreme weight savings are desired.

The yield strengths given in Table I represent the point on the stress-strain diagram where the set is 0.2 per cent. This arbitrary definition of yield strength, which has been adopted by the American Society for Testing Materials and accepted by all agencies that deal with aluminum and its alloys, is made necessary by the fact that the aluminum alloys have no pronounced yield point such as is found in structural steel.

The usefulness of any material to the structural engineer depends largely on the forms in which it is available. The structural aluminum alloys are available in the form of shapes, plate, rod, bar, forgings, and so on, which permit the material to be employed without any radical departures from the conventional types of construction. The actual production of these different forms of the metal is accomplished in much the same manner as for steel except that the rolling temperatures used are considerably lower, final products are heat treated to give them strength, and the extrusion process, not used with steel, is employed for certain shapes.

The aluminum alloy structural shapes and plates are built into structures in the same manner as steel. In fact, one of the advantages of aluminum alloy construction is that very worth-while weight reductions can be made by the simple substitution of aluminum alloy shapes and plates of proper size for steel shapes and plates with little, if any, further complications to the structure. Aluminum alloy shapes and plates can be used in any first-class structural shop with no changes of equipment and with only very little instruction to the personnel. Restrictions which must be observed are the elimination of the burning torch and careful supervision of all hot forming and welding. Since the struc-

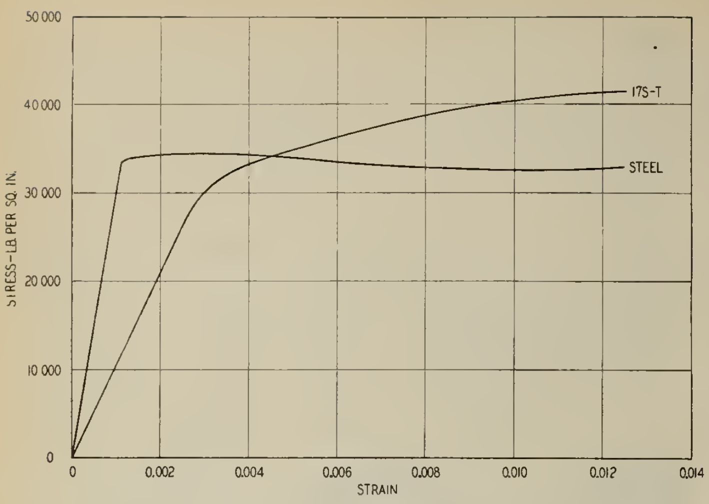

Fig. 1—Stress-strain curves for 17S-T and steel

tural aluminum alloys are heat-treated materials, it is obvious that all applications of heat during fabrication are potential sources of changes in the properties of the material and hence steps must be taken to insure either the elimination of all such operations or, where these cannot be avoided, an adequate technical supervision.

The design of aluminum alloy structures, like the fabrication, parallels very closely conventional practice in steel. It is essential, however, that the designer be familiar with the properties of the particular alloy he is planning to use, and that he appreciate fully the significant differences between the behaviour of aluminum and that of steel under stress. An understanding of this difference in behaviour hinges on an understanding of the stress-strain curves of the two metals.

Figure 1 shows the first part of the stress-strain curve of structural steel compared with that of aluminum alloy 17S-T, plotted to the same scale. It will be noted at once that the slope of the straight line portion of the 17S-T stress-strain curve differs radically from that of the steel curve, the modulus of elasticity of the aluminum alloys being approximately 10,000,000 as compared with 29,000,000 for steel. This difference in modulus means that within the elastic range aluminum alloys deform approximately three times as much for a given stress. Generally speaking, this

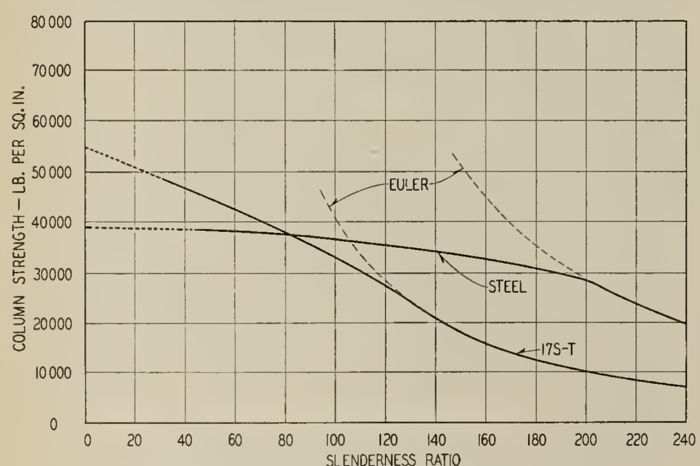

Fig. 2—Column curves for 17 S-T and steel

difference is negligible in tension members, but may become important in flexural members and compression members. In flexural members the difference in modulus becomes evident as a difference in the deflection of the beam, girder or truss and in those few cases where the difference is of some importance, it is corrected for, either by camber in the members or by increasing the moment of inertia sufficiently to bring the resulting deflection within the desired limits. In compression members the difference in modulus operates to reduce the column strength and the critical buckling strength of aluminum alloy members below that of steel members of equal size. This fact is readily taken into account by modifications of the conventional design formulas and rules, as will be explained later.

In addition to a difference in initial slope, the stress-strain curves of steel and aluminum alloy differ from each other in that the steel shows a definite yield point or flat spot in the stress-strain curve, whereas the aluminum alloy curve, in common with the curves of most nonferrous materials, rises continuously until it reaches the ultimate strength, which is not shown in the figure. This difference in form of stress-strain curve is the key to the understanding of the fundamental difference in behaviour of the two metals under stress. The behaviour of almost all types of steel structural members, when exhibited graphically, shows a type of curve which tends to parallel the stress-strain curve of the steel, that is, almost all types of structural behaviour in steel tend to show a steady increase up to the yield point where

	STEEL	17S-T	WEIGHT SAVED
TENSION, Equal Strength L = 68 in. P = 80 000 lb.	4x3x3/8	4x3x3/8	64%
BENDING, Equal Strength L = 68 in. P = 5000 lb.	5"x10#	5"x3.53#	64%
BENDING, Equal Deflection L = 68 in. P = 5000 lb.	5"x10#	7"x5.42#	46%
COMPRESSION, Equal Strength L = 68 in. P = 70 000 lb.	4x3x3/8	4x3x7/16	60%

Fig. 3—Comparison of 17S-T and steel structural members

the curve flattens out. The corresponding curves for structural aluminum, on the other hand, almost always tend to show continuously rising curves, paralleling in a sense the stress-strain curve of the aluminum alloys. Take, for example, the column curves for the two materials. Figure 2 shows superimposed stress-strain curves of aluminum alloy 17S-T and steel columns. These curves, taken from actual data of carefully conducted flat-end tests, represent the condition of almost complete fixity at the ends of the specimen.* It will be noted that throughout the range of elastic action both metals tend to follow their respective Euler column curves, the ordinates for the steel curves being roughly three times as great as those of the aluminum curves, reflecting the difference in modulus of elasticity. At stresses corresponding to the limit of the elastic range, both curves depart from the Euler curve, the aluminum curves gradually and the steel curves much more abruptly. The steel curve contains a large, substantially flat portion corresponding closely to the yield point of the material, whereas the aluminum curve rises continuously even to values exceeding the yield strength of the material. It will be noted that in all these respects the column curves reflect the fundamental differences in the stress-strain curves of the two materials.

In much the same manner other examples could be

*Column Strength of Various Aluminum Alloys, Aluminum Research Laboratories Technical Paper, by Templin, Sturm, Hartmann and Holt.

shown of structural behaviour of the two metals. For example, in the matter of the buckling strength of flat plates subjected to edge compression, test data show that the behaviour of such specimens parallels very closely the behaviour of columns, except that instead of slenderness ratio being the important variable, the width-thickness ratio is substituted.

After much experimentation and study on the behaviour of various types of structural members, Aluminum Research Laboratories has prepared a rather complete set of formulas and tables for predicting the strength of aluminum alloy members. These have been incorporated into the revised Structural Aluminum Handbook of Aluminum Company of America and are available to all structural designers interested in lightweight structures. No attempt has been made to reduce this portion of the Handbook to a design specification because structural aluminum alloys are used in such a variety of types of structures that no such specification could possibly cover all cases. The information has been left in its most fundamental form with the idea that suitable factors of safety could be assigned to the various stresses by the engineers most familiar with the various types of construction in which aluminum is employed.

The outstanding characteristic of structural aluminum shapes and plates is their light weight, which is about 36 per cent of the weight of steel shapes and plates of the same size. Resistance to corrosion is sometimes an additional factor in the selection of aluminum alloys but weight saving remains the primary reason in most applications. In order to demonstrate the amount of weight which is saved in the ordinary application of aluminum alloys, Fig. 3 has been prepared. This chart shows four types of steel members, with 17S-T members designed for the same conditions, and the corresponding weight saving. The first case is a tension member having a length of 68 in. and a design load of 80,000 lb. For this case a pair of steel angles 4 in. by 3 in. by 3/8 in. will meet current steel specification requirements. The corresponding 17S-T member, designed for the same factor of safety, is made up of exactly the same size angles with a resulting saving in weight of 64 per cent. The second case is a beam with a length of 68 in. and a concentrated load of 5,000 lb. at the centre of span. For this case a 5-inch steel beam weighing 10 lb. per ft. will suffice and the same size 17S-T beam weighing 3.53 lb. per ft. represents equal strength at a weight saving of 64 per cent. In this case, however, the aluminum beam will deflect three times as far as the steel beam, and while the difference is negligible by most standards, it might be objectionable under certain circumstances. The third case in Fig. 3 shows a comparison of the same steel I-beam with a 17S-T beam designed for equal deflection. The 17S-T beam selected is a 7-inch I-beam weighing 5.42 lb. per ft. and representing a weight saving of 46 per cent. The last case on the chart shows a comparison of compression members designed for equal strength. In this case the steel member selected is the same as the tension member and is capable of carrying a load of 70,000 lb. with an unsupported length of 68 in. Because of the difference in column strength the aluminum member in this instance must be made somewhat thicker than the steel member, the final selection being a pair of 4 by 3 by 7/16 in. angles which represent a weight saving of 60 per cent with respect to the steel.

Structures in general are made up of combinations of tension, flexural and compression members, so that the weight saving percentages shown above give some idea of the amount of weight saving which can be expected of aluminum alloys compared to equivalent steel structures. In a size-for-size substitution it is evident that the weight saving will be approximately 64 per cent. Size-for-size substitution, however, is usually altered to compensate for deflection and column strength requirements, and this will tend to lower the weight percentage somewhat. Experience has shown that on most types of construction, aluminum alloy 17S-T members can be expected to save approximately 50 to 60 per cent of the weights of the corresponding steel members. Since relatively few structures are constructed entirely of aluminum alloys, these weight-saving figures do not apply to the overall weight saved on a given construction but only to the parts which are made of aluminum alloys. Generally speaking, the overall weight saved will be considerably less than the figures quoted above. For example, comparing an aluminum alloy railway car with a similar steel car, the weight of the aluminum structural frame may be only one-half that of the steel, but by the time the two cars are finished with duplicate interior trim, seats, tanks, trucks, etc., the percentage saving in the overall weights may be down to 20 per cent or even lower.

Fig. 4—Dredge boat equipped with a boom 240 ft. in length. A boom of this unusual length is made possible by the use of aluminum alloys in the outer 150 ft. of the length

Among examples of applications of the strong aluminum alloys may be mentioned the seven bulkhead units for the Galipolis Dam on the Ohio River. These units, each 127 ft. long and 13 ft. deep, are used to unwater the roller gates of the dam for routine inspection and are also used as emergency closures in case of accident to the gates. The weight of each unit is 56,000 lb. as compared with 156,000 lb. for structural steel gates designed for the same service. The saving in weight makes it possible to handle the units with a derrick boat, whereas

Fig. 5—A 32 cubic yard power shovel dipper built largely of aluminum alloys

the steel units would have necessitated much more elaborate handling equipment. The bulkheads were designed by the U.S. Engineer Corps and were built by the Nashville Bridge Co.

Figure 4 shows a dredge boat with a boom 240 ft. in length. This extremely long boom was made possible by the use of aluminum alloy construction in the outer 150 ft. of the length. The boom handles a six cu. yd. steel grab bucket with a loaded weight of 30,000 lb. It was built by the St. Louis Shipbuilding and Steel Co. and is owned by the Sternberg Dredging Co. of St. Louis, Mo.

Figure 5 shows one of the largest power shovel dippers ever built. This dipper is of aluminum alloy construction with steel teeth and steel liners to resist the wear on certain surfaces. The use of aluminum alloys in this dipper saved enough weight to permit the 32 cu. yd. dipper to be substituted for a 20 cu. yd. dipper of conventional construction, with only minor changes in the unit on which it is used. The dipper was built by the Marion Steam Shovel Co. and is operated by the Northern Illinois Coal Co.

Eight aluminum alloy streamline trains have been built by the Pullman-Standard Car Manufacturing Co. for the Union Pacific Railroad. One of these trains is composed of eleven cars of substantially all-aluminum construction, except for the trucks, end sills and articulation units between the cars. The car bodies are all designed for complete structural interaction of sides and roof, and each underframe includes a centre sill capable of withstanding the total specified buffing load.

The last example is the aluminum alloy floor for the Smithfield Street Bridge in Pittsburgh. A section of the highway side of the deck is shown being swung into place, in Fig. 6. By replacing the old steel and timber deck on this bridge with a modern lightweight floor, dead load amounting to about 2,000 lb. per lineal foot was removed from the old trusses, thereby increasing their live load capacity sufficiently to permit them to carry unrestricted traffic. This change adds an estimated twenty-five years to the life of the structure. The aluminum alloy floor was fabricated by the Fort Pitt Bridge Works and was erected by Walter S. Rae of Pittsburgh, Pa.

One of the most encouraging things about the progress of structural aluminum is the intelligent manner in which it has been employed by engineers in the various fields of construction. Without the co-operation of these engineers it would no doubt have taken many years longer to accomplish the progress which structural aluminum has made in the relatively few years that it has been available. The future shows no indications of any startling changes in the status of structural aluminum, but there is every reason to expect that it will continue to advance by the same steady, healthy growth that has marked its progress to its present stage of usefulness in the elimination of needless dead weight.

Fig. 6—A section of aluminum alloy floor being placed on the Smithfield Street Bridge in Pittsburgh, Pa.

Abstracts of Current Literature

Contributed articles based on current periodicals, papers and events

THE BULLION MINE AT BULLION, BRITISH COLUMBIA

Paper presented before the Vancouver Branch of The Engineering Institute of Canada, January 20th, 1939

Abstracted by T. V. Berry, A.M.E.I.C.

The Bullion Mine is an extensive placer gold property in the Cariboo district of British Columbia and is situated on the left bank of the south fork of the Quesnel river approximately three miles below the outlet of Quesnel lake. The properties lie on the road sixty-three miles northeast of Williams lake and the mine is served by the rail head of the Pacific Great Eastern Railway.

The prospect was originally discovered by a Chinese company in 1884. Working under primitive conditions this company recovered in excess of $900,000 in gold during the ten years that they worked the property. In 1894 a syndicate composed largely of members of the Canadian Pacific Railway directorate acquired the property and from 1894 to 1905 recovered approximately $1,234,000 in gold. The property was sold to the Guggenheim interests in 1906, who embarked on a considerable development programme to bring in additional water for hydraulicing. This project was never completed by that company and the property was closed down in 1907. From this time until the year 1932 there were several attempts to operate the property with little or no success.

In 1934 a strong company, Bullion Placers Ltd., was formed with ample capital to develop the property on a large scale production basis. The programme undertaken was twofold, first to supply the mine with an adequate water supply for hydraulicing operations, and second to improve facilities for the handling of a very much larger volume of material each season.

That the policy of the newly formed company was a wise one is indicated by the greatly increased yardage treated subsequently. This increase is shown in the following table.

Year	Material Treated
1933	190,000 cu. yd.
1934	453,000 "
1935	697,000 "
1936	960,000 "
1937	1,323,000 "

Had 1938 not been the driest season in the Cariboo for over fifty years, 1,800,000 cu. yd. of material would have been treated.

The Bullion channel is a large deposit having a varying width on bedrock of 150 to 250 ft. and from 1,000 to 1,500 ft. at the grass roots; the approximate average depth is 400 ft. The channel has a fairly uniform bedrock gradient and its course by drilling and exploration has been definitely determined for nearly 10,000 ft. The bedrock elevation of the channel is approximately 150 ft. above the present river which it parallels at an average distance of 1,200 ft.

The rock gorge lies in an altered greenstone or diabase containing syenite intrusions and is overlaid by roughly stratified gravels varying in thickness from 100 to 300 ft. Above the lower gravels there is a stratum of very firm boulder clay, which varies from 100 to 150 ft. in thickness. Above this again are well stratified gravels and above these a light layer of normal boulder clay extending to the grass roots.

When the present company took over the property, the mine was in a neglected state. Slides had buried the monitors, pipelines and sluices and plugged the sluice tunnel for some distance. Many thousands of cubic yards of debris were moved in order to place the pit again in working condition. The maintenance of a safe face of the pit has required much care. To ensure safety the face is kept in the form of a letter 'M', the two outside strokes representing the rims and the central 'V' being a large sloping pillar or toe. To maintain the face in this manner bank blasting and the use of a top monitor are resorted to. Holes are drilled some 30-50 ft. back from the top edge of the bank face to depths varying from 75 to 100 ft. and after being sprung are loaded with from 20 to 45 boxes of 40 per cent Polar Forcite. These charges are sufficient to break up the material and make it more amenable to hydraulicing. Despite rather heavy powder costs this method has been a great aid in stepping up the yardage handled by the monitors and amply repays the expenditure involved.

Naturally a placer mine with such a large seasonal treatment of material requires a large water supply. The company is fortunate in having the exclusive water rights on eight lakes which have a total annual storage (available) capacity of over 24,000 acre ft. derived from the catchment area of 54 sq. miles.

By a series of ditches and open flumes the longest of which is over 7½ mi. in length and has a carrying capacity of 90 c.f.s., the water from the storage lakes is emptied into the main pooling reservoir. Two of the lakes lie below this reservoir and the water from these is pumped into the pooling reservoir by two Diesel pumps of 2,500 and 4,000 gal. per min. capacity, respectively. Two other lakes are also pumped into the water system by a 10,000 gal. per min. pump against an 80 ft. head, the power for this being supplied by a hydro-electric plant also operated by the mine and situated on Quesnel lake.

The main working of the mine is served by a 52 in. pipe line reducing through 30 in., 24 in., 22 in. to 18 in. the size of the monitor intakes. Monitors are cabled down to bedrock with eyebolts and heavily weighted to eliminate vibration. The monitor set-up is changed at least once a month in order to keep the monitor nozzle within 200 to 250 ft. of the working face. With the size of sluices in use a minimum of 84 c.f.s. of water is needed, and as much as 110 c.f.s. has been utilized at times. The average material treated during 1937 was 560 cu. yd. per hr. of water use.

In order to facilitate movement of such large quantities of material and to increase water duty, a crew of seven or eight men drill and shoot all large boulders and boulder clay too large for the sluices. This crew averages three to four hundred shots per eight hour shift.

Sluice ways are made of local timber and are 6 ft. wide and 5 ft. deep. The floor is paved with steel rails, specially designed by the company for maximum strength and wear, and weighing 37 lb. per yd. They are laid longitudinally on 6 in. by 6 in. ties and fastened down with ½ in. by 3½ in. track spikes. These riffle rails and the manner in which they are laid down have proved an unqualified success in gold recovery and have greatly increased the carrying capacity of the sluices. The sluice in the Bullion pit is now 2,800 ft. long, approximately 1,100 ft. in the pit, 1,600 ft. in tunnel and 100 ft. at the tailings. Tailings are deposited in the south fork of the torrential Quesnel river.

Each month throughout the season the first 120 ft. of the head boxes are cleaned up, the final clean up of the season extending about 1,000 ft. down the sluice. This monthly clean up involves the lifting of the riffles, shovelling of the concentrates and the relaying of the riffles. Concentrates are put through a power driven amalgam barrel for a 1½ to 2 hour rotation. The amalgam is retorted in an electrically driven oil furnace and condensing plant.

The pits are served by skyline and hoists. Water control points and units are served by about 25 miles of telephone line. The mine has two compressor units, an up-to-date blacksmith and machine shop, a semi-Diesel power plant for electrical generation and camp accommodation for 120 men.

THE SWELLING OF COALS DURING CARBONIZATION

By G. E. Foxwell in Engineering, March 24, 1939

Abstracted by A. A. Swinnerton, A.M.E.I.C.

The stresses imposed upon the walls of carbonizing plants, especially by-product coke ovens, were not generally serious in the days when the flue temperatures were 1,100 deg. to 1,250 deg. C. and ovens were over 20 in. in width. Owing, however, to the progressive increase in flue temperatures and the reduction in oven width, the rate of coking has been greatly increased, till, in some cases, it is practically twice as rapid as formerly. This has resulted in a higher lateral pressure upon the oven walls. Cases have occurred chiefly in Germany and the United States in which oven walls have been irreparably damaged and have had to be rebuilt owing to the magnitude of the swelling pressure. Considerable investigational work on this subject is being carried out, and this is the first British paper that has been prepared dealing with this problem.

During the course of carbonization in the coke oven, the coal becomes partly fluid; this condition is known as the plastic stage and occurs generally between 380 deg. and 480 deg. C. There are reasons for believing that the formation of a strong coke is impossible, unless the coal develops a certain pressure during the plastic stage. This pressure is caused by the generation of gas within the plastic coal, which, owing to the high resistance of the plastic layer to the passage of the gas, is unable to escape. Foxwell's experiments have shown that the more rapid the rate of heating the more plastic the coal becomes, and the higher is the internal pressure in the plastic layer. It has also been established that the pressure is considerably affected by the density of the charge of coal, so that a coal producing a low pressure may be made to exert a dangerous pressure if more compressed.

Heat is transmitted to the coal laterally from each oven wall, and a plastic layer, therefore, travels from each wall to the centre. When the plastic layers meet in the centre, a peak pressure is set up for a few minutes, and this peak may be very much higher than the pressure exerted on the oven walls at any other period during carbonization.

To prevent damage to the coke ovens, the first essential is to be able to detect which coals may be dangerous, and in what circumstances a given coal may be dangerous. Experiments and apparatus have been devised to show how much pressure coals can exert and how much pressure a coke-oven wall can safely stand, but the apparatus now in use does not seem to be particularly reliable. Experiments at Sheffield University have cast doubts upon the accepted methods of testing and have led to modifications that are claimed to be more in accord with what actually happens in the coke oven. The composition of the blend, the rate of heating, and the degree of compression of the coal may all affect the safety of the oven structure, and there is urgent need for a test which will enable positive figures to be secured. Furthermore, this test should be acceptable both to the colliery owner and coke-oven operator. The interests at stake are large, and Dr. Foxwell's paper appears to have revealed the need for extensive research work upon the dangerous swelling pressures set up in coking coals during carbonization.

At the present time, the coke-oven operator can use several different methods for reducing the plasticity—and hence the pressure—of the coal. He can blend the coal with material from the same seam of less coking power, or he can blend with coals higher in volatile matter which shrink sufficiently to overcome the swelling of the dangerous coal. Coke breeze of fusain dust may also be used for blending purposes and flue temperatures may be reduced, which of course results in slower coking.

This paper serves a useful purpose in directing attention to this important problem and to the method of dealing with it.

AN INVESTIGATION OF THE FRETTING CORROSION OF CLOSELY-FITTING SURFACES

G. A. Tomlinson, D.Sc., P. L. Thorpe and H. J. Gough, D.Sc., F.R.S., in Engineering, March 10, 1939

Abstracted by R. H. Field, A.M.E.I.C.

This work was carried out at the National Physical Laboratory on behalf of the Aeronautical Research Committee, to investigate the mutual corrosion at the contact surfaces of closely-fitting machine components. Such corrosion is distinct from ordinary wear in that it occurs at surfaces which for all practical purposes are fixed in relation to each other, e.g. a ball race housing which is a press fit on the shaft. Vibration appears to be an essential factor in giving rise to the fretting.

A number of experiments were conducted by the authors to obtain information regarding the characteristics of fretting. It was found that a slight relative movement (i.e. true slip as distinguished from plastic or elastic deformation) of the surfaces was an important factor and hence apparatus was constructed to measure the slip during the tests. When the slip was zero no noticeable corrosion appeared, but a few millionths of an inch slip was sufficient to yield the characteristic oxide deposits. In most of the experiments the slip was between 10 and 30 millionths of an inch.

The critical nature of the slip was illustrated by experiments where a specimen with spherical ends, one of these being in contact with a flat plate, was given small rotations. Photographs show the effect after 5,000 alternating movements under a load of 103.5 lb. with maximum slips of 54 and 11.4 of a millionth of an inch. In each case an inner circle (the diameter of which agrees with the area where the tangential displacement of the surfaces is entirely elastic) is quite free from corrosion. There is an abrupt change to a zone of corrosion, having an outer diameter agreeing with the values calculated from the Hertz equations.

Further experiments dealt with pressure intensity, and showed there was no marked relation between the amount of corrosion and the normal pressure between the surfaces. Lubricants were found to reduce the corrosion, but not to prevent it.

In a discussion of the experimental results the authors suggest that the primary cause of fretting is mechanical rather than chemical, and that it is due to attrition on a molecular scale. This is borne out by the fact that in no combination of the materials tested—hard steel, mild steel, stainless steel, brass, nickel, chromium, Y-alloy and glass—was corrosion absent, and in the combination of the soft Y-alloy and hard chromium there is little doubt that the chromium had been fretted away, even though the number of reversals was equivalent to a test of only four minutes duration in the alternating stress machine. Nor do the authors think that a movement so small as .05 of a millionth of an inch can give rise to bodily abrasion, and they state that fretting is worse with highly polished surfaces.

Finally, it is to be noted that after 100,000 oscillations a plane surface of softwood produced corrosion on hard steel, that relatively soft brass appeared to fret its way into hard steel and that the sample stainless steel appeared to be the most susceptible material in any combination tested.

MAGNETIC CRACK DETECTION

Canadian National Magazine, March, 1939

Abstracted by R. G. Gage, M.E.I.C.

A means of detecting cracks in steel and iron castings and machine parts by the application of magnetism is being used with much success in railway shops, aeroplane factories and other specialized industries.

This method of magnetic crack detection is based on the fact that when electricity flows through a conductor, a magnetic field is set up around the path of the current and at right angles to it. The piece which is being inspected can be magnetized by putting it into the field inside a magnetizing coil; by wrapping a few turns of cable around it and passing current through the cable; or by using the part itself as the conductor for the current.

The parts are first cleaned of all dirt and grease and, after being magnetized, are sprinkled with a fine white metallic powder. If the metal structure is uniform and unbroken by cracks, the powder will rest uniformly on the surface and may be blown off without leaving any trace. If, however, there is a crack on the surface too minute to be detected even by a strong magnifying glass, or blow holes underneath the surface, the powder will collect along the crack or above the hidden flaw and clearly locate the defect. Cracks which cannot be seen with a glass can readily be seen by the eye after being treated with the Magnaflux powder.

There are several types of these machines and of two of the more common types one operates off a 12-volt battery, which is charged off the 110-volt lighting circuit through a bulb type rectifier and is suitable for small toolroom parts, springs, etc. The second operates off the 550-volt, 60-cycle shop circuit and is a transformer unit designed for use on axles, side rods, castings, etc. It is fitted with a magnetic "de-ion" switch which is designed to interrupt the current at the maximum point on the voltage curve, and as it operates very quickly—less than the normal frequency of the supply—it is the equivalent of magnetizing the part from an instantaneous direct current source.

In testing large parts with the transformer machines, the piece is magnetized by wrapping a few turns of heavy cable around it and applying alternating current for a few seconds, or by attaching two magnetic "leech" contacts which are energized by direct current from a small dry type rectifier to the particular area to be examined.

Since a crack or cavity forms a discontinuity in the path of the magnetic flux, the part should be magnetized so that the flux will be at right angles to the crack. This means that the magnetizing current must flow parallel to the crack since the electric current and its magnetic field are at right angles to each other. In examining an axle, for example, the magnetizing flux must be set up in both directions through the axle in order to detect both transverse and longitudinal cracks. Many applications of these tests will come to mind in the original machining of axles, wheel fits, high speed alloy cutting tools, etc., and also in the reclamation of many parts such as castings, springs and other parts which have been subject to fatigue stresses in service.

THE MINERAL RESOURCES OF THE UKRAINE

Large Coal and Iron Ore Deposits

Iron and Coal Trades Review, March 3rd, 1939

Abstracted by A. A. Swinnerton, A.M.E.I.C.

Ukraine, the extensive ethnographic region of the U.S.S.R. lying north of the Black Sea and stretching from the Carpathian mountains to within sixty miles of the Caspian sea, covers an area of 360,000 sq. mi. and has a population of fifty-three millions. About 82 per cent of the area and 80 per cent of the population form part of the Soviet Union, and the remainder belong to Poland, Rumania, and Czecho-slovakia.

In addition to vast agricultural wealth, Ukraine possesses substantial mineral resources, which include 72,300 million tons of coal, 4,066 million tons of iron ore containing 50 to 70 per cent iron, 40,900 million tons of ferruginous quartzite with approximately 35 per cent iron, 441 million tons of 35 per cent manganese ore, and 570 million tons of lignite, the bulk of which is still undeveloped.

Coal Resources

The principal coal-bearing area in Ukraine is the Donetz basin, covering an area of 8,900 sq. mi., with an estimated coal reserve of 71,000 million tons, thus constituting one of the largest and richest coal fields in the world. The volume of its reserves places the Don basin in fourth place in Europe, and in eighth place in the world. The proximity of the coal to the iron ore and manganese deposits has made the Don basin the principal centre of the heavy industries in the Ukraine. The coal output for 1937 was 77 million tons, immediately behind the United States, Germany, and the United Kingdom. The coals from this field contain a relatively high amount of ash, 10 to 12 per cent, and high sulphur, up to two per cent, making careful preparation necessary before utilization. Although there are some screening and coal washing plants, one of the most urgent needs of the coal industry is the provision of a larger number of coal preparation plants.

Iron Ore

The principal iron ore deposits in the Ukraine are located in the Krywyj Rih and Kertsch districts. In the former area, the ores are of the quartzite type and cover an area roughly 60 mi. long and 4 mi. wide. The most recent investigations have indicated that this area contains 40,900 million tons of this quartzite, with a total content of 12,130 million tons of iron. The production in 1937 amounted to 16,500,000 tons. The tertiary oolitic haematitic ores in the Kertsch and Tamen peninsula cover an area of 930 sq. mi. These deposits are estimated to contain 2,725 million tons, with an aggregate iron content of 1,000 million tons.

Manganese Ores

The principal manganese ore deposits occur at Nikopil, near Krywyj Rih. The reserves of these ores are estimated at 395 million tons, with a total manganese content of 150 million tons, making them one of the largest in the world. In 1937 a total of 1,400,000 tons were mined. There are also several smaller deposits.

REINFORCED BRICKWORK

By C. W. Hamann and L. W. Burridge in The Structural Engineer, April, 1939

Abstracted by S. R. Banks, a.m.e.i.c.

This paper, which is illustrated by fifty photographs, diagrams and charts, deals in comprehensive fashion with the various aspects of this type of construction, placing particular emphasis upon the trends of modern research and modern practice. In definition, the authors state that "Reinforced brickwork is a composite structural material consisting of load-bearing brickwork masonry into which lengths of suitable metal (normally steel) are introduced and so bonded as to render the resultant composite capable of resisting not only the compressive stresses but also the tensile and shear stresses which obtain in a structure."

A historical survey of the use of metal reinforcement in brickwork is given, ranging from early empirical practice in England in the eighteenth century (with which the name of Sir M. I. Brunel is associated) up to its widespread modern use, principally in India, New Zealand, Japan, and North America. The church of St. Jean de Montmartre in Paris is, incidentally, mentioned as a remarkable example of the value and the scope of reinforced brickwork.

In drawing attention to the several advantages which may be claimed for this material of construction, the authors point out that, by making possible the use of brickwork in the form of load-carrying beams, columns, and slabs, a greater freedom of architectural treatment of an aesthetically-acceptable material becomes available. The occurrence of unsightly cracking or even failure of walls carried on a doubtful subsoil (or built in locations where subsidence may be expected) may be largely avoided by the introduction of reinforcement at suitable levels. Extra floor-area is afforded by the use of thinner walls which can at the same time be utilized as brickwork beams. It is believed that reinforced brickwork will be found of considerable value in the field of structural air-raid precautions, and also in the building of earthquake-resisting structures. In the latter connection it is at present being employed in the reconstruction of the town of Quetta, India. Among disadvantages, it is to be noted that reinforced brickwork members are limited in size and shape by the dimensions of the constituent bricks, and that the comparatively greater depths of such beams (as compared with steel or concrete beams) may rule-out their employment in cases where clearances are limited.

Regarding the design of reinforced brickwork beams and slabs, it has been established, by several independent authorities, that this composite material behaves in precisely the same manner as reinforced concrete; and it is therefore found proper to make the same fundamental assumptions (and to use the same kind of stress-analysis) that apply in that type of construction. The authors, after developing working-formulae of the conventional type, have prepared a number of design-charts and tables which are based on suitable values of the modular ratio and of the compression working-unit. An illustrative example is presented of the design and method of construction of a reinforced brickwork beam. The compression working stress in brickwork may vary from the conservative figure of 200 lb. per sq. in. suggested in a British survey of 1937 up to as much as 750 lb. per sq. in. in present-day American practice. The modular ratio is found to vary between 40 and 15 according to the quality of brick under consideration. A usual working-unit for shear-stresses is from 20 to 30 lb. per sq. in., while 80 lb. per sq. in. is quoted for the allowable steel-mortar bond.

Mentioned in the course of an elaborate review of modern investigations of the subject are the pioneer work of Sir A. Brebner for the Indian government, the establishment in 1932 in the U.S.A. of the Reinforced Brick Masonry Research Board, the undertaking of experimental work by the Building Research Board in England, and numerous other investigations by various research organizations throughout the world, including one by the Department of Mines in Canada. In many cases the conclusions that have been arrived at are quoted.

A complete and careful report (with photographs and diagrams) of a series of "pilot" tests on columns and beams of reinforced brickwork, carried out by the authors themselves, is included in the paper, and their conclusions are stated fully. It is of considerable interest that, although the test-beams were deliberately over-reinforced in order to observe failures of the brickwork in compression, only one of the specimens failed in that manner. Comment is passed on the lack of information available regarding the compressive strengths (in bending and under axial loading) of the many varieties of bricks obtainable, and on the necessity for further study of, *inter alia*, the shear-phenomena of reinforced brickwork beams. As a practical consideration, the admixture of a modicum of lime with the cement for the brickwork is recommended as making the mix more workable, producing intimate contact and bond without undue absorption of moisture by the bricks, and tending to prevent corrosion of the reinforcing steel. It is, of course, essential that all joints should be properly filled with mortar.

Several actual examples of reinforced brickwork construction are described in some detail, with illustrative photographs and diagrams, and reference is made to the use of specially-shaped and notched bricks which have been found convenient for the better disposition of the reinforcement.

In conclusion, the authors advance the outlines of a tentative code of practice for reinforced brickwork construction, based primarily on generally-available knowledge of the subject, but suitably modified in the light of their own experiments and experience. There are two appendices to the paper, one dealing with the application of reinforced brickwork as an A.R.P. measure, and the other containing an extensive bibliography of relevant publications.

Editorial Comment...

THE ROYAL VISIT

By the time this Journal reaches most readers the King and Queen will have come and gone, but the memory of their visit will remain for ever in the minds of all Canadians. Never has there been such a triumph. Their Majesties won the hearts of old and young from coast to coast, and by their graciousness fanned the fires of patriotism, loyalty and affection of all our people.

From every city have come stories of thoughtfulness, kindness, friendliness, of interest in people, places and affairs, of unexpected informal departures from the programme that have endeared them to the people. Everywhere the populace has received them with enthusiasm and open hearts, and everywhere the royal couple have demonstrated their worthiness of it. It has been a veritable march of triumph from beginning to end.

What a blessing it is that at this time, of all times, Their Gracious Majesties were able to visit with us and with our good neighbours to the south. Such a manifestation of confidence in world affairs cannot help but contribute to the maintenance of peace and the support of justice and freedom throughout the world. Their visit to our country has driven from our minds the spectre of strife and the misery which accompanies it. It is a particular pleasure that we are able to share our happiness with our American neighbours, but it does seem unfortunate that all the nations of Europe cannot know this lovely couple whose very presence radiates good will to all people.

Canadians are proud of their Sovereigns, and are greatly appreciative of this opportunity to see them and know them. It is the prayer of every citizen that long life, peace and happiness may attend them always, and that the future may permit of similar visits under equally happy circumstances. Canada sings with a single voice God Save the King, God Save the Queen.

THE BY-LAW BALLOT

It is seldom that an Institute ballot has received such endorsation as that which is recorded elsewhere in this number of the Journal, for the recently submitted proposed changes to the by-laws. Two amendments and one new by-law were approved almost unanimously. The number of votes cast was also unusually large, particularly in view of the non-controversial nature of the questions. This is a healthy sign.

The new by-law, number 77, is complementary to the enabling by-law number 76, which was passed to facilitate the completion of co-operative agreements with provincial professional associations. With this new acquisition the Institute is now in a better position than ever to carry on negotiations with the associations towards further and closer co-operation.

NATIONAL VOLUNTARY REGISTRATION

Under this same title the Journal of last December announced a plan for registration of technically trained men in Canada, which had been inaugurated by the Department of National Defence, and which was to be carried out on behalf of the department by three national institutions, namely, the Canadian Institute of Chemistry, the Canadian Institute of Mining and Metallurgy and The Engineering Institute of Canada. The work has been carried on ever since, and members may be interested to know the present status of the undertaking.

The proposal was enlarged considerably beyond the original limitations. It had been the intention to canvass the members of the three co-operating organizations as an experiment, but the results were so satisfactory and the news spread so far beyond these limitations, that other technical bodies indicated their interest in the proposal. Wisely the Department enlarged the scope of the Committee's work in order to include the members of these groups.

The checking and cross checking that became necessary in order to avoid the irritation and expense of duplication, was a tedious and long drawn out process in itself. The Institute's share in the work involved the circulation of over ten thousand questionnaires to the members of twelve separate bodies, and in every instance the membership list had to be checked against the lists of the three co-operating institutes.

Approximately five thousand replies have been received from the ten thousand inquiries which were sent out by The Engineering Institute, and a similar or higher percentage has been experienced by the other institutes. Such a return indicates beyond a doubt that approval has been given to the Department's policy which is a necessary part for any plan of industrial preparedness.

The information has now been transferred to cards and each registrant classified in such a way that the officials at Ottawa, with an elaborate filing and indexing system, will have at their finger tips, the useful record of thousands of engineers and scientists of all ages and all types. It has been a big undertaking, but it has also been a real pleasure to work side by side with other organizations, to accomplish a task which has been required by the Government, and which at the same time may be of benefit to the profession.

The industrial resources of a nation also become of considerable importance in a programme of preparedness. While it is known that active steps have been taken to record the possibilities of the production of munitions in Canadian manufacturing plants, even further steps will be necessary before Canada is fully prepared. Perhaps the next phase will be a further development of industrial preparedness. Again the Institute will be glad to assist in any way that the Department may require.

PRESIDENTIAL ACTIVITIES

On the 14th of April, President McKiel visited the Moncton Branch and spoke briefly on the activities of the Institute including the forthcoming International Engineering Congress in New York and the committee for the welfare of the young engineer.

On April 20, he visited the Halifax Branch and met with the Executive Committee in the afternoon. He spoke on the Institute activities at a supper meeting.

The President gave an address on "The Place of Science in the Modern World" over station CKCW, Moncton, on April 24. This broadcast was part of an adult education programme of Mount Allison University.

The April number of "The Record," a publication of the Mount Allison Alumni, contained a biographical sketch of each of the engineering graduates of the University. The issue, which was printed in Dean McKiel's honour, carried his message to the alumni.

The President visited the Saint John Branch on May 4 and met the Executive Committee in the afternoon. At the dinner meeting, at which he addressed the membership, he presented the Plummer Medal of the Institute to H. I. Knowles.

On May 15, the President was the speaker at the annual dinner of the Nova Scotia Technical College Alumni and described "The Changing Rôle of the Engineer."

President McKiel attended the Encaenia of the University of New Brunswick on May 18 and presented the student prize of the Institute to James O. Dineen.

INTERNATIONAL ENGINEERING CONGRESS AT NEW YORK

A preliminary announcement of this meeting was made in the May Journal. The following information, while far from complete, will be sufficient to enable members to grasp the breadth of the programme and to realize the extent of the activities. It also furnishes enough information to permit of an estimate of cost being made. These costs would not be possible if it were not for the contribution being made by the American Society of Civil Engineers, and for the "quantity price." Our American confreres have arranged a splendid programme and have made the participation of English and Canadian engineers extremely simple and inexpensive.

If you are interested and desire accommodation or additional information, please communicate with Headquarters. If you so request, a map of Columbia University and a supply of interesting printed matter describing the World's Fair will be sent to you.

Following is an outline of all events. The list of technical papers will be found at the end of this programme.

Monday, September 4, 1939

Morning	Sightseeing trip about New York for men and ladies, $2.00.
Luncheon	Rainbow Room, Rockefeller Center, for men and ladies, $1.25.
Afternoon	Opening session, Engineering Societies Building, 29 West 39th Street. Reception and tea. Inspection of Library and offices for men and ladies. Compliments of the American Society of Civil Engineers.
Evening	Reception, buffet supper, dancing at Faculty Club, Columbia University, for men and ladies,—compliments of the American Society of Civil Engineers.

Tuesday, September 5, 1939

Morning	Technical sessions for men. Visit to museums for ladies $1.50.
Afternoon	Boat excursion about New York Harbour, terminating at World's Fair; for men and ladies. Luncheon and tea aboard ship. Admission to World's Fair. All inclusive, $4.50.

Wednesday, September 6, 1939

Morning	Simultaneous technical sessions for men. All-day sightseeing trip for ladies; luncheon at Bear Mountain Inn; tea at the home of Harvey N. Davis, President of Stevens Institute of Technology. All inclusive, $4.00.
Afternoon	Simultaneous technical sessions for men.
Evening	Banquet and dance Hotel Waldorf-Astoria, for men and ladies, $7.50 per person.

Thursday, September 7, 1939

Morning	Simultaneous technical sessions for men. Excursion for ladies, $3.00. Alternative shopping tour, etc.
Afternoon	Visit to World's Fair for men and ladies, 75c., or Inspection trip to engineering works in and about New York for men, $2.25.
Evening	Entertainment, McMillan Theatre, Columbia University, in celebration of the 75th Anniversary of the founding of the Engineering School. It is expected that Herbert Hoover will be the speaker. Compliments of Columbia University.

Friday, September 8, 1939

Morning	Closing session of meeting in Auditorium of Special Events at World's Fair.
Afternoon	At World's Fair. Visit to new North Beach Airport.

Professional Meeting Programme

(Civil Group)

All meetings take place at Columbia University unless otherwise indicated.

Tuesday, September 5th

A.M. **Activities for the Improvement of the Social and Economic Status of the Members of the Civil Engineering Profession.**

P.M. Boat Excursion.

Wednesday, September 6th

A.M. (a) **Advances in Construction Methods and Equipment.**
(b) **Advances in the use of Electricity in the Home, the Farm, etc.**
(c) **Modern Sanitation and Water Supply Practice.**

P.M. (a) **Air Transport, Landing Fields, Airdromes.**
(b) **City Planning—Operation of the Ribbon Development Act of 1935—Control of Borders along Main Highways.**
(c) **Soil Mechanics.**

Thursday, September 7th

A.M. (a) **Soil Mechanics** (continued)
(b) **Advances in Structural Design—Vibration in Bridges—Wind Pressure on Structures.**
(c) **Modern Highway Practice.**

Friday, September 8th

Joint Meeting at World's Fair Auditorium.

Institution of Civil Engineers.
Institution of Mechanical Engineers.
Engineering Institute of Canada.
American Society of Civil Engineers.
American Society of Mechanical Engineers.
American Institute of Electrical Engineers.
American Institute of Mining and Metallurgical Engineers.
Farewell Addresses, etc.

Note—Programme of Mechanical Papers will appear in the July Journal along with list of all authors for both mechanical and civil papers.

Registration

Registration can be made on any of the following three bases:

1. For those staying in Johnson Hall (University residence) a convention fee of $25.00 per person provides:
   (a) Transportation of person and baggage from railroad terminal to Columbia University.
   (b) A single room from Sunday, September 3, 1939, until departure on Friday or Saturday, September 8 or 9, 1939.
   (c) Admission to all events of the Meeting from Monday, September 4, 1939, through Friday, September 8, 1939, as described previously which would cost by single ticket purchases $21.00 for men and $27.00 for women.
   (d) Transportation of person and baggage from Columbia University to railroad terminal.

2. For those staying at Johnson Hall, a convention fee of $10.00 per person provides:
   (a) Transportation of person and baggage from railroad terminal to Columbia University.
   (b) A single room from Sunday, September 3, 1939, until departure on Friday or Saturday, September 8 or 9, 1939.
   (c) Admission to all events on Monday, September 4, 1939, except the luncheon at the Rainbow Room, Rockefeller Center; admission tickets to the above-mentioned luncheon and the other events of the meeting being purchased as each delegate, lady or guest may desire.

(d) Transportation of person and baggage from Columbia University to railroad terminal at close of meeting.

3. For those who stay at other apartments, such as Butler Hall, Kings Crown or Kingscote and therefore pay separately for accommodation, there will be no convention fee.

(a) They may purchase separate tickets for each event they desire to attend.

(b) Or they may pay $25.00 fee and get a book of tickets for all events.

Living Accommodation

The following living accommodation will be available at Columbia University. There is a difference between buildings as the prices indicate, but in every instance quarters will be extremely satisfactory. All rooms are well furnished, clean, comfortable, well situated and very reasonable in price. Johnson Hall is a beautiful building and has room for three hundred made up mostly of single rooms, eight foot six by fourteen foot six, well furnished and with hot and cold water. There are some suites available here also.

Johnson Hall—single room for six or seven days included in Convention Fee under clauses 1 and 2 previously mentioned, making actual room cost less than $1.00 per day.

Butler Hall—(limited accommodation) 2 room apartment for two or three persons $5.00 per day, $30.00 per week per suite.
Three room apartments for 4 or 5 persons, $6.50 to $8.00 per day.
One room apartment for 2 persons, $3.00 per day.
One room apartment for 1 person, $2.50 per day.
All with bath and kitchenette.

King's Crown Hotel (limited accommodation). Single and double rooms, two and three room suites averaging $2.00 to $2.50 per day per person—all with bath.

Kingscote Apartments—2 room apartment for 2 or 3 persons, $20.00 per week.

Dining Facilities

Through the courtesy of the management, all Canadians will be given a card to the Faculty Club of Columbia University, where meals may be enjoyed at the following prices.
Breakfast, 50c.; Luncheon, 75c.; Dinner, $1.10.

The club is conveniently located, and excellently equipped. There are several restaurants conveniently situated nearby with prices and service to suit everyone.

RESULTS OF BALLOT FOR AMENDMENTS OF BY-LAWS 32 AND 35 AND NEW BY-LAW 77

We, the undersigned, beg to report on the voting with reference to the proposed changes in Sections 32 and 35 of the by-laws and new By-law 77, as follows:

Total ballots received		1346
Members in arrears and spoiled ballots	41	
Ballots valid		1305
Section 32		
Yes	1288	
No	16	
	——	1304
Section 35		
Yes	1300	
No	5	
	——	1305
Section 77		
Yes	1289	
No	14	
	——	1303

Respectfully submitted,

C. K. McLeod, A.M.E.I.C.
Ernest Gohier, M.E.I.C.
E. R. Smallhorn, A.M.E.I.C.
Scrutineers.

PUBLICATIONS OF THE INSTITUTION OF MECHANICAL ENGINEERS

As a result of the visit to London of Past-President Fairbairn, the Institution of Mechanical Engineers has kindly offered to make available to members of The Engineering Institute of Canada the excellent publications of that body, at the reduced rate of £1 5s per annum. This offer was very much appreciated by council, and it is hoped that many members will find it to be of advantage to them. It is a reciprocal arrangement similar to that which has been in force for some time with the Founder Societies of the United States. Details of this latter arrangement will appear again in an early issue of the Journal.

MUSEUM TO PRESERVE INDUSTRIAL RELICS

The Society for the Preservation of Old Sheffield Tools is endeavouring to establish what is intended to be the finest Industrial Museum in Great Britain. In the vicinity of Sheffield, there are a number of old works which recall the early days of craftsmanship that made the name of this city inseparable from the art of fine cutlery. Among them are the Abbeydale Works at Beauchief which, with the dam and surrounding land, were purchased and presented to the city by the J. G. Graves' Trust.

It is proposed to preserve the interesting and unique water wheels, tilt hammers and scythe-making equipment, and to supplement these by other hand-forging tools and anvils. These are to constitute a permanent exhibition of machinery and tools formerly used by Sheffield craftsmen.

The 200-year-old works are at present in need of repair before they can be put into a satisfactory condition. The city already owns the property and is willing to take over the museum when completed and maintain it as a public building. The Society for the Preservation of Old Sheffield Tools is making an appeal for funds in order to raise the sum of £1,500 to save these works from demolition. Already £420 have been received and it is hoped that the remainder will be secured during the next few months. The equipment necessary to complete the museum has already been promised free of cost and includes one of the first rolling mills ever made.

In view of the background of British craftsmanship which many engineers and industrial concerns in this country possess, it is thought that some of them might be interested in helping to preserve the Abbeydale Works. The secretary's address is, W. H. Bolton, Department of Applied Science, St. George's Square, Sheffield, England.

QUEBEC BUREAU OF MINES

Reorganization of Geological Division

The Minister of Mines and Fisheries, the Honourable O. Gagnon, announces the reorganization of the geological division of the Quebec Bureau of Mines. Dr. J. A. Dresser, who has acted as Directing Geologist during the past ten years, is relinquishing his post in order to direct the preparation, for the Bureau of Mines, of a comprehensive report on the Geology of the Province of Quebec.

In view of the increasing importance of the mineral industry in the province, it has been decided to replace the Division of Geology by two divisions which will work in close collaboration; the first, to carry on the areal geological mapping of the province; the second, to undertake more detailed studies of the geology of mineral deposits. The first, the Division of Geological Surveys, will be under the direction of Dr. J. W. Jones; the second, the Division of Mineral Deposits, will be under the direction of Dr. B. T. Denis. Both Dr. Jones and Dr. Denis are mining geologists, having attended post-graduate schools at well-known universities, and having had very special training which designates them fully to the functions just assigned to them by the Department.

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

Lieut.-Col. J. A. Macphail, C.M.G., D.S.O., LL.D., M.E.I.C., is the first recipient of the Montreal medal which is to be awarded yearly by the Montreal Branch of Queen's University Alumni Association to those who have made meritorious contributions to the honour of the University. Lieut-Col. Macphail has been professor of general engineering at Queen's University for the past 35 years. Presentation of the medal was made at a complimentary dinner at the Ritz Carlton Hotel in Montreal on May 10. Professor Macphail, who is the retiring head of the Engineering Department of the University, received an honorary degree at Convocation on May 20.

Hon. C. D. Howe, Hon.M.E.I.C., Minister of Transport in the Federal Cabinet, received the honorary degree of Doctor of Laws at the Dalhousie University Convocation on May 16.

R. W. McColough, M.E.I.C., who has been for fifteen years chief engineer of the Nova Scotia Department of Highways, has recently been made Deputy Minister of the same department. Since graduation from the Nova Scotia Technical College in 1911, he has always been engaged in highway engineering except during the period of the war when he was captain attached to the R.C.E. He has served in the Department of Highways of his province since 1919, first as resident engineer, then as division engineer and later as inspection engineer. In 1924 he was appointed chief engineer, a position which he held until his recent promotion.

J. E. Belliveau, A.M.E.I.C., has been appointed chief engineer of the Nova Scotia Department of Highways to replace R. E. McColough, M.E.I.C. Mr. Belliveau entered the department in 1909 as a draughtsman and advanced to the position of assistant chief engineer in 1918, from which he was recently promoted to his present office.

R. E. Gohier, S.E.I.C., has been appointed assistant engineer and metallurgist of the new plant of the International Foils Ltd. at Cap-de-la-Madeleine, Que. He was graduated from the Royal Military College of Kingston in 1937 and went to McGill University where he obtained his degree of B.Eng. in metallurgy. He is the son of J. A. E. Gohier, M.E.I.C., vice-chairman of the Montreal Branch.

R. E. Stavert, A.M.E.I.C., is the new vice-president of the Consolidated Mining and Smelting Company of Canada. He is a graduate of McGill University. Shortly after graduation, he went overseas with the Canadian Expeditionary Forces. After the war, in 1919 he entered the General Electric Company and remained with the company until 1921 when he became connected with the British Metal Corporation (Canada) Ltd. In 1925, he was appointed general manager of this company and later president. Mr. Stavert joined the Consolidated Mining and Smelting Company in 1935 as assistant to the president, a position which he occupied until his recent promotion.

Capt. C. N. Mitchell, V.C., M.E., A.M.E.I.C., was among the five holders of the Victoria Cross who were presented to Their Majesties in Montreal on May 18. Captain Mitchell was overseas from 1914 to 1919 with the Canadian Engineers. He is now on the staff of the Power Corporation of Canada, Limited, in Montreal.

C. R. Whittemore, A.M.E.I.C., has been appointed research metallurgist for the Deloro Smelting and Refining Company, with headquarters at Deloro, Ont. Mr. Whittemore was previously metallurgist for the Dominion Bridge Company, Limited, in Montreal. In 1936, he was the recipient of the Plummer Medal of the Institute.

J. D. Sylvester, S.E.I.C., has secured a position with the Howard Smith Paper Mills in Montreal. A graduate in electrical engineering of the University of Alberta in 1938, he recently completed a year as demonstrator in power plant and hydraulic engineering at the University.

Hugh J. Gordon, Jr.E.I.C., has recently been transferred from the Engineering Department of the Canadian Pacific Railway in Montreal to the division engineer's office in Nelson, B.C.

L. J. Marshall, Jr.E.I.C., has accepted a position as broadcast operator for the new C.B.C. station at Watrous, Sask. He is a graduate in electrical engineering of the University of Manitoba. After his graduation in 1935, he served a seven-month apprenticeship with the English Electric Company at Stafford, England, after which he was maintenance engineer with the British Broadcasting Corporation in London. Upon his return to Canada in 1938, he became connected with the R.C.A. Victor Company Ltd., Montreal, as engineer in the transmitter department.

Elihu Thomson, A.M.E.I.C., who is with the Dominion Sound Equipment Ltd., has been transferred from Montreal to the Toronto office of the company. Since his graduation from McGill University in 1931, he has been connected with the Fred Thomson Company in Montreal and the Northern Electric Company.

R. L. Morrison, A.M.E.I.C., is now located at Portsmouth, England, where he is employed as a draughtsman by Airspeed Ltd. Since graduation from the University of British Columbia in 1929, he has been successively connected with the Canadian General Electric in Peterborough and with the Consolidated Mining and Smelting Company in Trail, B.C.

L. C. Young, A.M.E.I.C.

L. C. Young, A.M.E.I.C., has recently been elected secretary-treasurer of the Halifax Branch of the Institute. He received his general education at St. Francis Xavier University in Antigonish and was graduated from the Nova Scotia Technical College in 1930 with the degree of B.Sc. in electrical engineering. Mr. Young spent a few years in the electrical department of the Dominion Coal and Steel Company at Sydney. He is at the present time electrical engineer with the Nova Scotia Light and Power Company in Halifax.

J. H. Fregeau, A.M.E.I.C., divisional manager, North Division of the Commercial and Distribution Department, Shawinigan Water and Power Company, has been appointed general manager, St. Maurice Transport Company.

S. H. Clarke, A.M.E.I.C., has accepted a position with the Boiler Inspection and Insurance Company in Montreal. He was previously engaged with plant installations in the northern Quebec mining district.

E. G. Cullwick, A.M.E.I.C., has recently published a book on "The Fundamentals of Electromagnetism." Mr. Cullwick, who is professor and head of the department of electrical engineering at the University of Alberta, is an honour graduate of Cambridge University. He has been teaching the subject of electricity for ten years, seven of which were spent at the University of British Columbia and one year as lecturer at the Military College of Science at Woolwich, England. A short review of Professor Cullwick's new book appeared in the May number of the Journal.

A. E. Grégoire, S.E.I.C., who was previously with the Department of Mines of the Province of Quebec, has recently accepted a position with the National Electricity Syndicate in connection with the power development on the Ottawa river in the county of Temiscaming.

Visitors to Headquarters

Dr. E. A. Cleveland, M.E.I.C., chief commissioner of Greater Vancouver Water District and Past President of the Institute, with his son, Courtney, S.E.I.C., who has been doing post-graduate work at McGill University, on May 10.

J. W. Demcoe, S.E.I.C., of Bankfield Consolidated Gold Mines, Bankfield, Ont., on May 11.

C. A. Fowler, M.E.I.C., of C. A. Fowler and Company, engineers and architects, Halifax, on May 15.

G. F. St. Jacques, Jr.E.I.C., engineer with the Quebec Public Service Commission, in Quebec, on May 19.

Paul Vincent, A.M.E.I.C., district engineer for the Roads and Bridges Division of the Department of Colonization of the Province of Quebec, Quebec, on May 19.

Morris Fast, S.E.I.C., engineering student at the University of Saskatchewan, Saskatoon, on May 20.

Lieut.-Commander B. R. Spencer, A.M.E.I.C., engineer officer of the H.M.S.C. "Saguenay," on May 23.

Obituaries

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

Richard Griffith Boast, A.M.E.I.C., died suddenly while on duty at North Bay, Ont., on April 28. He was born at De Smet, South Dakota, on Feb. 22, 1885, and came to Canada when he was a child. He was educated at McGill University, where he received the degree of B.Sc. in civil engineering in 1911. He devoted his entire career to the Temiscaming and Northern Ontario Railway. Entering the company upon graduation as an instrumentman, he was later promoted to the position of resident engineer. At the time of his sudden death, he was engineer of maintenance of way.

Mr. Boast joined the Canadian Society of Civil Engineers as a Student in 1908 and became a Junior in 1912. He was transferred to Associate Member of the Institute in 1922.

William Roy Grant, M.E.I.C., who died suddenly at his home in Port Arthur, April 25, 1939. He was born at New Glasgow, N.S., on October 23, 1891. He received his general education at the New Glasgow Public and High School and his engineering training at McGill University where he was graduated in 1915 with the degree of B.Sc. in civil engineering. Upon graduation, he joined the Barnett-McQueen Company, Ltd., engineers and contractors, Fort William, Ont. His first position with the company was that of timekeeper. He gradually advanced through the positions of foreman and construction superintendent to that of chief engineer in 1925. In 1930 he was elected president of the company, a position which he still occupied at the time of his death. During 1917 and 1918 he was with the Royal Air Force.

Mr. Grant was elected Member of the Institute in 1938

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 following is a synopsis of the paper presented to the Border Cities Branch at the monthly dinner meeting held in the Prince Edward Hotel, Windsor, on April 21, 1939.

The subject, **Automotive Bearings,** was presented by Mr. Arthur F. Underwood of General Motors Research Laboratories Division. Mr. Underwood is a graduate of the Mass. Inst. of Tech. having received his S.B. and M.S. degrees there and has since graduation been continuously with the General Motors Research Laboratories and is now head of Mechanical Engineering Dept. No. 5.

The elimination of friction where it is not desired has long been a major problem to the mechanical engineer, and in the motor industry much time and expense is consumed in research to obtain more satisfactory bearings. Assisted by over 50 coloured lantern slides the speaker discussed the use of the various materials such as babbits, cadmium, copper-lead, aluminum and bronzes, etc., in the manufacture of automotive bearings.

Anti-frictional properties, resistance to corrosion, fatigue and mechanical wear together with low cost of production present major difficulties. The type of materials used depends on the special service the bearing is desired to perform. The fatigue of copper-lead, its low cost, the anti-friction of babbit, the bond and mechanical strength of silver, the conformability and embeddability of babbit are the chief considerations in the selection of these materials for a particular job. No one material combines all these properties.

Due to the low thermal conductivity of babbit and galvanic currents which cause corrosion, very thin layers are necessary, thus decreasing the embeddability of the bearing. Some bearings are made of more than one material, thus combining their properties. The importance of using the correct oil and changing oil before acids are generated due to oxidation which cause corrosion was stressed by the speaker.

The technique of testing bearings requires special machines in order that bearings may be quickly broken down.

Pictures of various bearings which had failed from such causes as fatigue, corrosion, mechanical wear, over-heating, and scouring were shown to the members and these, combined with the remarks of Mr. Underwood, were most interesting and understandable to the members.

A discussion period followed.

EDMONTON BRANCH

F. A. Brownie, A.M.E.I.C. - *Secretary-Treasurer*
J. W. Porteous, Jr.E.I.C - *Branch News Editor*

The last regular dinner and meeting of the year, for the Edmonton Branch, was held at the Macdonald Hotel on Tuesday, April 18.

After the dinner, the chairman, W. E. Cornish, A.M.E.I.C., introduced the speaker, Dr. R. L. Rutherford of the Dept. of Geology of the University of Alberta. Dr. Rutherford's subject was, **Turner Valley Districts, 1938,** and for the following hour and a half the members were treated to a history of the Turner Valley Oilfields interspersed with geology and humour. In concluding, the speaker discussed the probable extent of the field and the nature of some of the drilling which will be useful in establishing its boundaries.

There was a good discussion following the meeting, in which about half of the members present took part.

A hearty vote of thanks was given Dr. Rutherford for a very interesting paper well presented.

HAMILTON BRANCH

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

The joint meeting of the Hamilton Branch E.I.C. and the Toronto Section of the American Institute of Electrical Engineers was held in the Westinghouse Auditorium on April 21 when A. F. Kenyon, Assoc.M. A.I.E.E., of the sister Westinghouse in the U.S.A., spoke to an audience of 235 on the subject, **Recent Trends in Steel Mill Electrification.**

The speaker explained how advances in the steel industry in the last ten years had been confined largely to the finishing process due to the increasing demand for lighter steel plates, such as those used in automobile bodies, refrigerators, tinplate manufacture, and even railway trends were towards lighter steel finishes.

Mr. Kenyon showed slides illustrating many electrical installations for driving steel mill rolls and immense power plants entailing advanced engineering design. He showed the new mill put in at the Steel Company of Canada last year and the electrically operated sheet mill of the Dominion Foundries and Steel, which is also located in Hamilton.

The meeting was opened by John R. Dunbar, A.M.E.I.C., on behalf of The Engineering Institute of Canada and then turned over to W. J. Gilson, Chairman of the Toronto Section, A.I.E.E., who introduced the speaker. After the meeting refreshments were served by the kindness of the management of the Canadian Westinghouse Company.

The Branch held a joint meeting with the Queen's University Alumni on Tuesday, May 9, 1939. John R. Dunbar, A.M.E.I.C., presided. Major Hugh Lumsden, M.E.I.C., introduced the speaker, Mr. C. A. Robbins, District Engineer, Department of Highways, Ontario, whose subject was **Highway Trends in Ontario.**

The speaker brought his listeners a very clear concept of the highways and their problems. The average resident of Ontario has very little idea of the extent of road development which has been accomplished in his own province. The Province maintains 7,200 miles of King's Highway, and 3,200 miles of secondary roads. Of these 3,500 miles are paved highways.

In the development of better highways, the Province is faced with two alternatives, either to improve the existing roads or to select an entirely new location for the construction of a highway.

In the improvement of existing highways, the expense is high owing to the damage to property which has been built up along these roads, the interference with traffic which must be maintained, the destruction of pavement necessitated because a better alignment must be effected, and the cost of adjusting existing grades.

On selecting a new location, the Department has no built-up areas to contend with and therefore is able to obtain a 200 ft. right-of-way at small expense. They are also able to control building, thereby safeguarding the effectiveness of these main arteries of traffic.

The Province has undertaken the construction of super highways for two reasons: first, to provide the tourist with quick and ready access to the country, and secondly, to keep pace with the steady increase in motor car registrations in Ontario, thus assuring the public of adequate motoring facilities. The revenue derived from the tourist traffic would in itself be sufficient justification for the expense involved in construction of these roads.

These new super highways will be of the dual type with a 30 ft. boulevard between each lane, similar to the new highway between Toronto and Hamilton. These roads will by-pass the towns and villages and in so doing will increase their efficiency because these roads are designed for heavy, long distance traffic.

In order to safeguard life, these new roads will be provided with grade separations of the clover leaf type. These grade separations are provided only at the intersections of two heavily travelled roads, for example, where there may be 10,000 cars a day travelling one road and 8,000 cars on the other road.

Access from large centres of population to these roads will probably be provided with 'limited roads.' These roads, four to five miles long, will permit no entrance of traffic from intermediate points: thus a car will enter this road at the city limits and will have no interference from cross traffic for four or five miles. In this manner quick access to and from large cities will be effected. In some instances semi-limited roads will be used where traffic will be allowed to enter at limited points from overhead.

At the conclusion of his talk, Mr. Robbins showed some slides illustrating typical steps in the construction of various types of highways. Also included in the slides were views of the modern highways in Germany and in England. This concluded a most interesting address.

Dr. H. T. Uart of the Queen's Alumni moved the vote of thanks and at the same time expressed the thanks of the Alumni to the branch for sponsoring the joint meeting.

The meeting adjourned for refreshments, which were provided jointly by the Branch and Queen's Alumni. There was an attendance of 68.

Prior to the meeting the Branch entertained Mr. Robbins at an informal dinner in the refectory, McMaster University.

LONDON BRANCH

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

The regular monthly meeting was held in the Board Room of the Public Utilities Commission on May 12, 1939, the speaker being Harry H. Angus, B.A.Sc., heating engineer, of Toronto, and his subject the **New Ontario Mental Hospital**, St. Thomas.

The meeting was presided over by H. F. Bennett, M.E.I.C., Chairman of the Branch, who opened by calling attention to the approaching visit of the President of the Institute on May 30 and extended a cordial invitation for all members to attend a dinner meeting to be held on that date to welcome him.

Mr. Bennett also called attention to a series of 12 broadcasts over the CBC network of dramatized Canadian engineering features which is now being arranged and called for suggestions and preparation from members. Mr. Stead, Jr.E.I.C., designing engineer for E. Leonard and Son, boiler makers of this city, introduced the speaker. He said that the speaker's father, now deceased, was connected with the Leonard firm for many years and was well known in this city.

Mr. Harry H. Angus opened his remarks by a short description of the last mental hospital built by the government some 25 years ago at Whitby. This consisted of a number of cottages arranged in semi-circular fashion with the dining hall in the centre.

The layout of the new St. Thomas Hospital occupied a site about one mile square just east of the No. 4 Highway, south of St. Thomas. The buildings are in separate units ranging from two to four or five stories high. The layout is both practical and symmetrical. However, the nurses' home and official residences are on the west of the highway. The administration building is approached by a semi-circular driveway. All the buildings of the hospital itself and the power house and laundry are connected by subways eight feet wide, half above ground and with service tunnels (also eight feet wide) below the subways. After the administration building the examination and observation buildings together with a general hospital extend easterly in a straight line up to the central dining hall and cafeteria with kitchens behind. Branching north and south from the dining hall are other infirmaries and wards and at the north end the power house, laundry and garage.

The south portion is devoted to female and the north to male patients.

The population will consist for the present of 1,800 patients plus 300 to 400 staff and the ultimate will number 3,600 (including a staff of 700).

The sewage is pumped up a grade of one in 300 from the power house to the St. Thomas sewage works, a distance of 1½ to 2 miles. The sewage is collected from all the units of the hospital and conveyed to the power house by iron pipe mains supported on I-beams overhead in the service tunnels (as are the other services, water, heat mains, etc.). Two storage tanks with total capacity of 500,000 gal. are provided for emergency use. Surface drainage waters are taken to the creek. There are three pumps (two electric and one steam) and three boilers by Leonards with stokers by Combustion Engineering Corp. Ltd.

Water is supplied from the St. Thomas waterworks and is distributed through mains in the tunnels to all parts. A water tower 150 ft. high with 150 gal. tanks is also installed. The hospital is steam heated—the steam being conveyed in 10 in. insulated mains through the tunnels. The radiators are safe from interference, being covered with metal shields. Hot water is supplied in the same manner with installations in each building. A large tank is installed for the receipt of condensed water from the return mains. The electric lay-out is carried by cables in fibre ducts below the floors of the tunnels. The voltage is 5,000 and transformers installed outside of each building step it down to 450-500. A 125 hp. fire pump is also installed.

W. C. Miller, M.E.I.C., city engineer of St. Thomas, in moving a vote of thanks to Mr. Angus, described the method of dealing with the water service at his end and also the treatment of sewage.

The speaker's brother, Professor R. W. Angus, Hon.M.E.I.C., of the Toronto University, was present and the chairman called upon him to say a few words.

Mr. Angus complied with this request by giving some interesting comments on the action of a water hammer which his brother had mentioned.

About 25 members and guests were present.

MONCTON BRANCH

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

Liquid Air was the subject of an address delivered at a branch meeting on April 14 by Prof. D. G. MacGregor of Mount Allison University. B. E. Bayne, A.M.E.I.C., Chairman of the Branch, presided. Through the courtesy of the Canadian Liquid Air Co., Montreal, a quantity of the liquid had been supplied for demonstration purposes by the Halifax Branch of the Company.

Prof. McGregor gave a historical account of experiments leading up to the liquefaction of gases and the production of extreme cold. In 1935 a temperature of but five thousandths of a degree above the absolute zero was attained. Combined cooling and pressure are required to liquefy the permanent gases. The two commercial processes are known as the Linde and the Claude. The air liquefies at a temperature of about minus 314 deg. F. under the atmospheric pressure. Its chief industrial use is the production of liquid oxygen. The nitrogen in the liquid air has a lower boiling point than the oxygen, and consequently evaporates first, leaving the oxygen which is then stored in tanks either in the liquid or gaseous form. Oxygen is used commercially in welding. It is interesting to note that cotton soaked in liquid oxygen is highly explosive and it is possible that this is the principle of the devastating bombs used by the Germans in Spain.

Prof. MacGregor demonstrated some of the remarkable properties of liquid air. Soft rubber immersed in the liquid air became hard and brittle. A soft solder wire spring, with practically no tensile strength, was rendered capable of supporting a pound weight. A test tube filled with liquid oxygen and suspended between the poles of a magnet was shown to have magnetic properties. Proving oxygen a vigorous supporter of combustion, a cigarette soaked in the liquid and then lighted blazed fiercely and was consumed in a few seconds.

A vote of thanks to the speaker was moved by C. S. G. Rogers, A.M.E.I.C., seconded by G. E. Smith, A.M.E.I.C. On motion of F. O. Condon, M.E.I.C., seconded by R. H. Emmerson, A.M.E.I.C., thanks were also extended the Canadian Liquid Air Co. for donating a quantity of its product for use at the meeting.

Following Professor MacGregor's address, Prof. H. W. McKiel, M.E.I.C., President of The Engineering Institute of Canada, spoke to the meeting and discussed, more or less informally with the members, the policy of the Institute.

Sackville Meeting

A meeting of Moncton Branch was held at Mount Allison University, Sackville, on May 1. Mr. Roy MacKay, President of the Mount Allison Engineering Society, was in the chair. A paper was read by H. J. Crudge, A.M.E.I.C., Building Engineer, Atlantic Region, Canadian National Railways, on the subject, **An Investigation into the Causes of Damage to Brick Walls by Water Penetration.** The speaker described the principal materials of construction and made comparisons between the earlier type and the modern high strength standards, and from an analysis of the various physical properties demonstrated that while the modern materials were far superior from many standpoints, their increased density could be detrimental as well as advantageous. It was brought out in the course of the paper that considerable study is yet necessary before ideal methods can be developed, but several suggestions were made as a means to eliminate the heavy costs of repairs which are now so common.

A vote of thanks moved by Mr. MacKay was tendered the speaker.

NIAGARA PENINSULA BRANCH

George E. Griffiths, A.M.E.I.C. - *Secretary-Treasurer*
J. G. Welsh, S.E.I.C. - - *Branch News Editor*

On March 21, 1939, the Niagara Peninsula Branch of the Institute held a dinner meeting at the Leonard Hotel in St. Catharines. Chairman C. G. Moon, A.M.E.I.C., presided. M. B. Atkinson, M.E.I.C., introduced the speaker of the evening, Mr. W. W. Cushing, chief draftsman of the Hamilton Bridge Company, who spoke on the **Lion's Gate Bridge.**

For this bridge, which has the longest single suspension span in the British Empire, and the longest pre-fabricated cable strands in the world, Monsarrat and Pratley, Montreal, were designing and supervising engineers, and W. G. Swan, M.E.I.C., of Vancouver, associate engineer. Mr. Cushing was engineer representing the Hamilton Bridge Company at the erection.

Through the medium of slides and motion pictures the erection procedures were shown. The numerous questions asked the speaker regarding the bridge and erection procedure, attested the great interest taken in the topic by those present.

Following a hearty vote of thanks to Mr. Cushing and the thanks of Mr. Moon to A. W. F. McQueen, M.E.I.C., for his capable organization of the programme, the meeting was adjourned.

A complete paper embracing the design, fabrication and erection of this bridge is in course of preparation. It is expected that the paper will be published in a later number of the Journal.—Ed.

On the evening of April 25, 1939, the Niagara Peninsula Branch held a Ladies' Night at the Welland House in St. Catharines, Ont. Chairman C. G. Moon, A.M.E.I.C., introduced the speaker of the evening, Diamond Jenness, M.A., Hon. Litt.D., F.R.S.C., Chief, Division of Anthropology, National Museum of Canada, who spoke on **The Origin of the American Indians and their Contributions to Civilization.**

Dr. Jenness traced the migration of the peoples from Eurasia across Bering Strait and hence over the entire North and South American continents. In spite of the handicap of much fewer natural resources, corn being the only grain natural to the western world and no animals suitable for domestication, also the fact that the eastern world had many thousands of years start, by the time of the discovery of America by Columbus a high state of civilization had evolved in several sections, notably in what is now Peru and Mexico. Agriculture was practised extensively, and the moulding and painting of pottery was the equal of any to-day. Superb cotton fabrics were in existence, gold ornaments of the most intricate designs were being worn, and an advanced stage of government had evolved. However, the eastern world overwhelmed the western peoples and their gifts to the world are often forgotten. Among these were cocoa, cocaine, rubber, cotton, corn, squash, several varieties of beans, potatoes, sweet potatoes, and tobacco.

Following this talk the speaker was deluged with questions. W. R. Manock, A.M.E.I.C., moved a hearty vote of thanks to Dr. Jenness, following which a buffet luncheon was enjoyed.

OTTAWA BRANCH

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

At the noon luncheon on April 13, J. L. Busfield, B.Sc., M.E.I.C., of Montreal, gave an address on **Modern Applications of Diesel Engines.**

The Diesel engine was first built as a stationary engine, stated Mr. Busfield, and had a large bulk and enormous weight. Gradually, however, it has been developed so that to-day it may range from the small 4 hp. unit to the large central Diesel power engines of several thousand horsepower. He characterized it as one of the most efficient prime movers ever produced.

Germany leads the world in the use of Diesel rail cars and locomotives, according to the speaker. Among the 33 countries in the world amongst which are distributed the 3,600 rail cars, Germany leads, with France coming second; and of the 2,100 Diesel rail locomotives in the world Germany has more than half. Canada was somewhat of a pioneer in the development of the Diesel rail car but for some reason has been left in the background in later years.

Referring specifically to the matter of costs, the speaker illustrated how the greater initial costs for Diesel engine equipped vehicles is overcome after a certain amount of operation by citing the case of heavy trucks weighing with load, say, 15 tons. When these trucks operate from 50,000 to 75,000 miles per year the gasoline-propelled vehicle might cost about five cents per mile, whereas the other would cost 1½ cents per mile or a saving of 3½ cents. On the other hand the initial cost of the Diesel engine propelled vehicle would be such that it would have to travel about 90,000 miles before costs would be equalled. Maintenance costs would be quite similar.

The latest field for the Diesel engine is in connection with aeroplanes. There are some 15 firms in Europe to-day experimenting and developing these engines for this purpose but so far they are still in the experimental stage.

J. H. Parkin, M.E.I.C., chairman of the Ottawa Branch, presided.

At the last regular noon luncheon of the spring season, held at the Chateau Laurier on April 27, A. F. Gill, M.A., dealt with the work of the **Codes and Specifications** Section of the National Research Council, of which he has latterly been in charge, and paid particular attention in his address to activities in connection with Government purchasing specifications and the National Building Code.

With regard to the former activity, work on these is carried on through the Canadian Government Purchasing Standards Committee. This latter committee, set up several years ago, brings together the services of technical and professional representatives of all government departments interested in standard specifications. The actual preparation of specifications and direction of any necessary laboratory work rest with a number of subcommittees and panels, of which there are some twenty at the present time.

Resulting specifications are all subject to approval by the co-operating departments, with their use entirely on a voluntary basis. In some instances they have been adapted also to the needs of industry and last year several thousand copies of such specifications were sent to enquirers outside of government circles. They are apparently being used to an increasing extent by municipalities and other public bodies as well as by some of the larger corporations.

The speaker then briefly sketched the manner in which this principle was applied to the specifications governing a number of commodities dealt with, such as paints, petroleum products, textiles and paper, and mentioned others now under investigation.

With regard to the other main activity, namely, the preparation of the National Building Code, co-operation in a larger field is involved. This code is 'essentially a technical document setting forth recommended minimum standards for the guidance of municipal authorities in controlling construction within their own jurisdiction.' It was felt that a comprehensive model document of this nature would tend to improve the standard of construction, to eliminate obsolete and unworkable codes, would provide a basis for greater uniformity and thereby tend toward more economical methods of construction.

Work of various committees in connection with the preparation of this Code, which he characterized as the most important activity of the Council to date in the field of industrial standards, were briefly dealt with by the speaker.

PETERBOROUGH BRANCH

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

On April 22, the Council of the Association of Professional Engineers of the Province of Ontario honoured Peterborough by holding their monthly meeting here. The members of the Executive of the Peterborough Branch of the E.I.C. and Mr. L. A. Wright, General Secretary of the E.I.C., were present at this meeting, by invitation.

Following the meeting, the members of the Association and of Peterborough Branch of the E.I.C. held a joint dinner at Kawartha Golf and Country Club. W. P. Dobson, M.E.I.C., of Toronto, President of the Association, was chairman of the dinner.

An outstanding feature of the dinner was the intense competition which developed between the various gentlemen appointed as ham-carvers. At the conclusion of their labours, C. E. Sisson, M.E.I.C., of Toronto, and I. F. McRae, A.M.E.I.C., of Peterborough, were nominated for the prize. When Mr. Sisson admitted that he had allowed a spot to appear on his borrowed apron, Mr. McRae was declared the champion cut-up.

After the dinner, V. R. Currie, A.M.E.I.C., speaking for W. T. Fanjoy, A.M.E.I.C., Chairman of Peterborough Branch of the E.I.C., who was unable to be present due to illness, extended a hearty welcome to the members of the Association from the E.I.C., and expressed the hope that this would be the first of many similar get-togethers. Mr. Dobson then outlined briefly the history of the Association, and its aims and objects.

The speaker for the evening was Commander C. P. Edwards, A.M.E.I.C., of Ottawa, who gave an address on the Trans-Canada Airways. Commander Edwards reviewed the numerous problems encountered in getting the TCA ready for operation, and he discussed the tremendous amount of equipment required to ensure safe and punctual operation of the airline. The talk was very informative, and was presented in an extremely interesting manner. At its conclusion, the speaker was accorded a hearty vote of thanks by the audience.

The Annual Meeting of the Branch was held on May 3 at the Y.M.C.A. The retiring Chairman, W. T. Fanjoy, was in the chair. After a light supper, the Chairman called on the Secretary-Treasurer, Mr. A. L. Malby, for his report; following this the chairmen of the various committees presented their reports for the previous year.

Mr. Fanjoy, A.M.E.I.C., then presented Institute buttons to B. K. Scarlett, S.E.I.C., and J. R. Dunn, A.M.E.I.C., who had presented papers at the annual Junior and Students' Night.

The scrutineers then announced the result of the ballot for the election of the Branch Executive for the following year. B. I. Burgess, A.M.E.I.C., J. Cameron, A.M.E.I.C., V. R. Currie, A.M.E.I.C., R. L. Dobbin, M.E.I.C., A. L. Malby, Jr.E.I.C., and I. F. McRae, A.M.E.I.C., were elected.

Joint meeting of the Peterborough Branch and the Ontario Association of Professional Engineers, April 22nd, 1939

The retiring Chairman then gave his closing address. He presented a brief resumé of the branch activities for the previous year, and passed along several suggestions to the incoming executive. Following this, an open discussion of the branch activities was held, and several suggestions for a technical outing were reviewed. At the conclusion of the business meeting, the members adjourned to the sports department of the Y.M.C.A. and spent the remainder of the evening in bowling and volley-ball.

At a later meeting of the new executive, Mr. Burgess was appointed Chairman of the Branch for the following year. Mr. Malby was re-appointed Secretary-Treasurer.

SAGUENAY BRANCH

F. T. Boutilier, A.M.E.I.C. - *Secretary-Treasurer*

The regular monthly meeting of the Saguenay Branch was held in the Main Office of the Aluminum Company of Canada Ltd., Arvida, on February 5. Several interesting papers were presented on **Operating Experiences with Electric Steam Generators,** by A. G. Joyce, Affil.E.I.C., R. A. Lane, J. W. Gathercole, A.M.E.I.C., J. Foster and G. H. Kirby, A.M.E.I.C. M. G. Saunders, A.M.E.I.C., occupied the chair and at the conclusion of the papers the fifty members and guests present took part in an enthusiastic discussion.

SAINT JOHN BRANCH

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

The annual meeting of the Saint John Branch was held in the Admiral Beatty Hotel on May 4, 1939, at 5.30 p.m.

The reports of the various committees were received and filed. H. F. Morrisey, A.M.E.I.C., was elected Chairman. Other officers elected were: Vice-Chairman, J. P. Mooney, A.M.E.I.C.; Secretary-Treasurer, F. L. Black, Jr.E.I.C.; Executive, D. R. Smith, A.M.E.I.C.

The annual dinner followed, at which forty members and guests were present. President H. W. McKiel paid his official visit to the branch and also presented the Plummer Medal, awarded to H. I. Knowles for his chemistry paper, **Building Invisible Edifices,** presented before the Saint John Branch, March 24, 1938, and published in the August, 1938, issue of the Journal.

In his address, President McKiel mentioned the need of educating the public as to the value of the technically trained men and in this connection told of the radio broadcasts to be undertaken by the Institute in the near future.

Following the President's address, J. S. Hoyt entertained the branch with a programme of moving pictures.

SASKATCHEWAN BRANCH

J. J. White, M.E.I.C. - *Secretary-Treasurer*

A general meeting of the Saskatchewan Branch along with The Association of the Professional Engineers of Saskatchewan and the Saskatchewan Section of The American Institute of Electrical Engineers was held in the Kitchener Hotel, Regina, on March 24, 1939, to hear an illustrated address given by Dr. Norman W. McLeod, research engineer of the Technical Service Division of the Imperial Oil Limited. Dr. McLeod's paper, **The Characteristics and Uses of Asphaltic Materials,** was provocative of much discussion.

TORONTO BRANCH

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

On March 16 A. T. Cairncross, A.M.E.I.C., spoke to the branch on **Engineering Experiences in China.** He has recently returned from China where he spent four years on construction work and on different engineering projects. This interesting address was illustrated with slides and films showing the conditions in that country.

On April 5, the Toronto Branch held its annual meeting and election of officers for the ensuing year at the Canadian Military Institute on University Avenue. The meeting was highly successful, and well over one hundred members attended the dinner and later the address by S. C. Hollister, Dean of the Engineering School of Cornell University. The remodelled quarters of the Military Institute were almost uncomfortably crowded and next year we must apparently look for a larger place of meeting as increasing interest in the affairs of the branch has been evident throughout the year, and this final meeting augurs well for the future. C. E. Sisson, M.E.I.C., the retiring chairman, occupied the chair for the evening and his final summation of the year's work and aims for the future was well received by those present. J. J. Spence, A.M.E.I.C., Secretary-Treasurer, reported total receipts of $1,069.30, including $89.00 received as the result of a special appeal to the members. Total expenditures were $809.00, leaving a balance of $259.30. The amount expended for publicity in the past year was $40.00. The Membership Committee reported 489 members including 137 full Members, 219 Associates, 58 Juniors and 75 Students. Six new Members, four new Associates and seven new Juniors were added to the total membership for the year. The auditors, Douglas Laidlaw, A.M.E.I.C., and Edgar Cross, M.E.I.C., reported everything in good order, and the scrutineers convened by Prof. W. J. Smither, M.E.I.C., and aided by J. J. Traill, M.E.I.C., F. E. Wellwood, S.E.I.C., D. Cameron, A.M.E.I.C., and W. E. Bonn, M.E.I.C., reported the results of the election as follows:

Chairman, Dr. A. E. Berry, M.E.I.C.; Vice-Chairman, Nicol MacNicol, M.E.I.C.; Secretary-Treasurer, J. J. Spence, A.M.E.I.C.; Executive, W. E. P. Duncan, M.E.I.C.; M. Barry Watson, M.E.I.C.; G. H. Rogers, A.M.E.I.C.; H. E. Brandon, A.M.E.I.C.; W. S. Wilson, M.E.I.C.; A. O. Wolff, M.E.I.C.

In attendance at the meeting were Mr. Zimmerman and Mr. Wm. Rae representing Cornell Alumni; J. R. Dunbar, A.M.E.I.C., Chairman of the Hamilton Branch; W. T. Fanjoy, A.M.E.I.C., Chairman of the Peterboro Branch; C. G. Moon, A.M.E.I.C., Chairman of the Niagara Peninsula Branch; A. R. Hannaford, A.M.E.I.C., Secretary of the Hamilton Branch; J. A. Vance, A.M.E.I.C., Councillor of the London Branch, and Eric Muntz, M.E.I.C., of the Hamilton Branch.

Dean Hollister of the Cornell Engineering School was the principal speaker of the evening, and reviewed 300 years of engineering progress from the time of Galileo in 1600 A.D., with particular reference to the progressive advances in the science of bridge building. His address was accompanied by some highly interesting slides, and gave the members a new appreciation of the keenness of perception of engineers of the past, who struggled against the handicap of limited mathematics, public distrust of those who sought to shed new light on the unknown, and other endless disappointments to say nothing of lack of funds and apparati. Dean Hollister's address was thoroughly enjoyed by the members, as were the remarks of Prof. C. R. Young, M.E.I.C., who introduced him, and of Brig.-Gen. C. H. Mitchell, M.E.I.C., who also spoke.

VICTORIA BRANCH

KENNETH REID, Jr.E.I.C. - *Secretary-Treasurer*

At a luncheon meeting of the Victoria Branch held in Spencer's Dining Room on May 5, 1939, the members of the Branch were privileged to have as their guest speaker Lt.-Col. R. L. Fortt, Officer Commanding Royal Canadian Artillery on the Pacific Coast, who spoke on the subject, **Coast Defence.**

In introducing the subject, Col. Fortt suggested that the equipment used for defence was perhaps of great interest to a group of engineers and proceeded to briefly describe the present and future equipment necessary for the adequate defence of British Columbia's extensive coast line. To the layman it would appear that only certain points of the coast were being defended but the aim was to defend all strategic points and to make use of mobile forces for the defence of other vulnerable areas. In reality Esquimalt was the defence of Vancouver and Canada's western gateway and such guns as were mounted in the immediate vicinity of Vancouver were for local protection only. The Esquimalt station would be wholly adequate for the complete defence not only of Vancouver but of the southern portion of the island, the dry dock and the naval base, as well as the city of Victoria.

The entrance to the straits along the northeast coast of the island is protected by a completed fort sited and constructed to protect Vancouver against attack from that direction.

The speaker differentiated between the use of battle cruisers and battleships for high-seas engagements and the smaller craft for coast defence. Canada's naval defence requirements are coastal only, requiring destroyers, mine layers and sweepers, submarines, coastal launches, motor boats, etc. He explained the use of naval examination vessels and their accompanying shore batteries; the value of searchlight service; the use of infantry, artillery, engineers, ordnance and army service corps. He explained the artillery used for counter-bombardment and close defence and the new quick-firing anti-motorboat guns.

Much importance was placed on modern air-force superiority, the air-force being the eyes of the artillery battery. The increased speed of planes made the problem of air defence more serious and special developments had been made in this regard. The air bomb and other air obstacles such as the curtain balloon barrage were some of these.

Col. Fortt contrasted the development of anti-aircraft defence during the last war with present-day requirements and efficiency, and the use of improved height-finding instruments, predictors, sound detecting devices, searchlight and artillery batteries and the practicability of aerial bombardment and defence. It was regretted that time did not permit for a more extensive discourse on this timely and all-absorbing subject.

On March 16, Mr. J. A. Knight, M.E.I.C., Mgr. Highway Engineering Service, Brunner, Mond Canada Ltd., presented a paper on **Calcium Chloride in Engineering Construction.**

The addition of small quantities of calcium chloride to cement mortars accelerates the setting and increases the workability of the mix, the latter characteristic being important due to possible reduction of the water-cement ratio and the ensuing increased strength.

The low freezing points of calcium chloride solutions are made use of by adding the salt to stock piles of coal, gravel, etc., to prevent freezing into a solid mass.

Due to its deliquescent properties, calcium chloride is important to the highway engineer as a dust layer. The fact that calcium chloride brine is much thinner than water, and hence produces a thinner moisture film around the clay particles, gives it the important property of decreasing the compactive effort of clays, and has led to its use in compacting or soil stabilization.

Consolidation is a maintenance method in which the binder soil, obtained by cutting down the road shoulders, is incorporated with loose stone on the road surface to produce a stable mixture, which is shaped to an adequate crown and treated with calcium chloride.

COMING MEETINGS

American Society for Testing Materials—Forty-second Annual Meeting, June 26-30, 1939, at Chalfonte-Haddon Hall, Atlantic City, N.J.

American Society of Mechanical Engineers—1939 Semi-annual Meeting, July 10-15, San Francisco, Calif. Chairman of Registration and Information Committee, George L. Sullivan, professor of mechanical engineering, University of Santa Clara.

American Water Works Association—Fifty-Ninth Annual Convention, June 11-15, at Atlantic City Auditorium, Atlantic City, N.J. Secretary, H. E. Jordan, 29 West 39th St., N.Y.

Canadian Electrical Association—Forty-Ninth Annual Convention at The Pines Hotel, Digby, N.S., June 21-24, 1939.

Canadian Good Roads Association—Twenty-fifth Annual Convention, September 12-14, at Chateau Frontenac, Quebec City. Secretary-treasurer, George A. McNamee, New Birks Building, Montreal, Que.

Library Notes

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

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 BRIDGE METHODS

By B. Hague. 4 ed. New York and Chicago, Pitman Publishing Corp., 1938. 587 pp., diagrs., charts, tables, 9 x 6 in., cloth, $8.50.

In this new edition of a standard work will be found theoretical and practical information dealing with a.c. bridges for the measurement of inductance, capacitance, and effective resistance at low and telephonic frequencies. The separate chapters cover fundamentals, symbolic theory, apparatus, the classification of bridge networks, and the various available methods, including necessary precautions.

APPLIED PHOTOGRAMMETRY

By R. O. Anderson. 2 ed. Ann Arbor, Mich., Edwards Bros., 1939. 190 pp., illus., diagrs., charts, tables, 8 x 5 in., cloth, $2.50 (10 copies or more, $2.00 per copy).

As in the previous edition, methods for determining the correct scales of aerial photographs are given, together with an analytical radial-line method of control, which takes into account both relief and tilt. In the revision, the theory has been extended and a chapter added on the graphical-ray method of control. The present volume constitutes a textbook as well as a reference work for the application of aerial photography to various types of surveys.

CITY PLANNING, Why and How

By H. M. Lewis. New York and Toronto, Longmans, Green & Co., 1939. 257 pp., maps, charts, tables, 9 x 6 in., cloth, $2.50.

The intention of this book is to set forth in simple language the need and advantages of planning for the future growth or change in a municipality, and to indicate the part the average citizen can play in this development. The first part deals with reasons for planning, and the second with procedures through which desired objectives can be gained. Many illustrative maps and diagrams are included.

DESCRIPTIVE LIST of the NEW MINERALS, 1892-1938

Compiled by G. L. English. New York and London, McGraw-Hill Book Co., 1939. 258 pp., 9 x 6 in., cloth, $3.00.

This volume is intended to contain all the new mineral names that have appeared in the literature since the publication of the sixth (1892) edition of Dana's "System of Mineralogy". The book includes references to each mineral and, so far as available, information on its crystal system, form, color, hardness, specific gravity, chemical composition and formula, and prominent localities.

(THE) ECONOMICS OF BUSINESS ENTERPRISE

By W. Rautenstrauch. New York, John Wiley & Sons, 1939. 445 pp., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

The objects of this book are to describe what is generally considered to be good practice in dealing with the economic problems of specific business enterprises, to inquire into the theories on which these practices rest, and to develop methods of analysis with which to deal more intelligently with the economic problems of a given business. The final chapter treats in general of business enterprise on a national scale.

ELECTRIC CIRCUITS AND WAVE FILTERS

By A. T. Starr. 2 ed. New York and Chicago, Pitman Publishing Corp., 1938. 476 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $6.00.

The opening chapters of this text present fundamental mathematical processes, alternating-current theory, and electric circuit theory. Design information is given for resistances, condensers and coils, including transformers, preceding a full discussion of wave filters. Separate chapters are devoted to low pass, high pass, and band pass filters. Attention is also given to acoustic analogies, electro-acoustics, and transients in networks. Long appendices summarize the information about filters, and the characteristics of band pass filters are expressed in a monogram.

Les GAZOGÈNES, Théorie, Pratique, Contrôle

By H. Guillon. Paris, Chaleur et Industrie, 1939. 126 pp., diagrs., charts, tables, 9 x 6 in., paper, 30 frs.; bound, 50 frs.

Following a discussion of the principles of the gasification of solid fuels, the author gives practical information concerning the various types of gas producers and their operating characteristics, and their regulation, and describes producers for various special purposes.

GLASS FACTORY YEAR BOOK AND DIRECTORY, 1939 Ed.

Pittsburgh, Pa., American Glass Review. 160 pp., tables, 8 x 6 in., paper, loose leaf, $5.00.

Complete data on all manufacturers of glass products in the United States and Canada are given in this annual compendium. Also included are classifications of glass products, indices of raw materials, equipment, finished products and manufacturers, and some statistical and technical information.

MACHINING OF METALS

By H. Ernst, H. B. Knowlton, J. W. Bolton, A. H. d'Arcambal, W. E. Bancroft and H. P. Croft. Cleveland, American Society for Metals, 1938. 177 pp., illus., diagrs., charts, tables, 9 x 6 in., lea., $2.50.

The five lectures collected in this volume were presented to the American Society for Metals. The topics considered include the physics of metal cutting, the machinability of various irons and steels, and the machining of nonferrous metals. Numerous photomicrographs illustrate the text material.

THE MANAGEMENT OF MUNICIPAL PUBLIC WORKS

By D. C. Stone. Chicago, Public Administration Service, 1939. 344 pp., diagrs., charts, tables, 10 x 7 in., cloth, $3.75.

The science of management as developed in industrial plants is here applied to municipal public works administration. Based on actual practice, the material covers all phases of accounting, purchasing, administration, etc., including many illustrations of sample forms, and will serve as a reference manual as well as a textbook.

METHODS OF STATISTICAL ANALYSIS

By C. H. Goulden. New York, John Wiley & Sons, 1939. 277 pp., diagrs., charts, tables, 9 x 6 in., cloth, $3.50.

Designed for the student who intends to do practical research work in the biological sciences, this book presents methods and actual examples for the handling of statistical material in these fields. Considerable discussion of principles and theory is included, coordinated, however, with the direct application of these principles.

MODERN MAGNETISM

By L. F. Bates. Cambridge, England, University Press; New York, The Macmillan Co., 1939. 340 pp., diagrs., charts, tables, 9 x 6 in., cloth, $4.50.

Much of the student's difficulty in studying magnetism comes, in the opinion of Dr. Bates, because the subject is treated too much from the theoretical and too little from the experimental point of view, and this text is written to remedy this state of affairs. Prominence is given to a description of fundamental experiments, and accounts are given of much experimental work, particularly foreign work, which is of importance to those interested in industrial applications of magnetic materials.

PIPE CORROSION AND COATINGS

By E. Larson and G. I. Rhodes. New York, American Gas Journal, 53 Park Place, 1938. 455 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $2.50.

In this volume the author has collected, co-ordinated and explained the various theories of corrosion and of pipe protection, in particular with respect to external corrosion of underground gas pipe lines. Soil testing, the making of corrosion surveys, the types of protective coating and the methods of applying them are covered in detail, and there is a chapter on cathodic protection.

PHYSICAL SCIENCE IN MODERN LIFE

By E.G. Richardson. New York, D. Van Nostrand Co., 1939. 256 pp., illus., diagrs. 8 x 5 in., cloth, $3.00.

A well written account, intended for the general reader, of some recent developments in physics, is provided by this book. The author has chosen subjects which touch our everyday existence. Streams and eddies, vibrations and waves, colloids, heat, light, electricity, sensation and reaction are among the matters considered.

SAMPLING AND ANALYSIS OF CARBON AND ALLOY STEELS

New York, Reinhold Publishing Corporation, 1938. 356 pp., diagrs., tables, 9 x 6 in., cloth, $4.50.

This collection of methods represents the practice of the chemists of the subsidiary companies of the United States Steel Corporation. The text covers the whole range of determinations required in the steelworks' laboratory, and includes detailed directions for the methods that have been found most satisfactory.

SILICOSIS AND ASBESTOSIS, by various authors, edited by A. J. Lanza

London and New York, Oxford University Press, 1938. 439 pp., illus., tables, 9 x 6 in., cloth, $4.25.

A comprehensive presentation of the medical and public health aspects of these industrial dust diseases is provided in this work, to which several physicians have contributed. The history of the diseases, their symptoms and diagnosis, their pathology and their prevalence in various occupations are discussed, as well as methods of prevention and control. Each section has a bibliography.

SPONTANEOUS FLUCTUATIONS OF VOLTAGE, Due to Brownian Motions of Electricity, Shot Effect, and Kindred Phenomena

By E. B. Moullin. Oxford, England, Clarendon Press; New York, Oxford University Press, 1938. 251 pp., diagrs., charts, tables, 10 x 6 in., cloth, $6.00.

This book is devoted to the study of the fluctuations in electric circuits caused by thermal agitations of free electrons in conductors or by their random emission from hot surfaces. The subject has interest for communication engineers, since Brownian motion imposes an inescapable background of noise which must be shouted down and imposes an upper limit on useful magnification. This book, based upon personal experimental work, summarizes present knowledge concerning these phenomena.

STEAM-ENGINE PRINCIPLES AND PRACTICE

Ed. by T. Croft, revised by E. J. Tangerman. 2 ed. New York and London, McGraw-Hill Book Co., 1939. 513 pp., diagrs., charts, tables, 8 x 6 in., cloth, $3.50.

A clear, practical text for the operating engineer and plant superintendent, which has been thoroughly revised and amplified to represent current practice. The selection, operation, maintenance and repair of engines are covered in detail.

STEEL AND ITS HEAT TREATMENT. Vol. 2, Engineering and Special-Purpose Steels

By D. K. Bullens and the Metallurgical Staff of the Battelle Memorial Institute. 4 ed. New York, John Wiley & Sons, 1939. 491 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $5.00.

The second volume of this new edition deals with carbon and alloy steels for engineering and other special purposes. Special attention has been given to the characteristics of the alloying elements, the special properties that these confer upon steel and the variations in heat treatment required to utilize alloy steels most fully and economically. The revision of this edition has been done by the metallurgical staff of the Battelle Memorial Institute.

SUNDIALS. How to Know, Use and Make Them

By R. N. Mayall and M. L. Mayall. Boston, Hale, Cushman & Flint, 1938. 197 pp., illus., diagrs., charts, tables, 8 x 6 in., lea., $2.00.

This book gives definite instructions for making and using sundials of many kinds. The text calls for no special mathematical or astronomical knowledge, but is adapted to amateur requirements. A chapter on interesting dials is included, with photographs of many examples.

SYMPOSIUM ON IMPACT TESTING

Phila., American Society for Testing Materials, 1938. Pp. 21-177, illus., diagrs., charts, tables, 9 x 6 in., paper, $1.25.

This pamphlet contains the papers and discussions presented at a meeting in June, 1938. Attention was concentrated upon the present fields of commercial use for the impact test, with particular references to fields where it gives necessary information not supplied by static tests, and upon the basic theory underlying the test.

TAR ROADS. (The Roadmakers' Library)

By A. C. Hughes, W. G. Adam and F. J. E. China. London, Edward Arnold & Co.; New York, Longmans, Green & Co., 1938. 196 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $6.50.

The manufacture and use of tar for road work are covered in five sections, of which the first is historical. Part II discusses sources, physical structure, and refining and blending processes, likewise the various mixtures, compounds and emulsions, and the specification and testing of road tars. Part III describes equipment and the application of tars to roads. Parts IV and V and appendices cover briefly footpaths, testing of tar-bound materials, and specifications.

(The) THEORY of MACHINES

By T. Bevan. London and New York, Longmans, Green & Co., 1939. 549 pp., diagrs., charts, tables, 9 x 6 in., cloth, $5.40.

Following a brief résumé of the principles of elementary mechanics, the succeeding chapters deal with the various fundamental types of mechanisms, such as gears, cams, belt drives, etc., and discuss the subjects of vibration and balancing. To facilitate the graphical solution of problems, diagrams have been carefully drawn to scale. The answers to the problems given with the text are collected in the back of the book.

TIMESTUDY FOR COST CONTROL

By P. Carroll, Jr. New York, McGraw-Hill Book Co., 1938. 305 pp., diagrs., charts, tables, 10 x 6 in., cloth, $3.00.

A practical method is outlined in detail for completing the timestudy measurement and control of cost without rearranging the shop. The preparation and use of standard data precede changes rather than follow them, as is the case with individual operation timestudy. The author shows the logical extension of the method to form the basis for many managerial controls.

TRAVAUX MARITIMES, Vol. 4. (Bibliotheque de l'Ingénieur de Travaux Publics)

By L. Prudon. Paris, Dunod, 1939. 396 pp., illus., diagrs., maps, tables, 8 x 5 in., paper, 95 frs., bound, 112 frs.

This is the concluding volume of a comprehensive treatise on dock and harbor engineering. This last volume is devoted to accessory works intended to protect, maintain and operate the principal works; to buoys, lighthouses and other aids to navigation; and to port administration. A chapter is given to seaplane ports.

(A) TREATISE ON LIGHT

By R. A. Houstoun. New York and London, Longmans, Green & Co., 1938. 528 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.50.

This popular treatise provides a well balanced treatment of the subject. The first section is on geometrical optics. The second section discusses physical optics. The third section is devoted to spectroscopy and photometry. The final section gives the mathematical theory. This edition has been entirely reset and extensively revised, a chapter having been added on the quantum theory and a half-chapter on photo-electricity, as well as additions to many topics throughout the book.

WHAT ENGINEERS DO, Engineering for Everyman

By W. D. Binger. rev. ed. New York, W. W. Norton & Co., 1938. 304 pp., illus.. diagrs., 9 x 6 in., cloth, $2.75.

The major fields of civil engineering and construction work are simply and clearly explained. Brief mention is made of the historical development of such work, and the characteristics and deportment of an engineer are discussed.

(The) WORKING AND HEAT-TREATING OF STEEL

By R. H. Harcourt. Stanford University, Calif., 1938. 261 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.75.

The aim of this textbook is to supply a concise account of the principles and methods involved in making, working and heat treating steel, for use in technical schools and colleges. Part one describes the manufacture and heat treatment of steel. Part two is devoted to methods of forging and the hardening and tempering of steel tools.

WATER SUPPLY ENGINEERING

By H. E. Babbitt and J. J. Doland. 3 ed. New York and London, McGraw-Hill Book Co., 1939. 690 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $6.00.

A comprehensive introductory textbook presenting material on fundamentals and practical applications in all phases of the subject. Finances, hydraulics, ground water and wells, dams and mechanical equipment, electrical equipment, distribution systems, filtration, and the analysis, softening and purification of water are important topics dealt with. Problems are contained in an appendix.

ADDITIONS TO LIBRARY

PROCEEDINGS, TRANSACTIONS, ETC.

American Institute of Consulting Engineers: *List of Members, 1939.*

American Institute of Electrical Engineers: *Year Book, 1939.*

American Society of Civil Engineers: *Year Book, 1939.*

Punjab Engineering Congress, Lahore: *Proceedings, Vol. 26, 1938.*

The Society of Naval Architects and Marine Engineers: *Transactions, Vol. 46, 1938.*

REPORTS, Etc.

Canada Department of Mines and Resources: *The Treatment of Fence-Posts with Preservatives (Dominion Forest Service Circular 56).*

Canada Department of Labour: *Wages and Hours of Labour in Canada, 1929, 1937 and 1938. (Supplement to The Labour Gazette, March, 1939).*

Edison Electric Institute: *Cable Operation, 1937.*

Illinois State Water Survey: *Bulletin No. 21, Supplement 1.*

Ontario Department of Mines: *Forty-seventh Annual Report, 1938, pt. 3, 4, 7.*

Rutgers University; College of Engineering: The Dynamics of Sedimentation by J. J. Slade (Jr. Am. Water Works Assoc., Nov. 1937); Orientation and Training of Young College Graduates in Industry No. G-2); Pulsating Air Velocity Measurement by Neil P. Bailey (MR-3).

U.S. Department of the Interior Bureau of Mines: Coal Mining in Europe (Bulletin 414); Some Suggestions on Safety in Timbering Anthracite Mines (Miner's Circular 38); Allaying Dust in Bituminous-Coal Mines with Water (Technical Paper 593).

TECHNICAL BOOKS

Elements of Practical Aerodynamics

By B. Jones, 2 ed. New York, John Wiley & Sons, 1939. 436 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.75.

This simple exposition of the fundamentals of aerodynamics for beginning students relates mainly to aeroplane practice, and includes brief information on materials and construction, instruments and avigation. A long glossary and a set of answers to the problems given in the book are appended.

High-Frequency Alternating Currents

By K. McIlwain and J. G. Brainerd. 2 ed. New York, John Wiley & Sons, 1939. 530 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $6.00.

The mathematical analysis of the operation of electric circuits at high frequencies is presented as a course for advanced electrical engineering students, to be accompanied by practical laboratory work. The comprehensive coverage is indicated by the list of topics following the general introductory chapters, including thermionic vacuum tubes, electric wave filters and transmission lines, amplification, modulation, detection, etc. The co-ordination of quantities and units in electromechanical-acoustic systems is considered in the final chapter. Chapter bibliographies facilitate further study on any topic.

Industrial News

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

CANADIAN WESTINGHOUSE PROMOTIONS

At a meeting of the Board of Directors of the Canadian Westinghouse Company, Limited, held recently, John R. Read was elected president of the company. Mr. Read's promotion has been rapid. He was elected vice-president in 1936, prior to which he was connected with the Vancouver District Office of the company, first as sales engineer and subsequently as district manager. Mr. Read was elected a director of the company in 1938.

Paul J. Myler, the retiring president, continues as chairman of the board. N. S. Braden, vice-president, was elected vice-chairman of the board. Both Mr. Myler and Mr. Braden will continue to take an active part in the affairs of the company.

John S. Martin was elected to the new office of comptroller. He has been connected with the accounting department of the company for many years, having been promoted to the position of general accountant in 1937.

CONTRACT FOR BOILERS AWARDED

Foster Wheeler Limited have been awarded the contract for furnishing two of their "S-A" type boilers for the new Carnation Milk Plant now under construction at Sherbrooke, P.Q. These boilers will each have a designed capacity of 27,000 lbs. steam per hour at 180° working pressure and 485° total temperature and will be fired with pulverized Dominion coal.

SEMI-AUTOMATIC "JACKBIT" GRINDER

A new semi-automatic, electric motor-driven, high production "Jackbit" Grinder has just been announced by the Canadian Ingersoll-Rand Company Limited.

Known as the Size J-5, this machine enables a single operator to grind 60 hand bits or 100 annealed bits per hour. Gauging is done automatically while the operator is forming the face of the bit.

The J-5 is particularly suitable for mines, quarries, contractors, and while primarily developed to handle "Jackbits," collets can also be furnished for grinding practically all makes and sizes of detachable bits.

Detailed information on the J-5, and also on the "Jackrod" Thread Forming Device for use with Canadian Ingersoll-Rand Sharpeners, is given in new bulletin No. 2534, available to readers on request from the company's head office, New Birks Building, Montreal, or any branch in Canada.

SPOUT TYPE MAGNETIC SEPARATORS

Bulletin No. 97, covering spout type magnetic separators, has been issued by the Stearns Magnetic Manufacturing Co., Milwaukee, Wis. The bulletin covers the enlarged models for large capacity requirements. The safety trap is a patented feature in the Stearns high duty spout magnets and is especially important as a means of positive protection not only against current failure, but also other operating conditions. The bulletin contains complete specifications together with illustrations, and a copy can be secured by writing to either a branch office or the home office at Milwaukee.

NICKEL CAST IRONS CHART

Due to the broadening interest in the special nickel alloy irons, "Ni-Resist" and "Ni-Hard" which have been developed by the International Nickel Company, and the fact that minor changes and additions in the specifications of the lower alloyed types shown on the original nickel cast irons chart were past due, a second and much improved edition of this circular chart has now been prepared and issued by the company.

MONEL IN SULPHURIC ACID

A sixteen-page bulletin entitled "Monel in Sulphuric Acid" has been issued by The International Nickel Co. of Canada Ltd. in which the causes of sulphuric acid corrosion have been outlined and a possible solution to resultant problems is suggested. The subject is dealt with under eighteen headings and is well illustrated with photographs and graphs.

SEAMLESS FLEXIBLE METAL TUBING

A new twenty-four page catalogue, elaborately illustrated with seventy-five up-to-date pictures and charts, has just been published by the American Metal Hose Branch of the American Brass Company covering Seamless Flexible Metal Tubing. The catalogue contains complete discussions on the proper use of the product for conveying steam, liquids, gases; controlling vibration, connecting misaligned and moving parts, and the part that seamless plays in product design. There are also complete engineering data and specifications, with simple installation rules.

COMPRESSORS, PUMPS AND DIESEL ENGINES

A series of bulletins have been issued by Worthington Pump and Machinery Corp. of Harrison, N.J., dealing with their various types of compressors, pumps and diesel engines, etc. These bulletins range from four to twelve pages and each is well illustrated and contains useful reference data. Those recently received may be referred to as follows:

Diesel Engines, bulletin S-500-B36.
Diesel Engines, bulletin S-500-B5E.
Pumps—Deepwell, bulletin W-321-M3A.
Pumps—Centrifugal Brewery Mash, bulletin W-360-B2.
Pumps—Heavy Duty Process for Refinery Service, Type UT, bulletin W-341-B4, and type LT, bulletin W-341-B5.
Pumps—Centrifugal, Turbine Drive, bulletin W-321-B13.
Pumps—Deep Well, Turbine, bulletin W-450-B19C.
Pumps—Cofferdam Dewatering and Mine Sinker Service, bulletin W-450-B25A.
Compressors—Portable Gasoline Engine Driven, bulletin H-850-B52.
Compressors—Portable Full-diesel Drive, bulletin H-850-B56.
Compressors—Refrigeration Horizontal Duplex Type, bulletin C-1100-B2.
Compressors—Feather Valve, bulletin L-611-B8.
Hydraulic Decoking Systems for the Oil Refining Industry, bulletin WP-1099-820.

CURRENT TRANSFORMER FOR FIELD TESTING

A new portable current transformer, the JP-1, is announced by Canadian General Electric Co. Limited. Designed especially for field testing, the transformer is a lightweight, multi-range device with an accuracy suitable for use with portable instruments. A combination of wound-primary and through-primary construction, and a tap in the secondary, are used to obtain additional ratios.

The JP-1 transformer has a core window 2¾ inches in diameter. Primary ratings of 10/20/50/100 amperes are obtained from a wound primary with terminals on top of the case. Passing the primary cable through the core window once obtains ratings of 600/800 amperes; passing it through two or more times obtains ratings of 150/200/300/400 amperes. The transformer's secondary rating is five amperes.

COAL STATISTICS OF CANADA—1937

The Dominion Bureau of Statistics, Ottawa, has published the annual report of Coal statistics for Canada for the calendar year 1937. This report is prepared by the Mining, Metallurgical and Chemical Branch of the Bureau and contains a complete analysis of the coal industry during that year.

Canadian coal production in 1937 was four per cent greater than in the preceding year, the totals were 15,835,954 tons and 15,229,182 tons respectively. A nine per cent increase in Nova Scotia's output together with production gains in Saskatchewan and British Columbia accounted for the advance in 1937.

CHEMICAL PUMPS AND PROPORTIONERS

Milton Roy of Philadelphia, Pa., has issued an eight-page descriptive bulletin, No. 938, devoted to the features, specifications, etc., of the Milton Roy chemical pumps and proportioners. This may be obtained upon application to the Canadian representative, Wood Industries Supply Co. Ltd., P.O. Box 1270, Montreal, Que.

FLASHING BEACON CONTROLLER

An inexpensive flashing beacon controller, utilizing a suppressor unit to prevent radio interference, has just been announced by Canadian General Electric Co. Limited. Easy installation is assured by a hanger lug and two screws through the back of the case.

NEW-TYPE COPPER OXIDE RECTIFIER ANNOUNCED

A new type copper-oxide rectifier for oil circuit breaker operation is announced by Canadian General Electric Co. Limited. Rated 50 amperes, 120 volts d-c, 220 volts a-c, for two cycle operation not exceeding four per minute, the new unit has been developed to supersede the former 3-ampere unit, or multiple combinations of such units.

With its 50-ampere rating, it is claimed that one of the new rectifiers can replace 16 or 17 units of the previous design. It requires less space and eliminates possibility of trouble due to improper balancing or dividing of current through numerous parallel paths.

RAIL BONDING

"Recent Developments in Rail Bonding" is described in an article which appeared in the February issue of "Railway Signalling," and due to the wide interest in rail head bonding Canadian Ohio Brass Co. Ltd., Niagara Falls, Ont., are distributing reprint copies of the article.

PROCESS INDUSTRIES MACHINERY

William & J. G. Greey, Limited, of Toronto, have published a catalogue, No. 38, of one hundred pages, dealing with machinery for the process industries, particularly mixing, grinding and separating equipment.

SPEED REDUCERS

A fully-illustrated eight-page catalogue giving complete engineering information about SACO Speed Reducers has been published by Stephens-Adamson Mfg. Co. of Aurora, Illinois. This catalogue is No. 7838 and copies may be obtained by applying to Stephens-Adamson Mfg. Co. of Canada, Ltd., Belleville, Ont.

WIDE-STRIP TACHOMETERS

The Bristol Co. of Canada, Ltd., Toronto, Ont., have issued an instructive four-page bulletin, No. 473, describing Bristol's Wide-Strip Tachometers of the electric-magneto type, with a chart 12¼ inches wide.

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

SALES ENGINEER required with electrical training. State experience if any, and salary expected. Investment required to insure permanency after training. Apply to Box No. 1850-V.

ELECTRICAL ENGINEER, familiar with toll and automatic telephone equipment, sales experience an advantage. Salary $150 monthly. Apply, giving full particulars, to Box No. 1905-V.

ELECTRICAL ENGINEER, graduate engineer with six to ten years experience, preferably in maintenance and operation of large electrical equipment or an extended test course. Age 28 to 35 preferred. Send full particulars with application to Box No. 1908-V.

SITUATIONS WANTED

CIVIL ENGINEER, M.A.Sc., A.M.E.I.C. Eight years survey and municipal engineering experience; three years draughting, detailing steel, concrete, and timber structures. Apply to Box No. 467-W.

INDUSTRIAL ENGINEER, B.Sc. (McGill), with fifteen years broad experience in general design and construction and in practically all departments of industrial design and operation, would consider responsible permanent position with progressive industrial concern. Apply to Box No. 492-W.

ELECTRICAL ENGINEER, B.Sc. Age 40. Married. Jr.E.I.C. Eight years experience in operation, maintenance and installation of electrical equipment in hydro-electric plants and sub-stations. Five years electrical maintenance and construction, motor windings, relays, meters, and all automatic equipment. Also experience on geological survey and highway construction. Best of references. Sober and reliable with ability to handle men. Available at once. Any location. Apply to Box No. 636-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.

ELECTRICAL ENGINEER, B.Sc. '31, (U.N.B.), Jr. E.I.C. Age 31. Single. Experience in electrical wiring construction of concrete wharves, inspection of piling, rip rap, concrete reinforcing, forms, and dredging. Instrumentman during the preliminary survey of a concrete road. Final calculations of quantities of concrete and excavation for concrete road. Junior engineer during the construction of a frostproof shed, a steel shed and a boiler house, which included a general inspection of wiring system for sheds lighting and to the unit heaters in the frostproof shed. Available at once. Apply to Box No. 722-W.

DESIGNING ENGINEER, M.Sc. (McGill), D.L.S., A.M.E.I.C., P.E.Q. Experience in the design and construction of water power plants, transmission lines, field investigations of storage, hydraulic calculations and reports. Also paper mill construction, railways, highways, and in design and construction of bridges and buildings. Available at once. Apply to Box No. 729-W.

ELECTRICAL ENGINEER, B.Sc., Jr.E.I.C. Eight months on installation of power and lighting equipment; three years as manager of sales and service dept. of an electrical firm; seven months as tester on power and radio equipment, one and a half years as inspector on electrical and power equipment. Interested in inspection or sales engineering. Available on short notice. Location immaterial. Apply to Box No. 740-W.

CIVIL ENGINEER, B.Sc., A.M.E.I.C., R.P.E. Age 48. Twenty-five years construction experience on railways, highways, bridges, dams, flumes, pipe lines and buildings. Expert on earthworks and transportation. Location immaterial. Apply to Box No. 841-W.

MECHANICAL ENGINEER, Jr.E.I.C., technical graduate, bilingual, age 36, married. Experience includes five years with firm of consulting engineers, design of steam boiler plants, heating, ventilating and air conditioning. Seven years with large company on sales and design of heating systems, air conditioning, steam specialties, etc. Available on short notice. Apply to Box No. 850-W.

CIVIL ENGINEER, A.M.E.I.C. Age 48. Married. Ten years municipal work. Five years highway construction, familiar with all types of paving. Presently with consulting engineers on municipal work, water supply, etc. Best of references. Available immediately. Further particulars on request. Apply to Box No. 1141-W.

CIVIL ENGINEER, A.M.E.I.C. Married. Experience of over 26 years. Surveys, railways, canals, highways, including location, construction, inspection, giving monthly and final estimates. Building locks, dams and all kinds of buildings. Experienced in steel and munitions work, on laboratory inspection of shells and gauges for same. Seeking for steady employment. Apply to Box No. 1168-W.

ELECTRICAL ENGINEER, B.Eng. (McGill '35). Four years experience design and estimates of substations, control and metering layouts, bus layouts, transformer layouts and fire protection, transmission lines. Hydraulic studies. Also knowledge of town planning, house design, reinforced concrete, water and sewer works, sidewalk and street design. Two years supervision. Interested in design of any description. Married. Age 24. Location immaterial. Available on reasonable notice. Apply to Box No. 1288-W.

MECHANICAL ENGINEER, B.A.Sc., (Toronto '34) Age 27. Recently completed the Alexander Hamilton Institute course in Modern Business. Thoroughly experienced in the heat treatment and selection of tool and die steels, with a wide knowledge of modern production methods. Also familiar with aircraft steels and tubing to British specifications. At present employed as sales representative for an English steel company. Desires position in the field of production control and/or procession or factory management. Complete information given upon request. Apply to Box No. 1348-W.

FIRE PROTECTION AND SAFETY ENGINEER, A.M.E.I.C., B.Sc. '24, (Mech. Engrg.). Age 35. Bilingual. Twelve years experience with insurance underwriters inspection bureau covering phases of field work. Thoroughly familiar with insurance requirements. Position desired industrial or other concern maintaining self insurance or relative departments. Location Montreal or vicinity preferred. Apply to Box No. 1395-W.

CIVIL ENGINEER, B.Eng., B.C.L. '39 (McGill). Perfectly bilingual. Worked for railway company, industrial company and on construction. Age 24. Would like work in time study or similar. Apply to Box No. 1428-W.

ELECTRICAL ENGINEER, B.Eng. Elec. (McGill '35), M.Eng. Elec. (Rensselaer '36), S.E.I.C. Single Age 25. Experience includes planning and production work in large factory and two years electrical and mechanical engineering on temporary staff of National Research Council, Ottawa. Available at once. Apply to Box No. 1468-W.

CIVIL AND ELECTRICAL ENGINEER, B.A., B.A.Sc. '32. A.M.E.I.C. Age 32. Single. Bilingual. Presently employed. Thoroughly familiar with electricity and gas rates and their industrial and commercial applications. Experience also includes heating and lighting engineering. Interested in electrical contractors' and consulting engineers' work. Best references. Available on short notice. Apply to Box No. 1518-W.

CIVIL ENGINEER, B.Sc. (Univ. N.B. '32), A M.E.I.C., R.P.E., Dy.L.S. Age 33. Married. Experience: ten years surveys, mines, land, legal, railways, geological, appraisal, mine management, construction. At present in private practice in civil and mining engineering. Would consider employment in a foreign field. Apply to Box No. 1562-W.

*MECHANICAL ENGINEER, B.Sc., in mechanical engineering with six years experience in pulp and paper mill engineering and maintenance. Wishes employment in maintenance department as assistant to master mechanic or similar work. Can furnish references. Married. Available on short notice. Apply to Box No. 1694-W.

MECHANICAL AND ELECTRICAL ENGINEER, graduate Toronto university; machinists and tool makers trade; lengthy designing experience, pumps, diesel engines, steam generating and distributing equipment, water turbines, steam control and power plant equipment, paper mill and heavy machinery. Fully conversant with mass production on shop methods; foundry practice; forged work; machine shop practice. Excellent experience in specification, research, and development duties. Have been consultant to sales engineering staff large national concern ten years. Employed but available in thirty days. Apply to Box No. 1699-W.

REFINERY ENGINEER, B.Sc. (E.E.), Man. '37. Experienced in supervising operations and maintenance of small refinery. 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. '31, A.M.E.I.C. Experience includes one year hydrographic surveying, two years municipal work, five years highway work. Familiar with all types of pavement, concrete design, bridge construction, sewer design and water layout, road construction. Available on short notice. Apply to Box No. 1815-W.

CIVIL ENGINEER, B.E., Jr.E.I.C., 28 years of age. Married. Desires position with reliable construction firm. Intends to make construction life work. Over five years experience on permanent highway construction, inspection, estimates and instrument work. Available on short notice. Apply to Box No. 1820-W.

SALES ENGINEER REPRESENTATIVE, B.A.Sc., C.E. Age 30. Contact in Northern Quebec mine belt. Interested in selling any kind of materials. Experience in heating and air conditioning. Speaks both English and French. Available at once. Apply to Box No. 1859-W.

CIVIL ENGINEER, B.Sc., S.E.I.C. Married. Six months surveying; mill site; water supply, power line location, earthwork, drainage, topographic. Have 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.

CHEMICAL ENGINEER, graduating Toronto '39. S.E.I.C. One and a half years general ore dressing laboratory work. One and a half years' general milling and assaying. Seeking a permanent position in chemical industry. Apply to Box No. 1867-W.

TECHNICALLY TRAINED EXECUTIVE, general experience covers organization and management in business and industrial fields; including sales, purchasing, productions, accounting and costing, also industrial surveys, reorganizations and amalgamations in the United States and Canada. B.Sc. degree in mechanical engineering. Married. Canadian. Apply to Box No. 1871-W.

MANUFACTURING EXECUTIVE, B.Sc. in mechanical engineering. Married. Canadian. Experienced in munitions manufacturing and other precision work. Apply to Box No. 1872-W.

SALES ENGINEER. Several years experience selling to industrial, mining and railroad organizations in Ontario and Quebec. B.Sc. in mech. engrg. Married. Canadian. Apply to Box No. 1873-W.

CHEMICAL ENGINEER, S.E.I.C., graduating this Spring. Has had experience with platinum, gold, etc. Two years in a biochemical research laboratory and a good knowledge of plumbing and electrical equipment, desires position either on production or in research. Apply to Box No. 1876-W.

INDUSTRIAL DESIGNER seeks position, part-time employment or commissions. University graduate, A.M.E.I.C., long architectural designing experience. Location Ottawa. Apply to Box No. 1878-W.

CIVIL ENGINEER, S.E.I.C., McGill, '39. Age 22. Consistently high scholastic standing. Ready to adapt himself to any kind of work promising future advancement. Experience includes maintenance work in an industrial plant, surface exploration for minerals in northern Quebec, surveying, mapping, and selling. Excellent references. Present residence, Montreal. Available June, 1939. Apply to Box No. 1881-W.

CIVIL ENGINEER, B.Sc. Age 27. Married. Four years experience in highway work, including instrument work on preliminary surveys and construction, estimating and inspection. Prefers position with construction firm. Available at once. Apply to Box No. 1883-W.

CIVIL AND STRUCTURAL ENGINEER, B.A.Sc. (Toronto), A.M.E.I.C. Three years experience in plant engineering work entailing mechanical and structural design and supervision. Also two years on construction work. Desires permanent position with industrial firm or consulting engineer. Apply to Box No. 1893-W.

CIVIL ENGINEER, A.M.E.I.C. Married. Ten years experience on railway location and construction. Twenty years on hydro-electric power and mill construction in executive capacity in charge of preliminary investigation, engineering, estimating, costs and purchasing. At present unengaged owing to the firm associated with discontinuing operations. Available at once. Apply to Box No. 1896-W.

MECHANICAL ENGINEER, B.E. (Sask. '38), S.E.I.C. Age 25. Single. Year's experience with large steel plant, general piping, fuel oil lines and storage tanks, surveying, draughting, furnace construction and operation, adjustment of automatic control equipment, testing. Considerable electrical knowledge. At present employed but available on short notice. Desires specialized position but will consider others. Apply to Box No. 1907-W.

CIVIL ENGINEER, B.A.Sc. (Toronto '09). M.E.I.C., R.P.E. Ont. and B.C. Age 50. Presently employed. Over thirty years experience: design, estimate and erection of structural steel, heavy timber and monolithic concrete; large scale surveys, maps, contours, railway and highway location, farm drainage. Apply to Box No. 1910-W.

ELECTRICAL ENGINEER, B.Eng. (McGill '37). Age 24. Eighteen months experience in test department of big English electrical manufacturing firm. Returning to Canada in June. Would prefer design, sales, or practical work. Apply to Box No. 1911-W.

CIVIL ENGINEER, A.M.E.I.C., R.P.E. Age 48. Married. Fifteen years city engineer, fourteen years experience on design, construction, maintenance, road location, railways, underground, also experience in hardware, plumbing, heating, air conditioning. Desires steady position. Available on short notice. Apply to Box No. 1923-W.

ELECTRICAL ENGINEER, B.A.Sc. (Toronto '35). Age 27. Jr.E.I.C. Graduate of business college. Technical experience in aeronautics, comfort air cooling, refrigeration and communication equipment. Office experience, including shorthand, typewriting and correspondence compilation. Apply to Nox No. 1926-W.

PRELIMINARY NOTICE

of Application for Admission and for Transfer

May 26th, 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 July, 1939.

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 bad responsible cbarge 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. Tbe 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 brancb 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 be has attained an equivalent standard.

A Student shall be at least seventeen years of age, and shall present a certificate of baving 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

DROVER—JACK WHITEMARSH STURDEE, of Newfoundland Airport, Nfld. Born at Brown's Arm, Exploits Bay, Nfld., July 19th, 1915; Educ.: 1931-34, Memorial University College, St. John's, Nfld.; 1934-36, survey work in connection with Govt. Land Settlement; 1936, geophysical prospecting with Hans Lundberg Co.; 1936-37, and at present, asst. engr., Newfoundland Airport, Newfoundland.

References—F. C. Jewett, R. A. Bradley, K. R. Cbestnut, J. W. Morris, A. Vatcber.

FARAND—LAURENT CHARLES, of 2293 Harvard Ave., Montreal, Que. Born at Montreal, July 31st, 1912; Educ. Completed 8th grade at Mont St. Louis College. Private courses in maths. and land surveying from civil engineers; Reg'd. Land Surveyor of Quebec, 1938. 1929 to 1938 with tbe Hon. J. P. B. Casgrain, A.M.E.I.C., four years ap'ticeship in land surveying, later as transitman, rodman, dftsman., office man. and secretary, and 1938 and 1939 in charge of surveys. Now Quebec Land Surveyor witb J. M. O. Lachance, successor to Mr. Casgrain.

References—E Gobier, N. J. A. Vermette, J. Comeau, H. Massue.

FRAIKIN—LEON ARTHUR, of 680 Sherbrooke St. W., Montreal, Que. Born at Brussels, Belgium, Feb. 4th, 1907; Educ: Civil Engr., Univ. of Ghent, Belgium, 1929. M.Sc. (Civil), Mass. Inst. Tech., 1931; 1931-33, designing engr., Société des Pieux Franki, Leige, Belgium; 1934-35, works mgr. on the Charleroi Canal for the above firm; 1936-37, with Braithwaite Burn & Jessop Construction Co., Calcutta, British India, as consltg. engr. for design and execution of alterations to Anderson Weir Damodar, Bengal; foundations of the Howrah Bridge; Burj Drainage Canal and Rapids; Nirgadjni hydro-electric power house; Ganges Canal; Karad Bridge; 1937-38, asst. to the chief engr. on the Mahammed Alia Barrages, Cairo, Egypt, for Macdonald Gibbs & Co. (Engineers), London, England; Jan. 1939 to date, vice-president and general manager, Franki Compressed Pile Co. of Canada Ltd., Montreal, Que.

References—A. Frigon, J. B. Stirling, E. G. M. Cape, W. G. Mitchell, J. L. E. Price.

FREDERICK—STANLEY EDWARD, of Sydney, N.S. Born at Glace Bay, N.S., June 17th, 1908; Educ.: N.S.Tech. Coll., Dept. of Correspondence Study—Certs. in "Substation" 1934, "Common Battery and Toll Equipment," 1936, "Telephone Testing," 1938. Sergeant Cert., Royal Can. Engrs. (N.P.), 1936. Radio Amateur Cert., 1933; 1927-29, clerk, blueprinting and junior dfting., Dominion Coal Company, Ltd.; 1929-30, night foreman, experimental mill and tester in research dept., Canadian Johns-Manville Co. Ltd., Asbestos, Que.; 1931 to date, with Maritime Tel. and Tel. Co. Ltd., as follows: 1931-37, junior mtce. man, on substation equipment, central office switchboard, also installns., etc.; 1937, transferred to Sydney central office staff, duties include central office mtce., also on Canadian Broadcasting Corporation control feeding local station CJCB.

References—S. C. Mifflen, M. F. Cossitt, W. E. Clarke, A. L. Hay.

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References—E. Gauer, G. H. Herriot, W. F. Riddell, A. E. Macdonald, E. P. Fetherstonhaugh.

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References—O. O. Lefebvre, G. E. Templeman, H. Milliken, R. N. Coke, R. A. C. Henry.

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References—D. W. McLachlan, C. J. Mackenzie, G. Kydd, W. L. Mackenzie, C F. Morrison.

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References: S. Ball, H. S. Johnston, R. W. McColough, W. P. Morrison, W. P. Copp.

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References: F. S. Small, E. C. King, W. H. Powell, A. Peebles, J. C. Oliver.

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References: F. C. Jewett, R. J. Griesbacb, K. R. Cbestnut, A. Gray, J. Stephens, E. O. Turner.

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References: N. J. A. Vermette, R. D. Bennett, H. J. Ward, H. K. Wyman, A. H. Heatley.

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"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 INSTITUTE AND THE YOUNG ENGINEER

Another group of students has just graduated from the engineering schools of Canada. It is not generally recognized that we have a duty to these young men which has not, up to the present, been performed as it should have been.

We all agree that when a young man receives his degree from the University he has just taken the first step towards entering the profession. His further progress depends on his securing the right training and experience, and on his being properly placed in the field to which he is best suited.

Members of The Engineering Institute, individually and as an organization, can give these graduates valuable assistance in their after-college placement and training, particularly in the way of employment.

Existing employment services of The Engineering Institute and other agencies are very helpful. Individual members can assist greatly by urging those in charge of industries to welcome young graduate engineers into their organizations. This policy would be a good investment for many industries which have not as yet built up a reserve of young technically trained men.

The President has recently named a committee to study training and welfare problems. In outlining a constructive programme for this committee, three activities seem to be clearly indicated. These may be briefly described as follows:—

First,—youth guidance in the preparatory schools, and the elimination of those who cannot possibly succeed in engineering studies. This should be done in co-operation with educational authorities, assisting them in what they are already doing in the field of vocational guidance.

Secondly,—a study of the present curricula of the engineering schools. Possibly practising engineers can suggest improvements in the engineering courses. Closer contact between practising engineers and the university faculties seems desirable. Some scheme of summer training, or employment, may be worked out, so as to give the students some idea of practice in the field in order to balance the theory of the classroom.

Third and probably the most important phase of our studies will relate to after-college guidance and training. This we believe should be definitely a function of The Engineering Institute. It is hoped to provide improved employment services, and to develop greater interest of the branches in the young men, leading to closer contact between them and the older engineers. This would greatly assist them in passing from the period of controlled activities at school to positions where they must take responsibility.

Certain industrial corporations for many years have provided post-graduate training courses for selected students. They realize that the young graduate has many adjustments to make before he can assume his place in industry. An effort should be made to extend this system so as to assist those who are not fortunate enough to find places in these special industries.

The committee will approach other members of the Institute for information and suggestions, and the writer bespeaks for it your earnest co-operation.

HARRY F. BENNETT, M.E.I.C.,

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MANITOBA POWER COMMISSION TRANSMISSION SYSTEM

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SUMMARY—After noting the early difficulties in the development and operation of the system, largely owing to the small size of the units supplied, the financial results are stated, with particulars as to contracts and rates. Service to farms has been limited by expense of connection. The staff and organization for maintenance and operation are described.

Origin and Development

The Electrical Power Transmission Act was passed by the Provincial Legislature in March, 1919. It provided that the Lieutenant-Governor-in-Council might appoint a board which should be known as the Manitoba Power Commission to assist the Minister of Public Works in carrying out the provisions of the act. Arrangements were made whereby municipalities throughout the province might apply to the Commission for a supply of electric power and might enter into a contract with the minister for such supply. The minister was given power to make all necessary arrangements to generate or purchase electricity and distribute it to municipalities or individuals. It was provided that the price to the purchaser should be sufficient to cover fixed charges on capital advances, maintenance and replacement charges, and the operating costs of the Commission.

The act was, no doubt, patterned after Ontario legislation governing the Hydro-Electric Power Commission of that province and until 1932 the Commission in Manitoba functioned in much the same way as did the older utility in Ontario. For reasons which will be given later, however, the method of operating has been entirely changed during the last few years.

The first municipality to make application for power was the City of Portage la Prairie, and a provisional contract between Portage la Prairie and the minister was drawn up early in 1919 and the construction of a transmission line from Winnipeg was commenced in the fall of that year. The line was completed in August of 1920 and the first service provided by the Commission was extended to the City of Portage la Prairie at that time.

During 1920 an existing hydro-electric plant at Minnedosa was purchased and the construction of a Diesel engine-driven plant to provide additional capacity at that point was commenced. Construction of a second Diesel plant at Virden was commenced the same year. Both of these plants were placed in service in 1921.

Since that time extensions have been made annually with the single exception of the year 1933, and the system now stands as shown in Fig. 1. It consists of 1,556 circuit miles of line and serves 118 cities, towns and villages with a total of 14,040 meters at November 30th, 1938.

Early operations of the Commission were in line with the practice which still prevails in Ontario, the Commission owning and operating transmission lines and substations and selling power in bulk to the municipalities; the municipalities in turn taking care of the cost of distribution and retailing power of individuals.

There are many objections to dividing in this way what is essentially one process; some of which can be attributed to the small units which feature the territory served and others which are inherent in the method. Cities such as Toronto, Hamilton, London and Windsor may be large enough to operate separate systems properly, but a town of 600 people is not.

Most municipalities appointed Electric Light Committees

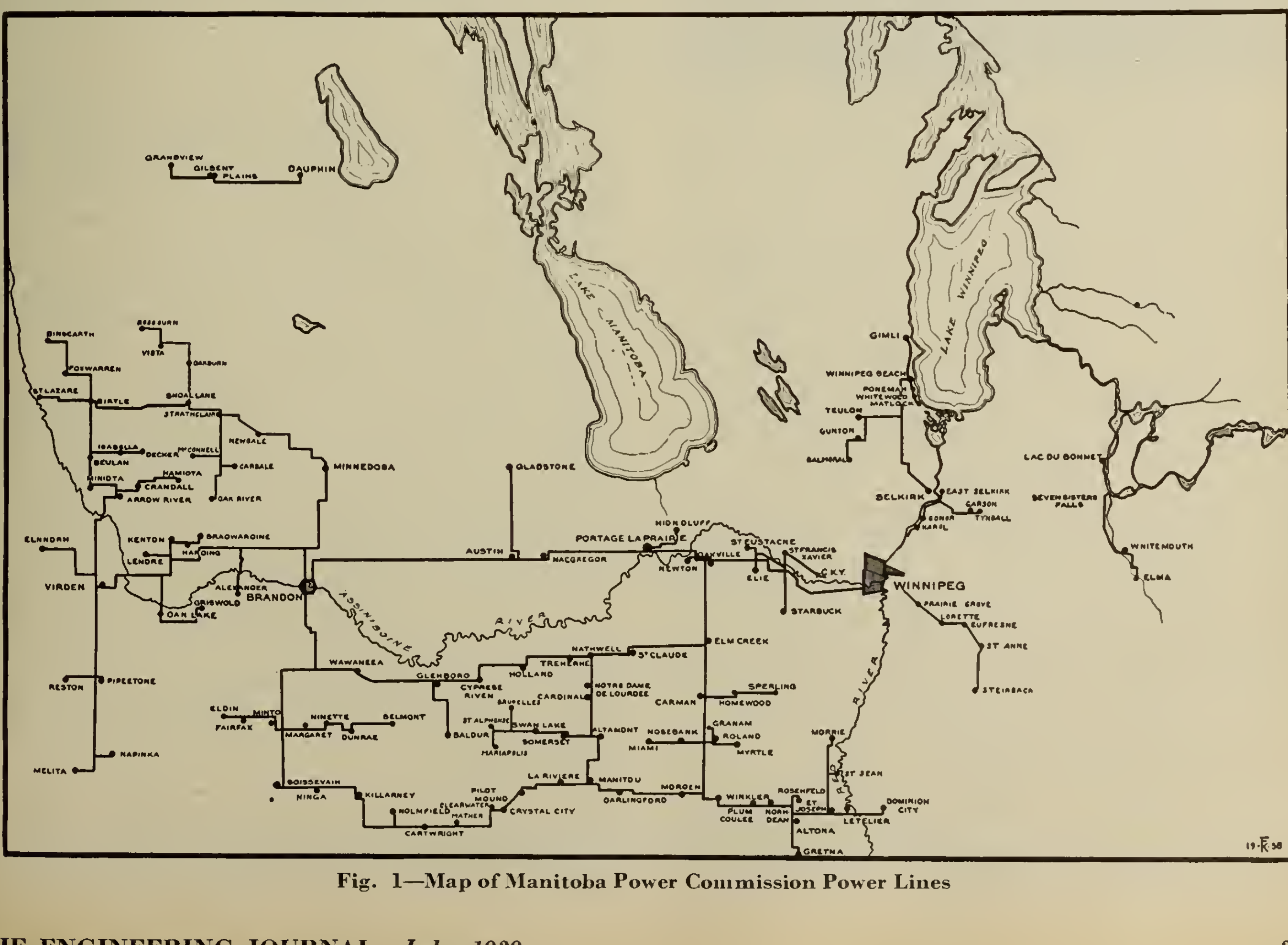

Fig. 1—Map of Manitoba Power Commission Power Lines

to assist the Council with the management of the electric distribution. Naturally, very few men were available for these committees who had any knowledge or experience whatever along the lines required. Some were content to act as liaison officers between their fellow citizens and the Commission, but others wished to take a very active part in the management of their own affairs and brought forward numberless suggestions, particularly with respect to rates. There was also a great diversity of opinion with respect to street lighting charges; some municipalities making fairly heavy tax levies in order to reduce the cost of service to individuals, and others going to the opposite extreme of collecting all, or nearly all, of the cost of street lighting from the users of electricity to the benefit of the general tax-payer.

While the Commission nominally had jurisdiction over rates at all points, it was not practicable to override the municipal officials in all cases and the tendency was toward a great diversity of rates which in turn resulted in dissatisfaction arising from comparison of rates in adjacent towns. When the Commission sought to introduce promotional rate forms the benefit to each town was not immediately apparent and many of the committees objected to placing such rates in effect. If they were placed in effect after objection had been made any subsequent inadequacy in revenue, whatever the cause, was blamed on such rates.

When the municipalities began to feel the effects of the depression in 1930 and 1931 many other weaknesses of the system quickly developed.

Local committees found it very difficult to collect accounts, and after a couple of years of hard times, a considerable number of municipalities found their accounts receivable to be in a very unsatisfactory condition.

As soon as receipts began to fall off the municipalities had difficulty in making their payments to the Commission. Some had always supplemented electric revenues by a tax levy and, with tax collections totalling only a small percentage of normal, councils were very loath to turn over any money from that source to the Commission and some promptly resorted to paying to the Commission only their collections. Some went considerably farther and placed electric revenue into their general funds and hoped to collect enough taxes to square accounts with the Commission at some later date. Debts contracted in this way were considered by at least some municipalities as debts to the government and consequently much less deserving of immediate attention than indebtedness to other creditors.

With these various factors at work the cash receipts of the Commission began to fall behind necessary revenue at a rather alarming rate and the future of the whole enterprise appeared for a time to be in jeopardy, but after a careful study of the situation the Commission was convinced that the main proposition was sound and that other methods would make a very marked improvement in results. Subsequent developments have verified the soundness of this decision, which was arrived at in 1932.

In that year a start was made on a revision of contracts with municipalities. Instead of requiring the municipality to assume responsibility for all costs to the Commission of supplying a wholesale service, the new contracts covered only the power required by the municipality for street lighting, water pumping or other municipal purposes, and the Commission undertook to deal directly with all individual customers. The municipality had no greater liability to the Commission than any other customer requiring the same service. The new contracts deprived the Commission of the apparent security of a tax tevy as a final resort for the collection of required revenues; but developments since 1932 have shown that the advantages gained were of much greater value than the guarantees of the municipalities which had proved to be of little value when required. The net revenue of the Commission was actually less for three years than it had been in 1931 under the old contracts, but collections were very much better and the financial position began to improve with the change of contracts and has improved continuously ever since.

Financial Status

The Electrical Power Transmission Act of 1919 authorized the minister to pay out of the consolidated revenue of the province such moneys as might be necessary to enable the Commission to function, and also granted the Government permission to borrow money for the same purpose. There has been no alteration of this arrangement and all capital moneys expended by the Commission have been advanced by the province. In recent years the province has obtained money for this purpose from the Dominion, but in all cases the loans have been from the Dominion to the province and not direct to the Commission. The Commission is not indebted to anyone except the Provincial Treasury.

Like many other enterprises in the optimistic west, the Commission system possibly started off on too large a scale with double circuit steel-tower lines and other forms of construction, good in themselves but more expensive than the limited amount of business available in the early years could support. The cyclone of 1922 was also a major disaster as a considerable portion of the line between Winnipeg and Portage la Prairie was blown down and the necessary repairs and alterations to towers were quite expensive. By 1925 it was apparent that the municipalities being served could not be expected to pay enough for power to carry the system as it stood at that time, and the provincial government, guided by the report of the Sullivan Commission, accordingly adjusted the capital charges for which the Commission should be responsible to bring them into line with the estimated cost of an adequate system as at that date.

There have been no write-offs or adjustments of any kind since 1925 and the Commission's profit and loss account indicated a surplus of $9,900 at the end of 1938.

A sinking fund was set up on a 40-year basis and is fully paid up to date, containing at the end of 1938 $642,500 in Province of Manitoba bonds or bonds guaranteed by the province.

A replacement fund calculated to be sufficient to replace all materials and equipment at the end of its useful life has also been accumulated and now contains $1,166,000 in Dominion of Canada bonds, or Dominion guaranteed bonds. These two funds, together with one or two other small reserves, amount to $1,868,000 and the liabilities of the Commission total approximately $6,375,000.

As liquid reserves were practically nil at the end of 1929 and the customers served less than half of the present number, the Commission has made progress during a severe depression period of which it may well be proud.

In 1929, in order to reduce the cost of power to customers of the Commission, the Provincial Government undertook to pay sinking fund and interest charges on not more than 50 per cent of the cost of constructing generating stations, substations and transmission lines. Carrying charges on money spent on distribution systems were not included. An amendment to the Electrical Power Transmission Act passed that year provided that "all moneys received by the province after May 1st, 1929, as rentals for water powers, shall be paid into consolidated revenue and the amount of such payments after deducting the cost of administering said water powers shall be credited in the books of the province to the Electrical Power Transmission extension account." It further provided that payments from the said extension account should be made to cover the above mentioned items.

Beginning at May 1st, 1929, each municipality under the old form contract was credited with its share of the payments received by the Commission. After the contracts were changed that benefit was passed directly to the customer by way of the rate structure. Payments from the extension account in 1938 amounted to $113,000 or 13½ per cent of the Commission's net electrical revenue. On the average, therefore, present rates are 13½ per cent lower than they could be if payments from the extension accounts were not being made.

Rates

The original intention of the legislation creating the Power Commission was that the service should be supplied at cost in each town. As the cost was different at every point the rates were necessarily different. Begun in this way and varied by the local committees a multiplicity of rates soon developed which were not particularly satisfactory.

In 1929 the Commission had Mr. J. J. Jeffery, chief municipal engineer of the Hydro-Electric Power Commission of Ontario, make an examination of the system and recommendations with respect to future expansion, rates and many other features. Mr. Jeffery recommended the adoption of the Hopkinson demand block form of rate in all towns and in 1932 rates of this form were placed in effect. The original plan of service at cost was, however, adhered to and the disparity of rates between adjacent towns continued to be a source of criticism by the users.

The following rates are typical of those now in use:

Domestic

Service charge—2 wire service—55c. per month.
—3 wire service—55c. per month plus 11c. per kw. of capacity of appliances of greater than 1,000 watt rating.

(Note: Maximum 2 wire service: 30 amp., 110 volts)

First 25 kw.h. @ 15c. per kw.h.
All additional energy @ 3c. per kw.h.

Commercial

Service charge—10c. per 100 watts of connected load. (80 per cent of actual connected load.)
First 60 hours use of connected load: 14c. per kw.h.
All additional energy: 3c. per kw.h.

Power

Service charge—$1.12 per hp. of connected load (80 per cent of actual up to 10 hp.; kva. demand meters installed on larger power loads).
First 30 hours use of connected load: 4c. per kw.h.
Second 30 hours use: 3c. per kw.h.
All additional energy: 2c. per kw.h.

The minimum domestic bill varies from $1.00 to $2.50. Commercial and power minimum bills are the service charge. A prompt payment discount of 10 per cent is allowed on all bills.

The Hopkinson form of rate has been used by a great many power companies during the last thirty years or more and is probably the fairest rate yet devised; a fair rate being one which recovers from the customer as nearly as possible the cost of extending to him whatever service he may have received.

On the Manitoba Power Commission system approximately one-half of the total cost of doing business is fixed and must be paid even though not a single kw.h. be sold. It is made up of interest, sinking fund and replacement charges. It seems reasonable to set off against this a service charge which is fixed by the customer's demand, which in turn reflects the portion of the system which he uses. Energy is purchased on a peak demand basis and, therefore, a customer who operates only a few hours per month at the time of the system peak should pay a comparatively high rate for his energy. As his load factor improves he is undoubtedly using more and more off peak energy and this can be furnished to him at the relatively low second and third block rates.

The Hopkinson form of rate is also promotional inasmuch as the first block is short, and after that has been paid for, a great deal more energy can be used at little additional cost.

The fixed charge per month, which is an important feature of this rate form, has been called various names by different power companies, and many others by the customers. It may be known as a demand charge, a delivery charge, a service charge or what you will, and it would not appear to differ in any way from a freight or express charge for the delivery of goods, but on this system at least it is the cause of a great deal of complaint. No doubt one reason for this is that it appears as a separate item on the bill, and be the energy consumption large or small the service charge remains fixed. A common feeling is that nothing is received in exchange for this payment and from that point of view it is naturally resented. It is also an easy criticism of a bill to suggest that this item be eliminated.

Another point against this rate form is that it is complicated, difficult to explain to customers, and requires a great deal of work in the billing department. A great many domestic customers have a service charge of 55c. but there are also many others at higher rates. The first block is fixed for nearly all domestic services but in a few towns is 35 kw.h. instead of 25. Commercial and power customers have individual service charges and energy blocks which vary from time to time with changes in connected load, so that the billing department must keep a considerable number of records and calculate each bill individually.

In spite of these objections to the rate it is still in use on practically the whole system, as it is felt that it reflects

Fig. 2—Threshing with electric power—Manitoba, 1926

the cost of service more accurately than any other which has yet been suggested. In a few small towns added to the system during the last two years an experiment is being tried with rates which do not include a service charge, but to date no conclusions can be drawn from the experience obtained.

A domestic contract rate made effective in 1933 has been found to be very popular and very effective as a load builder. In its first form this contract covered the supply of 150 kw.h. of energy for $6.24 where an 8 kw. range was installed; or $5.45 where no large appliances were used. All additional energy was furnished at 1.8c. net per kw.h. In a town with a rate of 16c. and 3c. the corresponding figures were $8.26 and $7.47 or $2.00 higher per month. Stating the matter in another way, the man without a contract would receive 75 kw.h. of energy for the same price as the contract holder paid for 150 kw.h. Naturally, persons using an average of 75 kw.h. or more per month took the contract rate which guaranteed the Commission a minimum bill of $5.45 throughout the year. During certain months of the year many of these people would not at first use all the energy for which they were paying, but they soon devised means of using the full amount each month. The habit once formed was not easily broken, and as additional energy at 1.8c. is cheap the majority of them were soon taking more than 1,800 kw.h. per year to the benefit of themselves and the Commission.

In October, 1937, this rate was revised by reducing the minimum to $5.34 for 100 kw.h. with all additional energy at 1.8c., and within a year 50 per cent of all domestic customers who were not already enjoying more favourable rates were using this contract. As with the earlier contracts, the average consumption increased. The 100 kw.h. contract was based on a first block of 25 kw.h. at 12c. with all additional energy at 2c. (gross), and on January 1st, 1939, this rate was made available without contract in 60 of the older towns.

When the contracts with the municipalities were revised the charges for street lighting service were made uniform over all of the territory supplied from Winnipeg. Shortly after, a domestic contract rate and water heater rates were adopted which were the same at all points. Since that time all rate changes have been made with a view to eventually attaining uniform rates for the entire system. With a complicated transmission network it is difficult, if not impossible, to determine accurately the cost of service at any given point, and this being true it may be argued that a uniform rate will in the broad sense be as equitable as any which could be established by making assumptions as to cost. Uniform rates tend to equalize opportunities for development throughout the territory and are, in the main, popular with the users. The village most remote from the water power site feels entitled to share the benefits of this natural

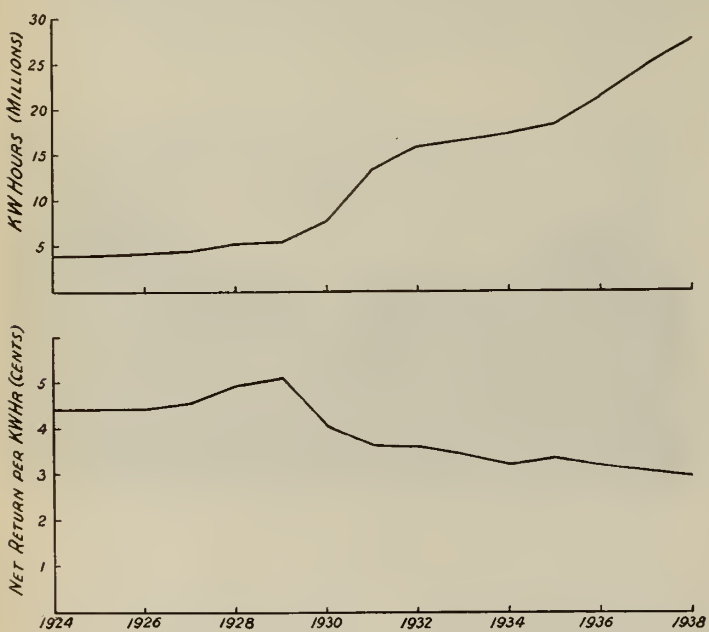

Fig. 3—Power distributed and net return per kw.h.

resource of the province equally with other places, which are by accident of geography much nearer to the source of supply. This same reasoning justifies the use of revenue from water power rentals to assist in the distribution of electric power to outlying sections of the province.

Figure 3 indicates the effect of the rate changes which have been made during the last 14 years. As detailed figures of kw.h. sold while the old form municipal contracts were in effect are not available, the chart has been based on kw.h. generated and purchased. System losses have decreased relatively as the total load has grown so that a chart based on sales would show an even greater percentage decrease.

Figure 3 in addition to indicating the effect of rate reductions shows the increase in the number of kw.h. purchased and generated. In 1938 the exact figure was 27,413,325 with a maximum of 20 minute integrated demand of 6,900 kw. at 78 per cent power factor leading. The annual load factor for 1938 was 46 per cent.

Except in Brandon, the Commission owns and operates all street lighting equipment and takes care of maintenance including the replacement of bulbs. The lights are controlled by time clocks and a complete service from dusk to dawn 365 days in the year is furnished. Lamps burn approximately 4,000 hours per year. Four old towns have series systems but in all others the multiple system is used. 100-150-200-300-500 watt incandescent lamps are used, the 300 and 500 being in enclosed fixtures of the Holophane type, and the smaller sizes open with reflectors.

Each town enters into a contract with the Commission for street light service and pays a flat rate per year based on the number and size of lamps used. The amount of light in the various towns varies widely with ability to pay, and the preference of the municipal authorities. Accounts vary from approximately 50c. to $2.50 per capita per year. $1.75 would probably be a fair average with very few towns as low as $1.00 per capita. Accounts for street lighting are rendered to each town monthly.

Farm Service

Since the inception of the Commission it has been the desire of everyone connected with its operations that electric service be extended to the greatest possible number of farmers. Unfortunately, Manitoba farmers are so widely scattered that the cost of construction must be relatively high.

The first policy of the Commission was to extend to farmers on the same basis as towns, the Commission paying all costs of construction, and the farmer undertaking to pay, annually, an amount sufficient to reimburse the Commission its carrying charges, and monthly for the energy used. Annual charges under this plan ran from $65.00 to $105.00 and were paid with ease for a few years prior to 1929. When the prices of farm products dropped to very low figures in 1931 and 1932, practically every farmer connected found it difficult or impossible to pay such amounts and nearly all accounts were soon in arrears. Discontinuing service was a hardship to the customers and of little financial benefit to the Commission, but as there was no other action that could be taken a considerable number were disconnected.

For a few years no farms were added to the system, but during the last few years there has been a renewed demand for service. A farmer is now required to pay cash in advance for the line from the nearest village or low voltage transmission line to his buildings, and to pay monthly for energy.

A typical farm rate at present time is: Service charge $1.25 per month, 1st 40 kw.h. at 7c., balance at 2.5c., prompt payment discount 10 per cent. Once service is established the monthly bill is comparatively small and the customers are, generally speaking, well satisfied with the service.

When a farm line has been built the Commission assumes full responsibility for operation, maintenance and replacement as long as the customer continues his monthly payment.

This policy for farm extensions safeguards the Commission financially, but still leaves it very expensive for farmers who are any great distance from low voltage lines. The fact that to date only 144 farms have been connected indicates that this problem has not yet been solved. Construction costs have been reduced to approximately $490.00 per mile for a two wire farm line, and during the last year the Commission has been supplying transformers, lightning arresters, cutouts and meters. With this assistance 39 farms were connected up in 1938, but it is apparent that still further assistance from some source must be provided if any appreciable percentage of the occupied farms are to be electrified.

Maintenance and Operation

The system is supervised and maintained by thirty district supervisors, located throughout the territory served. Each of these men is particularly responsible for from one to seven towns, forty or fifty miles of transmission line, and whatever substations may be in his area. With the help of such labour as may be available locally he takes care of maintenance and emergency repairs of lines and distribution, runs new services, installs meters, makes extensions up to six or seven poles in length, hangs extra transformers, investigates complaints with respect to voltage or other features of the service, is continuously on the lookout for sources of radio interference, reads meters, inspects wiring, assists the collection department, is an active member of the sales department on the lookout for new customers, load increases and appliance sales, and has other duties too numerous to mention, of which the writing of reports is not the least. He is expected to work eight hours per day but frequently has emergency calls at all hours. He is required to keep closely in touch with his home by telephone twenty-four hours per day, six days per week. Each man has one day off in seven, during which time emergency calls are handled by the next nearest supervisor.

District supervisors make one routine patrol each month if they have no business or emergency calls which require them to cover their lines in the interval. These patrols were at one time made as frequently as once per week in winter and twice a week in summer, but results obtained since the number was reduced indicate that this expense was not warranted.

The operation of the system is under the direction of a load despatcher located in the Winnipeg office during office hours and in his own residence at other times. An assistant load despatcher affords relief alternate weekends and at such other times as may be required. A third man is trained to handle this work in emergencies. All despatching is normally by telephone but the telegraph has been used when telephone circuits were out of order. The circuit breakers controlling the lines leaving Winnipeg are located in the Fort Garry substation of the Winnipeg Electric Company and are closed or opened by the operators of that station on instruction from the load despatcher.

The district west of Brandon is operated from that point as a subsection of the system, and to a limited extent the same procedure is followed at Elm Creek and one or two other main switching points; but the load despatcher is at all times informed of all major switching operations. The facilities of the Manitoba Telephone System are used exclusively. The Commission does not own any telephone lines.

The map, Fig. 1, indicates a number of operating loops made available by the construction of tie lines. These have proved to be extremely useful in restoring services quickly in cases of serious line damage, and they also greatly facilitate routine line maintenance. The repair of high voltage lines with hot line tools has not been attempted.

At several points generating plants were in operation before transmission lines connecting with Winnipeg were built, but in all cases these were closed down as soon as lines were completed. The cost of generating in isolated plants of small capacity is greatly in excess of the cost of transmitting the same power over very considerable distances. With larger plants where the same labour cost could be spread over a very much greater number of kw.h. the differential in favour of the transmission line would not be so great, but with the fuel prices that prevail in Manitoba small plants cannot produce cheap power.

Diesel engine plants are maintained in good operating condition at Virden, Birtle and Minnedosa, and a boiler plant and steam turbine unit at Brandon to provide standby service in case of line failure. They are used very infrequently and usually for only a few minutes at any one time, but they help to satisfy a very insistent demand from the customers for an absolutely continuous supply of power.

Construction Features

During the first few years the Commission had a portion of its construction work taken care of by contractors, but more recently has handled all such work with its own forces. In 1927-28 and -29 digging machines and other mechanical equipment were used to a certain extent, but since that time, in order to give employment to as much local labour as possible, all digging has been done by hand.

Men who act as district supervisors during the balance of the year are used as foremen on construction. A certain number of skilled linemen are more or less continuously employed on maintenance and construction work. All other men are picked up as required, semi-skilled where they may be found, and unskilled labour in the district where work is in progress. For the last four or five years there has been a surplus of labour at all points and the Commission has requested local municipal officials to furnish lists of names of men who should be employed. If these men are satisfactory they are retained so long as the crew is working in the municipality in which they reside. If unsatisfactory they are discharged and other men from the list employed. In some cases so many men desire work that each can be employed a few days only.

This method of securing labour is not conducive to maximum efficiency but it has assisted the municipalities with their unemployment problem, and gangs secured in this way are surprisingly good.

At the end of 1938 the transmission system had a total of 1,556 circuit miles and distribution systems in 118 cities, towns and villages.

There are 77 miles of double circuit 66 kv. three phase line on steel towers; 81 miles single circuit 66 kv. three phase also on steel; 39 miles of three phase, single circuit 33 kv. on steel; 601 miles of three phase single circuit 33 kv. on wood poles; and 681 miles of single circuit three phase lines

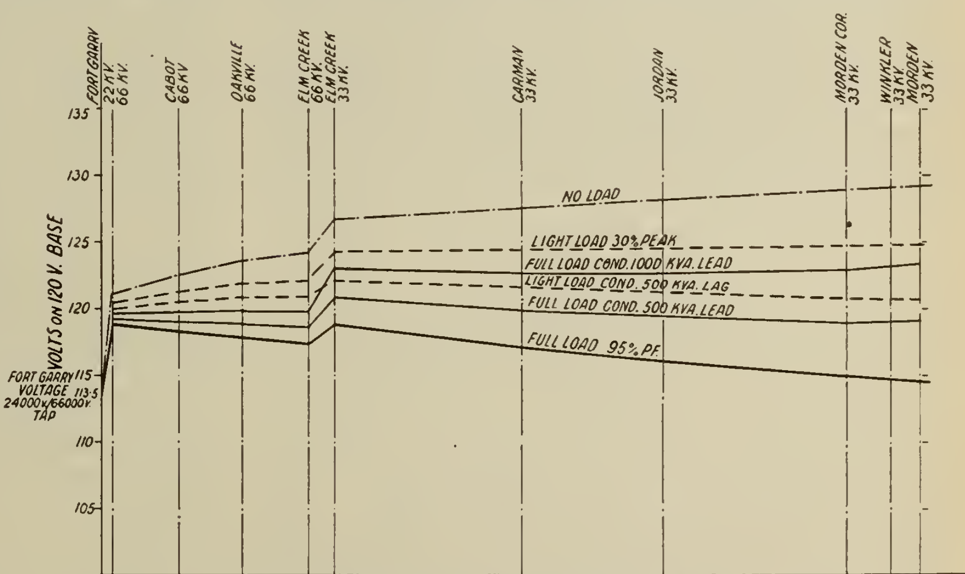

Fig. 4—Chart showing voltage conditions on Elm Creek-Morden system. Peak loads as at November, 1938

of 12, 8, and 4 kv. or single phase branches of same all on wood poles.

66 and 33 kv. circuits are all delta connected, ungrounded. All lower voltage lines are four wire star connected with multigrounded neutral or two wire single phase branches of same.

Steel reinforced aluminum cable has been used almost exclusively throughout the system in various sizes from 3/0 to No. 4.

Twisted sleeve joints have been used exclusively on A.C.S.R. lines and have been found to be entirely satisfactory. On the older lines dead end clamps were of the bolted type, the steel core being separately snubbed in some cases. On the newer lines, all of which have conductors, No. 1 or smaller, clamps of the ram's horn type have been used.

Except for a very few full length treated pine, practically all poles used have been western red cedar. All erected in 1927 and since have been Pentrex butt treated.

Most of the 33 kv. wood pole lines have triangular galvanized steel pole top fixtures giving conductor spacings of 3 ft., 3 ft. 6 in. and 4 ft. In the greater part of the territory these have been quite satisfactory, but where hoar-frost and sleet formations occur, greater horizontal clearance is essential and such lines are now being built with eight foot wooden crossarms to give flat spacing of conductors 3 ft. 9 in. apart.

The Brandon-Portage 66 kv. steel tower circuit is supported on suspension type insulators. All other lines carry standard insulators of the pin type. Standard suspension units are used at strain points on all lines.

On some of the very light, low voltage, single phase lines during the last three years vertical spacing of conductors has been used with the phase wire supported by pole top pins and insulators, and the neutral wire on uninsulated brackets on the sides of the poles. Where there is any likelihood of hoar-frost formation, pole spacing and conductor characteristics must be watched with this type of construction. It is approximately $70 per mi. cheaper than two pin crossarm construction.

Some of these light lines have been built with copperweld, and with copperweld copper conductors, with pole spacings up to 310 ft. (17 poles per mi.). Except for lines of this class, A.C.S.R. has always been found to have the advantage of lowest first cost.

The distribution system construction used has no particularly novel features. In Brandon, Portage and a few other of the older towns where existing distribution systems were purchased, primary circuits are three wire, three phase, 2,200 volt. In all newer construction the common neutral system has been used and voltages of 4,600 and 6,900 to ground. Bare primary and bare tie wires have been found necessary at these voltages to prevent radio interference. Lines are built in lanes wherever possible, and except where three phase primary is required, no crossarms are used. The phase wire is supported by a pole top pin and secondary wires on racks.

The neutral conductor is grounded at all transformers, at the end of each secondary feeder, and at every three wire service. A ground rod is installed on the customer's premises where there is no water system. Where there is a water system the service conduit and neutral conductor are connected thereto. One lightning arrester is connected at each transformer and grounded to the common neutral. Transformer cases are grounded.

Customers are required to wire premises in conformity with the Canadian Electrical Code. Conduit services and entrance switches are required. Wiring is inspected by district supervisors and checked by the chief wiring inspector. All special jobs and larger buildings are checked by the chief inspector before service is connected.

All meters installed in new towns in 1938 were of the plug-in type and it is expected that this practice will be continued, the Commission furnishing to local electricians the meter sockets required.

Approximate cost figures of the above outlined types of construction are as follows:

Line costs do not include any cost of right-of-way. In nearly all cases lines are built on public roadways and only very seldom is anything paid for purchase or easement of right-of-way. Small substations are also frequently built on roadways and the figures below do not include cost of property.

Lines	Cost per Mile Material	Labour and Expense	Total
3 wire, 3 phase, 33 kv. 8 ft. wood crossarm, Class No. 4 poles—21 per mi. No. 2 A.C.S.R.	$897.00	$201.00	$1,098.00
4 wire, 3 phase, 8 kv. 8 ft. wood crossarm, Class No. 4 poles—21 per mi. No. 4 A.C.S.R.	638.00	266.00	904.00
2 wire, 1 phase, 8 kv. No crossarm. Class No. 6 poles—17 per mi. No. 8A copperweld copper	372.00	85.00	457.00

Distribution systems eight kv. primary; average small town including street lighting and meters—$100.00 per service.

Substation 33/8 kv. three phase, 150 kva. with line sectionalizing switches, wood pole structure—$5,300.00 (three one phase transformers). Substation 33/8 kv. one phase, 25 kva. without line sectionalizing switches; wood pole structure—$1,700.00.

In spite of these moderate unit costs, loads are so small and the territory so extensive that the total investment in transmission, substations and distribution is approximately $540.00 (not including standby equipment) per kw. of maximum system demand. While it is difficult to estimate accurately future costs, it is not believed that it will be possible to lower materially the above mentioned figure. It will be necessary immediately to spend considerable sums on voltage control equipment, and the greater load served will render imperative the construction of additional tie lines to guard against serious service interruptions, and it may be that the cost of these items will keep step, or nearly so, with the load increase on a "dollars per kw. of demand" basis.

Voltage Regulation

Until 1936 the system was operated without voltage regulation of any kind and quite good voltage was maintained at all times at points as remote from the source of supply as Melita and Elkhorn. The Winnipeg Electric Company makes changes in the switching arrangements on its system which result in an increase from light load to peak load of approximately two volts on a 120 volt base on the bus which supplies the system of the Commission. This adjustment is, of course, of assistance, but the above mentioned operation without voltage regulation was made possible only by the fact that system loads are small, and of high power factor, and the voltage rise due to line charging currents counterbalanced the drops due to load currents. The lightest load on the system at any time is approximately 22½ per cent of the maximum in kilowatts and 66⅔ per cent in kva., so that transformer taps can be set for the highest permissible customer voltage at light load and the voltage variation is that resulting from the addition of 75 per cent of the maximum load in kilowatts to the light load kva. In 1938 the variation was approximately from 6,060 kva. to 9,200 kva.

When the Birtle system with a load of approximately 100 kw. was added to the extreme end of the system in 1936, it became necessary to regulate voltage in that territory and since that time two synchronous motors, formerly used for operation of the Street Railway system, have been operated as condensers on the 2,300 volt bus at Brandon. These machines have a combined rating of 1,000 kva. at zero power factor either leading or lagging, and with them in operation it is possible to boost voltage on the 33 kv. bus at Brandon by four per cent at peak load and to reduce voltage five per cent at light load which gives satisfactory results in Brandon and at all points north and west.

Voltage variation in the southeast corner of the province had reached the limit of satisfactory service during the early fall of 1938 and the installation of a synchronous condenser at Morden is planned for the immediate future.

Synchronous condensers at the ends of the system are preferred to tap changing equipment at intermediate points as the former influence voltage at all points back to the source of supply, whereas tap changers affect only portions of the system beyond their location.

Figure 4 shows calculated voltage conditions on the Winnipeg-Morden-Boissevain line. It shows very clearly the rise in voltage caused by the leading line charging currents passing through line and transformer bank reactances. It will be noted that a transformer bank of comparatively small capacity and a reactance of seven per cent affects the voltage as a very considerable length of line. Such check tests as it has been possible to make indicate that the actual results are very well in line with these calculations.

The system characteristics, insofar as voltage regulation is concerned, have been very fortunate as it has been possible to defer the cost of voltage control equipment until system load and revenue have been built up to a point where it will not be a burden. The leading power factor of the system has also been a benefit rather than a burden to the Winnipeg Electric System, and beyond requiring transformers larger than would otherwise have been necessary at Winnipeg, Elm Creek and Brandon, it has been no detriment to anyone.

Sales Promotion

Recognizing from the beginning that its transmission plant would inevitably be very extensive for the amount of load available, the Commission realized the importance of securing the greatest possible amount of business in every town served. The first step was to bring to the attention of all its customers the many uses of electricity and the economies to be effected by substituting this new form of energy for whatever else might be in use. Early sales efforts were accordingly of an educational nature and displays and practical demonstrations were arranged at country fairs throughout the territory and on farms.

Display rooms are maintained at Brandon and Portage la Prairie and district supervisors are supplied with catalogues and price information. Each supervisor is required to spend a definite amount of time each month on sales promotion and to report in detail on all calls made and the results obtained.

Throughout its sales efforts the Commission has cooperated with local dealers to the greatest possible extent. List prices are always maintained and no trade-ins are accepted. Display facilities to the Commission are freely used by dealers.

Results of sales efforts are easily discernible in the reports of energy sold as well as in the sales department statements. The former, of course, also reflect the use of equipment sold by dealers, but there can be no doubt that without the publicity and sales promotion activities of the Commission the average consumption per customer would be far below what it is to-day.

As the necessary figures for the whole system are not readily available, the following for the Town of Morden have been chosen as being typical.

	1934	1938
*Kw.h. per meter	576	1,004
Kw.h. per domestic customer	476	741
*Net revenue per meter	$41.79	$56.32
Net revenue per domestic customer	$37.85	$45.99
Electric ranges in service	20	41

*Flour mill and street lighting not included.

Saturation figures for major appliances throughout the whole territory are not high but the following figures for the Town of Wawanesa indicate what can be done in a medium-sized town with a rate structure such as has been described.

Population	418
*Number of buildings	136
*Number of buildings served	119
Electric ranges in use	28
Refrigerators	32
*Kw.h. per meter	1,155
*Revenue per meter	$66.02
*Revenue per capita	$18.80

*Flour mill and street lighting not included.

Fig. 5—Double circuit 66 kv. three legged tower

Sales of appliances have been increasing rapidly each year for the last three or four years and there seems to be every likelihood that this will continue for several years more at least with corresponding increases in sales of energy and increased customer satisfaction as without exception the customers who are making the greatest use of the service available are reaping the greatest economic and social advantages from that service, and they are the Commission's most enthusiastic supporters.

Conclusion

While the map, Fig. 1, indicates that a considerable portion of older parts of the province is already served, there are still several towns of importance in this area with other sources of supply and large territories east of the Red river, between the lakes, and to the northwest which have not been touched. Extension to the greater part of these areas would be economically justified and a more complete service can be given at lower cost by transmission than by generating locally. This is rapidly being realized by the patrons of existing plants, and the remarkable improvement which invariably follows the extension of lines to districts previously without any service is so apparent that the Commission is continuously besieged with petitions for further extensions. These will no doubt be taken care of as soon as the necessary capital money can be obtained, and it seems very likely that the next five years will see many major additions to the system. These will in all probability be accompanied by important load increases on the present system and the two together will make possible further improvements to service and further rate reductions.

TYPICAL OPERATING PROBLEMS IN AN ELECTRIC POWER SYSTEM

The Determination of Power Capacity and the Regulation of Plant Loading

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Based on the paper presented to the Winnipeg Branch, October 13th, 1938

SUMMARY—After describing briefly the Winnipeg Hydro-Electric System the author explains the methods and equipment developed for dividing the load between the various units so that each turbine is operated at a gate opening which gives the best efficiency for the head available. The division of the total load between the two plants, the regulation of the Winnipeg load, and the results attained, are also discussed.

When it becomes convenient or necessary to operate a power system, a plant, or a single piece of equipment at or near its full load capability, a knowledge of that capability is important. For a single piece of apparatus, the problem of determining this true maximum rating is often relatively simple, for example, it might be that load at which the allowable upper limit of temperature is reached, other factors remaining as specified. Often factors other than temperature impose the limit; referring to electrical equipment it might be established by one or more of such considerations as the voltage, the frequency, the wave form, the potential gradient or the power factor.

When several generating stations operate in parallel to supply an electric power system, a complete knowledge of performances, of true ratings and of rating changes of the plants for various changes in operating conditions is definitely necessary. When a single plant can be usefully and economically operated to feed its full capacity into the system, or when controllable load can be superimposed on the primary firm load to the limit of the capability of the generating equipment, then this knowledge of the various performances and true ratings is of great financial importance. Additional complications are presented when both steam and hydro plants supply energy. This article will deal only with the case where hydro plants are normally the sole source of power supply, but under conditions of varying head and river flow, and where for the greater part of the year controllable off-peak load up to 40 per cent of the generating plant capacity may be varied at will. Only those main factors will be mentioned which relate to the system of control which has been developed here, a method which aims to define the responsibilities of each station operator in such a way that changes in load or in operating conditions are speedily taken into account, producing daily load factors for the entire system of as much as 90 per cent, yet without requiring the services of a system load dispatcher.

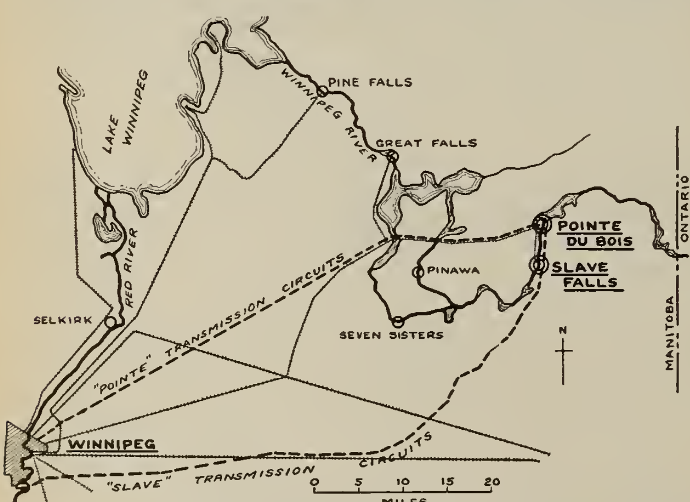


Fig. 1—66 Kv. Transmission System of the Winnipeg Hydro-Electric System

Description of Power System

A brief description of the power system with which the author is associated will be useful. Reference to Figs. 1 and 2 will indicate the general layout of the generating and the 66 kv. transmission system, both geographically and electrically. The two hydraulic plants, Pointe-du-Bois (105,000 hp.) and Slave Falls (1937-1938 36,000 hp.) are six miles apart on the Winnipeg River. They are electrically connected by a tie circuit. From Pointe-du-Bois four 66 kv. circuits 77 mi. in length connect with Rover Avenue station, Winnipeg, and from Slave Falls two 66 kv. circuits (132 kv. future) run 86 mi. to Scotland Avenue station, Winnipeg. The two rights-of-way are separated by as much as twenty-two miles. The Rover Avenue and Scotland Avenue stations are four miles apart and are connected by three 12 kv. links and by two 66 kv. tie lines. At these two receiving stations the power is transformed to 12 kv. for re-transmission (mostly underground) to the eight distribution substations. The steam standby plant in Winnipeg, with which is combined the central steam heating plant, ties to the 12 kv. system at two separate points either for the purpose of delivering the output of the standby plant turbo-generators or for the purpose of taking off-peak electric energy for the electric boilers.

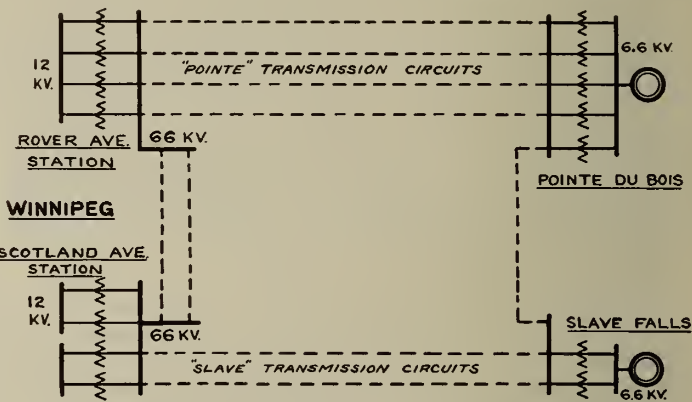
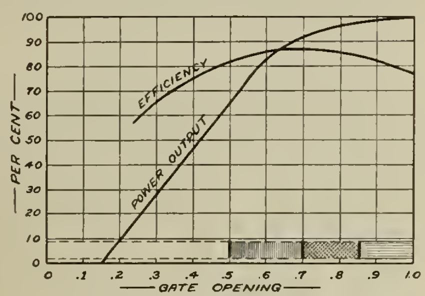


Fig. 2—Connection diagram of system shown in Fig. 1

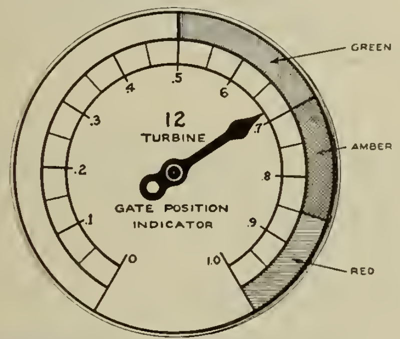
The fact that the controllable electric boiler load is large in comparison with the total power available has already been noted. From the hydraulic plants in the winter of 1937-38 there were actually available after transmission to Winnipeg about 115,000 hp., whereas there is a connected load of 50,000 hp. in large controllable electric boilers in two central steam heating plants. Obviously a maintained maximum output of generators and plants, together with a flexible close control of electric boiler loads, is essential if full advantage is to be taken of the generating and transformer equipment and transmission circuits of the electric power system.

Loading of Hydraulic Turbines

At Pointe-du-Bois the machines are horizontal Francis units, operating throughout a working range between 44.5 and 47.5 ft. of head. At Slave Falls the machines are vertical propeller units operating throughout a usual working range between 29 and 32 ft. of head. Although these variations may not appear large, yet the change of 10 to 15 per cent in power output is important when any extra output due to extra head can be utilized, or on the other hand, when as head drops off the output must be reduced to avoid operating with those turbine gate openings at which runner cavitation may be considerable. The revenue derived from the electric boiler load is not sufficient to warrant frequent



EFFICIENCY AND POWER VS GATE OPENING



CORRESPONDING GATE POSITION INDICATOR DIAL, No. 12 UNIT, POINTE DU BOIS

Fig. 3—Efficiency and power versus gate opening curves of Pointe-du-Bois turbine, and corresponding gate position indicator dial

welding of the runners of the types and sizes installed. The cost of providing load ratio control or automatic load control has not yet appeared to be justified.

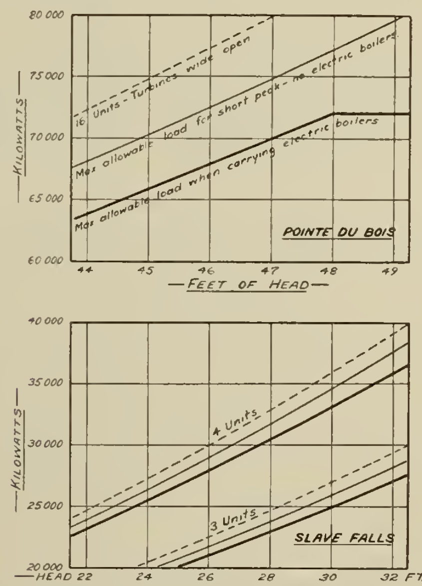
At all times the operators have before them the indication of the feet of head available and other necessary information. Proceeding on the assumption that for the ranges of head encountered the best gate openings at which to operate would change by an amount which for practical purposes might well be disregarded, for several years the machines were operated from tables of head versus kilowatts output, the endeavour being to maintain the proper gate openings by noting the readings of the machine kilowatt meters. At the Slave Falls plant, where all units are similar, this plan was moderately successful. However, the sharp peak of the efficiency-output curve of a fixed blade propeller unit is well known, and gate openings tended to wander around the best operating point. At Pointe-du-Bois, although the Francis units have typically flatter efficiency curves, there are installed four different designs of turbines, hence operating this plant by tables of head versus switchboard kilowatts had its practical drawbacks. It was therefore decided to install switchboard gate position indicators on all units, so that the operator would have continually before him the gate openings of all his units, and therefore would have no excuse for not operating all the machines at their best output at all times. These indicators for both plants were made up by the maintenance staff using small selsyn motors.

A feature of interest on the dials of these indicators is the use of colour to denote the various operating ranges. Referring to the efficiency-gate opening curve of one of the Francis units as shown in Fig. 3, superficially the best operating range appears to be between 0.6 and 0.8 gate opening. Experience indicates that above 0.7 gate opening, cavitation of the runner is to be expected. Hence a normal operating range of between 0.5 and 0.7 gate opening is allowed, which gives a convenient variation in power output,—in the example shown, a variation between 65 per cent and 92 per cent of maximum rating. The outer band of this range of the indicator dial is accordingly coloured green, shown in the figure as vertical hatching. The normal operating point of the unit is the upper part of the green range, whose upper limit must not be exceeded for purposes of carrying superimposed electric boiler load. The gate opening range between 0.7 and 0.85, hatched diagonally on the figure, is coloured amber on the dial. This operating range of all units is available for the purpose of carrying firm load should occasion arise. For the machine shown, the output of this range is between 92 per cent and 98 per cent of maximum. When electric boiler load is being carried to the limit of system capacity, this small range is the only spare rotating capacity being carried, protection against sudden loss of generators being furnished in a manner to be described later. Gate openings between 0.85 and 1.0 which are hatched horizontally on the example shown, are coloured red on the actual dial. The turbine is not to be operated in this range, there is practically no power advantage, efficiency in the use of water is decreased, and the extra water consumption of the unit tends to drag down the head by an undue amount.

Under conditions of moderate variations in head, then, the gate position indicators with colour ranges as described have been found very valuable. In the opinion of the author they should be included as standard indicating equipment on all large turbine units whose loadings are to be manually controlled.

Loading of Hydraulic Plants

The next point for discussion has to do with establishing the loading which at any time may be allowed on any generating plant. Based on the allowable gate openings, a simple curve has been prepared for each plant for the use of the shift operators. These are reproduced in Fig. 4. For any ordinary head, the operator can determine exactly what maximum load he can carry on the plant for purposes of supplying a superimposed electric boiler load, or, what maximum firm load of short duration he can carry on



CURVES TO ESTABLISH GEN. STATION LOADINGS

Fig. 4—Curves used by operators to establish generating station loadings

occasion, or again, the loading at which the plant will begin to 'sit down' on him. The information is complete enough to give him an understanding confidence in the plant's capabilities.

In order to indicate to the operator in each plant exactly what all his machines taken together are doing, a Lincoln-Sangamo totalizer continuously records the plant output in kilowatts; a second totalizer shows him the total output kilowatts of the two hydraulic generating stations added together.

Since Pointe-du-Bois is the upstream plant, its forebay elevation is kept as high as possible at all times, the load on the plant and the spillage if any being regulated accordingly. The Slave Falls forebay elevation is regulated to give least loss of head between the two plants, and with a view to avoiding difficulty with ice jams above some submerged rock hogsbacks immediately below Pointe-du-Bois.

Given a large river flow, say 21,000 c.f.s. or over, the procedure in establishing the load to be carried by the generating system is as follows. When an operator at Slave Falls comes on shift, he determines the head of water and from the head-load curve estimates the load including electric boilers which the plant can carry for the next several hours. He communicates this information to the Pointe-du-Bois operator, who is in operating charge of the generating end of the system. The Pointe-du-Bois operator similarly estimates the allowable load on his own plant, and adds the two figures together. By means of another suitable curve shown in Fig. 5, he then converts this figure of power house load to allowable load as in Winnipeg, and informs the operator at Rover Avenue station, Winnipeg, of the amount.

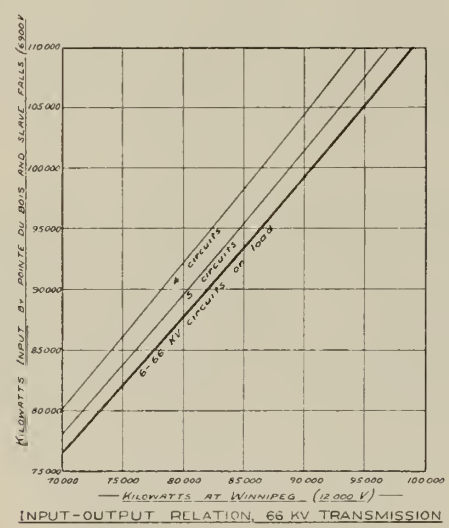


Fig. 5—Curves used by operators to obtain allowable load in Winnipeg from figure of allowable load at generating stations

Regulation of Winnipeg Load

By the use of two Lincoln-Sangamo totalizers, the Rover Avenue station operator has information regarding the magnitude of the Winnipeg total load directly before him. One totalizer gives him the total load input to Winnipeg whether this be supplied by either transmission system or generated at the steam turbine plant which is not normally on load. The second totalizer shows him the total Winnipeg load exclusive of that taken by the large electric boilers. The difference between the two recorders is therefore the electric boiler load, which for the four large boilers installed can be somewhat in excess of 37,000 kw. or 50,000 hp.

One of the large electric boiler units rated at 10,000 kw. is in one of the central steam heating plants supplying a residential area. The amount of power taken by this boiler is usually constant at full load throughout the whole of the severer part of the winter except for a scheduled daily cut-off of between two and three hours at the time of the peak firm load on the electrical system. The remaining three boiler units are all installed in the central steam heating plant which is operated in conjunction with the electrical utility and which supplies steam to the central business district of the city. In this plant, immediately alongside the electric boilers there is a combination indicating and circular chart recording totalizer. This instrument is operated by a re-transmission from that totalizer at Rover Avenue station which indicates the total load in Winnipeg as supplied from all sources.

These various totalizer instruments make the supervision and control of the loading of the electrical system a simple problem. After the Pointe-du-Bois power house operator determines what load can be carried on the generating plants and converts it to the Winnipeg figure, the Rover Avenue operator is so informed and thereby becomes responsible for taking immediate action to load the system up to the established figure if this is possible, or to reduce the electric boiler load should this allowable load for Winnipeg be exceeded by 1,500 kw. It is seldom he needs to take action, because each time a change in maximum allowable load comes through, he immediately telephones the electric boiler operator at the central steam heating plant and informs him of the revised load limit. The electric boiler operator alters the position of the load limit marker on his totalizer instrument accordingly, and proceeds to vary the electric boiler load by an amount which will hold the total load on the electrical system at or below the new figure established. This is readily done because the balance of the steam requirements of the central steam heating plant is furnished by pulverized coal boilers.

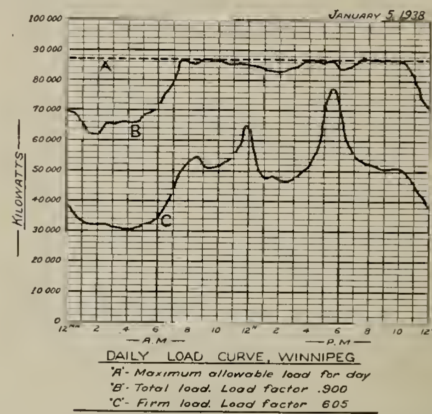


Fig. 6—Typical daily load curve of Winnipeg load

The accumulation of experience with this method of control of the loading of the electrical system has proved it to be as effective as it is simple. Its effect on the load curve and the load factor of the electrical system will be of interest, and will be described.

Protection Against Sudden Loss of Generating Capacity

It will have been noted that should a generating unit drop out or should a large block of load be suddenly picked up when carrying electric boiler load, there is no spare rotating generating capacity being carried in the plants other than an extreme margin of 12 per cent which possibly might be obtained by pushing all units to the limit, and which is represented by the difference between the maximum allowable plant loads and the plant maximum capabilities. Should this margin ever prove insufficient (and for practical reasons when required simultaneously from both plants it is not fully available) then for such an emergency an underfre-

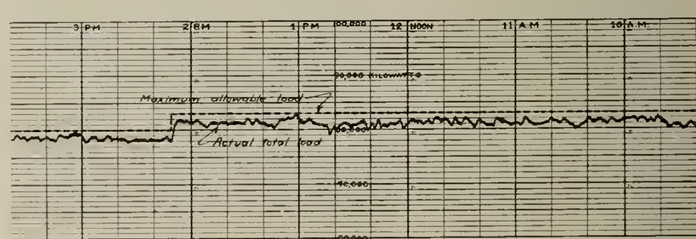


Fig. 7—Sample totalizer chart showing total Winnipeg load

quency relay has been installed on each of the electric boilers so that if for any reason the system frequency should sag below 59 cycles, without any operator having to divine the trouble or make any decision, the electric boilers are automatically tripped out, one at a time at intervals of several seconds, until the total load is reduced enough to compensate for the loss in generating capacity, providing this is within the scope of the electric boiler load. It is believed that this underfrequency feature allows the system to be operated safely without any spare rotating generating capacity other than the overload capacity of the various units.

Results Attained

The results which have been obtained with the manual type of load control as described are best shown by typical load curves. Figure 6 reproduces a sample 24-hour load chart with a daily load factor of 0.9. It will be noted that the generating system is being run fully extended for 15 hours of the day; in cold weather 14 to 16 hours at full load is usual. Figure 7 will be of interest in respect to the minute-by-minute regulation of the total system load. This is a sample strip of chart from the totalizer which records total Winnipeg load. On this particular day up until 2.10 p.m. the allowable load limit established for the city was 83,000 kw., at which time the limit was cut to 80,000 kw.

Table I indicates a few of the monthly plant and utilization factors which have resulted from this system of operation, these two factors expressing the performance of a generating station or system much better than the more familiar load factor. It will be remembered that the plant factor expresses the ratio of the average load for the period to the nominal installed plant capacity, and the utilization factor the ratio of the peak load carried to the installed plant capacity.

Table I

Monthly Plant and Utilization Factors for Generating Stations, 1938

Month	Pointe-du-Bois plant Plant factor	Pointe-du-Bois plant Util. factor	Slave Falls plant Plant factor	Slave Falls plant Util. factor	Both plants together Plant factor	Both plants together Util. factor
January...	.793	.981	.844	1.020	.818	.969
February..	.796	.981	.879	1.019	.818	.968
March....	.738	.969	.783	1.032	.760	.942

The monthly load factors for both generating stations taken together, for the three months referred to in Table I, are .844, .845 and .807.

THE WILLANS LAW IN THE ANALYSIS OF STEAM PLANT PERFORMANCE

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Mechanical Engineer, Montreal Engineering Company Ltd., Montreal, Que.

Paper presented before the Montreal Branch of The Engineering Institute of Canada, February 3rd, 1938

SUMMARY—A straight line law is found to express the relation between fuel consumption and electric output in a power plant, and applies also to other items of plant expense. By selecting suitable constants from operating records, simple formulae and charts can be made, which will save much work in predicting the results to be expected from proposed changes in or additions to equipment.

Mr. P. W. Willans, the father of the well-known high speed engine, in the course of his investigations of steam engine performance, enunciated a principle which has proved to be very general in its application.

Mr. Willans found that if he plotted graphically, on a base representing the load on an engine, the rate of total steam consumption at different loads set up as ordinates, the resulting graph was a straight line cutting the axis of ordinates at a point some distance above the origin of co-ordinates.

Figure 1 is a typical diagram for a 100 h.p. engine. The steam consumption at full load is represented by the ordinate bB where the abscissa Ob represents 100 h.p.

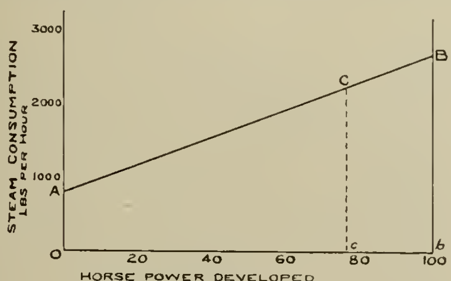

Fig. 1

When the engine is just turning over without producing any external power there is still a certain consumption of steam in overcoming internal friction in cylinder condensation, etc. This is represented by the ordinate OA.

At any intermediate power output represented by Oc, the steam consumption will be represented by the ordinate cC. The Willans Law asserts that it is found by experiment that the point C lies upon the straight line AB. This line AB constitutes the graph of the rate of steam consumption of the engine as related to the amount of external power delivered by the engine.

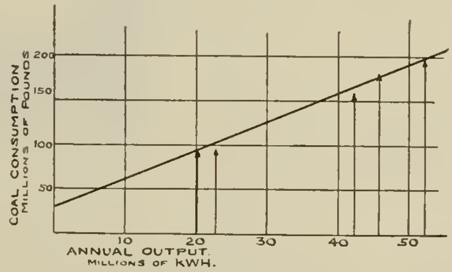

Fig. 2

Expressed analytically, the formula for the line AB is of the form:

$$y = A + bx \qquad (1)$$

in which A is the steam consumption of the engine at no load:

b is the increment of steam consumption:

y is the total steam consumption for a given load x.

This formula then expresses an experimental law which is known as the Willans Law. The line traced on the diagram representing the same relation is known as a Willans Line.

This is not to be understood as the expression of an absolute theoretical relation applicable to every engine. In some types of engines, as the load carried varies, the efficiency of conversion of heat into mechanical energy also varies, so that the straight line relation does not remain strictly true. The Willans Law may be regarded as a first approximation, close enough for most practical purposes.

This relation of the steam consumption to the power output of a steam engine illustrates the earliest and most elementary example of the Willans Law. Others, and notably R. H. Parsons, M.E.I.C., of London—and for some years of Edmonton, Alberta—realized the possibility of a much wider application of this principle. Mr. Parsons developed and used this principle in the analysis of the different stages in the production of electric power from fuel and published a number of papers dealing with various phases of the subject. It is believed that the same general method of analysis can be still further extended in attacking some of the problems connected with the production of steam-generated power. The purpose of this paper is to discuss some of these problems and indicate how the Willans Law may be employed in seeking a solution. In order to do this, it may be well to review briefly the development of this principle as applied to the various stages of power production.

As the steam turbine gradually superseded the reciprocating engine as a prime mover, the Willans Law was observed to hold good for the relation of the rate of total steam consumption to power output. Furthermore, as Mr. Parsons pointed out, a similar relation exists between the fuel consumption of a boiler and its output of steam. Having once established the applicability of the straight line formula to these principal stages of power production, it becomes evident that a similar simple relation exists between the rate of fuel consumption and the rate of production of electric energy. In other words, the graph of fuel consumption in relation to electric output is a Willans Line.

Multiplying each of the factors in such an expression by a time unit, such as one hour, it is evident that a Willans Law indicates the relation of the hourly fuel consumption to the output in kilowatt-hours. It is not necessary for the rate of output to remain constant for this to be true. The

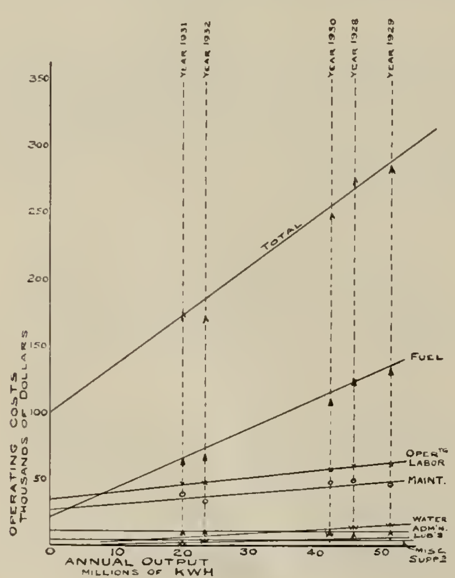

Fig. 3

steam or fuel consumption being a straight-line function of the rate of output, if the rate of output, x, persists for a time t, the fuel consumption rate during the same time will be a function of x of the form $A+bx$, and the fuel consumed during that period will be:

$$y = At + bxt \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

If the rates of output during a series of periods t_1 t_2 . . . etc. are x_1 x_2 . . . etc., the fuel consumption in those same periods will be

$$At_1 + bx_1t_1,\ At_2 + bx_2t_2 \ldots\ldots\ldots \text{etc.}$$

Whence the total fuel, Y, consumed during the series of periods $t_1 + t_2 + \ldots$ *etc.*, or a total time T will be:

$$At_1 + bx_1\, t_1 + At_2 + bx_2\, t_2 + \ldots \text{etc.}$$

which may be written:

$$At_1 + At_2 + \ldots \textit{etc.} + bx_1t_1 + bx_2t_2 + \ldots \text{etc.}$$
$$= A\ (t_1 + t_2 + \ldots \textit{etc.}) + b\ (x_1t_1 + x_2t_2 + \ldots \text{etc.})$$

or $Y = AT + bx_mT \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$

where x_m is the mean value of the rate of output during the whole period T: and x_mT is the total output during that period.

Hence the Willans Law established for steady conditions of operation, also gives the relation of the total fuel consumption to the total k.w.h. output, even though the rate of that output is a varying quantity. This conclusion is equally true whether the total period in question is an hour, a day, a month or a year.

If C is the amount of fuel consumed in a given period and K is the number of kilowatt hours generated during that period the expression (3) becomes of the form:

$$C = A + bK \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

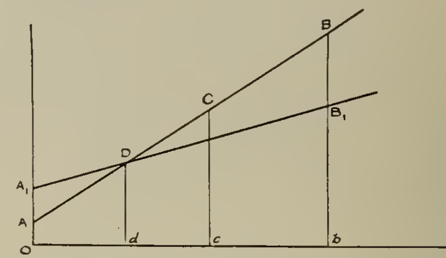

Fig. 4

Here A is a definite quantity of fuel which may be called the zero load component:

b is a definite increment quantity of fuel required to generate one k.w.h.

It is assumed that the quality of the fuel remains constant during the period T; or else that suitable corrections are applied to compensate for any observed variations in quality.

Figure 2 gives a graphical illustration of this statement taken from the actual records of electrical output and corresponding fuel consumption for a certain steam station in which practically the same equipment was in use during the series of years covered by the observations. In this instance it will be noted that the zero load ordinate represents a fuel consumption of the order of 15,000 tons. This represents the fuel required to make up the inherent heat losses in the plant, whether it is generating energy in any quantity, or is just in a stand-by condition ready to do so. The irreducible losses included in the zero load component are of a compound character, and include such items as grate losses, radiation from boiler setting, heat loss in furnace gases, radiation losses from boiler steam piping, fuel used in starting up boilers when a change-over becomes necessary, blow-down losses, steam used in starting up turbines, steam required to keep turbine units running at speed and to supply steam auxiliaries, electrical and heat losses in generator, and energy required for electric auxiliaries. The aggregate of these "no-load" losses determines

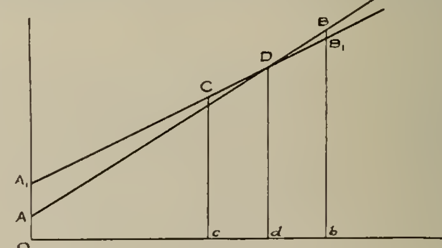

Fig. 5

the no-load component of the fuel consumption, represented in the Willans Line formula by the symbol A.

The actual production of useful energy entails a further expenditure of fuel in direct proportion to the energy generated. In the case illustrated in Fig. 2 the total consumption of fuel for 50,000,000 k.w.h. output is seen to be 95,000 tons or 80,000 tons in addition to the no-load consumption of 15,000 tons. The increment fuel consumption is thus seen to be 0.0016 ton per k.w.h., or 3.2 lb. per k.w.h.

The formula for fuel consumption in this particular case becomes:

$C = 15{,}000 + 0.0016\ K$ (expressed in tons) . . . . (5)

or $C = 30{,}000{,}000 + 3.2\ K$ (expressed in pounds) . . . . (6)

Having established from known data the Willans Line for fuel consumption for any particular set of equipment, the value of the formula lies in providing a ready and practically dependable means of predicting the fuel consumption for any output within the range of that set of equipment.

To obtain such a result synthetically, calculation of the various factors entering into the problem is a laborious process; and even when all the determinable factors have been taken into account, there still remains some uncertainty as to the numerous incidental losses, the precise amount of which can only be approximated or assumed, and which may be overlooked. The Willans Line method sidesteps these difficulties, as these indeterminate items have been included in the data from which the formula was constructed, and will be reflected in the results obtained from it.

It has been pointed out that the principle of the Willans Law was originally applied to the steam consumption of a reciprocating engine, but that it equally applies to the steam or fuel consumption of a complete power unit. Its field of application, however, extends much further. The item of fuel is only one of several entering into the problem of electric power production. The other items may be conveniently summarized as under:

Operating labour
Water supply
Lubricants
Miscellaneous supplies
Plant maintenance material
Plant maintenance labour
Administration

The most convenient way in which these widely different items can be reduced to a comparable basis is in terms of monetary cost. If the expense attached to each of these items is plotted in reference to various amounts of energy output, the result is found to conform very closely to a straight line of the same general nature as the Willans Line established for fuel consumption. That is to say, the figures for expense comply with a formula of the form

$$y = A + bx$$

The constants A and b, however, have widely variant values, in some cases becoming zero.

Figure 3 shows the graphs of these items of operating expense for the same plant for which the fuel graph shown in Fig. 2 was constructed. The graph for fuel is also included in Fig. 3 but in a modified form to represent cost instead of quantity of fuel.

The graphs for operating labour and maintenance (material and labour) both show a high no-load component and a very small increment with the generation of additional energy.

The graph for water supply shows a no-load component which is itself zero. This would be expected to be approximately true as regards make-up for boiler feed. However, when the turbine is on the line, there would always be a certain amount of circulating water used which entails a small cost for pumping. These charges appear to have been applied somewhat arbitrarily; but in any case they are not large enough to materially affect the whole picture.

The graph for the expense of administration shows no increment.

The same applies to that for miscellaneous supplies; but the figures themselves are quite erratic, probably depending on when purchases happened to be made.

In the case of lubricants, the graph shows no appreciable no-load component and a fairly defined increment cost.

In the case of the two last mentioned items, the individual points on the graph are not shown, the amounts involved being relatively small.

All these items of expense being found subject to a straight line formula, it follows that the sum of the items, or the total expense, will also follow the same Willans Law. The values for the total expense inserted in Fig. 3 demonstrate and confirm that this is the case within a small margin of error.

In using this principle to determine the probable expense involved in generating any desired output, it is usually sufficient to deal with the known figures for total expense. It is obviously desirable to collect as many data as are available, as there will always be some irregularities from one period to another; and by having a large number of points to work with, it will be possible to determine the mean trend of the Willans line with greater accuracy. For example, it may be desirable to use monthly operating

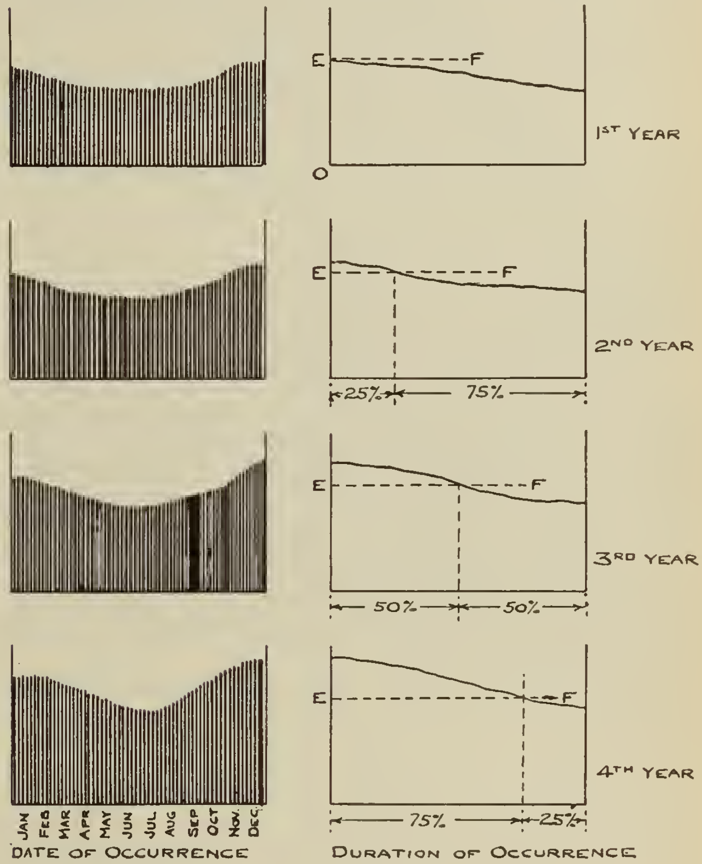

Fig. 6

figures to determine points on the line, selecting results found in both high output winter months and low output summer months so as to obtain points spread over as wide a range as possible. Of course, it must be observed that the no-load component A varies with the length of period. Also, if shorter periods are being dealt with the figures should be carefully scrutinized and suitable adjustment made for any obviously abnormal items of expense, such as large purchases of supplies, or unusually heavy repairs undertaken during a particular period. In fact, it seems advisable, in respect of such items as are obviously not directly related to the output in a particular period, to determine the average value for a number of similar periods and to use that figure in preference to the actual amount recorded for the period in question.

Such matters as proper allocation of costs call for the exercise of judgment founded on practical experience and knowledge of the layout and operating conditions of the plant. Conversely, the study of operating records by this method may serve to draw attention to faulty allocation of expenses, which gives a misleading view of the results being attained.

The fundamental expression (4)

$$C = A + bK$$

as has been pointed out, applies equally to a simple prime mover or to a group of equipment constituting a complete generating unit. Each such unit, however, has a Willans formula peculiar to it; and the formula for one unit does

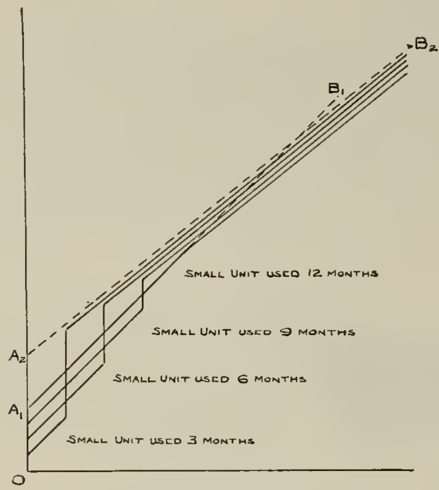

Fig. 7

not hold true for another. Any variation or modification of equipment in the unit results in a change in one or both of the fundamental constants A and b in the formula.

If a formula has been definitely established for a certain combination of equipment, it forms a valuable starting point for working out the formula applicable to a closely similar combination only modified in certain known respects. It is possible to estimate fairly accurately what change in performance is likely to be brought about by a specific change in equipment. If this is done for two or more conditions of output, enough points can be established to define the new Willans Line to meet the changed set-up of equipment, and thence to devise the corresponding formula, with new values of the constants A and b to meet the changed circumstances.

The most common way in which plants undergo change is in the addition of new equipment to meet increasing demands in the territory served. If the new equipment installed is of a more modern and more efficient type than that already in use, this will result in a diminution of the constant b, mainly due to the cutting down of the fuel increment. If the new equipment is of approximately the same size as the older equipment, there will probably be little or no appreciable change in the constant A. If, however, as is more often the case, the new equipment is on a larger scale, insofar as it is brought into use in place of the older equipment, some increase in the constant A may be expected.

This situation is illustrated in Fig. 4. The line AB represents the operating cost for an old unit, which is supplemented by a larger and more efficient unit, as it is found that at a point C the original plant is no longer able to meet the peak demands.

The new unit has a Willans Line A_1 B_1 and, due to its larger size, the no-load component OA_1 is larger than the corresponding component OA for the old unit. The new unit having a higher efficiency, the line A_1 B_1 has a lower increment component and proceeds less steeply than the line AB. The two lines intersect at a point D: up to an output represented by Od it would be less expensive to run the older unit than the newer one, although the former is less efficient. Beyond the output Od, however, the larger unit becomes the more economical.

If the output Od is less than Oc as shown, there will be economy in using the larger unit for any output beyond Od. If, on the other hand, the difference in efficiency between the old and new units is so small that the intersection of the two lines falls beyond C, as in Fig. 5, then, although the new unit would be necessary beyond an output represented by Oc to carry the occasional peaks, yet it would be run at the outset at some sacrifice of economy.

Instead of using the new unit exclusively and relegating the older unit to purely reserve or emergency use, an alternative course is usually open. In the normal expansion of system demands the maximum daily peaks usually occur during a limited season of the year, the ordinary daily peaks during the remainder of the year being lower.

The series of graphs in the left-hand diagram of Fig. 6 show a typical distribution of daily peak loads throughout a year; and for succeeding years in which the peak demand is continually increasing. Corresponding graphs of duration of these periods of peak occurrence can be set out as shown in the diagrams on the right-hand side. Taking an ordinate OE representing the capacity of the smaller unit and running a line EF parallel to the base line, it is easy to determine what proportion of the time the smaller unit will be capable of meeting the peak demands of the system. It is fairly safe to assume that if a peak is encountered once during 24 hours, necessitating the use of the larger unit, there is little or nothing to be gained by shutting it down, and reverting to the smaller unit, as any saving in no-load expense will be offset by the expense incident to starting it up again when the next peak period approaches. Thus generally, it may be taken that during the portion of the year in which the daily peak demand exceeds the capacity of the smaller unit, the larger unit should be kept in continuous operation.

If the smaller unit is used during the period in which it is capable of handling the daily peaks, by plotting the resultant costs making the proper adjustment of the no-load component corresponding to the part-time use of the unit and then superposing the similarly derived graph for the larger unit, as shown in Fig. 7, the operating cost for the whole year can be arrived at. Ordinarily it is found that the final result is very little affected, whether the smaller unit is used part time or not at all. The loss due to the higher increment component is just about offset by the reduction in the no-load component.

From this it appears that if a smaller and less efficient unit is substituted for a larger, more efficient unit, while the latter is out of commission for overhauling, the effect on the cost of operation over the whole year is hardly appreciable.

If, on the other hand, the larger unit has to be taken out of commission on account of breakdown at a time when other units of practically the same capacity are necessary to carry the peaks, then there is no reduction in the no-load component, while the increment component is higher, and the overall expense is consequently increased.

It becomes apparent that when the Willans Law is invoked to deal with the performance of a group of units

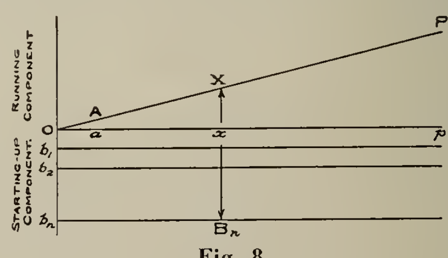

Fig. 8

over an extended period of time, the no-load component becomes a more complex factor than in the elementary case of the rate of input and output of a simple unit.

All the units of a group will not usually be operated continuously, but will be started up and kept running for varying lengths of time, depending upon the exigencies of the service.

If the units are operated intermittently, each start of a unit involves a certain input, which goes to increase the no-load component for the group. This gives rise to what may be called the "starting-up component."

Then for the time each unit is kept in operation, the time element must be taken into account in conjunction with what may be termed the "idling component."

Thus the no-load component becomes a combination of two components: (*a*) The starting-up component and (*b*)The idling component. Every time a machine is started up from rest a certain input (*a*) is necessary to bring it up to a state of being immediately capable of furnishing energy externally. After being brought up to this operating state a further input (*b*) is necessary to merely maintain the machine in that state without furnishing any energy externally.

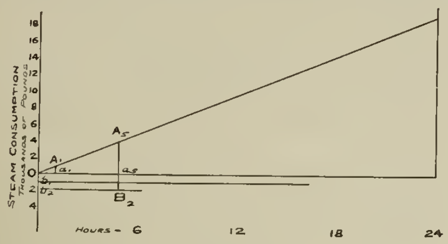

Fig. 9

In the analysis of input over an extended period, the no-load component for a machine applying to the whole period is made up of the starting-up component multiplied by the number of starts, plus the idling component for a unit of time multiplied by the time that the machine is in operation during the whole period.

This is illustrated graphically in Fig. 8. The starting-up component is represented by the ordinate Ob_1 for a single start and by multiples of that quantity Ob_2 . . . etc. for more than a single start during the period Op under consideration.

The running or idling component for unit time is represented by the ordinate aA, so that for the whole period Op this component will become pP. For any less period Ox this idling component will be represented by xX.

If the equipment is actually running for a time Ox out of the whole period Op and that period of running is such that no fresh starts are involved, then the actual no-load component applicable to the equipment under these conditions of operation during the period under investigation is represented by the sum of Ob_n and xX, or B_nX.

Fig. 9 shows as a typical example such a diagram for a 24-hour period, based on the performance data of a 5,000 k.w. turbine. In this case the steam required to bring the turbine up to temperature and speed from a cold start is estimated at 950 lb., represented by Ob_1; and the hourly consumption, when running light, at 800 lb. per hr., represented by a_1 A_1. Supposing the unit is started up twice during the 24 hours to assist in carrying peak loads, the starting-up component Ob_2 is 1,900 lb. Supposing the total duration of the two runs to be five hours, the idling component a_5A_5 is 4,000 lb. The resulting no-load component A_5B_2 has the value of 5,900 lb. for this programme of operation.

Probably the most useful field in which the Willans Law principle may be applied is in the investigating of future costs of generating outputs greater than those for which records are available. Increased outputs eventually involve the consideration of increased capacity of generating equipment. In the normal supply system the maximum peak of output reached in a year bears a fairly constant relation to the total yearly output. In most Canadian cities the annual load factor is of the order of 40 per cent, which corresponds to a consumption of 3,500 k.w.h. for each k.w. of demand of the highest peak reached during the year. It follows that when the consumption divided by 3,500 tends to exceed the capacity of generating plant available, an addition to that plant becomes necessary.

It has already been noted that any particular Willans Line only applies to the particular generating unit for which it has been constructed.

An inquiry into the effect of adding units leads to an interesting conclusion which is sometimes lost sight of. This applies more particularly to the fuel costs, which usually constitute the most important item of the total operating costs.

Fig. 10 is a diagram showing fuel consumption (or cost) in a plant in which the capacity of the original unit No. 1 has been extended by adding a second unit, No. 2, of somewhat larger size and of higher efficiency. The Willans Lines for the two units are A_1 B_1 and A_2 B_2, respectively. The No. 1 unit had sufficient capacity to furnish unassisted an output up to Oc_1 after which the No. 2 unit is capable of carrying on unassisted until the output reaches a value represented by Oc_2.

Beyond this point it would be necessary at times to press both units into service. It might be assumed that the fuel values would continue to follow the line C_2 B_2; or at the worst, would proceed along the line C_2G parallel to the Willans Line of the No. 1 unit. A little consideration will show that neither assumption is correct.

As long as the No. 2 unit alone is in use, the no-load ordinate is OA_2. As soon as it becomes necessary to bring the No. 1 unit into service as well, to handle occasional peaks, the no-load ordinate will be increased by A_2A_3 where the ratio A_2A_3/OA_1 is the fraction of the year during which the No. 1 unit is kept in operation. Thus the ordinate for the corresponding output Oc_3 will be c_3C_3 where the line A_3C_3 is parallel to A_2B_2. Similarly for other points C_4 C_3 . . . etc.

When the output reaches the value Oc_6, at which the maximum capacity of both units 2 and 1 is required to take care of the maximum daily peak—that is, the annual peak—then, if the minimum daily peak during the year is not less than the capacity of the larger No. 1 unit, both units will have to be kept in readiness for service continously, and the no-load ordinate will be OA_6, equal to the sum of OA_2 and OA_1. Then the ordinate c_6C_6 for the output Oc_6 will be determined by the intersection of the line A_6 C_6 parallel with A_2 B_2 and the ordinate c_6 C_6.

Thus, after reaching the output possible with a single unit, the fuel consumption ceases to increase at the increment rate determined for that unit, and begins to increase at a more rapid rate following a graph passing through the points C_3 C_4 . . . etc. and ending up at the point C_6 when the output reaches the limit possible with two units in combination.

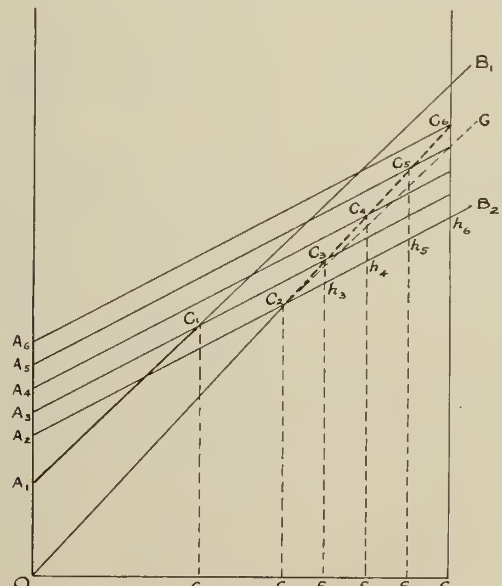

Fig. 10

Certain relations can be established governing the magnitude of these ordinates cC and their increment as indicated by the inclination of the line traced by the point C.

Examining the triangles $OA_2\,C_2$ and $C_6\,h_6\,C_2$ the following ratios may be noted:

$$\frac{C_6\,h_6}{OA_2} = \frac{A_2\,A_6}{OA_2} = \frac{OA_1}{OA_2}$$

Also
$$\frac{OA_1}{OA_2} = \frac{c_3\,c_6}{Oc_2} = \frac{C_2\,h_6}{A_2\,C_2}$$

Also the angle $OA_2\,C_2 =$ angle $C_6\,h_6\,C_2$

Hence the two triangles $OA_2\,C_2$ and $C_6\,h_6\,C_2$ are similar and

The angle $OC_2\,A_2 =$ angle $C_6\,C_2\,h_6$

Hence the lines OC_2 and $C_2\,C_6$ form one straight line; that is to say, the point C_6 is on a continuation of the straight line OC_2.

The line through all the points $C_2\,C_3$ . . . etc. evidently approximates to the straight line $OC_2\,C_6$.

If the duration of use of the No. 1 unit increases uniformly with the excess of output over that derivable from the No. 2 unit alone, then the triangles $C_3\,C_2\,h_3$, $C_4\,C_2\,h_4$ . . . etc. can be shown to be all similar, which means that the intermediate points $C_3\,C_4$ . . . etc. will all lie along the straight line $C_2\,C_6$.

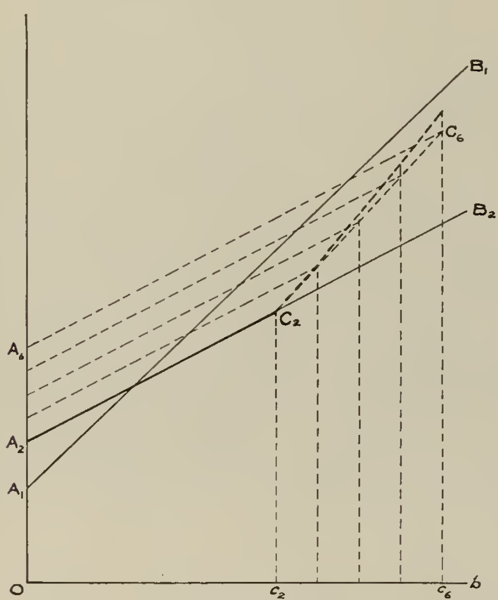

Fig. 11

One minor correction should be noted. In Fig. 10, in projecting the lines $A_3\,C_3$ . . . etc., these were drawn parallel to the Willans Line for the more efficient unit—that is, assuming that all the energy needed could be generated by that unit. This is not, of course, actually the case. The less efficient unit, in taking care of peaks, would have to generate a small amount of energy, increasing as the excess output grew. To compute the exact amount of this energy would require a close study of the daily load graphs throughout the year. When determined, the effect could be indicated by applying to the portion of the load generated by the less efficient unit, the line parallel to $A_1\,B_1$ established for the No. 1 unit. This is illustrated in Fig. 11, which is a modification of Fig. 10.

Another consideration tends to offset that just referred to. In dealing with an increasing demand, it may be possible to so adjust the running time of the second unit in such a way as to cut down its total no-load component to a small extent. This would lessen the gradient of the fuel consumption line beyond C_2 through the points $C_3\,C_4$ . . . etc.

Apart from these minor corrections, the simple fuel increment rate for the primary unit operating alone is superseded at the point of maximum possible output by a compound increment rate which is equal to the lowest average fuel rate reached by the primary unit when operating alone. This is irrespective of the relative capacities of the primary and secondary units, and is not sensibly affected by the intrinsic efficiencies of those units.

Also, it is independent, to a very large extent, of the intrinsic efficiency of the secondary unit. The fact that an old unit has a rather low efficiency detracts very little from

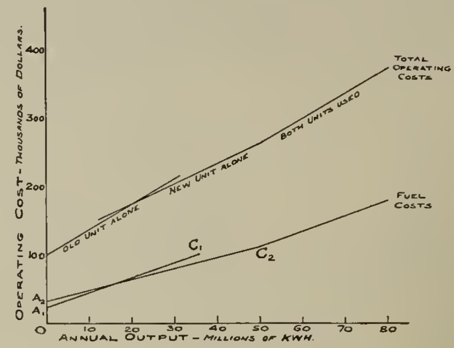

Fig. 12

its value as a secondary unit, so long as it affords the requisite capacity and is mechanically reliable.

This same general law applies to any further extensions of plant, when the largest and most efficient unit becomes the controlling factor in determining the compound Willans Line for the whole plant output.

Having determined the trend of fuel consumption, and consequently of cost, it is a simple matter to superimpose the costs constituting the other items which make up the total operating expense as enumerated earlier. In the case of most of these items, the trend determined for a group of units will be disturbed very little, or only to a fairly calculable extent, by the addition of another unit or units.

In Fig. 12 graphs are worked out showing the effect on future operating costs of an expansion of the plant, for which Fig. 3 illustrates the past operating experience. In this typical example it is assumed that a new primary unit is provided of 50 per cent greater capacity than the existing primary unit; and also that this new primary unit has a better full-load efficiency by 15 per cent, than is shown by the existing one.

It need hardly be pointed out that the development of operating costs as illustrated is entirely apart from the question of augmented carrying charges arising from additional capital investments in plant and equipment.

Examples could be multiplied showing the application of this general principle to the determination of fuel consumptions, special costs and overall plant expense. Enough has been said to indicate the adaptability of the methods to a wide variety of circumstances. Every problem that arises contains special features which must be given intelligent consideration in building up the correct formula to give reliable results.

Like most experimental laws, the principle embodied in the Willans Law is true in a broad and general sense. At the same time it is admittedly subject to certain deviations arising from the known characteristics of certain types of apparatus and irregularities due to less traceable causes. However, these departures from the simple straight line relation are in the main of such minor importance as to become practically negligible. Their existence does not detract from the value of the method in the analysis of steam plant performance.

The Willans Line method is especially commended to those who have to deal with problems involving the coordinated operation of several plants, in the course of which it becomes necessary to examine a large variety of methods of operations, when a ready and reasonably reliable method of arriving at comparative results is of great value.

REGULATION OF TRAFFIC IN A CITY

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Paper presented before the Toronto Branch of The Engineering Institute of Canada, November 17th, 1938

SUMMARY—Rapid increase in motor cars has presented serious problems in traffic regulation. City streets are often of widths unsuitable for motor traffic and traffic movement is affected by parking, one-way streets, signals, and intersectional interference. Average speeds are very low. New and widened streets may be only a palliative. The expense of limited way highways, special intersections, and elaborate traffic signals is very great. Accident records will not show real improvement until the public regards dangerous and inconsiderate driving or disregard of traffic regulations as definitely antisocial.

The regulation of traffic on the highways of the province of Ontario, both rural and urban, is a legislative function of the Highways Department of the province, to the extent that its approval is required to all municipal by-laws passed for that purpose and to the further extent that the Highway Traffic Act provides that all municipal by-laws whether passed by a municipal council or a police commission must be consistent with the provisions of that act.

This procedure is perhaps defensible on the grounds that uniformity of regulation as to the manner of doing certain things and making certain movements is an undoubted contribution to highway safety but there is some room for doubt as to the extent to which provincial control should be applied. For example, while the manner of making a left turn should be the same everywhere, the question of where a left turn may or may not be permitted would seem to be a question of purely local importance as far as an urban municipality is concerned and one that can only be determined by those having knowledge of local conditions. It would seem reasonable that the rules of the road should come under the jurisdiction of federal authorities, both here and in the United States, and that, further, there should be some form of international tie-up that would make for continent-wide uniformity.

The Highway Traffic Act does not define 'traffic'. It does, however, define 'vehicle' as motor vehicle, trailer, traction engine, and any vehicle drawn, propelled or driven by any kind of power including muscular power, but it does not include the cars of electric or steam railroads running only upon rails, for the obvious reason that their position on the roadway is fixed and that they are not subject to change of direction at the will of the operator. There is some question whether a parked vehicle is traffic. In Ontario a city's power to regulate parking is derived from its power under the Municipal Act to prevent the encumbrance of highways; however this may be, the Department of Highways has taken the position that parking is under its jurisdiction and as a consequence parking regulations in Ontario require provincial approval before becoming operative.

The outstanding item of traffic that renders regulation necessary is, of course, the motor vehicle, and it is perhaps desirable to get some idea of the magnitude of the problem to be faced from this source alone.

While the progenitors of the present automobile, as we know it, first saw the light of day about 90 years ago, it was not until 1894 that the automobile era began. As a result of optimism in the future of the new form of transportation, there are now upwards of 35,000,000 automobiles in the world, of which about 30,000,000 are on this continent. They have brought with them beneficial changes in living conditions but at the same time have caused personal injury, suffering and economic loss whose magnitude is illustrated by the following figures. In the United States alone 38,000 people were killed in traffic accidents last year and over 1,000,000 injured, involving an estimated cost to the nation of $1,600,000,000. Ontario figures are about on the same population ratio.

The regulation of the use of this wonderful and terrible means of transportation to-day constitutes the biggest problem of cities, provinces, states and even nations. The problem is twofold; it involves both movement and safety. As is generally known, this part of Canada is blessed or perhaps cursed with streets of a uniform width of 66 feet because the Gunter's chain, 66 feet, or one eightieth of a mile, was the standard unit of measurement when southern Ontario was carved out of the forest at the end of the seventeenth century and the first part of the eighteenth. But why is a mile 5,280 feet; and why was a foot what it is and why an inch? It seems that in the ninth century King Etheldred sought a unit of length; picked on the length of three barley corns as being suitable, and called it an inch. From that the 66-ft. chain seems to have developed. The chain width of a street would not be so bad if it were not for the things that have to fit into it. Why, for instance, does a car line have to be the width it is. It is said that the length of a wagon axle enters into the question; then why is a wagon axle that length? Why must a car be about six feet wide? Why must it seat three people with discomfort in the back seat? Why can't it seat two comfortably like a small Austin? Why must a

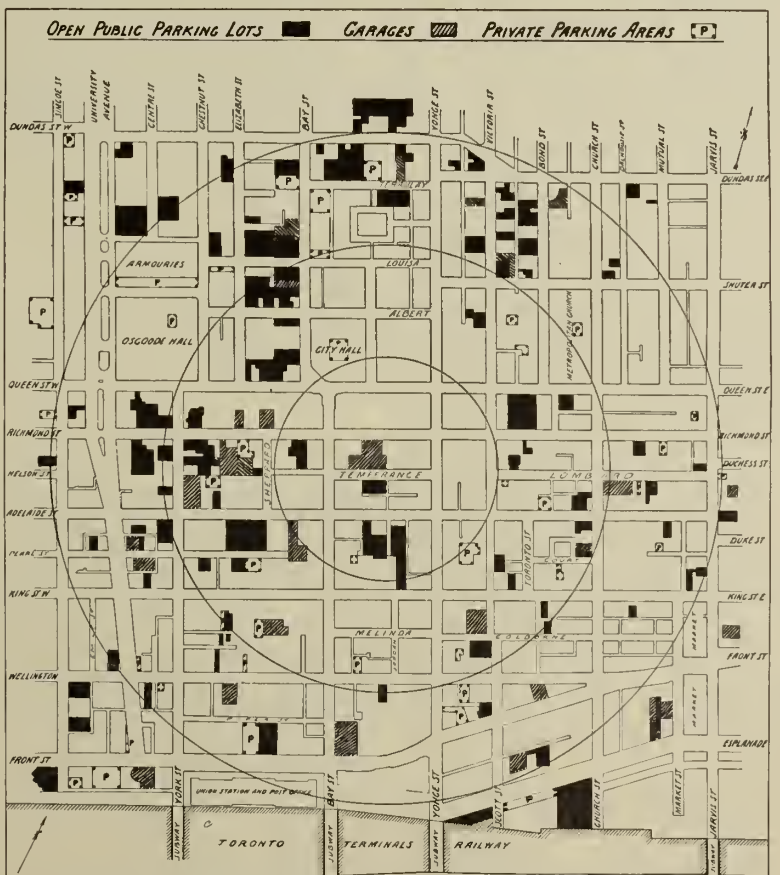

Fig. 1—Land used for off-street parking in the downtown area of the City of Toronto

street car be eight feet wide? These unrelated circumstances, starting with the barley corns, have combined to cost the City of Toronto, for instance, about $20,000,000 in the last twenty-five years. If it had been four barley corns instead of three, or if the chain had only been seventy feet instead of sixty-six feet, by far the greater part of these expenditures would have been unnecessary. If we could construct fifty foot pavements on car-line streets and still provide the ten feet of sidewalk accommodation considered the minimum for retail business, many of our troubles would no longer exist. Thus we must regulate traffic for movement and even when so doing recognize the possible futility of our regulation because of the uncertainty of our future automobile population. The 30,000,000 cars on this continent are largely congregated in the urban centres. Toronto, for instance, has 140,000 and a population of about 700,000 or one car to five persons. Other cities, such as Detroit and Los Angeles, are said to be motorized in the ratio of 1 to 3. Is that the saturation point? We do not know, but we do know that two or three years' prosperity might, on that basis, place 50 per cent more cars on our streets. Years ago town planners predicted the need for future new streets and widening on population statistics and could tell with reasonable accuracy when the need would arise. Now it is possible that we may have to face, in eighteen months or two years, a condition that formerly was a long-term consideration.

Regulation for movement means reasonable movement in accordance with conditions. Obviously one cannot expect the same speed at the commercial centre of an urban population of 1,000,000 as on rural highways or even on the urban approaches to that centre, and so the question arises what speed is proper. What speed is the dividing line between satisfaction and something that is intolerable? One m.p.h. would be intolerable; 30 m.p.h. would be unreasonable. Authorities are silent on this question, but in city streets 12 m.p.h. seems to be about as fast as safety permits, having in mind that this is an overall rate and that mid-block speed will necessarily be much greater, perhaps 25 m.p.h. The signals in the Chicago Loop are set at about 12 m.p.h. but except during the hours of low traffic volume this, from personal observation, appears to be generally unattainable, largely because of street car interference with uniform and continuous progress.

The means of improvement that present themselves are prohibition of parking, retiming signals for a faster progression, one-way streets and relief from intersectional interference. One-way streets have an important place in traffic regulations where the street layout is suitable. Under ideal conditions one-way operation will result in increased facilities for traffic movement, but under unsuitable conditions it may result in a state of affairs far worse than that which it is sought to remedy. The diversion of traffic from its natural course may cause loss to property owners and damage to business and often creates new congestion points. As a general rule one-way operation is only desirable after all other possible remedial measures have been applied, and even then it is essential that the reverse movement can be carried out on a street immediately adjacent, and that when street railway operation is involved, the loads which it is proposed to merge can be accommodated on one track instead of two. Four hundred feet is considered the maximum distance permissible between complementary streets for this class of regulation. Cities like New York and Philadelphia, laid out on a regular gridiron plan, lend themselves readily to its adoption but what is good in New York and Philadelphia is not necessarily good elsewhere.

Relief from intersectional interference means, in the final analysis, grade separation or traffic circles and these are frequently impracticable because of cost. Primarily, the traffic value of an intersection cannot be more than 50 per cent of that of either of the streets forming that intersection. After allowing for the time required for stopping and starting, it is found that it is little more than 33 per cent. This is borne out by actual traffic counts. For instance, a single lane of free moving traffic will pass continuously in one minute more cars than can cross the intersection on a six-lane thoroughfare in one direction in the same time, in spite of the fact that in the latter case three lanes are available for the purpose. Intersections are the greatest single factor contributing to traffic delays in an urban centre particularly on car-line streets and little can be done about it unless independent movement of both street cars and automobiles can be provided. Safety zones have been considered, of the chain and stanchion type for rush hour use only, but the maximum attainable pavement of 42 ft. on a 66 retail thoroughfare is perhaps below the minimum for this type of equipment. Mid-block prohibition of parking with prohibition of all standing or stopping in the vicinity of intersections appears to offer the best chance of improvement, but the strenuous opposition of merchants may be considered a foregone conclusion. It seems physically impossible, however, that the disastrous effects to business that are predicted can materialize. Prior to the total prohibition of parking in the Chicago Loop in 1928 a survey was made of 35 representative stores to ascertain what percentage of the daily customers arrived at the store from cars parked in the same block. 95,000 customers were recorded, of which 1.57 per cent came from cars so parked. Similar surveys made on Yonge Street in Toronto covering 8,000 customers entering 15 stores showed that only ⅞ of one per cent arrived from cars parked in the same block. Again, suppose every occupant of ground floor premises had a prescriptive right, to the exclusion of occupants of office buildings and upper stories, to the curb parking in front of his store after making a proportional allowance for essential prohibitions such as hydrants, entrances, etc., very few would have accommodation for more than one car, or 10 customers a day, on the basis of the average turnover. This, in many cases, would be less than one per cent of the total. The general question of parking is one of great complexity, owing to the change that has taken place in our methods of transportation. Formerly, we relied on mass transportation by common carrier; latterly, this has largely been superseded by individual transportation by private carrier. In the establishment of a common carrier system, terminal facilities have always been of primary importance, but very little official attention has been paid to the provision of terminal facilities for the individual carrier, this matter being left to private enterprise. While the demand for off-street parking accommodation has been a god-send to the owners of many obsolescent buildings during recent depressed times, parking is not an economic use of land and the time will come sooner or later when the space will be demanded for building operations. When that time comes, streets will be still less able to provide storage accommodation than they are now and it seems inevitable that municipal action must be taken to meet the need.

Some misapprehension exists, not, of course, amongst engineers, but in the public mind generally, as to the progressive timing of automatic signals. This usually takes the form of some uncomplimentary remarks about the individual responsible for setting the signals. This is not a matter entirely in the discretion of that individual. Given a 60 second cycle divided equally into green and red phases of 30 seconds each, the speed is definitely limited by the length of the block; for instance, if the blocks are 660 ft. in length the only speed that will fit a progression in both directions is 15 m.p.h. With unequal block lengths it is at times impossible to set up any progression at all in both directions, except perhaps over a fraction of the green phase. Any desired progression can, of course, be established in one direction only, and accordingly there has been developed what is known as the triple reset signal, which is capable of automatic resetting three times a day to accommodate the prevailing directions of traffic, such as inbound in the morning and outbound at night. In cases where this type is not available or suitable it is of course possible by juggling the lengths of phases and cycles to overcome some of the difficulties, but it is not always the traffic engineer's fault if a red light suddenly appears ahead. Another form of adjustment that is favoured under some conditions is the synchronous system, where the lights turn green at the same time for several blocks. This is valuable where cross traffic is not an important factor and can be made to wait, but it is not suitable on a car-line street unless safety zones or loading platforms are installed.

Traffic-actuated systems are ideal for isolated intersections, to the extent that they eliminate loss of valuable intersection time. Their cost, however, which is about four times that of other types, is a deterrent to their more frequent installation. The idea underlying the original development of traffic signals was the cost of officer control, and although it is generally agreed that no automatic signal, even embodying the latest actuated development, can fully take the place of an efficient officer who can utilize every second of the intersection time which has such an important bearing on the movement of traffic, he cannot be universally used.

The principal approaches to the central area naturally call for greater speed than is possible in the central area itself, which may be viewed perhaps as a large departmental store in which one must accept the disabilities attached to rapid movement at concentration point. An overall speed of at least 20 m.p.h. should be attainable but seldom is, except in the case of a highway system free from intersectional interference. Movement on main approaches may be assisted by the prohibition of parking during the rush hours and by classification as through streets under the provisions of the Highways Traffic Act. These provisions, if rigidly enforced and assisted when necessary by traffic signals of the triple reset progressive type, will do much to achieve the desired end. But there must not be too much infiltration of traffic from uncontrolled intermediate intersections that is out of step with the progression and completely nullifies its value. Where concentration is too great and approaches become overloaded it would appear that the only really satisfactory solution is the provision of a highway of the limited way type, that is free from intersectional interference and will permit speeds up to 45 m.p.h. between distribution points. New surface streets and widened streets act as a palliative but their permanent value is doubtful unless based on reasons entirely separate from traffic movement.

The item of regulation that affects both movement and safety is that of parked cars on residential streets. It is safe to say, from several standpoints, that parking on both sides of a pavement having a width of less than 30 feet is a definite hazard, particularly at night. It leaves insufficient room for moving vehicles to pass one another. It leads to a noticeable increase in one important cause of pedestrian injury, namely, stepping out from behind a parked car, and it is also a source of property depreciation when it is caused by close proximity to a theatre. Much improvement would result if citizens would universally adopt a practice of storing their cars in their driveways or garages when not in use.

Regulation of traffic for movement must be comprehensive. Where you increase the flow you must also consider the outlet. When you release traffic at one congestion point by a local regulation you must consider the effect that this change will have at the next point where movement is restricted. This is particularly true in relation to the prohibition of left-hand turns which are liable to very seriously decrease the efficiency of an intersection unless of such width that this movement can be made from a lane which is not required for through traffic. Every left turn prohibited means two left turns and a right turn elsewhere, and a general prohibition of these turns in the commercial centre of a city may defeat its purpose by increasing the vehicle miles travelled in the area and consequently may add to rather than relieve general congestion. There is no golden rule in these cases. What is needed is a very careful analysis of possible effect, based on engineering data ascertained by engineering methods and a comprehensive solution that maintains the relative traffic fluidity over the whole route or area.

The regulation of traffic for safety is primarily effected by enforcement of the rules of the road as laid down in the Highway Traffic Act, such as, the manner in which various turns may be made, the significance of traffic lights and signals, the limitation of speed, the rules for passing other vehicles and street cars, local regulation in the case of physical characteristics which create a hazardous situation, and by rigid enforcement of these rules and regulations

Fig. 2—Traffic flow into and out of the centre area of Toronto in 15-minute periods between 7.00 a.m. and 7.00 p.m.

where willing observance is not given. When one considers the accident record for this continent, indicating year after year that one person in about 120 will be killed or injured in the next twelve months by an automobile, the disregard of the simplest safe driving rules, the lack of courtesy and forbearance seen every day, makes one consider whether there should not be some other test of ability to drive or

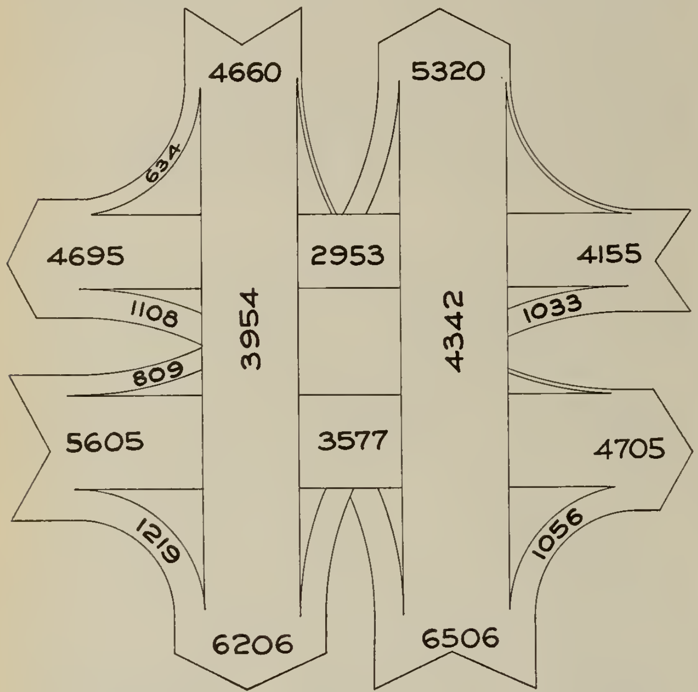

Fig. 3—Twelve-hour traffic flow diagram of the intersection of St. Clair Avenue and Avenue Road (Avenue Road vertical)

whether difficulties of enforcement have made these rules and regulations merely scraps of paper.

Analysis of accident records does not show any improvement in 1935-6-7; as a matter of fact there is a striking uniformity in both type and number over the three twelve-month periods. To what extent these accidents are attributable to lack of observance of traffic laws cannot be determined from examination of available records, but the fact that even after the publicity given to one recent fatal accident in Toronto, summonses for failure to observe the stop sign were issued at the rate of about 100 a day, would seem to be a clear indication of carelessness and inattention and perhaps even wilful disregard as a frequent accident factor. United States cities and states generally show a 20 per cent reduction in fatalities this year. Figures as to all accidents are not available but the fatality record may be taken as a criterion. This has been achieved by safety propaganda and enforcement, particularly the latter. Detroit, for instance, which shows a reduction in fatalities from 249 to 123 for the first nine months of this year, has a record of prosecutions in various divisions in up to 90 per cent of accidents.

It is impracticable to employ sufficient enforcement officers to cover all the streets in a city all the time and it seems that offences against traffic laws must be made anti-social before real improvement in conditions can be achieved. At present no driver who breaks one of these laws appears to feel that he has committed a crime against society, neither does he realize that in doing so he has been guilty of a selfish act that has deprived some other driver of his fair share of the use of a public highway. Take the case of a motorist who drives 70 m.p.h. on a highway that has been graded and aligned with horizontal and vertical curves on the basis of 50 m.p.h.—how often does he realize that he is limiting a driver coming towards him in the opposite direction to a speed of about 30 m.p.h. if safe stopping visibility is to be maintained? Similarly at an ordinary residential intersection where the line of visibility across the corner definitely fixes the safe approach speed, a motorist that approaches that intersection at more than that speed is taking, by force, a greater share of the use of that intersection than he is fairly entitled to. A man who pilfers a pair of socks from a departmental store is a criminal and frowned on by society, but a motorist who drives 70 m.p.h. on the highway and robs other people of a fair use of the public highways, endangering his own and scores of other lives, is a hero, or at the worst a crazy fool. No driver as a rule who has imbibed sufficient liquor to impair his reaction time realizes that he is a menace to safety, neither does society as a general rule indicate its disapproval. Enforcement can and will bring noticeable improvement, but the ultimate in traffic safety will only be reached when observance of regulations ceases to be a matter of convenience, is recognized as a social duty and becomes a matter of conscience.

WHERE CANADA'S GOLD COMES FROM

Ontario continues to be Canada's principal gold producer, about fifty per cent of the Dominion's production coming from the mines of the Porcupine and Kirkland Lake areas, according to the Department of Mines and Resources, Ottawa. Other important gold-producing regions in Ontario include the Little Long Lac and adjoining areas in the Thunder Bay district; Red Lake, Crow River, Sachigo River and Lake of the Woods areas in the Kenora district; Larder Lake and Matachewan areas in the Timiskaming district, and Goudreau and Michipicoten areas in the Algoma district.

Quebec's chief single producer is still the Noranda copper-gold mine, but the output from the gold-quartz mines in the Bourlamaque, Siscoe, Malartic and Cadillac areas in Abitibi county, and the Arntfield, Duparquet, Rouyn and Mud Lake areas in Temiscamingue county in northwestern Quebec, is increasing rapidly.

The chief sources of gold in British Columbia are the gold-quartz mines in the Bridge River area. Other important contributors are the gold-quartz mines of the Portland Canal area; of Wells camp in the Cariboo area; of Hedley camp in Osoyoos area; of Sheep Creek, Ymir and other adjoining areas in the vicinity of Nelson; and of Zeballos River, on the west coast of Vancouver Island.

Manitoba's gold is obtained chiefly from the copper-zinc-gold ores of the Flin Flon and Sherritt-Gordon mines, but production from gold-quartz mines in the eastern and northern parts of the province is increasing.

Saskatchewan's production of gold comes entirely from that portion of the Flin Flon mine lying within the province.

The Northwest Territories recorded their first commercial production of gold in 1938, the output having been obtained from the Yellowknife River area, on the north shore of Great Slave Lake.

Yukon's gold output is obtained almost entirely from placer deposits, the large-scale dredging of which is carried on chiefly in the Klondike area.

Nova Scotia's output is from the gold-quartz mines of Seal Harbour, Montague, Caribou, Moose River, Goldenville, and a few other areas.

In Alberta a few ounces of placer gold are produced annually.

Canada ranked third among the gold-producing countries of the world during 1938, with an output of 4,715,480 fine ounces valued at $165,867,009, an increase of 619,267 fine ounces, for $22,540,516 in value. The value of Canada's gold production in 1938 was equal to 51 per cent of the total value of all metals and 37 per cent of the total value of the entire output of the Canadian mineral industry.

—Canadian Resources Bulletin.

COMMENTS ON CONCRETE RESTORATION

J. A. McCRORY, M.E.I.C.
Vice-President and Chief Engineer, Shawinigan Engineering Company, Montreal, Que.

First Section of Report of the Committee on the Deterioration of Concrete Structures.

For a number of years the Shawinigan Water and Power Company has made periodic repairs to its concrete structures. Some of this work has been done by hand placed concrete where the depth of erosion or spalling has been great, some by the use of gunite and some by a combination of the two methods. The repairs have been made under the direction of the company's construction organization, the Shawinigan Engineering Company, which in some cases has carried out the work by its own organization.

The first restoration work of importance undertaken by the Company was that carried out in 1924 on the dam at Shawinigan Falls. This dam is situated at the head of the falls and consists entirely of sluiceways controlled by Stoney roller gates and separated by concrete piers ten feet thick with short concrete abutments at each end. The sills and aprons of the sluiceways consist of a concrete paving approximately two feet thick on the gneissic rock foundation. The dam is in two sections known as the Shawinigan Dam, which runs from the west bank to Melville Island,

Fig. 1—Substructure of the powerhouse at Grand'Mère. The restoration work consisted of facing the heavy slab over the exits from the draft tubes and the tops of the piers supporting this slab together with considerable work which is concealed behind the barrier shown above the slab. It will be noted that this work is still apparently in perfect condition. The sides and noses of the piers were not repaired at that time and in fact it was not until last year that any repairs were made to this part of the structure. Built in 1918

and the Almaville Dam, which lies between the island and the east bank. It was built in 1910, and while the concrete generally is of good quality it showed evidence of excessive water gain at the tops of the lifts and by 1924 erosion had taken place along these joints in some cases to a depth of six or eight inches. The lower ends of three of the concrete aprons had also been under-cut, the rock having been washed out to a depth of two or three feet.

The piers were repaired by cutting out all disintegrated material, dressing the surface with air chippers and filling the holes and re-surfacing with gunite. No reinforcement was used in this work. The work stood up well for four or five years. At this time, however, cracks began to develop and within a few years the gunite work had spalled to a considerable extent. The repairs to the sills, however, although roughened on the surface, are still in good condition. The piers were repaired again in 1937, the work being done by the Western Waterproofing Company. In this case the surfaces of the piers, including the tops, were chipped back to a depth of about two inches, all disintegrated concrete was removed and the surface restored to the original lines with gunite. The work was reinforced with a 2 in. by 2 in. mesh.

Fig. 2—Showing the deterioration that had taken place in unreinforced gunite placed on the piers of Almaville Dam in 1924. Dam built in 1910

In 1929 some extensive repairs to a portion of the dam and to the sub-structure of the power house at Grand'Mère were made for us by a gunite contractor. This work was done in the usual way by chipping off all disintegrated material and restoring with gunite reinforced with a 2 in. by 2 in. mesh. The gunite work on the power house substructure is still in good condition but in the case of the work on the dam it has disintegrated badly. It is evident that the contractor did not exercise sufficient care in sealing the horizontal joints, seepage along which had caused the disintegration in the first place.

Fig. 3—Shows the placing of the wire mesh for gunite repairs to Almaville Dam in 1937

In 1931 our own organization repaired three of the sluiceways on the overflow section of the dam at La Gabelle. The surface generally was in good condition but some spalling had occurred along horizontal joints resulting in the formation of holes, in some cases nine inches deep. The disintegrated material was cut out in the usual way and the whole surface of the sluiceway chipped to a depth of about one inch. Great care was taken in washing the prepared surface, the holes were filled with concrete and the surface restored to the original lines with one inch of gunite. In spite of the fact that no reinforcement was used, the work stood up well for five years; one of the sluiceways in fact is still in pretty good condition although some cracking and spalling has taken place, but the other two are not as good. Figure 2 shows the condition of two of these sluiceways in the summer of 1938.

Fig. 4—Shows the present condition of gunite work which was done at La Gabelle in 1931. Dam built in 1924

In the summer of 1938 the Quebec Streams Commission let a contract to the Foundation Co. (Quebec) Ltd., for repairs to the Gouin Dam at the headwaters of the St. Maurice River. This work is particularly interesting on account of the unusual method of unwatering used.

The Gouin Dam controls the most important storage reservoir on the St. Maurice, the capacity of the reservoir being 218 billion cubic feet. Owing to its situation near the height of land and 200 miles north of Three Rivers it is subjected to long and very severe winters. Under normal operation the reservoir is drawn down during the winter so that the upstream face of the dam while wet is exposed to extremely low temperatures. This has resulted in spalling of the upstream face, especially at the tops of the lifts where the concrete is most permeable. The normal drawdown covers the upper 15 ft. of the dam and it is this part that is most seriously affected. Below a level 20 ft. from the top of the dam practically no deterioration has taken place.

Owing to the importance of the reservoir in maintaining a high regulated flow in the river it is not feasible to draw the water down sufficiently nor to hold it down for a long enough period of time to make the necessary repairs, and an open caisson for unwatering the upstream face in short sections successively was devised by Mr. T. C. Creaghan and the author. The design of this caisson was worked up by the engineers of the Quebec Streams Commission and it has been operated successfully by the contractor. The caisson consists of a steel box approximately 22 ft. long, 4 ft. wide and 20 ft. deep, with the top and one 20 ft. by 22 ft. side open. The caisson is provided with flotation chambers. It is floated into place with the open side against the concrete, anchored and pumped out. The edges in contact with the concrete are sealed with rubber and when it is unwatered the pressure of the water against the outside holds it in place. There is sufficient room inside to permit chipping and guniting over an area of 300 sq. ft. and as soon as one section is completed the caisson is allowed to fill with water and it is moved to the next location. The work was suspended during the winter but was resumed again in the spring and will be carried to completion this year.

Whether it is possible to make permanent repairs to concrete with reinforced gunite remains to be seen. None of our work has been in service more than ten years. It is perfectly evident, however, that a permanent repair cannot be made to a surface subject to the seepage of water and to freezing temperatures. It is also apparent from our experience that it is difficult to make a permanent repair with a simple gunite coat not reinforced. In this case it would be necessary to make a perfect bond between the new work and the old and the author has very serious doubts as to the feasibility of accomplishing this with available materials and technique.

Fig. 5—Moving caisson being used on repairs to Gouin Dam shows the caisson in position against the upstream face of the dam. This dam was built in 1918

In addition to the prime requisites of eliminating all seepage through the concrete and using good materials properly proportioned there are four essentials in assuring reasonable permanency in concrete repairs.

First, all distintegrated material must be removed and the surface thoroughly cleaned of loose particles.

Second, adequate reinforcement must be provided and well anchored to the concrete.

Third, the work must be done by experienced men.

Fourth, the new surface must be properly cured.

If, in addition to the above, a method were devised of eliminating shrinkage in the new work and of assuring a good bond between the new work and the old we could correct mistakes of the past and devote all our energies to building better structures for the future.

TRANS-CANADA MOTOR ROUTE THROUGH THE ROCKIES

By shipping their automobiles by rail over the Selkirk Mountains, motorists may now travel over the Trans-Canada Highway from Port Arthur, Ontario, to the Pacific Coast. The only unfinished portion of the all-Canadian route is a stretch of about twenty-three miles on the Big Bend Highway between Golden, B.C., and Revelstoke, B.C., and as in the past few years, a daily automobile transport service between these points will be provided by the Canadian Pacific Railway during the 1939 season, commencing June 15 and ending September 30.

This arrangement provides motorists with a direct route to and from the Pacific Coast over one of the most spectacular highways in Canada. Passing through the heart of the Rockies, this motor road traverses the great mountain playgrounds of Banff and Yoho National Parks, providing access to such famous beauty spots as Banff, Lake Louise, Moraine Lake and the Valley of the Ten Peaks, Emerald Lake, and the Yoho Valley. In its western section the road in some localities, although open to traffic, is still in its construction stages.

Motoring in the Rockies provides unforgettable thrills and offers splendid opportunities to become acquainted with Nature in her most magnificent setting.

—Canadian Resources Bulletin.

Abstracts of Current Literature

Contributed articles based on current periodicals, papers and events

TWENTY TONS OF VOICE

By G. T. Stanton, Electrical Research Products, New York.

Abstracted by H. J. Vennes, A.M.E.I.C.

Probably the world's most interesting, and certainly its most patient, corps of "guides" will serve you when you ride through General Motor's exhibit—Highways and Horizons—at the World's Fair in New York. In company with a guide, who explains what the future holds in store for motorists, you will seem to be flying over the superhighway system of tomorrow. Actually, however, you will be seated in a comfortable car, one of more than 300 cars which form an endless "Carry-go-round". In the car behind you another guide, beginning a few seconds after, will be telling the same story to another traveller. Behind him another—another—and still they come, each telling his story a few seconds after the one in front.

The mechanism has acquired the somewhat frightening name of "Polyrhetor"*—but to its intimates it is known as "Twenty-tons-of-voice". Essentially, it consists of a finely wrought steel drum, which towers twelve feet above a massive circular base. Seven equally spaced columns rise from this base and curve in at the top where they meet and steady the vertical drum. This drum carries twenty-four bands of sound film, which are pierced at 150 equally spaced points by brilliant needles of light.

As the drum revolves, these light beams shine through the sound track and actuate photoelectric cells. The method is similar to that used in sound motion pictures.

The problem of designing the giant sound reproducer was assigned to Electrical Research Products Inc., by General Motors. Its solution involved finding still another answer to the age-old puzzle of combining great masses without loss of precision. An eight-foot drum, weighing in excess of seven tons, had to be designed for rotation at constant speed without changing its dimensions or wobbling so much as a thousandth of an inch—a degree of accuracy approaching the mechanical limits required in the world's great, though slowly moving, telescope!

The trolley system is also unique. Engineers found that a satisfactory relationship between sound and scene could be maintained for each spectator if a separate voice circuit was supplied to each pair of cars. This would appear to mean 150 different circuits and trolley tracks. But space between the car rails would not admit more than a few of them. Seven trolley rails were laid down and these were broken, with insulating joints, into seventy-foot sections throughout the whole tour.

The story for the first seventy-foot section of the tour is recorded on one of the twenty-four loops of film. This record takes forty seconds to play—one complete revolution of the loop—the time required for a given car to travel seventy feet. One of the light-beams, which scans this loop, is associated with one of the seven trolley rails extending along the first seventy-foot section of panorama.The loud-speakers in the first pair of cars on each seventy-foot section connect with this particular rail. Sliding contact is made through a silver impregnated shoe beneath the car.

In addition to this first scanner, six others are spaced at equal intervals around the loop of film, as previously mentioned. Each of these scanners connects with some one of the six remaining trolley rails in each section of track. All twenty-four loops are so scanned by seven beams. Obviously, the beginning of the story recorded on each loop arrives at each scanner progressively.

An eighth trolley rail, paralleling these seven, provides a common return path for all speech circuits. In addition, a short section of rail slotted into approximately two-foot lengths extends along the loading and unloading zone for synchronizing purposes.

Synchronization between the rotating drum and the conveyer is accomplished by apparatus adapted from automatic elevator control. An interrupter-cam, driven by the rotating drum, actuates a make-and-break contact, thereby advancing a mechanical contactor or "selector" in step with the drum's rotation. A second contactor, mounted on one car in each conveyor section, makes and breaks contact with a special synchronizing rail, which is located in one of the sections between the loading and unloading platform. This circuit advances a second "selector", step-by-step with the car's progress. At each step these two selectors connect with relays so arranged that a premature arrival of the car "selector" functions to slow the conveyor; a tardy arrival to speed it up.

The machine was shipped on a specially equipped car from the Kearny Works of the Western Electric Company to its present site at the World's Fair. Its extremely fine construction necessitates housing the instrument at the Fair in a special air-conditioned room where the temperature never varies more than two degrees and where humidity is held within five per cent. Although axial deviations in drum rotation of one-thousandth of an inch in eight feet could be tolerated, it is a matter of interest to note that actual deviations are somewhat less than four ten-thousandths of an inch. To minimize seismic effects, the machine is floated on a layer of structural sponge-rubber to insulate it from its special foundation. The 80,000 lb. structure was designed to have a natural frequency of vibration of 7.5 cycles per second, a figure well below the range of hearing.

*many orators.

PARIS OMNIBUSES

The Engineer, May 26th, 1939

A committee of traffic co-ordination was constituted by decree towards the end of last year to deal with the traffic problem in the department of the Seine, where the public services are a heavy burden on municipal finance. The Metropolitan Railway and the omnibus services are exploited by companies under concession from the General Council of the Seine, which guarantees them a specified minimum return on their capital. Both of these services have always been run at losses, which amount approximately to 200 million francs a year for the Metropolitan and 100 millions for the omnibuses. Increases of passenger fares had an effect contrary to what had been expected, and in the case of omnibuses it was deemed prudent not to apply the second instalment of an advance that was due last month, the first of which was put in operation at the beginning of the year, with the result that there was a serious decline in the number of passengers carried. Something must be done to make the services self-supporting. Furthermore, the omnibus service is a factor in the Paris traffic congestion, so that the committee of co-ordination had every interest in suppressing lines that were hopelessly deficient in receipts where the traffic could be handled by the Metropolitan underground railway. This does not affect private interests, since both services are departmental undertakings. Recently seventeen omnibus lines were suppressed, and omnibuses on others have now been withdrawn, with the result that more traffic is diverted to the Metropolitan. A further economy is being made by eliminating the necessity for omnibuses stopping unless signalled by passengers at the regular halts. It is affirmed that this suppression of unnecessary stoppages will realize an economy of more than three million francs a year.

OPERATING EXPERIENCE WITH ELECTRIC STEAM GENERATORS

A group of papers presented to the Saguenay Branch on February 3rd, 1939

Abstracted by F. T. Boutilier, A.M.E.I.C.

The first paper, which was read by A. G. Joyce, Affil.E.I.C., of the Aluminum Company of Canada, Arvida, outlines the uses, construction and operation of electric steam generators. When industrial plants contract for large blocks of hydro power on a horsepower-year basis, and periods occur when there is a surplus over the plant load demand, this excess power, to the limit of the contract, may be used to advantage in electric steam generators. They are also used to absorb excess power of the hydro plant, which is usually sold at special rates.

The electric boilers commonly used in Canada and the United States are of two general designs, the Kaelin type and the General Electric.

The Kaelin boiler, in the lower capacities, that is up to 25,000 kw., consists of a simple tank with three electrodes, while in the higher capacities there are three tanks with a single electrode in each tank. The electrodes, usually of steel or cast iron, are suspended from the boiler head or top by copper rods which act as the conductors and are insulated from the boiler shell. The electrodes are encircled by a neutral plate which protects the boiler shell against any action from the current which would result in pitting of the shell plate and also divides the boiler vertically into two zones, thus permitting a free circulation of the boiler water. The feed water inlet pipe enters the centre of the bottom head and is carried up as close to the electrodes as is possible without causing a current to pass to it; it is usually capped with a mixing nozzle. A blowoff connection is taken off at the lowest point of the sump, through which any sediment not carried off by the bleeder is blown off as often as is necessary. Steam is produced by the heat generated due to the resistance of the water to the current passing from one electrode to the other and from the electrodes to the neutral plate.

The General Electric type of boiler is somewhat similar in design, except that the tank is divided into two parts. In the upper part, containing the electrodes and neutral plate, the steam is generated in the same manner as in the Kaelin type. The bottom section acts as a hot well from which water is pumped to the top section through stand pipes.

Although there are several systems of automatic control on the market, some of which function to maintain constant power input, and some function to maintain constant pressure, electric boilers are generally manually controlled. A gain in efficiency may be expected from automatic control, due to more closely regulated conditions and the avoidance of steam losses through the safety valves.

The efficiency of electric boilers is usually high, over 90 per cent, the only losses being those from radiation, loss of steam through safety valves and the hot water bled off to maintain the required concentration of salts in solution.

Maintenance of an electric boiler consists of the inspection and cleaning of electrodes, shell plate, control piping, safety and stop valves. This is carried out as often as every three or four months in some plants, in others, ten to twelve months, depending in a large measure on the quality of water and load conditions.

Mr. R. A. Lane of Lake St. John Power and Paper Company Limited opened his paper with a brief description of the steam plant under his supervision, following which he discussed some of the maintenance problems encountered with electric steam generators. It has been found necessary to change insulators once a year on the average, although occasionally they have run as long as fourteen months. However, the useful life does not exceed twelve months as at that age the insulators become brittle and tend to crack while in operation. Electrodes were changed at periods of from 62 months to 72 months. The difference is accounted for by the fact that in the first case the boiler was used for week-end heating with a very low immersion at all week-ends when heating is necessary, while in the second case the boilers were not used for this purpose. Comparatively little change appears to take place in the electrode during the first three or four years, after which the tips appear to corrode rapidly. Due to the purity of the feed water supply at Dolbeau no feed water treatment has been found necessary. There is, however, a certain amount of vegetable matter introduced with the water which forms a coating on the shell and the neutral plate up to the operating water line. At week-ends when shutdowns are of long duration and the water level is lowered, the deposit curls and peels, dropping off to the bottom, where it is blown out in the ordinary way. The electrodes become coated with a thin, hard scale of iron oxide about the thickness of an eggshell. This serves as a protection and prevents the formation of the above-mentioned feed water deposit.

J. W. Gathercole, A.M.E.I.C., Steam Plant Engineer of Price Brothers and Company Limited, Kenogami, was the next speaker. Following a brief description of the three 28,000 kw. 6,600 volt boilers under his charge he outlined the technique of operation. The quantity of steam generated depends on the amount of electrode immersion in the water, which is controlled by raising or lowering the water level in the boiler. The amount of electrode immersion is affected by another factor, namely, the concentration of total solids in the boiler water. Pure water is a poor conductor of electricity, but as this concentration increases, the conductivity of the water rises. It must be allowed to do so until the boiler will carry full load. Since the steam is free from impurities, it does not take long for the water to become saturated with solids. To avoid too frequent operation of blowdown valves the highly concentrated water is bled off.

Electric boiler maintenance consists mainly in the repair or renewal of electrodes, drum lining, replacement of cracked or broken insulators and renewal of worn valve parts. Maintenance, particularly with respect to electrodes, is much greater on an intermittently operated boiler than on a constantly operated one. Electrode life on the latter is two to five times greater than on the former. The deterioration of electrodes, which is gradual, may be due to electrical, chemical or physical causes and probably a combination of all three. The electrical corrosive effect is due to the high current density in the immersed part of the electrode, while chemical corrosion is due to free oxygen attacking the metal to form iron oxide. Numerous designs and several materials have been experimented with in order to obtain an ideal electrode, with each resulting in some undesirable quality. With improved material and sufficient installing experience, insulators or porcelain bushings will give the minimum amount of trouble and expense.

The chief advantages of electric steam generators are their ease of operation, simple construction, cleanliness, compactness, high efficiency, minimum danger of explosion, ability to pick up load rapidly, low maintenance and high reliability factor.

The main disadvantages are their small steam storage capacity, tendency to prime when heavily loaded and even when normally loaded, greater carry-over of solids as compared with combustion boilers, with serious erosive effect on piping and valves, and their dependence on uninterrupted supply of power.

The next paper was prepared by J. Foster, Steam Plant Superintendent, Price Brothers and Company Limited, Riverbend. After giving a brief description of the boiler plant, he showed by means of projected photographs the more important parts of the boilers, naming in each case the causes which might lead to maintenance expense. Corrosion of the bottom head of the tank was found to take place slowly at first and then more rapidly. Electric welding is being used to check this condition. Due to unequal expansion, minor leaks sometimes develop at the butt straps and rivets. The neutral plates, although subject to wear and pitting, especially on the immersed parts, have very rarely to be changed.

G. H. Kirby, A.M.E.I.C., Electrical Superintendent, Price Brothers and Company, Limited, Riverbend, then dealt with the electrical features of electric boilers, with particular reference to those at the Riverbend mill. In contrast to the boilers at the other plants, which are operated at 6,600 volts, those at Riverbend are operated at 13,200 volts; boilers operating at this voltage are somewhat rare. Due to this high operating voltage the tanks are of large diameter and hold for a given load a relatively large volume of water, heated by half the current that a boiler at 6,600 volts and the same rating carries. This large volume of water tends to make the boiler slow to follow load changes, unless the water is allowed to become a better conductor of electricity by a concentration of the impurities and salts in solution. Under this condition the volume of water is reduced, and a higher current density results. This has the advantage of heat conservation during the concentration process, owing to minimizing the amount of bleed necessary, and therefore enables the boiler to run at a high thermal efficiency.

One disadvantage, however, is the rapid burning away of the electrode and even of the boiler itself, where it is not protected by the neutral plate. A second disadvantage to the operation of this boiler at a high current density is an apparent tendency for the impurities in the water to create concentrated paths of high conductivity over which large currents flow momentarily, until broken down by some quenching action. This sets up a pulsating load beyond the power of the operator to control.

Another novel feature of the Riverbend steam plant is that the boiler actually connects direct to the power house bus only 8,000 ft. away. Due to the comparatively large currents transmitted through overhead lines, this sets up several electrical phenomena which Mr. Kirby explained in some detail.

THE CHARACTERISTICS AND USES OF ASPHALTIC MATERIALS

Abstract of paper presented before the Regina Branch of The Engineering Institute of Canada, March 24th, 1939

By Norman W. McLeod

Asphalts are obtained either from natural formations as, for example, the well-known deposit in Trinidad, or from petroleum refinery operations. From 80 to 90 per cent of the world's production comes from the latter source.

Asphaltic materials are composed essentially of asphaltenes, resins and oily constituents, the proportion of each determining the consistency of the compound which varies from very fluid liquids to solids. The fluidity of an asphalt may be reduced by distillation, whereby some of the oily constituents are removed, or by air-oxidation whereby some of these constituents are converted to resins and some of the resins to asphaltenes. There are four general methods for liquefying semi-solid and solid asphalts. (1) By heating. (2) By dissolving the asphalt in a petroleum distillate which later evaporates leaving the semi-solid or solid asphalt. (3) By dispersing the asphalt in water as an emulsion which consists usually of 50 per cent water and 50 per cent asphalt. (4) By refining the asphalt until it is brittle and can be powdered and using this powder with a very liquid asphaltic flux oil in which the powder gradually dissolves giving as the ultimate binder a fluid whose consistency depends upon the proportions of the constituents.

Asphalts have served as building materials for at least six thousand years. They were used by ancient civilization in Mesopotamia and Egypt largely as waterproofing and binding materials. To-day, their principal use is for the surfacing of streets and highways.

For the low cost highways where traffic is light, asphalts known as liquid asphalts are most widely used. These are liquid at ordinary temperatures and are divided into three classes on the basis of their rate of setting up: rapid curing, medium curing and slow curing liquid asphalts. The first two classes are formed by cutting back semi-solid asphalts with petroleum solvents which they lose gradually in setting up. The slow curing liquid asphalts contain no solvent and therefore set up very slowly. All three types of liquid asphalts are further classified on the basis of their fluidity and numbered accordingly.

The choice of a particular class of liquid asphalt is determined by the type of aggregate, either dense graded or open graded and by the method used, whether the aggregate is cold or previously heated.

The low viscosity liquid asphalts are used as primers and are applied to the roadbed just ahead of the finished mixture to ensure a good bond between the roadbed and the bituminous surface.

Because the failures in the paved surfaces are most frequently due to the lack of subgrade support, the modern tendency is to build a substantial stabilized soil base course before laying a bituminous surface. A satisfactory base can be constructed from a scientifically designed mixture of gravel, sand and clay. In regions where clay is not available bituminous materials are frequently used as the binder. There is in existence a considerable length of base courses constructed of bituminous stabilized soil mixtures.

While the largest part of the production is used for road surfacing it is interesting to note that asphalt finds its place in construction as a waterproofing or binding material. When moulded in blocks or tiles, it is used for road, bridge or floor surfacing.

There have been some recent interesting engineering developments involving the use of asphalts as lining materials for erosion control and waterproofing of hydraulic works. The most spectacular method of asphalt construction is used by the U.S. Army Engineers for surfacing the underwater slopes of certain locations along the banks of the Mississippi to prevent erosion of either natural banks or levees. Wire reinforced slabs or mattresses of an asphalt mixture, 218 feet wide by an average of 500 ft. in length, are precast on the deck of a barge and lowered to the river bottom to depths of 180 ft. These mattresses are anchored to the banks just above the water line.

There have been two rather recent developments in asphalt technology, the use of powdered asphalt as a universal asphalt binder and the use of wetting agents for promoting high adhesion between bitumen and mineral aggregates.

With the use of powdered asphalt and flux oil, any degree of hardness of the binder can be obtained by simply varying the proportions of the asphalt powder to the flux oil. It is interesting to note that for the past three or four years the City of Winnipeg has been using powdered asphalt and flux oil for paving mixtures rather than the asphalt cement formerly used.

A development which may increase the rate of adoption of powdered asphalt and flux oil is the possible use of wetting agents.

At the present time, mineral aggregates must be dry before they can be coated with asphaltic materials. This is because the aggregates have greater affinity for water than for asphaltic materials. By the use of certain chemical reagents, generally known as wetting agents, the affinity of the aggregate can be made greater for asphalt than for water.

If the development of the use of wetting agents is perfected, powdered asphalt and flux oil will undoubtedly be the most largely used asphaltic binders. By the use of wetting agents, the very fluid flux oil would coat even very wet aggregates in the cold, and any desired consistency of bituminous binder could be obtained by regulating the proportions of flux oil and powdered asphalt employed.

THE KUT BARRAGE

Civil Engineering and Public Works Review, April, 1939

Abstracted by L. Trudel, A.M.E.I.C.

The Kut barrage recently completed in Iraq is intended to divert the flow of the river Tigris into a stream, the Shatt-el-Gharraf, for irrigation purposes. The barrage is located immediately upstream of the natural mouth of the Shatt-el-Gharraf and a new mouth with a regulator has been provided for the stream above the barrage. The old mouth has been closed by means of a dyke and it is now possible to control the flow from the Tigris into the stream at all stages of the river which rises from 12,400 c.f.s. at low water to 140,000 c.f.s. during high water.

The bed of the river being of loose sand, the barrage is seated on a concrete raft with adequate sheet piling cut-offs below. It has 56 openings, 19 ft. 8 in. wide, each controlled by a single sluice gate. The total length of the works, including a lock for navigation on the right bank, is approximately 1,615 ft.

Preliminary excavation was effected by means of three 12 in.-cutter suction dredges, final dressing to the required levels being carried out after the cofferdans had been unwatered. The first stage in the barrage works was the construction of the lock by means of a steel sheet piling cofferdam which was driven as far as possible along the line of existing sand banks and was subsequently strengthened by pumping sand around it. The principal dimensions of the lock are 262 ft. in length, 54 ft. in width, with a low river depth over the sill of 9 ft. 10 in.

After completion of the lock section on the right bank, operations were transferred to the barrage section on the left bank, a steel sheet piling cofferdam being driven to take in approximately one-half of the length of the barrage. The mass concrete raft carrying the piers has a width of 270 ft. and is built up in panels, the joints in which are staggered and adequately keyed. The piers are constructed of precast concrete blocks backed with a concrete hearting. Concrete arches cast in place carry the 9 ft. 10 in. wide roadway which runs the length of the barrage. To prevent percolation below the floor of the barrage, four rows of steel sheet piling have been driven, and between a fifth double row the sand has been excavated and a mass concrete corewall poured. With the completion of the first half of the barrage, the lock was brought into operation.

Owing to the constriction in flow of the river caused by the first half of the barrage, even with all the vents open, the velocity in the remaining section was increased. It was thus necessary, before driving the piles for the cofferdam, to string a row of pontoons on the required line and dump sandbags in order to form a sill diverting the flow through the vents.

The sluice gates, 20 ft. span by 17 ft. 5 in. depth, are counterbalanced and electrically driven. The highest upstream level above the floor when the vents are all closed will be 26 ft. 3 in.

Since a new mouth to the Shätt-el-Gharraf was to be constructed, it was possible to build the regulator and the navigation lock which are required in the dry. The regulator has seven openings and the principal dimensions of the lock are 180 ft. 5 in. length, 26 ft. 3 in. width, with a normal depth of 9 ft. 10 in.

The completion of the works involved the excavation of some 350,000 cu. yd. of material, the pouring of 300,000 cu. yd. of concrete, and the driving of some 6,000 tons of steel sheet piling. The cofferdams involved the driving and withdrawing of approximately 4,000 tons of piling. The labour used on the contract was principally Iraqi under the supervision of British engineers.

Messrs. Coode, Wilson, Mitchell and Vaughan-Lee of London, England, were consulting engineers. The successful tenderers were Messrs. Balfour, Beatty and Co. Ltd. and the contract price in excess of £1,000,000.

A NEW ENERGY UNIT

In the fashion of modern publicity, the booklet, 'Lest We Regret,' proposes a new energy unit which it dramatically calls a 'danger unit'.

This unit represents the impact which would be experienced by a person falling from the top of a two-storey building, approximately 20 feet. It is possible to survive such an impact but it is just about the shock limit for the human body. A unit couched in such untechnical terms is within the understanding of everyone, and therefore has a ready appeal. The energy absorbed by the collision of a car running at 25 m.p.h., with a solid object, is just the same as that of a person falling a distance of 20.9 feet. Thus the danger from motor car driving is related to the shock from falling in terms of 'danger units'. Hence a driver rolling in his automobile at 25 m.p.h. carries with him one 'danger unit'. If he should suddenly apply the brakes, it will take 35 to 40 feet, or one street-width, to bring the car to a stop. In the case of a sharp turn or a slide, a car is liable to roll over once for each 'danger unit' it carries. On a dry concrete pavement, the safe turning radius of the automobile must be 80 feet longer for each of those units of energy.

With such concrete illustrations of the amount of energy carried when travelling at 25 m.p.h., it will be more easily realized by the layman what represents a rate of increase proportional to the square of the speed. In fact, should he turn too sharply when his speedometer marks 50, he is liable to roll over not only twice, because 50 is twice 25, but indeed four times, provided he is lucky enough not to hit a pole or a good solid wall before completing his turns. Should he hit the solid object directly, he will experience the same stubborn opposition as he would landing from an eight-storey jump.

The examples are still more striking when we think of the 70 m.p.h. speed which is common on many roads. At such a rate, one carries a carload of eight 'danger units', which is equivalent to a 16-storey jump or eight roll-overs. Should he realize it suddenly and apply the brakes, it will take him eight street-widths before he can stop and think it over. Seeing auto danger through the speedometer does not give a true picture, since the distance on the dial between 35 and 45 is the same as between 45 and 55. Yet, one is storing energy or 'danger units' twice as fast between 45 and 55 as he was between 35 and 45. The slogan is suggested, 'It's the extra D.U. that gets you!'

This new concept of danger developed in the annual booklet published by the Travelers Insurance Company, although it is meant for the general public, may be of interest to engineers since it is based on a scientific principle.

LIGHTING SYSTEM FOR AIR RAID PRECAUTIONS

Engineering, May 26th, 1939

A system of artificial lighting, for rendering factories invisible from the air at night, has been developed by Messrs. Metropolitan-Vickers Electrical Company Limited, of Trafford Park, Manchester. The system involves two components—a sodium source fitted with an enveloping filter, and a lacquer in the complementary colour of the emitted light, which is sprayed on to windows, roof lights, etc. The lamp and filter produces a narrow band of monochromatic yellow light to which the lacquer is opaque, and it is claimed that their combined use does not allow any visible radiation to penetrate into the outside atmosphere. The lacquer is sprayed on to the outside of the glass, forming a matt surface which prevents light from outside sources being reflected on it, and yet allows sufficient daylight (10 per cent) to pass for general machine work and assembly processes to be carried out on a normal day without recourse to artificial lighting. For any precision marking, or for work of a similar nature, additional artificial lighting may be required in the daytime, but at night the sodium illumination, which is of a highly efficient type, is sufficient to meet all ordinary needs. The enveloping filter, which absorbs about 40 per cent of the illumination from the discharge lamp, is readily detachable and need not be fitted in time of peace. For small undertakings, where the installation of a sodium lamp is not required, a similar system using an ultra-violet, or gas filled metal filament lamp with filter, in conjunction with a similar lacquer is stated to be quite satisfactory. The advantages of the complementary-colour system of artificial lighting are that it dispenses with the need for a costly installation of blinds and shutters over a large area of glass, and also allows the workers to operate in conditions of natural lighting, which are impossible with the alternative method of black painted glass.

TERRAIN CLEARANCE INDICATOR

By Lloyd Espenshied and R. C. Newhouse in the Bell System Technical Journal, January, 1939

Abstracted by H. J. Vennes, A.M.E.I.C.

The problem of an altimeter for aviation has engaged the attention of many inventors and experimenters for twenty years or more. The familiar aneroid altimeter has reached a high degree of perfection and enables the pilot to maintain level flight at any desired altitude but it gives no clue as to the variation of the elevation of the terrain beneath. The pilot has to know his position at all times and perform a mental calculation in order to know his height above the ground at any given moment. A number of airplanes have drifted off their normal courses and have crashed on higher ground. An altimeter based upon the use of a sound echo is subject to two fundamental limitations. The first of these limitations is the extremely high noise level produced by the airplane's motors and propellors. The second is that the speed of sound is not enough greater than the speed of airplanes.

There is in radio the corresponding phenomenon of an echo, an electric-wave reflection. The velocity of a radio signal is so great that an echo from the earth's surface is almost instantaneous; in fact, the time interval is so small as to give rise to a problem in measuring it. For instance, for heights less than a thousand feet the time to be measured is less than two millionths of one second.

The method used in the present instrument is extremely simple in theory. A radio transmitter is provided on the airplane which sends towards the earth a signal, the frequency of which changes at a definite rate with respect to time. The signal is reflected by the earth and returns as an echo after a time delay equal to twice the height, divided by the velocity of propagation. During this interval the frequency of the transmitter has changed and now differs from that of the echo by an amount equal to the product of the rate of change of frequency and the time of transit. The reflected wave is combined in the plane receiver with some of the outgoing wave energy and the difference or "beat" frequency is measured by a frequency meter. Since the reading of the meter is that of the "beat" frequency, it is proportional to the time delay of the echo and, hence, to height and thus can be calibrated directly in feet.

The terrain clearance indicator in its present experimental form indicates altitudes between approximately twenty and five thousand feet. When over smooth water or land, it is subject to errors as indicated by a consideration of the fundamental equation upon which the altimeter is based. A total error of ± 9 per cent might occur if all the errors were simultaneously in the same direction. Fortunately, all these are of a percentage nature, so that the error in feet becomes smaller as the ground is approached. An absolute error in the indication is still possible because of the limitations of the milliammeter used on the instrument panel. The Weston aircraft meter used is guaranteed to be correct to within one per cent of its full scale reading at any point on its scale, which permits maximum errors of ten feet on the 1000-foot scale and fifty feet on the 5000-foot scale.

Tests have been made over New York, Raritan, Newark and San Francisco Bays, Great Salt Lake, Lakes Erie and Michigan, the timbered mountains of Washington and Oregon, the deserts and mountains of the southwest and the cultivated areas of the midwest during the period of the recent demonstration flights made with the equipment installed in the United Air Lines Flight Research Airplane.

An indication of the character of the surface over which the airplane is flying is given by the variations in the meter reading. A city usually causes rapid fluctuations of the order of fifty feet, depending, of course, upon the height and the spacing of the buildings. Cultivated farmland causes fluctuations of lower frequency and amplitude. An isolated high object such as a skyscraper or a chimney is indicated only by a slight meter kick as the airplane passes over it, which may not be noticed by the observer. If the airplane passes over only a few feet above the object and the top is large enough to contribute momentarily most of the echo signal received by the airplane, the indication is unmistakable and the correct distance to the object is indicated by the meter. For instance, the gas storage tank near the Chicago airport is an excellent object upon which to demonstrate the altimeter performance. The instrument is useful as a position indicator when approaching an airport on a course which crosses an obstruction of appreciable height and size since the moment of passage over the obstruction is clearly indicated. In fact, use as a position indicator may be one of the altimeter's most valuable applications.

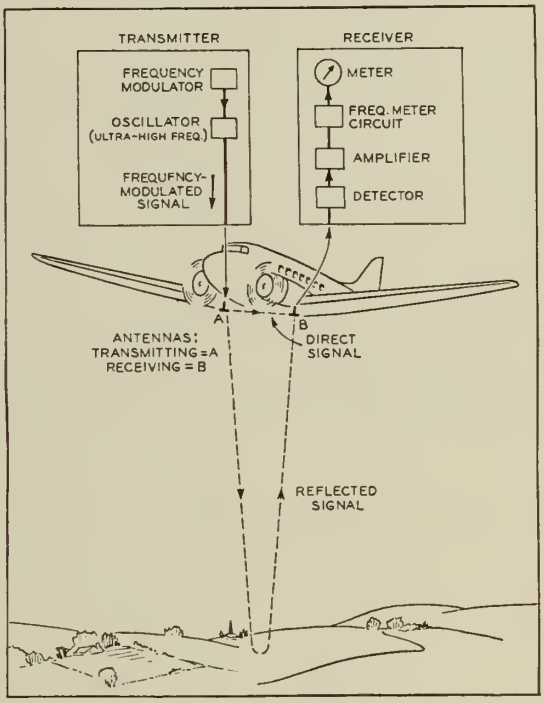

Fig. 1—Overall system.

A study of the circumstances in connection with a number of crashes in the west during recent years has revealed that in most of the cases the airplanes crashed after having been within a few feet of the ground without the pilot knowing it for several minutes before they struck. In such a situation the terrain clearance indicator should be capable of warning the pilot in ample time to avert a crash.

Editorial Comment...

ENGINEERS IN THE NEWS

It is not unusual to see names of engineers in the news, but it is unusual that in one issue of a paper, in two different editorials, mention is made of three members of the Institute. This occurred in the *Montreal Gazette* of June 2nd. In the belief that many members may not have seen it, and that all members will be interested, portions of each editorial are reproduced herewith.

In the first instance tribute is paid to C. A. Magrath, Hon.M.E.I.C. The editorial deals with the King's speech in Victoria, B.C., wherein he said there is in the North "a field for enterprise for youth which it will take generations to exhaust." Following up on the subject of the development of northern Canada thus introduced, the editorial goes on to say—"In a thoughtful address before The Engineering Institute some little time ago Mr. C. A. Magrath, of Victoria, former parliamentarian and a man who knows the west as few men know it, visualized the possibilities of northern development, planned and co-ordinated, as a factor in, among other things, the solution of some of the prairie's major problems. Mr. Magrath is one of the comparatively few men of real vision in this country, a gentleman of long experience and of international reputation. He has no interest to serve other than the orderly acceleration of this country's progress. He would have the new areas of the Dominion brought into production under the guidance of men of known achievement in similar undertakings in this and other countries."

The second editorial pays compliment to the Hon. C. D. Howe, Hon.M.E.I.C., Minister of Transport, for the excellent work he has done with the Trans-Canada Air Lines, and to Denton Massey, A.M.E.I.C., member for Greenwood (Toronto), for his fairmindedness in acknowledging the Minister's achievements, even though a political opponent. As the *Gazette* says "such incidents are exceptional." A portion of the editorial reads as follows:

"It does not often happen in the House of Commons for the Opposition to pay tribute to any member of the Government however convinced members of the aforesaid Opposition may be as to the Minister's capacity and industry and the worth of his achievements. Nevertheless, and to the credit of the Conservative members, this occurred on Tuesday last during discussion of a Supply item under the heading of air service administration. The Minister of Transport, as most people are aware, has official responsibility over Trans-Canada Air Lines and there is evidence that he is discharging that responsibility with a vigor and with a success that do not always characterize the promotion of a business enterprise by the political head of a department of government.

"It is a record of noteworthy progress, so much so that Mr. Denton Massey was moved to compliment Mr. Howe and the Trans-Canada personnel on what has been accomplished. . . . Mr. Massey's frank commendation of the results achieved in a new and important branch of administration is in pleasing contrast with the ungenerous attitude usually adopted by opposition groups. Nevertheless, such incidents are exceptional, even when, as in the case of Mr. Howe, a minister finds himself in a position to give an impressively satisfactory account of his stewardship."

These gentlemen have brought credit to themselves and to their profession.

MARITIME PROFESSIONAL MEETING

The branches at Halifax, Sydney, Moncton and Saint John are planning to hold a professional meeting at Pictou Lodge, Pictou, N.S., on August 31st and September 1st. Such a meeting is particularly appropriate this year in view of the fact that the President is from the Maritimes.

A preliminary meeting also at Pictou is in session at the time this is being written, at which all the organization work will be done. Committees will be established, programmes settled, speakers selected and so on.

The Lodge will be reserved exclusively for the Institute on these dates. A special rate of $5.50 per day (American plan) has been arranged which of itself should be a great attraction. Not many places in Canada are as well situated or equipped for a meeting of this kind as is Pictou with its splendid air and scenery, and its lodge. These facts coupled with the ability of the Maritime branches to do well anything they undertake should bring many engineers not only from New Brunswick and Nova Scotia, but from farther west as well.

A Council meeting will be held there on the afternoon of August 30th. A complete programme will be available for the August Journal.

DETERIORATION OF CONCRETE

As an outcome of the 1936 meeting of the World Power Conference, committees were formed to study the deterioration of concrete structures. In Canada the work was undertaken by a special committee of the Institute under the chairmanship of R. B. Young, M.E.I.C., and the vice-chairmanship of E. Viens, M.E.I.C.

The work was classified under three headings, i.e., causes, repairs, and prevention. The chairman now reports that it was considered a more constructive method to attack the problem first from the angle of how to repair the damage, rather than from a study of the causes. The more academic side of the question will take longer, and therefore has been left until later for a more intensive investigation.

Reports by committee members have been submitted to the chairman, and it is the Journal's privilege in this issue to give to its readers the first one which has been approved for publication. Others will appear in subsequent numbers. The committee invites the comments of members of the Institute.

PRESIDENTIAL ACTIVITIES

The President has had a very full month of Institute affairs. The following notes give a brief outline of his activities.

On May 26th he attended the annual meeting of the Niagara Peninsula Branch at St. Catharines.

On May 27th he presided at a meeting of Council held in Hamilton, and on the 29th addressed the Hamilton Branch at a meeting held at McMaster University.

On May 30th he visited London and during the day spoke to the entire student body at two of the principal schools. At the Technical Collegiate Institute, before an audience of fifteen hundred, he spoke on "The Field Industry Offers the Trained Mechanic." At the Central Collegiate Institute, before almost the same number, he talked on "The Purpose of a College Education." In the evening he spoke to the London Branch on Institute affairs.

On the 31st the President was at Windsor, where the Border Cities Branch held a special meeting to greet him. At all these Ontario meetings the President was accompanied by Vice-President Buchanan and several of the Ontario councillors.

The St. Maurice Valley Branch turned out in splendid numbers at Grand' Mère for the President's visit on June 8th. From there, he motored to Arvida to spend an evening with the Saguenay Branch on the 9th.

The President represented the Institute at two annual meetings of important sister societies. On June 21st and 22nd he attended the meeting of the Mining Society of Nova Scotia at Pictou, N.S., and on the 24th he spoke to the members of the Canadian Electrical Association at Digby, N.S.

The President plans to visit the western branches in the fall.

On the occasion of the King's birthday, celebrated in Canada on May 20th, President McKiel, on behalf of the Institute, sent a telegram to His Majesty extending congratulations and good wishes, and assuring him of the Institute's loyalty and desire to be of service. An acknowledgement was received from the King's Private Secretary, which reads as follows: "The Private Secretary is commanded by The King to thank sincerely the President and Members of The Engineering Institute of Canada for their kind message."

ECOLE POLYTECHNIQUE TAKES THE LEAD

An analysis of the lists of this year's engineering graduates reveals the interesting fact that at l'Ecole Polytechnique de Montréal every graduate with the exception of three is a student member of The Engineering Institute. This is 90 per cent, which is the highest figure obtaining at any Canadian university. The University of New Brunswick, at Fredericton, where there is no branch of the Institute, is next with a percentage of fifty, followed by Saskatchewan, where the figure is forty-six per cent.

It would greatly increase the usefulness of the Institute if the figures for all universities were as high as at Ecole Polytechnique. Perhaps no greater service could be rendered the Institute than that transfusions such as this should take place at every university. In return the Institute could give to the embryo engineer the help and encouragement which he will need when he steps over the line that separates his university work from his life work.

PARIS ENGINEERS VISIT MONTREAL

On June 12th a few members of the Institute had the pleasure of dining with Messrs. Charles Galatoire-Malégarie, Director General of the Compagnie Parisienne de Distribution d'Electricité, and Georges Smagghe, chief engineer of the same company. These gentlemen were in Montreal on their way back to Paris from New York, where they have been supervising the preparation of the electrical industries exhibit at the French pavilion at the World's Fair.

Monsieur Malégarie is well known to many Canadian engineers, having visited this country on previous occasions and especially after the World Power Conference held in Washington in 1936.

In the course of the conversation, he made some impressive remarks on the community of interests and ideals which exist between the great democracies.

The dinner which was held at the Cercle Universitaire was presided over by Huet Massue, M.E.I.C.

The following day, the French engineers made a visit to Headquarters of the Institute.

CORRESPONDENCE

THE EDITOR, May 24, 1939.
The Engineering Journal
Dear Sir:

I have before me the "coming-of-age" number of The Engineering Journal. It revives many interesting experiences, and I am herein yielding to the temptation to speak of some of them for your information, and perhaps for the information of the readers.

I was particularly interested in the page signed by Past-President Vaughan, and his reference to the change in name from The Canadian Society of Civil Engineers to The Engineering Institute of Canada. I have been wondering if there is a record any place of how that change really came to pass.

To Professor H. E. T. Haultain must go the principal credit for this reformation as he was chairman of the Committee on Society Affairs which recommended it.

Professor Haultain's committee was supported by a subcommittee in each branch, and the principal interest was a revision of the by-laws which might result in attracting other than civil engineers into the Society. In Ottawa the sub-committee was made up of G. B. Dodge, R. deB. Corriveau, and the writer. We met every day for one hour over a period of three months.

At the meeting in Montreal, under Professor Haultain's guidance, three long days were spent in settling many issues. I was called on by the chairman to speak of a topic which he knew I had on my mind. With some diffidence I presented my reasons for recommending the change of name, but unfortunately my suggestion did not get a sympathetic hearing. I do not think there was one delegate in the group from coast to coast who was willing to support me.

At the end of the meeting Professor Haultain was summing up the three days' activities, and he concluded with a request that a discussion be given to my "important suggestion" of changing the Society's name. A discussion followed, but not much enthusiasm was evinced. I well remember the dulcet tones of that refined gentleman from Quebec, Mr. Doucet, saying, "After all, Mr. Murphy, don't you think that a sentimental reason is a good reason?". My answer was, "One bearing my name should not be asked such a question. I come from a race of people who die for sentiment."

After the meeting was over, Professor Haultain came to my office in Ottawa to inaugurate a campaign for changing the Society's name. Professor Haultain worked relentlessly with members all over the country, with the result that when the committee met again in Montreal a few months later the proposal to change the name to The Engineering Institute of Canada was carried unanimously, which shows you that a just cause can be advanced satisfactorily if properly planned and prosecuted.

All this is written because, as I said in the beginning, I don't think there is any mention in the records of the Institute of how this great change actually came to pass.

Sincerely yours,

(Signed) JOHN MURPHY.

A NEW PUBLICATION

A new publication in the field of current engineering literature appeared during the month of May. This is the International Power Review, which its publishers describe as an "international digest for engineers and manufacturers."

The first number has just been received, and it is interesting to note that the first paper published therein is taken from The Engineering Journal of July, 1938, the title being "The Use of Hydrogenation in the Production of Aviation Fuels," by T. E. Warren. Another paper, "Railways Progressing towards Continuous Rails," by H. C. Drake, is also extracted from the Journal of September, 1938.

As the title indicates the "Review" is made up almost entirely of condensed versions of papers appearing elsewhere. Its object is to "give you each month a condensed report of the most important developments in each country where engineering is an important industry, with sufficient details to keep you informed of modern progress in research, manufacturing technique, and industrial applications."

Volume I, Number I, makes very interesting reading. If this standard can be maintained the publication should become popular, as it brings to the reader a simplified method of keeping in touch with world progress in matters that have to do with power. The central office is in Budapest, Hungary, but the British edition is published in London under the editorship of J. V. Brittain, A.M.I.Mech.E., A.M.I.E.E.

Extracts from International Power Review will appear from time to time in the appropriate section of The Engineering Journal.

BRITISH-AMERICAN ENGINEERING CONGRESS AT NEW YORK

PROGRAMME OF PAPERS AND AUTHORS

CIVIL SECTION, COLUMBIA UNIVERSITY

Tuesday, September 5th

A.M.—General meeting—Subject: **Activities for the Improvement of the Social and Economic Status of the Members of the Civil Engineering Profession.**

Institution of Civil Engineers

Sir Clement D. M. Hindley, K.C.I.E., M.A.

Engineering Institute of Canada

C. R. Young, Professor of Civil Engineering at University of Toronto, jointly with R. F. Legget, Assistant Professor, Civil Engineering, University of Toronto.

American Society of Civil Engineers

E. R. Needles, Consulting Engineer.

Wednesday, September 6th

A.M.—Simultaneous sessions.

(1) **Advances in Construction Methods and Equipment.**

Institution of Civil Engineers

W. Storey Wilson, M.C., B.SC., Engineering Director, Holloway Bros. (London) Ltd.

Engineering Institute of Canada

J. A. McCrory, Vice-President, Chief Engineer, Shawinigan Engineering Company.

American Society of Civil Engineers

Edward P. Palmer, Consulting Engineer, and Harold W. Richardson, Associate Editor, Engineering News-Record.

(2) **Advances in the Domestic Uses of Electricity—Farm, Home, etc.**

Engineering Institute of Canada

Dr. O. O. Lefebvre, Controller, Province of Quebec Electricity Board.

American Society of Civil Engineers

Frederick W. Doolittle, Director, The North American Co.

(3) **Modern Sanitation and Water Supply Practice.**

Institution of Civil Engineers

David M. Watson of J. D. and D. M. Watson.

J. R. Davidson, C.M.G., M.SC., Chief Engineer, Metropolitan Water Board.

Engineering Institute of Canada

Dr. William Storrie, Consulting Engineer, jointly with Dr. A. E. Berry, Director, Sanitary Engineering Division, Dept. of Health for the Province of Ont.

American Society of Civil Engineers

Malcolm Pirnie, Consulting Engineer, jointly with Abel Woolman, Professor of Sanitary Engineering, Johns Hopkins University.

P.M.—Simultaneous sessions.

(1) **Landing Fields—Airdromes.**

Institution of Civil Engineers

R. L. Nunn, D.S.O., Director of Public Works, Singapore, S.S.

Engineering Institute of Canada

Hon. C. D. Howe, Minister of Transport, jointly with Philip G. Johnson, Vice-President, Trans-Canada Air Lines.

American Society of Civil Engineers

W. W. Pagon, Consulting Engineer.

(2) **City Planning.**

Institution of Civil Engineers

H. J. Manzoni, City Engineer, Birmingham.

Engineering Institute of Canada

Dr. Arthur Surveyer, Consulting Engineer, jointly with Dr. Jacques Greber, Professor, Town Planning Institute, University of Paris, and Aimé Cousineau, Superintendent Engineer, Department of Health, City of Montreal.

American Society Civil Engineers

Jay Downer, Consulting Engineer.

(3) **Soil Mechanics and Foundations.**

American Society of Civil Engineers

William P. Kimball, George L. Freeman, Donald M. Burmister and Hamilton Gray.

Thursday, September 7th

A.M.—Simultaneous sessions.

(1) **Soil Mechanics,** continued.

Arthur Casagrande and Charles Terzaghi.

(2) **Advances in Structural Design—Vibration in Bridges, Wind Pressure on Structure.**

Institution of Civil Engineers

C. E. Inglis, O.B.E., M.A., LL.D., F.R.S., Professor of Engineering at Cambridge University.

American Society of Civil Engineers

O. H. Ammann, Director of Engineering, Port of New York Authority.

George E. Howe, Designing Engineer, American Bridge Company, New York.

(3) **Modern Highway Practice.**

Institution of Civil Engineers

J. G. Pidgeon, Engineering Inspector, Ministry of Transport, Roads Department.

Engineering Institute of Canada

R. M. Smith, Deputy Minister, Department of Public Highways for Ontario.

American Society of Civil Engineers

Murray D. Van Wagoner, State Highway Dept., Lansing, Mich.

MECHANICAL SECTION, ENGINEERING SOCIETIES BUILDING

All papers are devoted to the mechanical problems of modern transportation, under the following classifications:

Tuesday, September 5th

A.M.—**Marine Transport.**

Sterry B. Freeman, Superintending Engineer, Alfred Holt and Co., Liverpool, England.

Robert C. Lee, Vice-President, Moore and McCormick Co., Inc., New York, N.Y.

Wednesday, September 6th

A.M.—**Light-Weight High-Speed Trains**

William A. Stanier, Chief Mechanical Engineer, L.M. and S. Railway, London, England.

Charles T. Ripley, Chief Engineer, Technical Board, Wrought Steel Wheel Industry, Chicago, Ill.

Thursday, September 7th

A.M.—**Highway Transportation**

E. C. Ottaway, Technical Officer, London Passenger Transport Board, London, England.

F. C. Horner, Assistant to the Chairman, General Motors Corp., New York, N.Y.

Friday, September 8th

A.M.—**Trans-Atlantic Airplanes**

A. Gouge of Short Bros., Rochester, England.

Edmund T. Allen, Director of Aero-dynamics and Flight Research, Boeing Aircraft Co., Seattle, Wash.

JULIAN CLEVELAND SMITH

M.E., E.E. (Cornell), LL.D. (Queen's and McGill), M.E.I.C., F.A.I.E.E., Mem. Am. Soc. C.E., M.Inst.C.E.

One of Canada's outstanding engineers passed away Saturday morning, June 24, in his 61st year, at his home in Westmount, Quebec, after a lingering illness. For over a third of a century Julian Smith's creative mind had so powerful an influence on the hydro-electric industry of the Dominion that he was everywhere recognized as one of its foremost leaders. Perhaps the broad scope of his engineering and executive ability is indicated best by the transformation that since the turn of the century has taken place in the St. Maurice Valley in the Province of Quebec. A great river flowing for two hundred and forty miles from its sources in the northern forests into the St. Lawrence, unharnessed in 1900, has, as a result of his foresight, enthusiasm and courage, become the main source of power for one of the notable electrical utility systems on the continent. While hundreds of engineers have given of their best in working out the many phases of the basic plan for utilizing the potential two million horse-power of the St. Maurice, Julian Smith was their guiding genius for thirty-five years. The hydraulic engineers who were responsible for the water conservation pro-programme; the civil and mechanical engineers who have developed nearly one million horse-power at the falls of Shawinigan, Grand'-Mère, La Gabelle, Rapide Blanc, and, presently, of La Tuque; the electrical engineers who designed the transmission and distribution network that covers the greater part of central Quebec; the chemical and research engineers who perfected processes that brought to the St. Maurice Valley some of the Dominion's principal industries—all gratefully acknowledge the professional inspiration received from their late chief.

Julian Cleveland Smith, M.E.I.C. Died June 24th, 1939

The recognized eminence of Julian Smith in the industrial, the banking, the utility, the transportation, the scientific and the university life of the Dominion is attested by the following partial list of the positions he held:

President: The Shawinigan Water & Power Company
Quebec Power Company
St. Maurice Power Corporation
United Securities Limited
The Canadian Light & Power Company

Vice-President: The Royal Bank of Canada
Dominion Bridge Company
Dominion Engineering Works

Director: Canadian General Electric Company
Consolidated Paper Company
Montreal Light, Heat & Power Cons.
Montreal Island Power Company

Director: Montreal Trust Company
Saguenay Electric Company

Governor: Montreal General Hospital
McGill University

Member: National Research Council

Notwithstanding his many corporate responsibilities, he found time to take a leading part in the work of the engineering societies of Canada, England and the United States. In 1928 he became the 39th president of The Engineering Institute of Canada, and for some time he has been the chairman of the Advisory Committee for Canada of the Institution of Civil Engineers of Great Britain. No matter how preoccupied he might be in shaping the policies of the many important corporations in which he was a dominant factor, he was often to be found in the Shawinigan board room closeted with officers of the Institute who were seeking his advice and assistance. He strongly supported their efforts to effect a real *entente cordiale* between the Institute and the provincial licensing associations. He urged close and continuous co-operation with the sister societies south of the international boundary. Being anxious that the Institute should be more aggressively concerned about its responsibility not only to guide the professional progress of the young engineer, but to guard his social and cultural advancement, he was greatly pleased when informed of the preparations that are being made by the Institute to minister more effectively to those young Canadians who enter the engineering profession. His last society activity was a generous encouragement of the Institute's participation in the congress of British and American engineers in New York next September.

His acts were always marked by that courtesy and charm, that poise and patience, which spring from nobility of character; he carried the weight of an unexampled technical knowledge with a modesty that was one of his most lovable traits. Even so, he led firmly, ruled wisely and commanded easily, developing in each new colleague a feeling of trust and respect which soon ripened into a deep and abiding affection.

A peerless executive; a conservator of national resources; a supporter of modern hospitalization; a pioneer in scientific and industrial research; an expert astronomer; a business and banking director of proven worth; an able governor of a great university; a firm believer in the *bonne entente;* a tried and true friend to high and low, to rich and poor. One of the builders of Canada has just experienced "The ultimate breaking strain."

J. B. C.

MEETING OF COUNCIL

A meeting of the Council was held at the Royal Connaught Hotel, Hamilton, Ontario, on Saturday, May 27, 1939, at 10.15 a.m.

There were present: President H. W. McKiel in the chair; Vice-President E. V. Buchanan (London); Councillors J. L. Busfield (Montreal), R. H. Findlay (Montreal), A. B. Gates (Peterborough), O. Holden (Toronto), H. A. Lumsden (Hamilton), W. R. Manock (Niagara Peninsula), H. Massue (Montreal), A. U. Sanderson (Toronto), J. A. Vance (Woodstock), E. Viens (Ottawa), and the General Secretary. The following were also present by invitation: Past Vice-Presidents H. G. Acres, R. L. Dobbin and A. H. Harkness; Past-Councillors E. H. Darling, E. P. Muntz, R. K. Palmer and F. W. Paulin; Branch Chairmen H. F. Bennett (London), B. Candlish (Border Cities), and C. G. Moon (Niagara Peninsula); J. R. Dunbar, chairman, V. S. Thompson, vice-chairman, H. B. Stuart and W. L. McFaul, past chairmen, A. R. Hannaford, secretary-treasurer, Alex. Love, past secretary-treasurer, and the following members of the Hamilton Branch executive—I. F. McRae, W. J. W. Reid, S. Shupe, and N. Wagner; K. O. Whyte, chairman of the Institute Membership Committee; M. Barry Watson, Registrar of the Association of Professional Engineers of Ontario; F. P. Adams, of Brantford, and G. W. House, of Hamilton. President McKiel extended a cordial welcome to all councillors and guests.

The President reported that on the King's official birthday he had sent a telegram to His Majesty, on behalf of the Institute, assuring him of the Institute's loyalty and desire to be of service. This action was unanimously approved.

The General Secretary reported that the Radio Broadcasting Committee was proceeding with its work, and that the Institute branches had been requested to suggest topics peculiar to their neighbourhood which would be suitable for the broadcasts, which it is hoped to commence in the fall.

The President presented a preliminary report of the Committee on International Relations, giving details of the arrangements which are being made for the International Engineering Congress to be held in New York in September.

The President outlined the purposes of the investigation to be made by the Committee on the Young Engineer, and discussion followed on the draft instructions from Council to that committee which had been prepared. After discussion, it was unanimously resolved that these instructions be approved.

Mr. Bennett, chairman of the committee, reported on the progress made since the Council meeting in Toronto. The committee's work would fall under three headings, namely,

(1) Pre-college training and selection of students
(2) The nature of the curricula of the engineering colleges
(3) The guidance and training of the young engineer in the years immediately following graduation, and the responsibility of The Engineering Institute to these men.

Mr. Holden reminded the meeting that these questions had been reported upon by the Toronto Branch with the idea of seeing what could be done to level out the demand for the various courses at the universities. Mr. Gates suggested to the committee that talks to high school students should be given one or two years before graduation. Mr. Muntz hoped that the committee's work would tend towards consolidating engineering groups rather than increasing the diversity of specialized lines of training. He thought specialization should take place either in a postgraduate course or in industry. Discussion followed on the proper name for the committee, after which it was left with the committee itself to give consideration to a proper title.

Mr. Bennett reported that his committee, having considered the subject of giving Student memberships in the Institute as prizes, would recommend that such membership be awarded to the authors of all papers of merit, the memberships to be for a period of one year, subject to extension in certain cases. It was also recommended that these free memberships be confined to one hundred each year. After discussion, the question of the proper handling of these prizes was referred back to Mr. Bennett's committee with a request to report further at a subsequent meeting.

The Secretary reported that Mr. Gaherty, after an interview with General McNaughton in Ottawa, reaffirmed his recommendation that a strong committee be appointed to survey the situation in regard to industrial preparedness. After discussion, it was unanimously resolved that a small committee, to be named by the President, be appointed for this purpose to report at a later meeting of Council.

The report of the scrutineers on the proposed amendments to Sections 32 and 35 and for a new by-law 77 was presented, and, more than two-thirds of the accepted ballots having been favourable, the amendments and the new by-law were declared to have carried.

Mr. Muntz reported that at the request of Council he had represented the Institute at the Foreign Trade Conference of the Canadian Chamber of Commerce, held in Hamilton on May 8th and 9th. The President expressed Council's appreciation to Mr. Muntz, and Council noted the desirability of the Institute being represented at such conferences.

The Secretary presented a letter from the Halifax Branch requesting the sanction of Council for a Maritime Professional Meeting, to be held at Pictou Lodge, Nova Scotia, on August 30th and 31st, 1939, the Saint John, Moncton and Cape Breton branches co-operating.

After discussion, it was unanimously resolved that Council authorize the Maritime Professional Meeting requested by the Halifax Branch.

The financial statement up to April 29th, 1939, was presented by the Secretary on behalf of the chairman of the Finance Committee, and it was noted that income was ahead of the budget and expenditure lower.

Five resignations were accepted; the names of two members were placed on the Life Membership List; a number of special cases were considered, and the names of four members were removed from the membership list.

After adjournment for lunch, the President presented a progress report of the activities in Manitoba and Alberta in respect to co-operation with the respective associations of professional engineers. A draft agreement had been prepared for consideration in Manitoba, and would shortly be considered. In Alberta the Institute had been approached by the Alberta Association and asked to set up a committee to co-operate with the Association's committee with a view to inaugurating in Alberta an agreement similar to that in Saskatchewan.

The President reported that it had been found desirable to consider the manner in which the Publication Committee could be of most assistance in the publication of The Engineering Journal. Discussions had resulted in the preparation of a memorandum regarding the publication which he presented for endorsation.

Mr. Findlay was of opinion that the Publication Committee should have the same authority in regard to the Journal as that given to it by the by-laws in respect to Transactions. He therefore suggested that the Council extend the functions of the Publication Committee. The President was of opinion that since this memorandum had been agreed upon by the President, the chairman of the committee, several councillors, and the General Secretary, Council should give its approval. After discussion, it was resolved that the publication of the Journal be handled in accordance with the memorandum which had just been read by the President.

Council noted with appreciation that Mr. K. O. Whyte, of Montreal, had accepted the chairmanship of the Institute Membership Committee. At Mr. Whyte's suggestion, the membership of the committee was approved as follows, with power to add to their number: K. O. Whyte, chairman; H. Massue and H. J. Vennes of Montreal, and C. E. Sisson, of Toronto. It was suggested that the chairmen of the various branch membership committees should be ex-officio members of the Institute committee.

Council accepted with appreciation an invitation from the Toronto Branch to hold the 1940 Annual Meeting in Toronto, and the Secretary was instructed to convey the thanks of Council to the branch.

It was unanimously resolved that Mr. E. P. Muntz be reappointed as the Institute's representative on the National Construction Council of Canada, with Mr. A. H. Harkness as alternate.

The Secretary reported correspondence with the Board of Trade of the City of Toronto regarding a definition of the term "air conditioning," particularly as applied to industry as well as to human comfort. After discussion, it was unanimously agreed that the Council felt that the definition suggested by the Toronto Board of Trade covered in a broad way air conditioning for human comfort, but that the wider scope of air conditioning should be referred to a competent authority to set up a code, the most suitable body being the Canadian Engineering Standards Association.

In accordance with the terms of the agreement with the Association of Professional Engineers of Saskatchewan, Council classified a number of members who had joined the Association since the signing of the agreement. Seventeen were classed as Associate Member, and one Junior and thirteen Students were added to the list.

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

Elections	
Members	6
Associate Members	15
Juniors	9
Affiliates	1
Students Admitted	9

Transfers	
Associate Member to Member	2
Junior to Associate Member	5
Student to Associate Member	2
Student to Junior	6

The Council rose at 4.30 p.m.

THE ENGINEERING INSTITUTE OF CANADA PRIZE AWARDS 1939

Eleven prizes known as "The Engineering 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	J. D. Kline
University of New Brunswick	James O. Dineen
McGill University	Earle Lester Robert Webb
Ecole Polytechnique	Jules M. Mercier, S.E.I.C.
Queen's University	B. G. McIvor
Royal Military College of Canada	G. C. Baker
University of Toronto	Thomas McCallum Kingsbury
University of Manitoba	Benjamin Baker
University of Saskatchewan	Donald Winslow Henderson
University of Alberta	Theodore Milne Schulte
University of British Columbia	John Duncan Leslie

RECENT GRADUATES IN ENGINEERING

Congratulations are in order to the following Students and Associate Members of the Institute who have completed their courses at the various universities:—

THE UNIVERSITY OF BRITISH COLUMBIA

PRIZE

Sutton, Arthur L., Vancouver, B.C., B.A.Sc. (Elec.); the Walter Moberly Memorial Prize.

DEGREE OF BACHELOR OF APPLIED SCIENCE

Breeze, John E., Vancouver, B.C., B.A.Sc. (Elec.).
Farmer, Philip J., Vancouver, B.C., B.A.Sc. (Elec.).
Garvie, Laurence, New Westminster, B.C., B.A.Sc., (Elec.).
Harrison, George E., Victoria, B.C., B.A.Sc. (Elec.).
Hetherington, W. L., Vancouver, B.C., B.A.Sc. (Elec.).

UNIVERSITY OF ALBERTA

HONOURS AND PRIZE AWARDS

Anderson, Lloyd Francis, Edmonton, Alta., B.Sc. (Elec.); Honours in Electrical Engineering; Association of Professional Engineers of Alberta Prize in Electrical Engineering.
Thorssen, LeRoy Allan, Edmonton, Alta., B.Sc. (Ci.); Honours in Civil Engineering; Association of Professional Engineers of Alberta. Prize in Civil Engineering.

DEGREE OF BACHELOR OF SCIENCE

Balderson, Kenneth, Edmonton, Alta., B.Sc. (Elec.).
Gads, Leonard Eustace, Edmonton, Alta., B.Sc. (Ci.).
Johnson, Frederick Paul, Edmonton, Alta., B.Sc. (Elec.).
King, Wilbur Archibald, Edmonton, Alta., B.Sc. (Elec.).
McArthur, Donald Stewart, Saskatoon, Sask., B.Sc. (Chem.).
McAulay, Graham Falconbridge, Edmonton, Alta., B.Sc. (Ci.).
McPherson, Eugene Lionel, Vulcan, Alta., B.Sc. (Elec.).
Monaghan, Cecil, Edmonton, Alta., B.Sc. (Elec.).
Nelson, Alvin Clarence, Edmonton, Alta., B.Sc. (Elec.).
Patterson, Charles Francis, Edmonton, Alta., B.Sc. (Elec.).
Prokopy, Peter, Edmonton, Alta., B.Sc. (Ci.).
Robinson, Eric Frank Vernon, Edmonton, Alta., B.Sc. (Elec.).
Slipp, John Gillespie, Edmonton, Alta., B.Sc. (Elec.).
Steeves, Kenneth Leslie, Edmonton, Alta., B.Sc. (Ci.).
Wray, Robert Houston, Irricanna, Alta., B.Sc. (Elec.).

UNIVERSITY OF SASKATCHEWAN

HONOURS

Peterson, Robert Oscar, Plato, Sask., B.Sc. (Ci.); Great Distinction in Civil Engineering.

DEGREE OF BACHELOR OF SCIENCE

Beaton, William Neil, Saskatoon, Sask., B.Sc. (Mech.).
Carroll, Arthur Fredrick Gascoigne, Saskatoon, Sask., B.Sc. (Mech.).
Erickson, Peter Ole Mattias, Prince Albert, Sask., B.Sc. (Mech.).
Harding, Herman, Punnichy, Sask., B.Sc. (Ci.).
Lancefield, Harold Allan, Saskatoon, Sask., B.Sc. (Mech.).
Leroux, Fred Clements, Saskatoon, Sask., B.Sc. (Agri. Eng.).
McArthur, Donald Smith, Toronto, Ont., B.Sc. (Chem.).
Olafson, Magnus Joseph, Mildmay Park, Sask., B.Sc. (Mech.).
Pagon, Robert Nelson, Davidson, Sask., B.Sc. (Mech.).
Rebin, Paul M., Blaine Lake, Sask., B.Sc. (Mech.).
Schwieder, Frank Mackay, Marquis, Sask. B.Sc. (Mech.).
Taylor, Harry, Winnipeg, Man., B.Sc. (Mech).

UNIVERSITY OF MANITOBA

MEDAL AWARDS

Demcoe, John William, Winnipeg, Man., B.Sc. (Ci.); University Gold Medal, in Civil Engineering.
Gusen, Aaron, Winnipeg, Man., B.Sc. (Elec.); University Gold Medal in Electrical Engineering

DEGREE OF BACHELOR OF SCIENCE

Bethel, Vincent Walter, Winnipeg, Man., B.Sc. (Elec.).
Birt, Thomas William, Montreal, Que., B.Sc. (Elec.)
Burbidge, George Wheelock, Winnipeg, Man., B.Sc. (Ci.).
Dixon, Howard Henry, Winnipeg, Man., B.Sc. (Elec.).
Goddard, Albert Reginald, Winnipeg, Man., B.Sc. (Ci.).
Ingram, Walter Wellington, Winnipeg, Man., B.Sc. (Elec.).
Jarrett, William Frederick, Winnipeg, Man., B.Sc. (Elec.).
Joyce, William Anderson, Winnipeg, Man., B.Sc. (Ci.).
Korcheski, William Bruno, Fort William, Ont., B.Sc. (Ci.).
McKie, William Massey, Winnipeg, Man., B.Sc. (Elec.).
Malmgren, Harvey Russell, Winnipeg, Man., B.Sc. (Elec.).
Papik, Edward, Winnipeg, Man., B.Sc. (Elec.).
Strachan, Jack Lyon, St. Vital, Man., B.Sc. (Elec.).
Swan, Andrew Munro, Winnipeg, Man., B.Sc. (Elec.).
Wardrop, William Leslie, Whitemouth, Man., B.Sc. (Elec.).
Woodfield, Percy Raymond, Winnipeg, Man., B.Sc. (Elec.).

UNIVERSITY OF TORONTO

HONOURS AND PRIZES

Anderson, Paul Chenery, Toronto, Ont., B.A.Sc. (Elec.); Honours in Electrical Engineering.

Rapsey, William Woodside Toronto, Ont., B.A.Sc. (Elec.); Honours in Electrical Engineering.

Smith, Arthur Dale, Toronto, Ont., B.A.Sc. (Mech.); Honours in Mechanical Engineering; The American Society of Heating and Ventilating Engineers' Prize.

DEGREE OF BACHELOR OF APPLIED SCIENCE

Perry, George Thomas, Ottawa, Ont., B.A.Sc. (Chem.).
Read, Frederick Cyril, Toronto, Ont., B.A.Sc. (Chem.).
Ross, Joseph Hope, Toronto, Ont., B.A.Sc. (Elec.).
Rule, Russell Alfred, Toronto, Ont., B.A.Sc. (Ci.).
Stewart, Murray Douglas, Toronto, Ont., B.A.Sc. (Mech.).
Vatcher, Chesley Holmes, Toronto, Ont., B.A.Sc. (Elec.).
Young, William Mackey, Toronto, Ont., B.A.Sc. (Chem.).

DEGREE OF MASTER OF APPLIED SCIENCE

Bowering, Reginald, Toronto, Ont., B.Sc. (Manitoba), M.A.Sc.
Rubin, Leon Julius, Toronto, Ont., B.A.Sc. (Toronto), M.A.Sc.

DEGREE OF MECHANICAL ENGINEER

Campbell, Harold Montgomery, St. Catharines, Ont., B.A.SC., M.E.
Rutledge, Louis Traver, Kingston, Ont., B.A SC., M.E.

QUEEN'S UNIVERSITY

HONOURS AND MEDAL AWARD

Brooks, Joseph Warren, London, Ont., B.Sc. (Ci.); Honours in Civil Engineering; Departmental Medal.

Cuthbertson, Charles Cassels, Windsor, Ont., B.Sc. (Chem.); Honours in Chemical Engineering.

McNally, Patrick Jessett, Bartonville, Ont., B.Sc. (Mining); Honours in Mining Engineering.

Roy, J. A. Maurice, Quebec, Que., B.Sc. (Ci.); Honours in Civil Engineering.

DEGREE OF BACHELOR OF SCIENCE

Brown, Malcolm Corsan Sutherland, Victoria, B.C., B.Sc. (Ci.).
Cousineau, Yvon, Montreal, Que., B.Sc. (Mining).
Elliott, John Milton, Hamilton, Ont., B.Sc. (Mech.).
Ferguson, Jack Andrew, Port Stanley, Ont., B.Sc. (Mech.).
Frigon, Rosario, Shawinigan Falls, Que., B.Sc. (Mining).
Furanna, Anthony Louis, London, Ont., B.Sc. (Elec.).
Magee, Edward Desmond Boyd, Kingston, Ont., B.Sc. (Ci.).
Slater, Stewart, Kingston, Ont., B.Sc. (Ci.).
Spencer, George Hylton, Toronto, Ont., B.Sc. (Ci.).

ROYAL MILITARY COLLEGE OF CANADA

HONOURS AND PRIZES

Brown, L. H., Britannia Heights, Diploma; His Excellency the Governor-General's Silver Medal; Toronto Branch Trophy; Special Prize Award in Mathematics and Engineering; Large Bexhill Cup; Strong Gymnastic Shield.

Bourbonnais, J. V. G. A., Vaudreuil Station, Que., Diploma; Air Force Award.

DIPLOMAS

Couture, A. E., Quebec, Que.
Ward, K. R., Kingston, Ont.

McGILL UNIVERSITY

HONOURS, MEDALS AND PRIZES AWARDS

MacGowan, William Hartley, Montreal, Que., B.Eng. (Elec.); Honours in Electrical Engineering; British Association Medal; Montreal Light, Heat and Power Consolidated First Prize; The Anglin Bursary, 1938-39.

Nathanson, Sol, Montreal, Que., B.Eng. (Ci.); Honours in Civil Engineering; British Association Medal; The Robert Forsyth Prize in Theory of Structures and Strength of Materials.

DEGREE OF BACHELOR OF CIVIL LAW

Lefort, Jean, B.Eng., Montreal, Que., B.C.L.

DEGREE OF BACHELOR OF ENGINEERING

Adams, John Douglas, Montreal, Que., B.Eng. (Ci.).
Buchanan, Arnold Amherst, Montreal, Que., B.Eng. (Mech.).
Drury, Chipman Hazen, Montreal, Que. B.Eng. (Chem.)
Ferguson, David Herbert, Burnaby, B.C., B.Eng. (Mech.).
Ferguson, Robert Norman, Burnaby, B.C., B.Eng. (Mech.).
Gohier, Roch Edward, Montreal, Que., B.Eng. (Met.).
Hall, John Herbert, Montreal, Que., B.Eng. (Chem.).
Kenst, Richard John, Saskatoon, Sask., B.Eng. (Elec.).
Leblanc, Raymond Forté, Montreal, Que., B.Eng. (Mi.).
MacKay, Norman Allison, Sydney, N.S., B.Eng. (Mech.).
Mendelsohn, Albert I., Ste. Agathe des Monts, Que., B.Eng. (Mech.).
Oatway, Harold Calahan, Stoney Plain, Alta., B.Eng. (Mech.).
Platt, Peter Leverich Waddington, Newton Abbot, Devon., England, B.Eng. (Chem.).
Tait, Eric, Westmount, Que., B.Eng. (Ci.).
Tanner, William John, Longueuil, Que., B.Eng. (Chem.).

ECOLE POLYTECHNIQUE

DISTINCTIONS ET PRIX

Asselin, Hector, Outremont, Qué., B.Sc.A., I.C.; avec distinction; la médaille de bronze de l'Association des Anciens Elèves de l'Ecole Polytechnique.

Boulva, Charles, Montréal, Qué., B.Sc.A., I.C.; avec grande distinct.on; la médaille du Lieutenant-Gouverneur; la médaille d'or de l'Association des Anciens Elèves de l'Ecole Polytechnique; le prix Ernest Cormier; le prix Paul d'Aragon.

Dufresne, André, Montréal, Qué., B.Sc.A., I.C.; avec distinction; la médaille d'argent de l'Association des Anciens Elèves de l'Ecole Polytechnique; le prix de la cinquantième promotion de l'Ecole Polytechnique.

Lecavalier, Fernand, Montréal, Qué., B.Sc.A., I.C.; avec grande distinction.

Lemieux, Henri-Julien, Outremont, Qué., B.Sc.A., I.C.; avec distinction.

Leroux, Jacques P., Montréal, Qué., B.Sc.A., I.C.; la médaille de bronze de l'Association des Anciens Elèves de l'Ecole Polytechnique.

GRADES

Amyot, Jean, St. Josaphat de Chambly, Qué., B.Sc.A., I.C.
Béique, Freddy, Outremont, Qué., B.Sc.A., I.C.
Bélanger, Maurice, Outremont, Qué., B.Sc.A., I.C.
Charland, Roger, Montréal, Qué., B.Sc.A., I.C.
Décarie, Yves, Montréal, Qué., B.Sc.A., I.C.
Desjardins, Roger, Montréal, Qué., B.Sc.A., I.C.
Guénette, Paul, Montréal, Qué., B.Sc.A., I.C.
Lalonde, Jean, Outremont, Qué., B.Sc.A., I.C.
Lebel, Raymond, Montréal, Qué., B.Sc.A., I.C.
Ménard, Raymond, Montréal, Qué., B.Sc.A., I.C.
Morin, Alphonse, Montréal, Qué., B.Sc.A., I.C.
O'Donoughue, Gérald, Montréal, Qué., B.Sc.A., I.C.
Paré, Léandre, Montréal, Qué., B.Sc.A., I.C.
Piette, Guillaume, Montréal, Qué., B.Sc.A., I.C.
Provost, Roger, Montréal, Qué., B.Sc.A., I.C.
Quevillon, Olivier, Montréal, Qué., B.Sc.A., I.C.
Racicot, Jacques, Montréal, Qué., B.Sc.A., I.C.

THE UNIVERSITY OF NEW BRUNSWICK

MEDAL AWARDS

Gray, Cyril John, Fredericton, N.B., B.Sc. (Elec.); Brydone-Jack Memorial Prize.

MacKinnon, Donald Lauchlin, Fredericton, N.B., B.Sc. (Civil); Ketchum Silver Medal.

DEGREE OF BACHELOR OF SCIENCE

Cameron, Curtis Burnette, Fredericton, N.B., B.Sc. (Ci.).
Colby, Alan Rutherford, Fredericton, N.B., B.Sc. (Ci.).
Duffy, Francis Hubert, Saint John, N.B., B.Sc. (Elec.).
McAuley, Vincent Cronkite, Centreville, N.B., B.Sc. (Ci.).
McDermott, Burton Duncan, Edmundston, N.B., B.Sc. (Ci.).

NOVA SCOTIA TECHNICAL COLLEGE

MEDAL AWARDS

Dumaresq, James Philip, Halifax, N.S., B.E. (Ci.); His Excellency the Governor-General's Medal.

Stephenson, Eric Paul, Hazel Hill, N.B., B.E. (Elec.); Alumni Medal.

DEGREE OF BACHELOR OF ENGINEERING

Ackhurst, William Hall, Halifax, N.S., B.E. (Elec.).
Bartlett, Ewart Horwood, St. John's, Nfld., B.E. (Elec.).
Carey, Leslie Clement, Sackville, N.B., B.E. (Ci.).
Cheesemen, Edgar Wilfred, St. John's, Nfld., B.E. (Mining).
Smith, Edgar Bernard, Caledonia, N.S., B.E. (Elec.).
Ternan, James Gerald Joseph Breifni, Bedford, N.S., B.E. (Elec.).

COMING MEETINGS

American Society of Mechanical Engineers—1939 Semi-annual Meeting, July 10-15, San Francisco, Calif. Chairman of Registration and Information Committee, George L. Sullivan, professor of mechanical engineering, University of Santa Clara.

Canadian Good Roads Association—Twenty-fifth Annual Convention, September 12-14 at Chateau Frontenac, Quebec City. Secretary-treasurer, George A. McNamee, New Birks Building, Montreal, Que.

Canadian Institute on Economics and Politics—Eighth Annual Session, August 14-26, Geneva Park, Lake Couchiching, Ont.

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, has been elected chairman of the newly formed technical traffic committee of the Province of Quebec Safety League. Mr. Beaubien, who is a director of the Royal Automobile Club of Canada, has been concerned with the problems of highway safety for a long time.

Dr. F. A. Gaby, M.E.I.C., past-president of the Institute, has been elected president of the Empire Club of Canada. Dr. Gaby is the executive vice-president of the British-American Oil Company in Toronto.

Dean E. P. Fetherstonhaugh, M.E.I.C., of the University of Manitoba, was among the educationalists attending the National Conference of Canadian universities at the Royal Victoria College in Montreal during the week of May 29th.

H. R. Webb, M.E.I.C., is the new registrar of the Association of Professional Engineers of Alberta, appointed to replace P. L. Debney, A.M.E.I.C., who has retired. A graduate of the University of Alberta in civil engineering in 1921, Mr. Webb obtained his M.Sc. degree in the following year. He then joined the teaching staff at the University of Alberta as lecturer in civil engineering. Since 1928, he has been assistant professor of civil engineering.

A. Ross Robertson, A.M.E.I.C., manager of the Ontario Division of the Dominion Bridge Company, Toronto, is the newly elected president of the Industrial Accident Prevention Association.

Robert F. Legget, A.M.E.I.C., assistant professor of civil engineering at the University of Toronto, has written an interesting article, "The Engineer and the Community," which appeared in the October, 1938, issue of the *Dalhousie Review* and which has been reproduced in extenso in *The Engineer*, London, April 28th, 1939. The English publication also contains a lengthy editorial supporting the ideas expressed by Mr. Legget and commending him on his article.

Alex. Larivière, M.E.I.C., has been appointed, by the government of the Province of Quebec, member of the new Transportation and Communication Board. Mr. Larivière who is a graduate of the Ecole Polytechnique from which he received the degree of B.A.Sc. in 1913, was a member of the Public Service Commission which has been replaced by the new Board. He joined the Commission as engineer in 1916 on the completion of a post-graduate course in electrical engineering. He was appointed chief engineer in 1922 and in 1931 he was made commissioner.

S. A. Baulne, D.Sc., M.E.I.C., has been appointed by the Quebec government to the new administration commission of the University of Montreal which will have control over the finances of the institution and will direct the completion of the buildings on the Mountain. Mr. Baulne is a graduate of the Ecole Polytechnique, from which he received the degree of B.A.Sc. in 1901. Upon graduation he joined the Canadian Pacific Railway and a year later went with the Cambria Steel Company. In 1904 he was with the Locomotive and Machine Company and remained with this firm until 1907, when he went into private practice. Since 1917 he has been a partner of the firm Baulne and Leonard, consulting engineers, of Montreal. Mr. Baulne has been connected with the execution of many engineering projects in his capacity of consultant on structural steel and reinforced concrete. He was on the advisory board of engineering during the construction of the Jacques Cartier bridge in Montreal. Last year, he was appointed president of the province of Quebec National Electricity Syndicate. Dr. Baulne has been professor of structural engineering and reinforced concrete at the Ecole Polytechnique since 1909.

P. L. Pratley, M.Inst.C.E., M.E.I.C., past Vice-President of the Institute and widely known across the Dominion, was admitted by his Alma Mater, the University of Liverpool, on Saturday, the 1st of July, to the degree of Doctor of Engineering.

"P.L.", as he is familiarly styled, took his ordinary Bachelor's degree in 1904, his Honours B.Eng. in 1905, heading the class in Civil and Structural, and proceeded to his Master's in 1908 after the requisite three years of practical experience, and is now advanced to the Doctor's, which is rarely obtained by practising engineers as distinct from those in the academic branch of the profession.

In addition to serving on the Council of the Institute for many years, including three as Vice-President, Dr. Pratley has also served as Canadian member of Council for the Institution of Civil Engineers in London. He has delivered many papers before various branches of the Institute.

Horace L. Seymour, M.E.I.C., housing and town planning consultant of Ottawa, has directed recently an educational week on town planning sponsored by the Council of the Town of Cornwall. As a result of this campagin the Council passed a by-law on June 12th, appointing a Town Planning Commission which includes three members of Council, three tax payers from the town and the Mayor. During July, Mr. Seymour will be in Fort William.

Douglas S. Laidlaw, A.M.E.I.C., has an article entitled, "The Modern Building Code—Arrangement and Organization," printed in the June number of *Civil Engineering.* Mr. Laidlaw, who is a structural engineer, is the chairman of the Editorial Sub-Committee of the Joint Committee of engineers, architects, business men and building officials that has for some time been revising the building by-laws of the City of Toronto.

R. F. Uniacke, M.E.I.C., who has been living abroad for a number of years, has returned to Canada and resides now in Toronto. Previous to his departure for Europe, Mr. Uniacke was with the Department of Justice in Ottawa, as structural engineer for the penitentiaries.

W. B. Wilson, A.M.E.I.C., has been promoted from the position of resident engineer, R.C.A.F. Station, Trenton, Ont., to that of Chief Works Officer R.C.A.F. Training Command, in Toronto. Mr. Wilson is a graduate of McGill University, where he obtained his B.Sc. degree in 1913. From that date until 1916, he was engaged in the construction of the Connaught Rifle Range in Ottawa. In 1917, he went into private business and it was in 1927 that he joined the Department of National Defence as resident engineer on the construction of the Ottawa Air Station. In 1929, he was transferred to the position from which he has just been promoted.

R. T. Bell, M.E.I.C., chief engineer of Jaeger Truck Mixers in England, has returned to America, where he is employed with the same company.

L. Austin Wright, A.M.E.I.C., Assoc.M.Inst.C.E., has been made honorary secretary of the Canadian Advisory Committee of the Council of the Institution of Civil Engineers.

B. C. Nowlan, A.M.E.I.C., was elected president of the Charles Fleetford Sise Chapter of the Telephone Pioneers of America at the annual meeting held recently in Windsor, Ont. Mr. Nowlan is sales manager of the telephone division of the Northern Electric Company Limited, with headquarters in Montreal. He is a graduate in electrical engineering of Iowa State College and entered the telephone industry in 1901. He has been connected with different firms in the United States until 1911 when he came to Canada, entering the telephone sales department of the Northern Electric and Manufacturing Company.

Major F. G. Bird, M.C., A.M.E.I.C., was elected president of the Military Engineers Association of Canada, at the annual meeting recently held in Ottawa. Mr. Bird joined the army upon his graduation from Queen's University in 1914 and from 1915 to 1919 he was in France with the Royal Canadian Engineers. He is at present in charge of the Land Department of the Imperial Oil Ltd. in Calgary, Alta.

C. L. Stevenson, A.M.E.I.C., is now employed in the engineering department of the City of Westmount, Que. Since his graduation in civil engineering from the University of New Brunswick in 1934, he has been engaged in construction work on various contracts. In 1938, he was plant engineer with the Abrasive Company of Canada Ltd. in Arvida, a position from which he resigned to enter the service of the City of Westmount.

Professor L. T. Rutledge, M.E.I.C., and **Lt.-Col. H. M. Campbell,** M.C., V.D., A.M.E.I.C., were the recipients of the degree of M.E. at the spring convocation of the University of Toronto. Mr. Campbell is assistant engineer of the Welland Canals in St. Catharines, Ont., while Mr. Rutledge is associate professor of mechanical engineering at Queen's University, Kingston, Ont.

A. I. Bereskin, A.M.E.I.C., of Winnipeg, Man., is at present employed with the Geodetic Survey of Canada in the northern area of Manitoba.

G. R. Connor, A.M.E.I.C., has accepted a position as sales and service engineer with the Aluminate Chemicals Ltd. in Toronto. Upon his graduation from the University of Toronto, where he obtained the degree of B.A.Sc. in chemical engineering in 1928, Mr. Connor joined the Spruce Falls Power and Paper Co. in Kapuskasing, Ont. At the time of his recent resignation, he was technical superintendent in the steam department.

Georges Demers, Jr.E.I.C., has recently taken charge of the office of Zachée Langlais, consulting engineer of Quebec. Since his graduation from the Ecole Polytechnique in 1935, Mr. Demers has been employed with the Roads Department of the Province of Quebec, first as resident engineer and lately as division engineer at Carleton, Que.

J. B. Striowski, A.M.E.I.C., has recently been appointed to the position of assistant engineer in the general engineering department of the Department of Transport in Ottawa. A graduate in civil engineering from the University of Manitoba in 1929, Mr. Striowski was a demonstrator at the University during the following year. In 1930, he received an honourable mention in a bridge design competition sponsored by the American Institute of Steel Construction. Since then, he has been associated in the design and construction of various projects of water power developments, roads and waterworks.

VISITORS TO HEADQUARTERS

T. W. Brackinreid, M.E.I.C., president of Philipps Electrical Works Ltd., Brockville, Ont., on May 26th.

S. Fromson, S.E.I.C., of Howey Gold Mines, Red Lake, Ont., on June 1st.

V. W. Bethel, S.E.I.C., of Winnipeg, Man., on June 3rd.

V. Jepsen, A.M.E.I.C., of the Consolidated Paper Corporation Ltd., Grand' Mère, Que., on June 5th.

D. L. Mackinnon, S.E.I.C., of Fredericton, N.B., on June 6th.

L. Télémaque, A.M.E.I.C, Professor in the Ecole des Sciences Appliquées, Port au Prince, Haiti, on June 6th.

Major W. G. Swan, M.E.I.C., consulting engineer, Vancouver, B.C., on June 7th.

Professor E. A. Allcut, M.E.I.C., Professor of Mechanical Engineering, University of Toronto, on June 9th.

A. G. Dalzell, M.E.I.C., Traffic Engineer, Planning Department, City of Toronto, on June 12th.

Charles Galatoire-Malégarie, Director General of the Cie Parisienne de Distribution d'Electricité, and **Georges Smagghe,** chief engineer of the same company, from Paris, on June 13th.

R. J. Chambers, Jr.E.I.C., of the Gaspesia Sulphite Company, Chandler, Que., on June 13th.

S. F. Hubbard, S.E.I.C., of Quebec, P.Q., on June 14th.

G. A. Sutherland, Jr.E.I.C., designing engineer, Kipp-Kelly, Ltd., Winnipeg, Man., on June 19th.

R. J. Askin, M.E.I.C., manager of Thunder Bay Paper Company, Port Arthur, Ont., on June 17th.

R. Donald McKay, A.M.E.I.C., sanitary engineer of the Department of Public Health, Halifax, N.S., on June 17th.

Dr. Alan Roy Dafoe, Callendar, Ont., on June 21st.

D. W. Miller, Jr.E.I.C., assistant mine engineer, Island Mountain Mines Co. Ltd., Wells, B.C., on June 22nd.

ELECTIONS AND TRANSFERS

At the meeting of Council held on May 27th, 1939, the following elections and transfers were effected:

Members

Archambault, Jules, B.Sc. (McGill Univ.), chief engineer, Montreal Tramways Commission, Montreal, Que.

Booz, Frederick Bernard, B.A.Sc. (Univ. of Toronto), Manager, Montreal Office, Horton Steel Works Ltd., Montreal, Que.

Dibblee, John, B.A.Sc. (Univ. of Toronto), asst. chief. engr., Hydro-Electric Power Commission of Ontario, Toronto, Ont.

Greber, Jacques, Bach. Letters and Sciences (Univ. of Paris), LL.D., (Lafayette Univ.), professor at the Town Planning Institute of the University of Paris, and Reporter of the Superior Commission of plans of cities for the Dept. of the Interior, France, 10 rue Pergolèse, Paris, France.

Harkness, Robert D., Col., D.S.O., M.C., B.Sc. (Queen's Univ.), vice-president and general manager, Northern Electric Co. Ltd., Montreal, Que.

Jeffery, Charlie Chantler, Dipl. in Civil Engrg. (Univ. of Toronto), acting district engr., Dept. of Public Works of Canada, Toronto, Ont.

Associate Members

Beverly, Ira William, B.Sc. (E.E.), (McGill Univ.), western sales mgr., Sangamo Company Ltd., Winnipeg, Man.

Dyment, Arthur Elliott, B.A.Sc. (Univ. of Toronto), mgr., technical dept., Canadian Industries Limited, Montreal, Que.

Ed, Kenneth Merrill, B.Sc. (Mining), (N.S. Tech. Coll.), district technical representative, Canadian Industries Limited, Montreal, Que.

Haultain, Robert Mitchell, (Grad., R.M.C.), field director, civil security survey section, Royal Canadian Mounted Police, Ottawa, Ont.

Koreen, Olof Joel, (Lulea Tech. Sch.), ship dftsman., Port Arthur Shipbldg. Co. Ltd., Port Arthur, Ont.

Laferriere, Rosario Aurez, B.A.Sc., C.E., (Ecole Polytechnique), asst. engr., Dept. of Public Works, Canada, Ottawa, Ont.

Langman, John Nelson, B.Sc. (Queen's Univ.), asst. divnl. engr., Dept. of Highways of Ontario, Grimsby, Ont.

MacNab, Archibald Cameron, B.A.Sc. (Univ. of Toronto), supt. and engr., Donald Ropes and Wire Cloth Co., Hamilton, Ont.

Milton, Charles William, (Mt. Allison Univ.), 1st asst., divn. engr's. office, C.N.R., Moncton, N.B.

Mitchell, Osborne, (Northampton Polytechnic Institute), secretary, Hydro-Electric Power Commission of Ontario, Toronto, Ont.

Moxon, Henry Wilding, B.Sc. (E.E.), (McGill Univ.), asst. district engr., Can. Gen. Elec. Co. Ltd., Montreal, Que.

Saint-Pierre, Roland, B.A.Sc., C.E. (Ecole Polytechnique), divn. engr., Quebec Roads Dept., Beauceville, Que.

Tanton, Frederick William, B.Sc. (E.E.), (N.S. Tech. Coll.), relay and batteryman, Southern Canada Power Co. Ltd., Drummondville, Que.

Turnbull, Allison Dewar, B.Sc. (M.E.), (N.S. Tech. Coll.), asst. chief engr., Dominion Sound Equipments Ltd., Montreal, Que.

Venart, Charles Herbert Somerville, inspection engr., Fidelity and Casualty Company of New York, 8744 Dante Avenue, Chicago, Ill.

Juniors

Dale, James Graham, B.Sc. (E.E.), (Univ. of Alta.), installn. engr., Northwestern Utilities, Edmonton, Alta.

Duchene, Theodore Francis, B.Sc. (Civil), (Univ. of N.B.), testing materials and ballistics, Dominion Arsenal, Quebec, Que.

Ferrier, John Alexander, B.Sc. (Mech.), (Queen's Univ.), power plant control, Ford Motor Company, Windsor, Ont.
MacDonald, John Thomson, B.A.Sc. (Civil), (Univ. of Toronto), time study engr., E. B. Eddy Co. Ltd., Hull, Que.
MacMillan, Donald Carter, (Grad. R.M.C.), B.Sc. (Queen's Univ.), Lieut., Royal Canadian Engineers, Toronto, Ont.
Motherwell, James Shearer, B.A.Sc. (Mech.), (Univ. of B.C.), paper machy. drawing office, Dominion Engineering Co. Ltd., Lachine, Que.
McEachern, Archibald Calvin, B.Eng. (Civil), (Univ. of Sask.), transitman, Prairie Farm Rehabilitation, Calgary, Alta.
Wallace, Ivan Morrow, B.A.Sc. (Univ. of Toronto), dftsman., Canadian Bridge Company, Walkerville, Ont.
Willis, Edwin Aubrey, (Matric., Univ. of London), electrn., Electricity and Gas Inspection Laboratory, Dept. of Trade and Commerce, Ottawa, Ont.

Affiliate

Clibbon, Arthur Robert Cecil, designing dftsman. and estimator, Canadian Car and Foundry Co. Ltd., Montreal, Que.

Transferred from the class of Associate Member to that of Member

Carr-Harris, Gordon Grant Macdonnell, M.M.E. (Cornell Univ.), asst. professor of engrng. and in full charge of the dept. of mech'l. engrg., Royal Military College, Kingston, Ont.
Gray-Donald, Erceldoune Donald, B.Sc. (E.E.), (McGill Univ.), M.Sc. (Laval Univ.), gen. supt., Quebec Power Company, Quebec, Que.

Transferred from the class of Junior to that of Associate Member

Braddell, Eberhard Sylvester Patrick, B.Sc. (E.E.), (Univ. of Man.), power apparatus sales engr., Northern Electric Co. Ltd., Winnipeg, Man.
Fraser, Ralph Percy, B.Sc. (E.E.), (Univ. of Man.), asst. to distribution engr., Winnipeg Electric Company, Winnipeg, Man.
Huggins, Mark William, M.A.Sc. (Univ. of Toronto), lecturer, dept. of civil engrg., Queen's University, Kingston, Ont.
Moloney, James Grant, B.Sc. (Civil), (Tri-State Coll.), editor, "The Canadian Engineer", Toronto, Ont.
Reevely, Frederick Richard, B.A. (Univ. of Toronto), industrial engr., Northern Electric Co. Ltd., Montreal, Que.

Transferred from the class of Student to that of Associate Member

Macleod, Douglas Norman, B.Eng. (Elec.), (McGill Univ.), equipment engr., C.P.R. Communications, Montreal, Que.
Reikie, Matthew Ker Thomson, B.Sc. (Chem.), (Univ. of Alta.), asst. supt. of research, Hudson Bay Mining and Smelting Co. Ltd., Flin Flon, Man.

Transferred from the class of Student to that of Junior

Bentley, Kenneth Earl, B.Sc. (Civil), (N.S. Tech. Coll.), inspector, Imperial Oil Limited, Dartmouth, N.S.
Burke, John Abel, B.Sc. (E.E. & C.E.), (Univ. of Alta.), field engr., St. Maurice Power Corporation, La Tuque, Que.
Dupuy, René, B.A.Sc., C.E. (Ecole Polytechnique), asst. to the mtce. engr., Quebec North Shore Paper Co., Baie Comeau, Que.
Hare, William Lester, B.Sc. (Mech.), (Queen's Univ.), junior engr., central engrg. dept., Dominion Rubber Company, Montreal, Que.
Sherwood, Harris Mitchell, B.Sc. (Chem.), (Univ. of Alta.), production engr., Canadian Industries Limited, Brownsburg, Que.
Whiteley, Eric, B.A.Sc. (Univ. of Toronto), asst. engr., AC-DC engrg. dept., Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

Students Admitted

Bradley, William John, (Senior Matric., Ont. Dept. of Educ.), lab. asst., National Research Council, Ottawa, Ont.
Breeze, John Ellis, B.A.Sc. (Univ. of B.C.), 6568 Maple St., Vancouver, B.C.
Carey, Leslie Clement, B.Eng. (Civil), (N.S. Tech. Coll.), P.O. Box 179, Sackville, N.B.
Duffy, Francis Hubert, B.Sc. (E.E.), (Univ. of N.B.), 204 Chesley St., Saint John, N.B.
French, John Kenneth, (McGill Univ.), 456 Pine Ave. West, Montreal, Que.
Kenst, Richard John, B.Eng. (Elec.), (McGill Univ.), 5562 Waverly St., Montreal, Que.
McAuley, Vincent Cronkite, B.Sc (Univ. of N.B.), Centreville, N.B.
McDermott, Burton Duncan, B.Sc. (Univ. of N.B.), Edmundston, N.B.
Ternan, James Gerald Joseph B., B.Eng., (N.S. Tech. Coll.), The Cedars, Bedford, N.S.

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 Ed tor*

The monthly dinner meeting of the Border Cities Branch of The Engineering Institute of Canada was held at the Sarnia Riding Club on May 20th, 1939. Seventeen members and twenty-four visitors were present.

Mr. Boyd Candlish, A.M.E.I.C., acting as general chairman of the meeting, stated that the executive committee had arranged the present meeting so that the out-of-town members, particularly at Sarnia, might have an opportunity to supply the chairman and speaker. Following this idea, Mr. C. E. Carson, M.E.I.C., would act as chairman and Mr. A. Russell would speak on **Inspection of Oil Refinery Equipment.**

Mr. Carson took the chair, and after welcoming the out-of-town members and visitors he introduced the speaker.

Mr. Russell, who is in charge of the maintenance of all high pressure and temperature equipment at the Sarnia Imperial Oil Refinery, proceeded to point out that safety of personnel and equipment is one of the important things in the operation of the plant. Safety of operation is dependent upon safety of design and systematic inspection of operating equipment.

Carbon steel is still largely used around the average oil refinery. Stainless steel is used only where the sulphur content of the crude is high but creeps badly at high temperatures. This factor is very important since the design is based on creep or elongation and not the ultimate stress of the material.

High pressure and high temperature equipment is protected against erosion by the use of a two-inch layer of cement. This layer has an insulating property as the temperature drop across it may be as high as 100 deg. at temperatures of 900 deg. F. It consists of a one to one mix and is put on by the use of high pressure spray guns. The steel is sandblasted before the application and the concrete is laid over reinforced steel which is bonded to the steel body. A life of two years is given and it may be patched during that time. The bond to the steel is usually very good even after two years at 900 deg. F.

The large tubes thus protected in the oil cracking furnaces are cleaned monthly. Large shrinkage cracks appear on cooling of the units. These are welded and the weld stress relieved and radiographed before being put back in operation.

The soaking towers are of seamless steel construction and also have the concrete coating inside. They operate at 1,000 lb. pressure and 1,050 deg. F. temperature, so must be rigidly inspected at short and regular intervals. This inspection consists of calipering the metal for thickness, a pressure test of 11,000 lb. per sq. in., a hammer test and an elongation test. Inspection holes are drilled through the metal and these are later filled with screwed plugs. These plugs must not protrude inside the tube or coke will form over this point and the resulting abnormal temperature will eventually lead to failure.

The protective coating of concrete is also used on the low pressure equipment where blistering of the carbon steel takes place due to acid.

A wet foam fire protection system protects the entire plant. This is supplemented by a similar type of extinguisher on wheels and dry powder where water is available.

The Crosley type of high pressure safety valve is used and these reseat themselves remarkably well even after lifting under 1,100 lb. pressure. They are removed and tested after each operation. The relief valve outlet is piped to stacks where water sprays play on the fire which results from the operation of the relief valve.

Special Dinner Meeting for the President

A special dinner meeting of the Border Cities Branch of The Engineering Institute of Canada was held in the Prince Edward Hotel on May 31st at 6.30 p.m., the occasion being a visit from the President of the Institute.

Twenty-nine were present at the dinner.

The guests were Dean H. W. McKiel, M.E.I.C., President of the E.I.C.; E. V. Buchanan, M.E.I.C., of London, Vice-President for Ontario; J. A. Vance, M.E.I.C., of Woodstock; H. F. Bennett, M.E.I.C., Chairman of the London Branch of the E.I.C.; Mr. Thomas R. Brophey of the "Windsor Daily Star"; Mr. E. W. Johnston of the Provincial Sanitary Engineering Department at Toronto; and Mr. R. C. Williamson of Montreal.

Chairman Boyd Candlish, A.M.E.I.C., introduced our speaker of the evening, Professor H. W. McKiel, B.A., B.Sc., M.E.I.C., President of the Engineering Institute of Canada, and Dean of the Faculty of Applied Science, Mount Allison University, Sackville, N.B.

The President consults with Vice-President Buchanan and Chairman Candlish.

President McKiel addressed the members on Institute affairs, particularly dwelling upon the place of engineers in industry and government. President McKiel believes that the rulers of to-morrow will be engineers.

"Whether we like it or not," the speaker told the Windsor engineers, "we are going to have more of the control of industry and government thrust upon us."

Supporting his prediction with historical references, Dean McKiel recalled how in the days of ancient Greece, when philosophy and the arts were the outstanding enjoyment of the people, philosophers and artists were the men who shaped the political life of the country.

The greatest achievements of ancient Rome were in the realms of law and with respect to military power—and the lawgiver and military men dominated Rome. Similarly, during the Middle Ages, when the Church was at its peak of influence, great churchmen took leading historical rôles. In the rise of England as "a nation of shopkeepers," the path of Empire followed trade routes—with the final result that industry came to have a decisive voice in the carrying on of public affairs.

"To-day," Dean McKiel said, "the world is dependent on the technologist and, if history tells us anything, engineers are destined to administer their own ideas."

The present division of the engineering profession into many classifications: civil, mechanical, mining, electrical and so on, was deplored by the speaker, who predicted that a different division will be made in the profession in the future.

Engineering students of to-morrow will be divided into two great classes, those with highly specialized technological training and those with broader scientific education coupled with a knowledge of human beings and their social and political organization.

"We've been pouring our inventions on an unprepared world," Mr. McKiel said, "and you cannot stop the technologist from improving things. But we can forecast the effect of these improvements on the sociological and economic structure of the community."

The status of engineering as a profession does not depend on technological developments, but must be based on the ideal of service. Engineers must become more articulate and accept their share of public responsibility.

The speaker declared that organization of one engineering institute in Canada, as against many groups in the United States, was a masterly bit of foresight. To-day in the United States engineers of various sorts find that their fields are overlapping so much that they must get together in co-operative societies to discuss common problems.

Mr. McKiel outlined his ideas for the training and qualifications necessary for the young engineer.

Mr. H. F. Bennett of London, the Chairman of the committee which the President has formed to report on this very important branch of Institute affairs, explained to our members present what his committee had accomplished to date.

Mr. Buchanan addressed the meeting on Institute affairs and expressed his great pleasure at being a guest of the Border Cities Branch on the occasion of the President's first visit.

Councillor T. H. Jenkins, A.M.E.I.C., moved a hearty vote of thanks to the President for his timely visit to this branch, reminding the members that Dean McKiel travelled half-way across the continent to be present at our meeting. This vote of thanks tendered by Chairman Candlish was replied to by the President.

HAMILTON BRANCH

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

The branch held the last professional meeting of the season on Monday, May 29, and on this occasion was honoured with the official visit of our President, H. W. McKiel, M.E.I.C., Dean of the Faculty of Applied Science, Mount Allison University, and Mrs. McKiel.

The meeting was held in the Lecture Theatre, McMaster University, and the speaker of the evening was Prof. W. Harvey McNairn, Dean of Geology at McMaster, and his subject was **Temperature and Life.**

Dealing with this subject, common to everyone but in anything but a commonplace manner, the speaker delighted members of the branch and a large number of guests when he went exhaustively into the connection between temperature and life. He stated that when the day was very hot people would complain, and again when very cold they would also complain not realizing that such a common matter as the daily temperature would be found to have developed from the co-ordination of many factors which are part of the amazing workings of the universe.

Prof. McNairn pointed out that the weather conditions as we have them are such as to be the best for all kinds of higher life and that everything depended on climate and climate depended on the sun and to distribute heat over a planet such as the earth so that there was not constant boiling or constant freezing necessitated a very elaborate system. Having enlarged earlier that all heat and energy came from the sun, which has a surface temperature of 10,000 degrees, it was only possible for the earth to keep within a range of temperature suitable for life according to its position away from the sun. Mars and Venus are the limits at and beyond which life is not possible. If the earth did not rotate on its axis, a day and a year would have the same length and under such circumstances life would cease on one side of the earth due to the excessive heat and also cease on the other side due to the excessive cold. On the other hand, if the earth were to rotate more rapidly then the whole of the surface of the earth would be too hot.

Water, offered the speaker, is the most amazing substance of which we have knowledge. As its temperature falls it becomes denser until it reaches about six degrees above freezing, when it starts to expand. He went on to explain how it is impossible for oceans to freeze from the bottom upwards and he revealed many interesting points in connection with the movement of fish from the sea into fresh water. The lecture was so full of instruction in connection with both daily life and our pursuits of engineering knowledge that one is not able to do justice to the subject in these few remarks.

The speaker, who had been introduced by the Chairman, John R. Dunbar, A.M.E.I.C, was moved a very hearty vote of thanks by E. H. Darling, M.E.I.C., who also expressed the appreciation of the branch to our President for the pleasure he had given to us by his presence on this occasion and by his remarks of encouragement to us all. Previous to this the President had addressed the meeting on this, his first visit. Past-President Alec Grant, M.E.I.C., and Vice-President E. V. Buchanan, M.E.I.C., were both asked by the Chairman to address the members and guests.

Mrs. McKiel very graciously offered the thanks of the ladies for the pleasure they had enjoyed from the meeting. Members and guests present numbered 104.

Before the meeting a dinner was given at the University dining room to welcome the President and Mrs. McKiel and the speaker of the evening, Dr. McNairn and Mrs. McNairn, and Dr. Burke and Mrs. Burke, also Vice-President E. V. Buchanan and Mrs. Buchanan, who had all come to join with the branch in this general welcome to President McKiel.

Luncheon with Council, May 27

The branch had the honour of entertaining the President and Members of the Council and the General Secretary at luncheon at the Royal Connaught Hotel on Saturday, the 27th of May, when the Council adjourned its meeting at noon.

J. R. Dunbar, Chairman of the branch, welcomed the President and members of Council and the atmosphere of friendship and understanding that permeated this gathering will remain as one of the big events of our branch.

Dr. Burke expressed the pleasure that McMaster University enjoyed in having the branch meet at the university each month and said that although he was not Mayor of the city he welcomed the many prominent engineers who had gathered here from various parts of the Dominion. President McKiel replied and this, his first address to the branch, was received with sincere appreciation. Vice-President E. V. Buchanan and E. P. Muntz, M.E.I.C., both spoke at some length on matters pertaining to the general advancement of the profession for the greater use of the public at large. After lunch Council and invited members of the Institute returned to the Mural Room, where business was continued until 5.30 p.m.

LONDON BRANCH

D. S. Scrymgeour, A.M.E.I.C. - *Secretary-Treasurer*
J. R. Rostron, A.M.E.I.C. - - - *Branch News Editor*

A dinner meeting was held at the Hotel London on the 30th of May, in honour of the visit of the President of the Institute, Dean H. W. McKiel, to this city in the course of his tour of western Ontario. Thirty-three members and guests were present to welcome him.

The Chairman of the branch, H. F. Bennett, M.E.I.C., presided.

E. V. Buchanan, M.E.I.C., Vice-President of the Institute for Ontario, introduced the guest speaker and explained that he first had the pleasure of meeting Dean McKiel at the Annual General Meeting in London last year. He pointed out that most presidents had their "hobbies" and that Dean McKiel was no exception. Dr. Challies, when President, for example, had the co-operation of the engineering profession of Canada at heart, while President McKiel was particularly interested in the training and welfare of the young engineer.

President McKiel, after thanking the officials and members of the branch for their welcome, said, in regard to Dr. Challies' "hobby" of co-operation, that he was heartily in sympathy with it, and much had been done and was being done along those lines. Regarding the welfare and training of the young engineer, he found that it was necessary in these days to include in the training of the latter, not only the technical elements of his profession, but the ability to work along with the economists and political and social leaders. In the past, the technical side, though necessary, had been too much stressed, but it was found that if the engineer was to attain prominence in his profession he must have a broad fundamental knowledge of world affairs. He must know something of finance, industry and commerce, of human needs and legal procedure. He should have personality and ability to take part in administration.

Probably two fields of engineers would be required; the one highly technical and scientific, the other not so highly technical but with broader executive knowledge. In the latter, the student would be trained to co-operate with the economist and other leaders of world affairs in applying the work of the technician to the needs of industrial, commercial and social enterprises in a practical and suitable manner.

This would make the engineer an important factor in civilization, exerting control not only in the scientific or technical field, but in the political and economic fields as well.

It may be found advisable to go back to the high school and instill there an idea of what engineering really is. It would then be necessary to give proper guidance to the student entering college to see that he entered the right field.

With this end in view, a committee of the Institute had been formed with H. F. Bennett, M.E.I.C., district engineer of the Public Works Department at London, as chairman, to consider the whole engineering educational system in Canada, and to make recommendations to the Institute accordingly. The work of this committee will not be confined to college training only, but more especially to the after-college years. Dean McKiel concluded by drawing attention to the proposed visit of British engineers to the World's Fair in September next, and pointed out that many of them would undoubtedly also visit Canada afterwards.

He was glad to announce that the finances of the Institute were improving, as at the end of the last finanial period the revenue was $1,610.00 ahead of the budget. The next Annual Meeting would be held in Toronto on February 7, 8 and 9, 1940.

H. F. Bennett, M.E.I.C., Chairman of the branch, and of the committee mentioned by the President, indicated in his usual humorous manner the extent of the work being undertaken by that committee, and the responsibility which must be assumed by the Institute in assisting the young engineer in his after-college days.

In response to questions from members, the President gave the following information:

Old, as well as young graduates could be absorbed in any courses or classes put on by the universities. Arrangements were in progress with the Canadian Broadcasting Corporation for a series of broadcasts of engineering features. Engineering publicity would be given by means of editorials in the press.

Col. I. Leonard, M.E.I.C., in moving a vote of thanks to the President said that he was entirely in accord with the movement outlined by the speaker, as too few graduates in after life attained positions of prominence. Some reason must exist for this situation and the studies now under way might help to correct this in the future.

J. A. Vance, A.M.E.I.C., seconded the vote of thanks, which was carried unanimously.

MONCTON BRANCH

V. C. Blackett, a.m.e.i.c. - *Secretary-Treasurer*

An address on **The Dial Telephone** was delivered at a branch meeting held on May 5th by A. A. Turnbull, a.m.e.i.c., Plant Engineer, New Brunswick Telephone Co. E. B. Martin, a.m.e.i.c., immediate Past-chairman of the branch, presided.

In 1889, just fifty years ago, a Kansas City undertaker, named Strowger, a man unlearned in science or mechanics, put together the first dial 'phone. Later a company was formed to develop the idea and in 1892 the first automatic exchange was installed at LaPorte, Indiana. Five lines were required from each telephone to the exchange and the technique of making calls was by no means as simple as it is to-day. However, notwithstanding these complications, the exchange worked successfully and gave satisfaction.

The system at present being installed in Moncton is known as the "step-by-step". With the aid of a demonstration set, the speaker made clear what happens when a subscriber dials a number. Suppose, for example, the number is 4952. When the digit 4 is dialed, a radial arm or wiper, in what is known as the first selector, rises to the fourth of a series of horizontal contacts, then rotates until it finds a contact "not busy". In the same way, when the second digit 9 is dialed, the wiper in the second selector rises to the ninth series, rotates and establishes a connection. The digit 5 is next dialed and the wiper in the "connector" rises to series five, and finally, when digit 2 is dialed, this wiper rotates until it finds the contact corresponding to the number 2, and the through connection is then complete. Mr. Turnbull also explained the operation of the mechanism when a line was busy, and when a call was completed.

A vote of thanks to the speaker and to the New Brunswick Telephone Co. was moved by T. H. Dickson, a.m.e.i.c., seconded by H. J. Crudge, a.m.e.i.c.

Following Mr. Turnbull's address, nominations were made for branch officers for the year 1939-40.

Annual Meeting

The annual meeting of the branch was held on May 31st. The Chairman, B. E. Bayne, a.m.e.i.c., presided. The annual report and financial statement were presented. The officers chosen to act during the coming year were announced as follows: Chairman, F. L. West, m.e.i.c.; Vice-Chairman, James Pullar, a.m.e.i.c.; Secretary-Treasurer, V. C. Blackett, a.m.e.i.c.; Committeemen, F. O. Condon, m.e.i.c.; G. L. Dickson, a.m.e.i.c.; R. H. Emmerson, a.m.e.i.c.; A. S. Gunn, a.m.e.i.c.; C. S. G. Rogers, a.m.e.i.c.; G. E. Smith, a.m.e.i.c.; Ex-officio, B. E. Bayne, a.m.e.i.c.; H. W. McKiel, m.e.i.c.

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 May 26, 1939, the Niagara Peninsula Branch of the Institute held its Annual Meeting in the Welland House, St. Catharines, Ontario. After an introduction to Messrs. Innocuous and Otherwise, the members sat down to a turkey dinner, following which C. G. Moon, a.m.e.i.c., the retiring chairman, introduced the new executive and the visitors who had honoured the branch with their attendance. The latter were H. W. McKiel, m.e.i.c., President of the Institute; E. V. Buchanan, m.e.i.c., Vice-President for Ontario; A. E. Berry, m.e.i.c., Chairman of the Toronto Branch; J. R. Dunbar, a.m.e.i.c., Chairman of the Hamilton Branch; J. A. Vance, m.e.i.c., Councillor of the London Branch, and Prof. C. R. Young, m.e.i.c., of Toronto, and the charter members of the branch.

President McKiel, after a few words of thanks and congratulations to the branch, spoke briefly on the changing position and attitude of the engineer. He pointed out that engineering was segregating into two divisions, one purely technical, the other dealing with the practical application of the technical discoveries. This was resulting in the integration of the different branches of engineering, such as civils, mechanicals, etc., into one entity, and the speaker looked for the day when all organizations would co-ordinate. As a result of this new trend, a change in the training of the young engineers was required. The President regretted the effort to bring trade unionism into the profession, stating that the engineer should place profession ahead of self.

Introductory to the presentation of the Gzowski Medal, Dean McKiel enlarged upon the fable-like career of Sir Casimir Gzowski. This man, son of a Polish nobleman, was born in St. Petersburg in 1813. He attended Military Academy, but the Polish revolt interrupted his military career and in 1831 he found himself a deportee in the United States with five dollars in his pocket and no knowledge of English. Soon he entered a law school from which he was called to the bar four years later. Thus with a knowledge of the laws and language of this new country, he was ready to enter upon his engineering career.

Through a succession of positions he finally found his way to a responsible position with a large contracting concern. Later he joined the Department of Public Works as divisional engineer in the London area. Quickly he rose to the position of one of Canada's greatest engineers. During this time he had not neglected the humanitarian side, and for his work in this regard he was knighted by Queen Victoria. This outstanding man made provision for a medal which was to be presented annually to the author of a paper on a civil engineering topic, if a paper worthy of the award were submitted. President McKiel presented this award to A. W. F. McQueen, m.e.i.c., for his paper on "The Eighteen Foot Diameter Penstock at Outardes Falls."

Mr. Moon introduced the speaker of the evening, Prof. C. R. Young, who spoke on **The Engineer as an Economist.** Professor Young pointed out that economics were not out of the range of the engineer, but were inherent to his profession. The engineer must not only practise the science of economics in his daily routine tasks, but also in public matters, since he is particularly capable of interpreting the effects, necessity, and economy of such work. It is his duty to point out the implications in the course of projected actions, to see that the service rendered is not personal, nor political, but in the general interests of the public. He must study the rating of all projects, considering the subject as a whole rather than isolated portions of it, rating the cost as value received which takes account of the life and maintenance of the project, and not merely the initial outlay.

Then the time element must always be considered. Interest must always be added whether the project is to be paid for out of savings or borrowed. If borrowed, care must be taken to arrange for the amortization of the debt within the expected useful life of the object in question. In regard to public business, the engineer should endeavour to hold down public debt by balancing necessity of, practicability and ability to pay for, any work considered.

E. V. Buchanan, m.e.i.c., moved a hearty vote of thanks to Professor Young for his highly instructive and very timely talk, and President McKiel expressed his appreciation of the talk, stating that he hoped other branches would have the chance of hearing it. The meeting was then adjourned.

OTTAWA BRANCH

R. K. Odell, a.m.e.i.c. - *Secretary-Treasurer*

At a special noon luncheon on June 15th Sir William McLean, k.b.e., former member of parliament in the British House and Member of the Institution of Civil Engineers, addressed the branch on **Experiences in the Sudan and Egypt.** Sir William had been designated by the Secretary of State for the Colonies in the British Government to take charge of the Colonial Exhibits at the British Pavilion, World's Fair, New York City. He saw service in the Sudan and Egypt where he was very active in the designing of water supply and drainage, and had also much to do with the planning of the city of Khartoum and the town planning of the city of Jerusalem.

By means of slides he illustrated features of the layout of these two and other cities, and explained in the case of Jerusalem the steps taken to preserve in particular the Mount of Olives from encroachment.

Speaking of the Colonial possessions which include the West Indies, portions of East and West Africa, Mauritius, Ceylon, Malaya, Fiji, Gilbert Islands, and other lands, he stated that research conducted by some of the American scientific institutions, as in connection with yellow fever and malaria, had been very helpful in the solving of problems of health. All the Dominions together with the United Kingdom are trustees to the 60 million people in these possessions, the aim being eventually to make them all self-supporting.

The speaker had visited most of these possessions and remarked that he had recently returned from a visit to Malaya, where he had been sent on an investigation into the possibility of setting up a university there.

ST. MAURICE VALLEY BRANCH

V. Jepsen, A.M.E.I.C. - *Secretary-Treasurer*

On the evening of Friday, May 26th, the St. Maurice Valley Branch held its first meeting of the current year. There were fifty members and guests present.

Through the kind co-operation of the division manager, Mr. W. D. Mosher, this meeting was held at the offices of the Consolidated Paper Corporation, Belgo Division, at Shawinigan Falls, Que. The Chairman of the branch, F. W. Bradshaw, A.M.E.I.C., occupied the chair. The principal speaker of the evening was R. E. MacAfee, M.E.I.C., manager of the Eastern Branch of Babcock-Wilcox and Goldie-McCulloch Limited, who gave a talk, illustrated with lantern slides, on the subject of **Modern Trends in Boiler Design.**

After bringing a greeting from the Montreal Branch, Mr. MacAfee said he was very glad as a member of The Engineering Institute to speak to fellow members of another branch and wished the branch good luck in its work.

Very often, the speaker said, designers of modern boilers are called upon to design a boiler which must have a capacity of three to four times that of an old boiler to be replaced, and occupy the same space.

The integral furnace boiler, such as installed at the Belgo Mill in 1938, was taken as an example of how a large heat absorbing surface (15,690 sq. ft.) can be placed around a certain combustion space, and the flame travel be such that only a minimum of heat would be carried away to the chimney. The lantern slides gave an excellent illustration of how the boiler was designed. They showed a 54 in. dia. welded bottom drum; between the drums and in the walls are 763 tubes of which those in the first pass are 3¼ in. dia. and those in the second and third pass 2½ in. dia. The furnaces have complete water cooling in all walls and the floor consists of water tubes protected by cast iron blocks.

The boilers are fired with pulverized coal, each furnace being equipped with four forced-draft circular burners all located in the front wall of the furnace. Two pulverizers of the ball mill type feed the four burners.

After a few remarks by the Chairman the meeting was turned over to Mr. K. D. Sheldrick, service engineer of the Bailey Meter Company, who showed a few slides and explained the operation of the control equipment as installed on the new boilers at the Belgo Division. One interesting feature of this modern installation is that although the control is fully automatic, it can also be turned over to hand control by the use of selector valves on the main panel.

E. B. Wardle, M.E.I.C., chief engineer of the Consolidated Paper Corporation Limited, proposed the vote of thanks to the two speakers, and then the meeting adjourned to the boiler plant, where one of the newly installed boilers was shown in operation, and the other was accessible for inspection. Numerous questions were answered by both the speakers and by employees of the Belgo Division who assisted in conducting the visitors around the boiler plant.

Undoubtedly it was an outstanding event of the year when, on the night of June 8, 1939, the St. Maurice Valley Branch had as its guest the President of The Engineering Institute of Canada, Dean H. W. McKiel. This meeting was held at the Laurentide Inn, Grand' Mère. The President's party included the General Secretary, Mr. L. Austin Wright.

Fifty-five members and friends were present when the Chairman, Mr. F. W. Bradshaw, A.M.E.I.C., introduced the President.

In his address Dean McKiel dealt with the future of engineering, the young engineer and the education of an engineer.

Looking ahead, said the President, we realize that the engineering profession is at the crossroads in its history, and that the choosing of the right course remains entirely to the decision of the engineers themselves. The engineers of the future will be absorbed by an industry which would demand two types of engineers: engineers who are specialists in some particular field whose duty it will be to translate pure science into engineering practice, and another group who will apply the findings of the specialists to the needs of industry.

The president predicted that in the future the natural development of this second group will result in there being only one class of general engineers turned out by the universities, and that after graduation these young engineers would be given further training in some kind of a technical institute in their chosen engineering field. A good example of this system is the training course given to young engineering employees of General Motors and Chrysler Corporation. He further stated that there was plenty of evidence that the leading engineers of the United States and Great Britain were beginning to talk about the mistake that had been made when the engineers in those countries split themselves into separate organizations such as civil engineers, mechanical engineers, electrical engineers, etc., and emphasized how fortunate we are here in Canada in having only one Engineering Institute to which all groups of engineers could belong.

The Institute had appointed a committee under the chairmanship of Mr. Bennett to inquire into the Institute's relationship with the young engineer. Surveys had shown that a large percentage of the engineering graduates depart from straight engineering work and become business managers, heads of industries, government ministers, etc., and that others find themselves in a different class of engineering work than the one for which they had trained when in college. Since engineers can no longer be regarded as purely technical men their university training should include studies to help them in the administrative positions they are occupying more and more every day.

Another step to improve the profession would be to make a better selection in high school. A boy who has a dislike for mathematics and physics has definitely no place in an engineering class. Statistics showed that only 40 per cent of the students that enlisted as engineering students ever graduate. The President asked the Chairman to co-operate as far as possible with the high school principals in his district by making them acquainted with the work and findings of Mr. Bennett's committee.

The President was thanked by Professor H. O. Keay, M.E.I.C., Vice-President of The Engineering Institute of Canada, for his very interesting and instructive address, whereafter the Chairman introduced the General Secretary, Mr. L. Austin Wright, A.M.E.I.C.

Mr. Wright explained the advantages of belonging to the Institute and mentioned particularly the employment bureau, the Institute library, the educational value of meetings, the prestige which membership carries with it, and the value of the Institute to the profession.

SASKATCHEWAN BRANCH

J. J. White, M.E.I.C. - *Secretary-Treasurer*

On April 21st the Saskatchewan Branch met in conjunction with the Association of Professional Engineers of the Province of Saskatchewan and the Saskatchewan Section of the American Institute of Electrical Engineers, for their monthly meeting in the Kitchener Hotel, Regina.

The meeting was preceded by a dinner at which sixty members and friends were present. Following the dinner, P. C. Perry, M.E.I.C., division engineer of the Canadian National Railways at Regina, addressed the meeting on **Stream Control in Relation to Droughts and Floods.** This paper was of such a nature as to win the Past-President's prize of The Engineering Institute of Canada for the year 1938-39.

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 Branch of the Institute held its regular meeting on May 25th when 23 members and guests sat down to luncheon at 6.45 p.m. in the Windsor Hotel. After a short business session Mr. Hugh MacDougall of Blind River, Ontario, divisional engineer of highways, gave an interesting talk on **Highways and Their Construction,** with particular reference to the Sault-Algoma-Manitoulin area.

R. S. McCormick, M.E.I.C., introduced a guest from Hamilton, Mr. Victor North of the English Electric Company. In the absence of Chairman A. E. Pickering, M.E.I.C., and Vice-Chairman A. M. Wilson, A.M.E.I.C., J. S. Macleod, A.M.E.I.C., occupied the chair.

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.

American Institute of Mining and Metallurgical Engineers:
Directory, 1939.

Association of Ontario Land Surveyors:
Annual Report and Proceedings of the Forty-seventh Annual Meeting, Feb. 21st-22nd, 1939.

Canadian Institute of Mining and Metallurgy and Mining Society of Nova Scotia:
Transactions, 1938.

Electric Supply Authority Engineers' Association of New Zealand:
Transactions of the Thirteenth Annual Conference, Sept. 12th-14th, 1938.

U.S. National Research Council Highway Research Board:
Proceedings of the Eighteenth Annual Meeting, Nov. 28th-Dec. 2nd, 1938.

University of Toronto, Engineering Society:
Transactions and Year Book, 1939.

REPORTS, ETC.

Alberta Department of Lands and Mines:
Annual Report, 1938.

American Society for Testing Materials:
The Torsion Test by Albert Sauveur (Edgar Marburg Lecture, 1938).

Bell Telephone System Technical Publications: Paper as a Medium for Analytical Reactions; Measurement of Absorption in Rooms with Sound Absorbing Ceilings; Noise Co-ordination of Rural Power and Telephone Systems; Effect of Temperature on the Mechanism of Oxidation of Rubber; An X-Ray Test of Superstructure in $FeNi_3$; A Short-wave Single-side-band Radio-telephone System; A Single-side-band Receiver for Short-wave Telephone Service; Composition and Colloidal Properties of Balata Latex; Molecular Rotation and Dielectric Behavior of Condensed Phases; The Oxide-coated Filament; An Improved Three-channel Carrier Telephone System; Crossbar Dial Telephone Switching System. (Monographs 1108-1118.)

British Rubber Publicity Association:
Rubber Tyred Farm Tractors, Rubber and Agriculture Series Bulletin No. 10.

Canada Civil Service Commission:
Thirtieth Annual Report for the Year 1938.

Canada Bureau of Mines:
Investigations in Ore Dressing and Metallurgy, July to December, 1937.

Canada Dominion Water and Power Bureau:
Surface Water Supply of Canada, Pacific Drainage, British Columbia and Yukon Territory, Climatic Years 1932-33 and 1933-34.

Edison Electric Institute:
Short-circuiting Relay Protectors (August 22, 1938, F 17).

Electrochemical Society: Analogies between Electrolytic and Chemical Methods of Reduction; Electrodeposition of Silver-lead Alloys for Bearings; Electric Carbonization of Coal; The Electrochemical Reduction of Furfural; The Mechanism of the Reaction of the Lead Storage Cell; The Comportment of the Palladium-hydrogen System Toward Alternating Electric Current; Relations Between Crystal Structure and Corrosion; New Stoneware in the Electrochemical Field; Refractories of the Alumina-Silica Series; The Relation of Low Weight to the Physical Properties of Furnace Refractories; Electrolytic Manufacture of Perchloric Acid from Sodium Chlorate; Physico-chemical Control of Properties of Clays. Preprint 75-17 to 75-28.

Kenya and Uganda Railways and Harbours:
Report of the General Manager for the Year Ended 31st December, 1938.

U.S. Department of Commerce:
Report of the Twenty-eighth National Conference on Weights and Measures (Miscellaneous Publication M 161).

U.S. Department of the Interior: Limits of Inflammability of Gases and Vapors —(Bureau of Mines Bulletin 279). Carbonizing Properties and Petrographic Composition of Pittsburgh-bed coal from Bureau of Mines Experimental Mine Bruceton, Allegheny County, Pa.—(Bureau of Mines Technical Paper 594). Spirit Levelling in Missouri pt. 6 Northeastern Missouri 1896-1938; Geophysical Abstracts 93, April-June, 1938; The Mineral Industry of Alaska in 1937—(Geological Survey Bulletin 898-F, 909-B, 910-A). The Venericardia Planicosta Group in the Gulf Province; Pleistocene Diatoms from Long Island, New York—(Geological Survey Professional Paper 189-F, 189-H). Surface Water Supply of the United States, 1937, Pt. 2 South Atlantic Slope and Eastern Gulf of Mexico Basins; Pt. 5 Hudson Bay and Upper Mississippi River Basins; Ground-Water Resources of the Holbrook Region, Ariz.; Floods of Ohio and Mississippi Rivers, January-February, 1937—(Geological Survey Water-Supply Paper 822, 825, 836-B, 838).

TECHNICAL BOOKS

Reinforced - Concrete Bridges, with Formulas Applicable to Structural Steel and Concrete:
By the Late F. W. Taylor, S. E. Thompson and E. Smulski. New York, John Wiley & Sons, 1939. 456 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $6.50.

Although the title specifies "reinforced-concrete," the information given in the book applies in many cases to steel bridges as well. The restriction lies rather in the fact that trusses and arches are excluded, although all types of girder bridges are fully covered. In addition to design principles and data there is also material on the effects of temperature changes, expansion joints and bearings, abutments, and piers.

WHITAKER'S ALMANACK, 1939:
London, 1938, 1096 pp. 5x 7 ½ in. cloth.

NEW AND REVISED SPECIFICATIONS

American Institute of Electrical Engineers:
Disconnecting and Horn Gap Switches (A.I.E.E. No. 22, July: 1925).

American Society of Mechanical Engineers:
Time-series Charts (American Standards Association Z15.2, 1938).

British Standards Institution:
Specification for Phosphor Bronze Sheets, Strip and Foil. (No. 407, 1939.)

Canadian Government Purchasing Standards Committee: Specification for Exterior Varnish; Tentative Specifications for: Priming Paint for Steel, Zinc Chromate-oil Varnish Type; Water-Emulsion Floor Wax; Marine Enamel, White and Grey; Marine Varnish.

U.S. Department of Commerce National Bureau of Standards:
Building Materials and Structures Report BMS16 Structural Properties of a "Tilecrete" Floor Construction sponsored by Tilecrete Floors, Inc.; Report BMS17 Sound Insulation of Wall and Floor Constructions; Report BMS19 Preparation and Revision of Building Codes.

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.

ARC WELDING IN DESIGN, MANUFACTURE AND CONSTRUCTION

Cleveland, Ohio, James F. Lincoln Arc Welding Foundation, c-o Lincoln Electric Co., 1939. 1,408 pp., illus., diagrs., charts, tables, 9 x 6 in., lea., $1.50 in U.S.A.; $2.00 in foreign countries.

Of the more than 400 papers which received awards from the James F. Lincoln Arc Welding Foundation, 109 have been selected and published in this volume. The papers describe the designing or re-designing of some machine, structure, building, or manufactured product of ferrous or non-ferrous metals for the use of arc welding in its production. The subjects of the selected papers have been chosen from the 44 sub-classifications to afford the widest possible variety, and a majority have been presented in full. There is a subject index.

AIR CONDITIONING

By B. H. Jennings and S. R. Lewis. Scranton, Pa., International Textbook Co., 1939. 467 pp., illus., diagrs., charts, tables, 9 x 6 in., flexible, $4.00.

The fundamentals of air conditioning are presented in this textbook in adequate amount to form a working basis for the engineering student or the practising engineer. The emphasis is on basic principles, although conventional methods of empirical treatment are given in some cases. Ordinary heating methods and refrigeration are considered at some length. Illustrative examples, problems, charts, and tables of data add to the reference value of the book.

AIR CONDITIONING

Fundamental Principles, Practical Installations and Ozone Facts.

By E. W. Riesbeck, 2nd rev. and enl. ed. Chicago, Goodheart-Willcox Co., 1939. 443 pp., illus., diagrs., charts, tables, 8 x 5 in., flexible, $3.50.

This practical book, written in a non-technical manner, explains the principles of air conditioning, differentiates between conditioning and cooling, describes methods, equipment, installation and adaptation, and shows how to figure requirements. Refrigeration, the use of ozone, and water sterilization are treated as allied subjects.

ALLOY CAST IRONS

Published by American Foundrymen's Association, 222 West Adams St., Chicago, 1939. 257 pp., illus., diagrs., charts, tables, 9 x 6 in., lea., $3.00.

The manufacture, uses and properties of modern alloy cast irons are discussed in this volume. The major portion of the book is devoted to the effects of various alloying elements on the physical and mechanical properties of gray irons, with chapters on foundry practice and heat treatment, and a table of specific applications. There is a large classified bibliography.

APPLIED ACOUSTICS

By H. F. Olson and F. Massa. 2 ed. Philadelphia, Pa., P. Blakiston's Son & Co., 1939. 494 pp., illus., diagrs., charts, tables, 9 x 6 in., lea., $5.50.

The growing importance of the theoretical and experimental aspects of electro-acoustics is recognized in this textbook, which presents information on the design, construction, operation, and analysis of modern microphones, loud speakers, and telephone receivers. Acoustical measurements, testing methods, architectural acoustics, measurement of noise, and physiological acoustics are also considered.

ARBEITSMAPPE DES HEIZUNGSINGENIEURS, Sammlung der auf den neuesten Stand ergänzten Arbeitsblätter aus der Zeitschrift "Heizung und Lüftung"

Berlin, VDI-Verlag, 1939. 33 pp., charts, maps, tables, 12 x 9 in., paper, 3.50 rm.

This collection of the tables and charts which have appeared at intervals in "Heizung und Lüftung" presents for ready reference many numerical data useful in the planning, calculation and investigation of heating and ventilating installations.

GEMS AND GEM MATERIALS

By E. H. Kraus and C. B. Slawson. 3 ed. New York, McGraw-Hill Book Co., 1939. 287 pp., illus., maps, diagrs., charts, tables, 9 x 6 in., cloth, $3.50.

This book gives a comprehensive treatment of the forms, properties, formation, occurrence and characteristics of gems and gem materials. It describes commercially important gems and gem materials, classifies them according to various properties, and includes tables of comparative characteristics. The cutting and polishing of gems and the manufacture of imitation, treated and synthetic stones are also covered.

HOW TO BUY, SELL AND BURN COAL

By T. A. Marsh. Chicago, Ill., T. A. Marsh, 5625 Kenwood Ave., 1939. 97 pp., tables, 7 x 5 in., paper $1.00.

The author presents in brief form practical information on the selection and utilization of coal, including schematic analyses of causes and remedies for combustion troubles.

INTERNATIONAL ASSOCIATION FOR HYDRAULIC STRUCTURES RESEARCH

Report on the First Meeting, Berlin, October 4-7, 1937. Publ. 1938 by the Association, President, W. Fellenius, Kungl. Tekniska Hogskolan, Stockholm. 286 pp., illus., diagrs., charts, tables, 8 x 6 in., cardboard, 10 rm.

This report on the first meeting of the International Association for Hydraulic Structures Research contains the proceedings of the meeting, lists of the members and participants, and the text of the technical papers presented, covering hydraulic measurements, structures, models, etc.

Introduction to MECHANICS AND HEAT

By N. H. Frank. 2 ed. New York and London, McGraw-Hill Book Co., 1939. 384 pp., diagrs., tables, 9 x 6 in., cloth, $3.00.

Intended for use as a text in an elementary course for scientific and technical students, this book presents a logical, systematic development of physical principles within the fields of mechanics, acoustics and heat. The use of mathematical methods is emphasized and numerous problems are included.

MAC'S DIRECTORY OF COAL OPERATING COMPANIES

6th ed. 1939. Pittsburgh, Pa., National Coal Publications. 136 pp., 12 x 9 in., paper, $7.50.

This directory contains geographical and alphabetical lists of all American operating companies, with data as to officers, capacity, equipment, etc. In addition, lists of purchasing agents are included and a list of producing mines, with the names of operators and locations.

MÉCANIQUE DES FLUIDES APPLIQUÉE, Vols. 3 and 4

By A. Tenot and A. Caquot. Paris, Dunod, 1939. Diagrs., charts, tables, 8 x 6 in. Vol. 3, 183 pp., paper, 45 frs.; bound, 53 frs. Vol. 4, 106 pp., paper, 28 frs.; bound, 36 frs.

These two volumes complete a textbook on applied fluid mechanics intended as a text for engineering colleges and a reference work for engineers. The first volume of the four presents the general principles of the subject and exhibits their applications to turbines, viscosimeters and lubrication. Volume two is concerned with aeronautical problems. Volume three discusses matters of hydraulics and hydromechanics. The final volume is devoted to the production and utilization of steam. In presenting the material, large use is made of worked-out numerical problems, selected to illustrate practical use of the laws of mechanics to common industrial problems.

METALS HANDBOOK

1939 ed. Cleveland, Ohio, American Society for Metals. 1,803 pp., illus., diagrs., charts, tables, 9 x 6 in., lea., $12.50.

This comprehensive volume of metallurgical information has again been revised to cover more completely the subjects of the manufacture, treatment and application of metals. The general section includes the structure, testing, heat treatment and welding of metals; processes, methods and equipment related to metallurgical operations; and a chapter giving definitions, trade names and tables of technical data. In the ferrous section the constitution, properties and testing of iron and its alloys are discussed, and the making, shaping and treating of iron and steel, including all types of surface treatment, are described. The constitution and properties of other metals are covered in the non-ferrous section, as well as the micrography, technology and uses of the more important ones. There is an extensive index.

METER ENGINEERING

By J. L. Ferns. 2 ed. New York and Chicago, Pitman Publishing Corp., 1938. 347 pp., illus., diagrs., charts, tables, 8 x 5 in., cloth, $3.75.

This concise practical book has been revised in accordance with recent developments. It covers in detail the whole field of work connected with the installation, testing and maintenance of electricity meters. Of particular interest is the chapter on meter faults and their treatment.

(The) MICROSCOPE in ELEMENTARY CAST IRON METALLURGY.

By R. M. Allen. Chicago, American Foundrymen's Association, 1939. 143 pp., illus., charts, tables, 9 x 6 in., cloth, $3.00.

A considerable field is covered in this small volume. The fundamentals of the physical metallurgy of cast iron are stated, followed by an explanation of the behavior of sulphur and phosphorus in cast iron, and a description of special cast irons. The value and use of equilibrium diagrams are discussed, and finally the microscope and the technique of its use are considered, including the accompanying etching and photographic processes. Many fine photomicrographs illustrate the various chapters.

Industrial News

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

BELT CONVEYORS AND MATERIAL HANDLING EQUIPMENT

A sixteen-page well illustrated bulletin, issued by the Robert Mitchell Co. Limited of Montreal, describes the Mitchell conveying and material handling equipment. In addition to the numerous photographs illustrating the products, there are a number of diagrams and convenient reference tables. A section is also devoted to the description of the Mitchell agitators for liquids.

SCREENS AND VIBRATORS

The W. S. Tyler Company of Canada, Ltd., St. Catharines, Ont., have released the following bulletins illustrating and describing their various products. These bulletins range from four to sixteen pages and, in addition to the general description of the products, they contain other related useful reference data. These may be procured from the company under the following titles:

Monel Wire Screen and Filter Cloth—Bulletin H-3.

High Capacity Screen Cloth—Bulletin 801-D.

Type 400 Screen—Bulletin 515.

The Ty-Rock Screen—Bulletin 905-D.

Ty-Speed Electric Vibrators—Bulletin 737-D.

Accuracy and Economy in Wet Screening—Bulletin 721.

ELECTRICAL INSTRUMENTS

An attractive four-page pamphlet of an illustrative nature has been issued by Bepco Canada Limited, Montreal and Toronto, which provides some idea of the wide range of electrical instruments handled by Bepco for switchboards, meter-testing, educational use, laboratories and general purposes.

CANADA'S WATER POWER WEALTH

The Dominion Water and Power Bureau, Surveys and Engineering Branch of the Department of Mines and Resources, have issued a forty-page booklet describing Canada's water-power resources. This has been reprinted from "Canadian Geographical Journal" of September 1937, and has been revised to date. The booklet contains more than fifty excellent illustrations showing power developments and undeveloped sites throughout Canada.

TESTING INJECTORS AND OTHER HYDRAULIC DEVICES

Diesel Equipment Corporation, 4401 N. Ravenswood Ave., Chicago, Illinois, are distributing a four-page bulletin describing the "Deco" hand pump for testing fuel injectors and other hydraulic devices such as transmissions, brakes, accumulators, presses, etc.

VALVE PRESENTED TO MUSEUM

The "Valve" is going to receive long delayed tribute at the Museum of Science and Industry, Jackson Park, Chicago. Representing all valves from the tiniest spigots to gigantic sluice gates will be a 17-ton 72-inch valve, the gift of Crane Co., Chicago, to the Museum.

Water from streams, lakes, oceans, bays, etc., all over the world will play a rôle in a dedication ceremony in which Dr. Philip Fox, director of the Museum, and Charles B. Nolte, president of Crane Co., will officiate. Water from the eastern hemisphere will be kept separate from water from the western hemisphere and the two will be merged as the "Waters of the World" in recognition of the fact that the valve was one of a type made for the Panama Canal.

The dedication rite, which will symbolize the control exercised by valves over liquids and gases wherever they have been put to the service of mankind, will be part of a program in which President Nolte will present the valve to the Museum formally. Officials expect that it will take several months to collect the samples of water from all over the world.

HARRY C. PARKER DIES AT TORONTO

Harry C. Parker, district sales manager of the Canadian Ohio Brass Company, Ltd., Niagara Falls, Ont., died suddenly at his home in Toronto on June 13 from an acute stomach disorder. Mr. Parker had been associated with the Canadian Ohio Brass Company, Ltd., since 1924.

Born at Tynemouth Creek, New Brunswick, in 1893, Mr. Parker held an electrical engineering degree from the University of New Brunswick and served as a captain with the engineers in the World War. He was well known in Toronto engineering circles having served as a director of the Engineers' Club, a member of the Professional Engineers of Ontario.

WOOD PRESERVING

A twenty-page booklet has been issued by the Osmose Wood Preserving Company of Canada. In the booklet, the company states that it has "endeavoured to present authentic data to substantiate the quality of our products, further showing methods of application and some of the large jobs completed so as to convey that 'Osmose' and our preservatives have been used with proven results for many years."

SPIRAKORE TRANSFORMER

The Spirakore Distribution Transformer recently announced by Canadian General Electric Co. Limited embodies a design principle completely revolutionary in the transformer art. As the name implies, the important new feature of this transformer is its core construction of two continuous strips of relatively low silicon content cold-rolled steel, tightly wound into two metal rings through and around the coils. The coils are oval in shape and of short axial length, interleaved in secondary-primary-secondary arrangement.

The significance of the Spirakore transformer can best be appreciated by considering that it completely eliminates the cutting and placing of the hundreds of separate pieces of steel that make up the core of the conventionally designed transformer. The two ribbon-like steel strips that comprise the cores of the new transformer are pre-wound and assembled on machines at high speed.

The Spirakore transformer will be supplied in the smaller capacities, starting at 1 kva. and probably up to and including 10 kva. capacity, 60-cycle.

COLOUR-FINISHING CONCRETE FLOORS

A two-page pamphlet has been issued by The Master Builders Co., dealing with the Glazecoat Method of colour-finishing concrete floors. The data covers the properties of "Glazecoat," special features and method of application.

CHEMICAL FEEDING EQUIPMENT

Chemical feeding equipment produced by "Proportioneers Inc." of Providence, R.I., is described in a well-illustrated, twelve-page booklet issued by the company as bulletin No. "RED." The company is represented in Canada by Keith, Merle Reg'd., 1100 Craig St. East, Montreal, Que.

WATER POWER FEATURED AT CANADIAN PAVILION AT NEW YORK WORLD'S FAIR

One of the outstanding exhibits in the Canadian Pavilion at the New York World's Fair is to be found in the presentation of "Canada's Wealth in Water Power." This exhibit has been developed jointly by the Departments of Mines and Resources and of Trade and Commerce.

The theme of the exhibit is "Canada—The Home of Low-Cost Power"— with power depicted as a dominating factor in the development of industries based on Canada's wealth of other natural resources of soil, forest and mine and as the source of abundant low-cost electricity for the comfort and convenience of urban and rural populations throughout the Dominion.

Hydro-Power is symbolized by a group in bronze standing fifteen feet high. This group shows a heroic Power figure holding aloft and releasing to mankind the versatile instrument of this machine age—low-cost electric energy. At his feet two wild horses arise out of a wild tumbling river depicting the horse-power development of hydro-electric energy. From a power-house below the figure power lines lead to industrial plants. To the right and left of the Power figure a series of revolving drums depict industrial scenes on transparent silk of the secondary industries of the Dominion—served by and largely dependent upon low-cost hydro energy.

Behind and above the Power figure a fifteen-foot map of the Dominion, in diminishing projection towards the northern Pole, illustrates the location and distribution of Canada's developed and undeveloped water-power resources.

HEAVY GRADING AND CONSTRUCTION EQUIPMENT

Two folders published recently by R. G. LeTourneau, Inc., deal with the full LeTourneau line of heavy grading and construction equipment, including dozers, carryalls, sheep's foot rollers, rooters, tractor cranes and power control units. A large number of job pictures illustrate the different types of work and jobs carried on under various conditions. Copies of these publications may be obtained from the company at Peoria, Illinois.

COOLERS AND PUMPS

Bulletins recently issued by Worthington Pump and Machinery Corp., Harrison, N.J., include the following:

Evaporative Coolers for Engine Jacket Water—Bulletin S-500-B37.

Centrifugal Hot Charge Pumps—Bulletin W-341-B6.

Horizontal Simplex Direct-Acting Piston Pumps—Bulletin W-111-B6C.

REPORTS OF DOMINION BUREAU OF STATISTICS

The Mining, Metallurgical and Chemical Branch of the Dominion Bureau of Statistics have recently issued the following reports:

The Compressed Gases Industry—1938. Annual Statistical Report of Canadian factories making industrial gases as their main products.

The Petroleum Industry—1937. Annual Statistical Report of the production of crude petroleum in Canada during 1937.

The Natural Gas Industry—1937. Annual Statistical Report of the production of natural gas in Canada during 1937.

Coal and Coke Statistics for Canada. Quarterly Report covering January, February and March, 1939, giving production, import and export figures.

Chemical and Allied Products Group. Preliminary Summary Statistics for 1938.

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

YOUNG ENGINEER, preferably mechanical, a graduate of three or four years, with some industrial or sales experience, to work through the different departments of a Montreal manufacturing concern with a view to learning the business. Apply to Box No. 1836-V.

SALES ENGINEER, conversant with modern power plant practice, to aggressively prosecute sales of water tube boilers, stokers, airheaters and other auxiliaries. Straight salary plus a bonus based on the gross volume of annual sales. Send applications with full particulars to Box No. 1909-V.

INSTRUCTOR in mechanical draughting and related subjects. A graduate in engineering with previous teaching experience preferred. Candidates should have at least three years experience on the board. A permanent position with prospects, for the right man. Apply to Box No. 1911-V.

VACANCIES WITH THE GOVERNMENT OF BIHAR, INDIA

The High Commissioner for India is prepared to receive applications for the appointments of

(i) Chief Electrical Engineer, and

(ii) Assistant Chief Electrical Engineer,

for service with the government of Bihar, India, in connection with the Bihar Electrification Project.

CHIEF ELECTRICAL ENGINEER—Candidates for the appointment of chief electrical engineer must have high academic qualifications in electrical engineering and practical experience in initiating and working large thermo-electric projects. They should be fully qualified to undertake the construction and operation of a large-scale thermo-electric project. The chief electrical engineer will be required to work out details of the project, with estimates, etc., for the electrification of the province of Bihar, subject to the general direction of the government, and will be responsible for putting the scheme into operation.

ASSISTANT CHIEF ELECTRICAL ENGINEER—Candidates for the appointment of assistant chief electrical engineer must have theoretical and practical knowledge of the working of large thermo-electric projects. The appointee will assist, and work under the direction of, the chief electrical engineer.

Applications must be made on printed forms available at the *Institute* headquarters, where full particulars may also be obtained.

SITUATIONS WANTED

INDUSTRIAL ENGINEER, B.Sc. (McGill), with fifteen years broad experience in general design and construction and in practically all departments of industrial design and operation, would consider responsible permanent position with progressive industrial concern. Apply to Box No. 492-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.

ELECTRICAL ENGINEER, B.Sc. '31, (U.N.B.), Jr. E.I.C. Age 31. Single. Experience in electrical wiring construction of concrete wharves, inspection of piling, rip rap, concrete reinforcing, forms, and dredging. Instrumentman during the preliminary survey of a concrete road. Final calculations of quantities of concrete and excavation for concrete road. Junior engineer during the construction of a frostproof shed, a steel shed and a boiler house, which included a general inspection of wiring system for sheds lighting and to the unit heaters in the frostproof shed. Available at once. Apply to Box No. 722-W.

DESIGNING ENGINEER, M.Sc. (McGill), D.L.S., A.M.E.I.C., P.E.Q. Experience in the design and construction of water power plants, transmission lines, field investigations of storage, hydraulic calculations and reports. Also paper mill construction, railways, highways, and in design and construction of bridges and buildings. Available at once. Apply to Box No. 729-W.

ELECTRICAL ENGINEER, B.Sc., Jr.E.I.C. Eight months on installation of power and lighting equipment; three years as manager of sales and service dept. of an electrical firm; seven months as tester on power and radio equipment, one and a half years as inspector on electrical and power equipment. Interested in inspection or sales engineering. Available on short notice. Location immaterial. Apply to Box No. 740-W.

CIVIL ENGINEER, B.Sc., A.M.E.I.C., R.P.E. Age 48. Twenty-five years construction experience on railways, highways, bridges, dams, flumes, pipe lines and buildings. Expert on earthworks and transportation. Location immaterial. Apply to Box No. 841-W.

MECHANICAL ENGINEER, Jr.E.I.C., technical graduate, bilingual, age 36, married. Experience includes five years with firm of consulting engineers, design of steam boiler plants, heating, ventilating and air conditioning. Seven years with large company on sales and design of heating systems, air conditioning, steam specialties, etc. Available on short notice. Apply to Box No. 850-W.

CIVIL ENGINEER, A.M.E.I.C. Married. Experience of over 26 years. Surveys, railways, canals, highways, including location, construction, inspection, giving monthly and final estimates. Building locks, dams and all kinds of buildings. Experienced in steel and munitions work, on laboratory inspection of shells and gauges for same. Seeking steady employment. Apply to Box No. 1168-W.

CIVIL ENGINEER, B.Sc. (Univ. N.B. '32), A.M.E.I.C., R.P.E., Dy.L.S. Age 33. Married. Experience: ten years surveys, mines, land, legal, railways, geological, appraisal, mine management, construction. At present in private practice in civil and mining engineering. Would consider employment in a foreign field. Apply to Box No. 1562-W.

MECHANICAL ENGINEER, B.Sc., in mechanical engineering with six years experience in pulp and paper mill engineering and maintenance. Wishes employment in maintenance department as assistant to master mechanic or similar work. Can furnish references. Married. Available on short notice. Apply to Box No. 1694-W.

REFINERY ENGINEER, B.Sc. (E.E.), Man. '37. Experienced in supervising operations and maintenance of small refinery. 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. '31, A.M.E.I.C. Experience includes one year hydrographic surveying, two years municipal work, five years highway work. Familiar with all types of pavement, concrete design, bridge construction, sewer design and water layout, road construction. Available on short notice. Apply to Box No. 1815-W.

CIVIL ENGINEER, B.E., Jr.E.I.C., 28 years of age. Married. Desires position with reliable construction firm. Intends to make construction life work. Over five years experience on permanent highway construction, inspection, estimates and instrument work. Available on short notice. Apply to Box No. 1820-W.

TRAINING AS SALES ENGINEER desired by civil engineer, B.E., Jr.E.I.C. Single. Age 27. Has taken extensive additional study in education, particularly in psychology and personality. Experience consists of surveying, detailing, designing, and principal of a high school. Desires permanent position. Available on short notice. Apply to Box No. 1843-W.

SALES ENGINEER REPRESENTATIVE, B.A.Sc., C.E. Age 30. Contact in Northern Quebec mine belt. Interested in selling any kind of materials. Experience in heating and air conditioning. Speaks both English and French. Available at once. Apply to Box No. 1859-W.

CIVIL ENGINEER, B.Sc., S.E.I.C. Married. Six months surveying; mill site; water supply, power line location, earthwork, drainage, topographic. Have 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.

CHEMICAL ENGINEER, graduating Toronto '39. S.E.I.C. One and a half years general ore dressing laboratory work. One and a half years' general milling and assaying. Seeking a permanent position in chemical industry. Apply to Box No. 1867-W.

TECHNICALLY TRAINED EXECUTIVE, general experience covers organization and management in business and industrial fields; including sales, purchasing, productions, accounting and costing, also industrial surveys, reorganizations and amalgamations in the United States and Canada. B.Sc. degree in mechanical engineering. Married. Canadian. Apply to Box No. 1871-W.

MANUFACTURING EXECUTIVE, B.Sc. in mechanical engineering. Married. Canadian. Experienced in munitions manufacturing and other precision work. Apply to Box No. 1872-W.

SALES ENGINEER. Several years experience selling to industrial, mining and railroad organizations in Ontario and Quebec. B.Sc. in mech. engrg. Married. Canadian. Apply to Box No. 1873-W.

INDUSTRIAL DESIGNER seeks position, part-time employment or commissions. University graduate, A.M.E.I.C., long architectural designing experience. Apply to Box No. 1878-W.

CIVIL ENGINEER, S.E.I.C., McGill, '39. Age 22. Consistently high scholastic standing. Ready to adapt himself to any kind of work promising future advancement. Experience includes maintenance work in an industrial plant, surface exploration for minerals in northern Quebec, surveying, mapping, and selling. Excellent references. Present residence, Montreal. Available June, 1939. Apply to Box No. 1881-W.

CIVIL ENGINEER, B.Sc. Age 27. Married. Four years experience in highway work, including instrument work on preliminary surveys and construction, estimating and inspection. Prefers position with construction firm. Available at once. Apply to Box No. 1883-W.

CIVIL AND STRUCTURAL ENGINEER, B.A.Sc. (Toronto), A.M.E.I.C. Three years experience in plant engineering work entailing mechanical and structural design and supervision. Also two years on construction work. Desires permanent position with industrial firm or consulting engineer. Apply to Box No. 1893-W

CIVIL ENGINEER, A.M.E.I.C. Married. Ten years experience on railway location and construction. Twenty years on hydro-electric power and mill construction in executive capacity in charge of preliminary investigation, engineering, estimating, costs and purchasing. At present unengaged owing to the firm associated with discontinuing operations. Available at once. Apply to Box No. 1896-W.

MECHANICAL ENGINEER, B.E. (Sask. '38), S.E.I.C. Age 25. Single. Year's experience with large steel plant, general piping, fuel oil lines and storage tanks, surveying, draughting, furnace construction and operation, adjustment of automatic control equipment, testing. Considerable electrical knowledge. At present employed but available on short notice. Desires specialized position but will consider others. Apply to Box No. 1907-W.

CIVIL ENGINEER, B.A.Sc. (Toronto '09). M.E.I.C., R.P.E. Ont. and B.C. Age 50. Presently employed. Over thirty years experience: design, estimate and erection of structural steel, heavy timber and monolithic concrete; large scale surveys, maps, contours, railway and highway location, farm drainage. Apply to Box No. 1910-W

ELECTRICAL ENGINEER, B.Eng. (McGill '37). Age 24. Eighteen months experience in test department of big English electrical manufacturing firm. Returning to Canada in June. Would prefer design, sales, or practical work. Apply to Box No. 1911-W.

CIVIL ENGINEER, A.M.E.I.C., R.P.E. Age 48. Married. Fifteen years city engineer, fourteen years experience on design, construction, maintenance, road location, railways, underground, also experience in hardware, plumbing, heating, air conditioning. Desires steady position. Available on short notice. Apply to Box No. 1923-W.

ELECTRICAL ENGINEER, B.A.Sc. (Toronto '35). Age 27. Jr.E.I.C. Graduate of business college. Technical experience in aeronautics, comfort air cooling, refrigeration and communication equipment. Office experience, including shorthand, typewriting and correspondence compilation. Apply to Nox No. 1926-W.

CIVIL ENGINEER, B.Sc. in C.E. '39, S.E.I.C. Age 20. Three summers experience in land survey. Will undertake any work of an engineering nature. Location immaterial. Further details on request. Apply to Box No. 1943.-W

PRELIMINARY NOTICE

of Application for Admission and for Transfer

June 30th, 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 August, 1939.

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 he considered as responsible charge.

An Associate Member shall be at least twenty-seven years of age, and shall have been engaged in some branch of engineering for 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 hy the Council shall be required to pass an examination before a board of examiners appointed hy 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 heen 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 he 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 hranch 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 hy 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 hy 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—RONALD GORDON, of Toronto, Ont. Born at London, England, Feb. 1st, 1889; Educ.: 1907-11, articled pupil under J. Hannay Thompson, M.I.C.E., engr. to the Dundee Harbour Trust. This period included six mos. at the Dundee Branch of St. Andrews Univ., and six mos. in the Dundee Harbour workshops; 1911-13, asst. engr. to the Dundee Harbour Trust; 1913-14, instru'man., C.P.R.; 1914-39 (with exception of five years war service), with the sewer section, dept. of works, City of Toronto. Successively drftsman., asst. designer, res. engr., designer. From 1929 to date, supervising engr. i/c of sewer contracts, experience includes sewer work of all sizes and description, also sewage disposal plants.

References: G. G. Powell, M. A. Stewart, G. Phelps, W. Storrie, I. H. Nevitt.

BELNAP—LaMONTE JUDSON, of Montreal, Que. Born at Burre Oak, Mich., Nov. 7th, 1877; Educ.: B.Sc. in E.E. and D.Eng., Univ. of Nebraska, 1898; 1898-99, student ap'tice, Western Electric Co., Chicago; 1899-1900, dftsman., and 1901-02, engr. on transformer design, Wagner Electric Co., St. Louis; 1902-03, erection and service engr., and 1903-11, district mgr. and mgr., Allis Chalmers, Montreal; 1914-19, president, Ingersoll Machine Co. Ltd., Ingersoll, Ont.; 1917-19, managing director, Williams Mfg. Co. Ltd., Montreal; 1911-25, vice-president, Rudel Belnap Machinery Co., Montreal; 1917-19, asst. director, war supplies, British War Mission, Washington, D.C.; 1919-25, president Rolls Royce of America, Springfield, Mass.; 1925-26, chairman, Wills St. Claire Co., Detroit, Mich.; 1926-31, president and 1931 to date, chairman of the board, Worthington Pump and Machinery Corpn., New York; 1931 to date, chairman of the board, U.S. Hoffman Machy. Co., New York; 1931 to date, president, Consolidated Paper Corporation, Montreal, Que.

References: G. H. Duggan, H. H. Vaughan, A. Surveyer, J. B. Challies, J. C. Smith.

BRANT—CECIL MORNINGTON, of Newfoundland Airport, Nfld. Born at Holbeach, Lincs., England, March 1st, 1908; Educ.: 1926-27, R.A.F. Electrical and Wireless School, technical and educational exams. passed 1927; 1933-35, Polytechnic Institute, London, 3rd year group course cert., 1935; 1922-26, ap'ticed, Henstocks Ltd., Chesterfield; 1926-32, radio operator mechanic, R.A.F.; 1932-35, radio instructor, London County Council; 1935-36, radio operator and mtce. engr., civil aviation branch, Air Ministry, London; 1936-37, placed in charge of the Air Ministry Radio School at Croydon, England, instructor in radio engrg., and operating, direction finding and radio navigation. Also responsible for erection of two radio stations for instructional purposes; 1937 to date, transferred to Trans-Atlantic Air Base, Botwood, Nfld., and promoted to technical supervisor, civil aviation branch, Air Ministry, London. (Established Civil Servant).

References: K. R. Chestnut, F. C. Jewett, R. A. Bradley, J. A. Wilson, W. A. Rush.

JONES—EVAN STENNETT, of Cranbrook, B.C. Born at Holdsworthy, England, May 19th, 1891; Educ.: 1906-09, articled to firm of Bott & Stennett, England. R.P.E. of B.C.; 1909-10, land survey; 1911-14, rodman, 1914-16, transitman, P.S.E. Rly., B.C.; 1919-20, transitman, 1920-22, res. engr., C.N.R.; 1922-23, res. engr., 1923-25, asst. district engr., and from 1925 to date, district engr., Dept. of Public Works of the Province of B.C.

References: A. L. Carruthers, P. Philip, C. W. Gamble, H. L. Hayne, F. L. Macpherson.

LAWRENCE—FREDERIC S., of 2082 Tupper St., Montreal, Que. Born at Montreal, Nov. 11th, 1899; Educ.: B.Sc. (Civil), McGill Univ., 1923, R.P.E. of Que.; 1925-29, instr'man., C.N.R.; 1929 to date, constrn. engr., Montreal Light, Heat & Power Cons., Montreal, Que.

References: W. Walker, H. L. Currie, W. J. Yorgan, D. O. Wing, F. V. Dowd.

McKAY—WALTER NEIL THOMPSON, of 269 Old Orchard Grove, Toronto, Born at Chatsworth, Ont., April 12th, 1910; Educ.: B.A., Univ. of Toronto, 1933. Grad. of Ontario Coll. of Education, 1934. At present studying for LL.B. degree from LaSalle Extension University; May, 1937 to Jan. 1939, asst. to registrar and sec.-treas., and Feb. 1939 to date, secretary-treasurer, Association of Professional Engineers of the Province of Ontario, Toronto, Ont.

References: M. B. Watson, W. E. Bonn, E. P. Muntz, W. P. Dobson, W. C. Miller J. C. Keith.

REID—ALEXANDER MacLAREN, of St. Paul, Alta. Born at Glasserton, Whithorn, Wigtownshire, Scotland, Dec. 21st, 1895; Educ.: Private tuition, and tech. evening classes, incl. surveying, engrg. maths., bldg. constrn. quantities and drawing; R.P.E. of Alta.; 1911-14, and 1919-21, served articles in county road surveyor's office, Wigtownshire; 1914-19, served in British Army, demobilized as Lieut., King's Own Scottish Borderers; 1921-27, asst. surveyor engr., civil engrg. dept., Anglo-Persian Oil Co., Persian Gulf, So. Persia; 1927, asst. on engrg. staff, E. G. M. Cape & Co., Montreal; 1928 to date, with the Dept. of Public Works of Alberta, as follows: 1928-30, instr'man. on highway survey & road constrn. work; 1930-32, res. engr., survey and constrn. of main highways; 1933-35, Alherta Relief Commission, administration of relief and relief work in Alberta drought area; 1935-38, res. engr., main highways branch, Edmonton, and April, 1938 to date, district engr., i/c District No. 7, St. Paul, Alta.

References: E. V. Collier, E. H. Harrison, J. W. S. Chappelle, J. M. Forbes, J. M Anderson.

ROBITAILLE—JEAN MARIE, of Montreal, Que. Born at Quebec, Que., Feb. 22nd, 1896; Educ.: 1916-17, 1st year Arts, Univ. of Toronto; 1917, I.C.S. Course in Civil Engrg.; 1917-18, inspection of steel, Imperial Munitions Board. i/c hydraulic testing plant, Imperial Ministry of Munitions; 1919-26, with deGaspe Beaubien, M.E.I.C., consltg. engr., Montreal, surveying, dfting., estimating, inspection, supervision, concrete work, valuations, design, etc.; 1926-32, with the Canadian International Paper Co. Ltd., i/c of survey parties, precise work, dfting., design, estimating, inspection, supervision of constrn. work, etc.; 1932-36, with the International Fibre Board Ltd., engrg. dept. work, including acoustical analyses, thermal insulation, refrigeration, supervision, estimating, specifications, reports, statistics, research; 1936-38, misc. temporary work for various companies; Aug. 1938 to date, surveys engr., Quebec Streams Commission, Montreal, Que.

References: deG. Beaubien, J. L. Busfield, J. A. H. Henderson, S. F. Rutherford, P. E. Bourbonnais, S. N. Tremblay, W. H. Abbott.

ROCHON—ROLAND CHARLES, of 610 Champagneur Ave., Outremont, Que. Born at Ottawa, Ont., Jan. 26th, 1901; Educ.: 1928, one year, Ecole Polytechnique, Montreal; B.Sc. (E.E.), Milwaukee School of Engrg., 1936; 1930-31 (summers), armature winding, United Motor Service, Milwaukee, Wis. With the Square-D Co., Milwaukee, as follows: 1932-33, assemhlyman on constrn. of switchboards and controllers, 1933-34, drftsman and designer, 1936-37, asst. i/c of testing elect'l. control equipment, industrial controller divn., 1937-38, on technical sales for same company at Montreal, on switchboards, power & lighting panel boards, industrial control equipment, switches, to constrn. engrs. and industrial firms; at present salesman and serviceman for Hector F. Beaupré, elect'l. machy. and power costs analyst, Montreal, Que.

References: A. J. E. Dugas, L. A. Duchastel, P. P. Vinet, C. H. Jetté, D. W. Heywood.

SMALL—WALTER HENRY, of 1048 Ridgeway St., Fort William, Ont. Born at Benzonia, Mich., July 20th, 1883; Educ.: B.Sc., Michigan State College, 1908; 1908-12, teacher of manual training; 1912-17, dftsman, for Bennett-McQueen, C. D. Howe, Hon.M.E.I.C., and Webster Mfg. Co., Tiffin, Ohio; 1917-19, with S. J. McQueen, Fort William, as chief engr.; 1919-34, chief drftsman., and 1934 to date, chief engr., Barnett-McQueen Co., Fort William, Ont.

References: R. B. Chandler, G. R. Duncan, C. B. Symes, S. E. Flook, K. A. Dunphy

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

RUNCIMAN—ARTHUR SALKELD, of Montreal West, Que. Born at Goderich, Ont., Aug. 11th, 1890; Educ.: Grad., 1911. E.E. 1928, Univ. of Toronto; 1912-14, asst. supt., City of Prince Albert Light & Power Dept.; 1915, on constrn. work for Canadian Westinghouse Co.; 1916-20, asst. engr., Marconi Wireless Telegraph Co.; 1920-26, mtce. engr. of lines, and 1926 to date, supt. of transmission lines, i/c of all high voltage line mtce. and communication radio, telephone and teletype, Shawinigan Water & Power Company, Montreal. (A.M. 1919).

References: J. A. McCrory, J. B. Challies, J. Morse, L. A. Wright, F. S. Keith.

FOR TRANSFER FROM THE CLASS OF JUNIOR

CHAMBERS—ROBERT JOHN, of Chandler, Que. Born at Winnipeg, Man., Sept. 21st, 1907; Educ.: B.Sc., 1933, M.Sc., 1935, Queen's Univ.; 1927-30 (intermittently), radio service, oil burner service, draft control work; 1931 (summer), timek'pr., Ryan Constrn. Co., Ottawa; 1935-37, mech. engr., Anglo Canadian Pulp & Paper Co. Ltd., Quebec; 1937 (summer), mech. engr., assisting engr. in charge of reconstrn. of Chandler mill, and from 1937 to date, mech and research engr., at Chandler mill, for the Gaspesia Sulphite Co. Ltd., on misc. engrg. and drfting work. (Jr. 1936).

References: L. M. Arkley, L. T. Rutledge, J. O'Halloran, R. H. Farnsworth, R. E. MacAfee.

ST. JACQUES—GUSTAVE F., of Quebec, Que. Born at Montreal, April 4th, 1911; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1936; 1935 (summer), instrument work, Public Works of Canada; 1936, cadet engr., Brown Corporation, La Tuque; 1936-37, engr. with the Consolidated Paper Co. at Three Rivers, and Dec. 1937 to June 1938, asst. to chief engr. of the same Company at Port Alfred; June, 1938 to date, engr. with the Quebec Public Service Commission, now the Provincial Transportation and Communication Board, Quebec, Que. (St. 1935, Jr. 1938).

References: A. Larivière, C. H. Jetté, C. H Boisvert, J. U. Archambault, A. Frigon, L. Trudel, S. A. Baulne.

THE ENGINEERING JOURNAL

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CHEVRIER COMMISSION REPORT

NORMAN D. WILSON, C.E. (Tor.)
Engineer-Economist to the Royal Commission on Transportation, Ontario.

The Royal Commission on Transportation, popularly known as the Chevrier Commission, was appointed by Order-in-Council of the Ontario Government on the 26th of August, 1937, to investigate and report on various phases of the transportation of freight by motor vehicles for gain or not for gain, and of passengers for gain.

The Commission was composed of The Honourable Mr. Justice E. R. E. Chevrier of the Supreme Court of Ontario, Chairman; Professor C. R. Young, M.E.I.C., Head of the Department of Civil Engineering in the University of Toronto; and Mr. E. Roy Sayles, Owner and Publisher of the "Renfrew Mercury."

The Order-in-Council instructed the Commission to compare the wages paid and the hours worked on motor vehicle freight transport and motor vehicle passenger transport for gain, with wages paid and hours worked on other transportation agencies; also to compare the rates and tariffs charged by motor transports with those charged on other transport agencies; also to compare the taxes paid by motor transports with those paid by other transport agencies, and as well the subsidies granted motor transport with those granted other forms of transportation.

The Commission was further instructed to investigate and report upon the existing methods of licensing and regulation of the aforesaid motor vehicles in order to insure just and reasonable service and prevent unfair competition between motor transport companies and other forms of passenger and freight transportation.

Lastly, the Commission was instructed to report upon the annual cost of constructing, maintaining and administering all public roads in the province, and the amount contributed by municipalities, and to determine to what extent the cost of such public roads should be met by the owners and operators of freight transportation vehicles and passenger vehicles operated for gain.

The Commission handed in its report on December 23rd, 1938, but printed copies of the complete report were not available until March of this year.

Transport Operation

The labour situation found by the Commission, in the words of the Report, "constitutes a genuine cause for public concern." While in a great number of cases wages of motor truck drivers and bus operators were found to be eminently fair, the conditions of employment good, and the hours of labour restricted to forty-eight hours or less, there were a great number of cases brought out in evidence where the hours of work and on duty were unbelievably long, and the weekly wage paid scandalously low. Weeks of ninety-six hours were found to be not uncommon, and by and large there was much need for reform and stabilization. The matter of wages and labour conditions was gone into thoroughly by the Commission, and the report is filled with details and recommendations.

The Commission made voluminous recommendations along the line of inspection of vehicles, lights on transport vehicles, width of vehicles, necessity of adequate brakes, both on motor cars and trailers, etc. It recommended that a motor transport vehicle should be sufficiently powered to maintain a speed of fifteen miles per hour ascending a five per cent grade. It also recommended the suppression of double hook-ups and the reduction of the permitted length of a motor train from fifty feet to forty feet.

The question of rates and tariffs on public commercial vehicles, carrying with it the question of competition between highway and rail transport, demanded some background of history, and this is given at some length in the Report.

Early efforts of the Automotive Transport Association to get the transport operators together and stabilize rates, were nullified by the introduction by the railways in 1933 of pick-up and delivery services and the elimination of severe packing regulations.

After the inauguration of the present pick-up and delivery group tariff by the railways in June, 1937, a further attempt was made by the Automotive Transport Association to stabilize rates, by adopting the railway group classification and, with some modifications, the railway rates of the pick-up and delivery tariff. The effort met with but limited success, owing to competition between truckers and pressure from shippers.

It is apparent from the study of motor transport costs by the Commission that the railway pick-up and delivery rates are, within the general range of truck operations, little if anything above trucking costs of package freight including pick-up and delivery services. On the other hand, the relatively small size of the truck load and the ability of the truck to proceed direct to its destination upon being loaded are elements of service which give motor vehicle transport overwhelming advantage in many circumstances.

The Commission looked into 2,138 specific cases of rates charged by motor transport Class "A" operators. On the basis of this sampling, for freight movements for which the railways would charge $10.00, under their pick-up and delivery tariff, the Automotive Transport Association tariff would specify $9.68, and actually the operators had charged $8.17.

There were many specific instances before the Commission of ridiculously low rates being charged under the stress of competition. In general the rates for canned goods were exceptionally low. Between Toronto and Hamilton trucking competition is very keen, and all rates are at rock bottom or below.

The Commission found that conditions in the motor transport industry were chaotic; that the industry had tried to regulate itself and had failed, and that the only solution was regulation by the government. From the industry itself there was unanimous acceptance of the necessity of some government regulations as to wages and hours, inspection of vehicles and so forth, and only one dissentient was heard in evidence in opposition to the principle of government regulation of tariffs.

The Commission recommended that a Transport Board be set up, either a separate board or a branch of an enlarged Municipal Board, with comparable powers over motor transport in Ontario to those the Board of Railway Commissioners has over railways throughout Canada.

Roads in Ontario

By all odds the most far reaching of the instructions given the Commission were those to report upon the annual cost of roads in the province, and whether commercial vehicles were paying their proper share of such costs. At once the Commission was faced with the question as to what was meant by the word "roads" as used in the Order-in-Council; whether same should be limited in its meaning to roads subsidized by the provincial government under the Highway Improvement Act, or did it include all roads open to vehicular traffic throughout the province. The Commission decided the latter; that Ontario was a single unit and that irrespective of the class of road, and whether located in New or Old Ontario, in rural township or urban centre, all roads were equally free and open for motor traffic, were equally highways in the common law meaning, and were all included in the word "roads" as used in the reference. Offhand this may appear a very minor matter but it is actually the foundation stone of the whole report.

From the time of the first enactment of the Municipal

Act in 1841 until the motor vehicle era, the opening and maintenance of roads were strictly matters for municipal concern, at least in all organized municipalities. The central government did, however, continue to spend very modest amounts of money annually on roads and bridges in unorganized territory.

In 1912, the Northern Development Branch was set up to build roads and in other ways assist settlers in the clay belt of northern Ontario. This branch became an independent department in 1926, and continued so until 1936, when it was merged with the Highways Department. It was preeminently a road building department, with its field of operations all Ontario lying north of a line drawn a few miles north of Orillia, Peterborough and Pembroke, or upwards of seven-eights of the area of the Province. In the twenty-four years of its existence, the Northern Development Branch and Department expended $126,825,447 on roads. Many of these roads, like the Ferguson Highway, or the roads adjacent to Port Arthur and Fort William were high class roads; others were strictly development roads, but everywhere it was motor vehicles that made predominant use of them from the moment of their construction. To organized municipalities within the area, the Department gave assistance by subsidy or otherwise towards the improvement of their roads in accordance with specific agreements.

As early as 1896, a good roads movement started in the well developed southerly part of the province and was fostered by a good roads instructor in the Public Works Department. In 1901 the first provincial credit was established to assist the rural municipalities improve their roads. In 1913, the Magrath Commission was set up to advise the government as to a road policy, which it did the following year, and its recommendations were given effect to in the Highway Legislation of 1915.

It is sufficient to state that the construction expenditure on rural roads contemplated by this Commission in 1914 was $30,000,000 to be spread over fifteen years.$171,990,489, or almost six times that amount was expended during that period due to the unparalleled growth in use and utility of the motor vehicle. For this reason as well, the recommendation of that Commission for local control of highways has been departed from, and since 1917 the King's Highways have been wholly under the control, and since 1935, at the entire cost of the province at large.

Under the Highway Improvement Act, there are three main classes of roads. King's Highways, built and maintained 100 per cent by the Highways Department; County Roads, built to somewhat lesser standards by the various counties, to the cost of construction and maintenance of which the province contributes 50 per cent; and Township Roads constructed and maintained under township administration, which the province subsidizes also to the extent of 50 per cent. While there are provisions by which towns and villages can receive provincial aid, such is not possible in the case of cities and separated towns. The Chevrier Commission saw no basis of equity in this distinction, and recommended that the principle of government subsidy for roads be extended to cities and separated towns.

In the 1920 amendments to the Highway Improvement Act, the Highway Improvement Fund was set up, but this account has never functioned as intended. To this fund have been credited year by year amounts equivalent to the receipts from motor vehicle licence fees and gasoline tax, as well as certain specific credits in its early days. As originally enacted, after providing for interest and sinking fund on outstanding debt, any balance in this account was available for Highways expenditure without further vote of the legislature. At no time since its inception has there been any published statement as to the status of this account, as no debt has ever been earmarked against roads, and authentic debt charges have not been available.

Provincial Expenditures on Roads

The total net expenditure by the Provincial Government on roads since the beginning of 1903, in which year revenue was first obtained from motor vehicles, has been $392,651,087.15 to March 31, 1938. This is exclusive of any interest on debenture or other debt. The total revenue from motor vehicles in the same period has been $259,297,216.37, or expenditure has been in excess of revenue by $133,353,870.78.

Since November 1, 1918, the total expended by the provincial government on roads, exclusive of Dominion subsidies or amounts repaid by municipalities, has been $377,690,693.82 to March 31, 1938, against total receipts of $255,733,235.24 or an excess of expenditures over receipts of $121,957,458.58. These deficits had to be met out of borrowed money, and further borrowings made to pay interest on such borrowings. On a 4½ per cent basis (which is if anything on the low side as representing the average rate paid on Ontario Government loans in the period) the total accumulated debt of the province for roads is $212,691,010.28 as of March 31, 1938. On a five per cent basis the debt would be $226,792,320.27.

While the Commission adopted 1918 as marking the beginning of the great highway era in the province, there are good reasons for starting accounting in 1903 when motor cars were first licensed. On that basis the accumulated debt of the provincial government at 4½ per cent to March 31, 1938 was $249,230,617, or at five per cent $268,345,022.

In other words the highway debt of Ontario as of March 31, 1938, is on the most minimum computation, $212,000,000 and can with reason be figured at $268,000,000.

As of March 31, 1938, the net funded and unfunded debt of the province, as per the 1938 public accounts, was $678,074,516, and one-third of this would be $226,024,839. The Commission recommended that one-third of all interest payments on this debt, and one-third of all payments on principal account as such fall due should be directly paid out of highway revenues, and with respect to new provincial loans as and from March 31, 1938, the percentage amount of each such loan necessitated by annual highway revenues not being sufficient to meet all highway expenditures including interest and debt payments, should be at once determined and specifically noted by the Treasury and publicly recorded as made for highway purposes. Thereafter the servicing of these bonds to the proportion noted would be a direct charge on highway revenue.

In substance this is nothing more than setting up the Highway Improvement Fund on a true accounting basis, as apparently it was at the first intended should be done. There is no proposal by the Commission to give the Highways Department any more independent status than it has at present as a department of the government.

The Commission admitted the right of the legislature to tax motor vehicles for general revenue, and recognized the very broad basis that the motor vehicle presents for general taxation. On the other hand the Commission admitted the propriety of the public at large paying toward the cost of purely development roads in northern Ontario. It suggested a saw-off, namely that all provincial expenditure on roads be met from motor vehicle revenue, and contrariwise that all revenue drawn from the motor vehicle be expended on roads and road debt.

General Public's Obligation for Roads

The Commission found that in the period November 1st, 1918 to March 31st, 1938, the Ontario public had through municipal taxation, paid 49.3 per cent of the cost of all roads in the province.

The social necessity obligation for roads discussed in the Report, is what its name implies. It is the minimum annual expenditure that would be found necessary to be made on the roads by the inhabitants of any local community to permit them to keep functioning as a community, whether it be township or city, if there were no motor vehicles at all or very few. Streets or roads of more than local utility are more than a local responsibility. Road traffic, other than local traffic, is entirely motor traffic.

Without going into minutiae of detail, from the extended but necessarily tentative studies made by the Commission, it would appear that the rural resident in the days prior to the war and the motor car age in Ontario, was prepared to spend out of municipal taxes a fairly consistent $3.00 per annum, and even in the depth of the depression just past, did not appear to find it possible to spend much less.

Similarly in the cities and towns, expenditures at the turn of the century averaged very little less than $3.00 per head per annum, and somewhat less during the depression years. These figures exclude sidewalks, lighting, utilities or ornamentation.

Over a period of forty-eight years from 1889 the rural taxpayer expended annually on physical road work $3.40 per capita, while the urban taxpayer expended $3.31 per capita, and this period includes the great era of paving programmes following the introduction of the motor car.

The Commission reached the conclusion that around $3.00 per capita represented the social necessity quota or the fair minimum amount to be raised by municipal taxes from the general taxpayers for the local roads they must have, motor car or no motor car, and irrespective of whether they live in rural or urban communities.

The total amount expended on roads by municipalities from January 1st, 1919 to December 31, 1936, totals $325,217,435, an average of $5.44 per capita per year. This total is in part an estimate, but if anything, is on the low side. It is divided $147,729,435 for rural roads and $177,-488,000 for urban streets.

All expenditures on county and township roads which received government subsidies, are accurately known, but it is likely there are some additional expenditures by townships and counties on road work which received no subsidy. Expenditures by cities and towns are known in any complete way in but a few cases only, and from this limited cross section the total expenditure by cities and towns had to be estimated. As regards the outstanding municipal debt for roads, whether same be large or small, it will have to be paid by the municipal taxpayer, since, as was stated by the Commission, it is a forlorn hope to anticipate that motor vehicle revenue will ever be sufficient and available to pay off any present municipal debt for roads.

Of the $5.44 above referred to as the average annual municipal expenditure on roads during the years 1919 to 1936, $1.73 was for maintenance, and $3.71 capital expenditure. On the basis that $3.00 per annum represented the fair quota to roads by the general taxpayer, the additional $2.44 per capita per annum represents subsidy to the motor vehicle owners. Over the period this capital subsidy would total around $146,000,000.

The total amount (exclusive of interest on loans) expended by the province in the eighteen years and five months of the corresponding fiscal years, was $334,755,929. This added to $325,217,434 expended by the municipalities on physical work gives a total of $659,973,364, of which the general taxpayer in the municipalities (city, town, township and village) supplied 49.3 per cent, and the motorists furnished 50.7 per cent, or will have done so when the outstanding provincial debt for roads has been paid. This computation totally ignores Dominion subsidies during the period and all expenditure on roads prior to November 1st, 1918.

If the municipalities' share during the period November 1, 1918 to March 31, 1937 had been limited to $3.00 per annum per head, the general taxpayer would have thereby assumed 27.2 per cent of the entire expenditure on roads. If in that period the municipal obligation had been limited to $3.68 per head, the general taxpayer would have paid only one-third of the total expended, rather than 49.3 per cent.

In principle the proposal of the Commission for gradual attainment is that the government determine a per capita quota of $3.00 or there abouts to be expended on roads in every local municipality from general municipal taxation, and any amount above this sum expended on roads wherever situated, be provided out of motor vehicle revenue. The conclusions leading up to such suggestion are important, and are given as written in the report.

(a) "Recognition of the principle that all roads and streets within the province have a right to some measure of provincial support, in view of the fact that they are all open to provincial traffic, and motor revenue is derived from vehicles operating anywhere upon them."

(b) "Assurance that every municipality pays the same relative amount towards the roads of the province and that none is relieved of its fair share of social necessity obligation because of a possible predominance of provincial highways in it."

(c) "Assurance that the motorist pays a proportion of the cost of every road or street he uses."

Dominion Assistance to Highways in Ontario

The Commission made no attempt to evaluate the roads in Ontario at any date, but confined itself to expenditures made upon them by the province and the municipalities. No consideration was given to the legacies from previous generations represented by the street and road allowances and road improvements as they existed on January 1st, 1903 or November 1st, 1918 as the case may be, nor to Dominion subsidies received.

Dominion assistance to Ontario roads has been fourfold.

(1) Direct subsidies under the Canada Highway Act in the years 1921 to 1927 totalling $5,887,283.28.

(2) Unemployment Relief Subsidies in the fiscal years 1931 to 1938, totalling $21,258,495.40, mostly in connection with the Trans-Canada Highway.

(3) Grants of part of the labour cost of municipal relief work, some of which, to an amount unknown, was urban road construction.

(4) Grants through the Grade Crossing Fund, for the elimination or protection of grade crossings, totalling $583,777.16 to the province since 1930 in connection with the King's Highways, and undetermined amounts over a more extended period in connection with urban streets.

The attitude taken by the Commission was that the Dominion subsidies received toward relief road work more than offset any monetary waste entailed thereby, and that full value in road construction was obtained by the province for all provincial expenditure made.

Annual Cost of Roads

The provincial debt is represented by so many series of debentures, several usually expiring each year and being paid off out of general revenues, or by refunding issues, that while few contain sinking fund provisions, or call for serial payments, in actual fact repayments on capital are reasonably uniform year by year, and to the extent met out of revenues represent amortization of the debt as a whole.

The Commission suggested that if deferred payment financing were to be continued, that a fair term for amortization of the debt would be thirty years. Basing the term on the estimated average service life of the highway elements representing the debt was found impracticable.

For purposes of comparative estimate, the Commission computed for the period November 1, 1918 to March 31, 1938, the annual requirements of revenue to retire each annual increment of highway debt over a period of thirty years on a 4½ per cent interest basis. In twelve of the nineteen fiscal years highway revenue was sufficient to pay ordinary expenditures of maintenance and administration, interest and sinking fund charges, and provide some surplus revenue, while in seven years deficits occurred. For the period annual revenues exceeded annual costs on the assumed basis by $23,018,410.

After taking credit for this surplus the net debt accumulated in the same period was $212,691,010.

For the last ten fiscal years provincial expenditure on capital account has averaged somewhat in excess of $17,-000,000. Assuming a continuation of capital expenditure at the rate of $17,000,000 yearly, results, under the deferred payment plan on a 4½ per cent basis, in the building up of a net debt by 1949 of something in excess of $300,000,000. This net debt would stabilize at $318,000,000 in 1970, and thereafter stay constant. Annual interest on this debt at 4½ per cent would require $14,310,000 without in any way reducing the corpus of the debt. On a three per cent basis the interest in perpetuity would be $9,019,800.

To attain a pay-as-you-go basis the Commission found that annual highway revenue $9,000,000 in excess of that latterly received was necessary. Such amount would take care of the cost of maintenance and administration, pay interest on and retire existing highway debt in forty years, and leave a minimum of $17,000,000 yearly, (rising to possibly $25,000,000 by 1945) for new construction, subsidies to municipalities, etc.

The views of the Commission are well set out in the report as follows:

"While under exceptional circumstances with assured large increases of revenue to be derived therefrom, a limited amount of work might be undertaken on the deferred-payment plan, the Commission is of the opinion that this should in general be avoided."

"The Commission has already suggested that the Department of Highways be charged with one-third of each individual issue of the outstanding Provincial Debt, namely $226,024,838. Furthermore $17,000,000 per annum is a very limited expenditure for road extensions and betterments having regard to the demands from all quarters for such, and to expenditures in the past few years. All in all the Commission is convinced that a three cent increase on the fuel tax is essential, if the highway business of the Province is to remain on a sound economic basis, and a reasonable programme of road expansion is to be maintained."

Allocation of Annual Cost to Various Types of Vehicles

The Commission was instructed to determine if freight motor vehicles and buses were paying their full share of the annual cost of roads used by them. As these vehicles use the roads in common with non-commercial vehicles, it was necessary to determine: first, if the cost of roads were increased by the presence of these classes of vehicles, in which case, such excess cost should be borne by them in full; and secondly, on what basis the balance of the cost should be divided among all classes of vehicles.

The Commission went deeply into these questions, and found them not amenable to precise analysis. After weighing all the many factors, it reached the conclusion that at the present time in the vicinity of seven per cent of the cost of all roads in the province is occasioned by the presence on the road of wider and heavier vehicles than the normal passenger car or light truck; also that the fuel tax represents the fairest means readily adoptable, to assess the cost of roads among the various vehicles in accordance with the use made of the roads by such vehicles. To the extent that weights of individual vehicles, or axle loads, are not fully given consideration in a fuel tax, an ascending scale of licence fees is required in conjunction.

Accordingly the Commission proposed that larger than basic licence fees on all vehicles heavier than normal passenger cars should be made to yield a revenue representing as closely as possible seven per cent of the total revenue required from all motor vehicles. That otherwise the basic licence fee should be more or less nominal, and the balance of revenue needed be obtained by way of the fuel tax. To provide such revenue the Commission recommended a tax of nine cents per imperial gallon on gasoline, and thirteen cents per gallon on diesel fuel oil. Due to the lesser consumption of fuel by diesel engines, the tax on diesel oil must be increased to provide equal payment for equal road use.

The Commission recommended gross weight of the vehicle as the desirable basis for licensing, with the price of the licence increasing with the weight of the vehicle, but at a faster rate, such basis to apply to all vehicles, whether passenger car, truck, tractor or trailer. For passenger cars and light trucks, the licence fees suggested do not materially differ from those presently in force, but for vehicles over 12,000 lb. gross, the licence fees suggested exceed present fees, until for the heaviest combination of vehicles possible to licence, the suggested fees are about double those now in force.

Licence fees and fuel tax as recommended dovetail together to yield the proportionate revenue required from each type of vehicle corresponding to its use of the roads.

Commercial vehicle licences

The Commission found that public commercial vehicles were unfairly taxed in comparison with private commercial vehicles with which they had to compete, and that this differential in impost was a contributing cause to the uneconomic rates charged by public commercial vehicle operators, and in turn contributed to the low level of wages paid.

The basis of licensing public commercial vehicles in Ontario is restriction as regards routes and territory, rather than as to commodities to be carried. Common carriers licensed to convey over specific routes loads made up of the package goods of any number of owners are granted licences either of classes A or B. C and D licences permit the carriage between definite termini of full loads of one person's goods. Class E are common carriers restricted to the carriage of milk and cream. Class F are common carriers of rough goods in bulk, such as cattle, lumber, cement blocks, etc., Class H carriers are restricted to used household furniture.

Certain relatively small changes in classification were suggested by the Commission, but the main change recommended was that the heavy special P.C.V. (Public Commercial Vehicles) licence fees be abolished, and be replaced by a licence fee of ten dollars per vehicle of every kind owned by a licensed operator. As regards public buses, it was recommended that the seat-mileage tax be abolished, and in lieu each inter-urban bus pay twenty dollars for a public vehicle licence.

As a means of controlling long hours and dangerous practices on inter-urban operations of private carriers, the Commission recommended that all commercial vehicles of over 6,000 lb. gross weight be restricted to a radius of twenty-five miles from their home municipality, unless further licensed as long distance transport vehicles, at a fee of twenty dollars. These latter would be subject to the same regulations as regards hours, wages, and safety regulations as the public commercial vehicle or public vehicle.

Subsidies

On the basis that municipalities had expended more money on highways since the beginning of 1919 than would have been expended had not the motor vehicle been introduced, a virtual subsidy of $146,000,000 expended on capital construction for the benefit of the motor vehicle was estimated. Also the excess of provincial expenditure over highway revenue of $121,957,458 is until repaid, a capital subsidy of the same character. That is to say motor vehicles have been provided to date $267,000,000 worth of facilities by the general taxpayers, in excess of the latter's legitimate obligation.

Against this the railways in Ontario, other than the Temiskaming and Northern Ontario Railway, have been given capital subsidies totalling $73,687,647. As regards the Temiskaming and Northern Ontario Railway, in 1937 it earned a net return of 4.53 per cent on the money invested in the road by the Province, or the same average rate being paid by the Government on the money borrowed and invested in the railway.

As regards annual deficits of the Canadian National Railways, which must be paid by the public, while these have been very heavy (ranging from forty to fifty million dollars annually) it was found wholly impossible to determine what part of this deficit was applicable to operations in Ontario. Public assistance for the Canadian National Railway has been required solely to meet debt charges for capital expenditures. It is quite possible that even as the railways have been supplanted by the motor vehicle in certain classes of business, that these new facilities, motor vehicles and roads, may in turn be partly supplanted by others. It was for that reason primarily the Commission advised a basically pay-as-you-go policy.

Highway Imposts

In the opinion of the Commission, motor licence fees and fuel tax are not general taxes, any more than postage is a general tax. Such imposts represent payments for facilities provided in direct proportion to the extent used.

In the case of P.C.V. Class A operators, these highway imposts for road facilities absorb about 8.79 per cent of revenue received, and all normal general purpose taxes about 0.99 per cent. As regards inter-urban bus operators, about 9.59 per cent of gross revenue is taken for highway imposts and 1.14 per cent for general purpose taxes.

While comparable figures for railway taxes for Ontario only could not be obtained, the Canadian National Railway paid 2.67 per cent of its 1936 Dominion wide gross revenue in general taxes, and the Canadian Pacific Railway 3.12 per cent.

Regarding gasoline imposts in other jurisdictions, the report noted that the gas tax in the three maritime provinces was ten cents per gallon, in the four western provinces seven cents per gallon, and in Quebec and Ontario six cents per gallon (eight cents since April 18 and April 1, 1939 respectively).

In the United States, rating the state and federal tax on the basis of imperial gallons, in nineteen states the gas tax was higher than in Ontario, in eighteen others practically the same as in Ontario, and in the remaining twelve less than in Ontario.

In fifty representative cities of the United States the average tax paid in 1936 was 6.42 cents per imperial gallon. (6.50 cents in 1937.)

The Commission expressed its belief that three cents additional levy on gasoline would not create more than a slight diminution in the rate of increase of consumption or have more than temporary effect. Four states, New York, Minnesota, West Virginia and Rhode Island increased gasoline taxes by one and one-fifth cents per imperial gallon in 1937. None of these states showed a decrease in gasoline consumption as a result, and all showed most substantial improvement in revenues.

The Commission recognized the important nature of the Ontario tourist trade, such representing an estimated $117,750,000 expended in the Province in 1937, and said with regard thereto:

> "The Commission believes that such is influenced most materially in its extent by the presence of good roads and very little by the level of the gasoline tax.
>
> "An extra forty or fifty cents per day per car, when moving, would not have any deterrent effect upon the tourist trade or the amount of money expended by tourists within the Province.
>
> "The Commission believes that the American visitor to Canada is quite prepared to pay equally with the Ontario citizen whatever motor fuel taxes are necessary to provide the roads on which he travels."

It is to be remembered that classed as tourists are the many American users of Ontario Highways solely to shorten their distance or time of travel between United States points.

Summary of Chevrier Report Recommendations

Summing up, the major recommendations of the Commission are as follows:

(1) That a Transport Board be set up, or a branch of the Municipal Board established with comparable jurisdiction over transportation by trucks and buses in Ontario to that of the Board of Transport Commissioners over railways in Canada, particularly with respect of freight classification, tolls and tariffs, applications for licences, inspection of transport vehicles, hours of work and rates of pay in the motor transport industry, etc.

(2) That all provincial expenditures for roads should be a charge on motor vehicle revenues.

That the general public, through municipal taxation, should be called upon to expend annually on roads such sum per capita, around $3.00 as the provincial government may determine from time to time.

That no municipality should be granted provincial assistance by the construction and maintenance by the province of roads within its borders, or by cash subsidies, that would reduce its annual expenditure on all counts for roads below such minimum amount per capita.

That no distinction should be made as regards the principle of subsidy between cities and other local municipalities, but that as regards practical details, the presence of more highly organized administrative machinery in cities, would appear to warrant specific per capita subsidies to cities rather than the approval of a specific list of work.

That provincial assistance re King's Highway connecting links should be granted to cities as it is to non-separated towns.

(3) That while municipal expenditure in past years in excess of around $3.00 per capita must for practical reasons be treated as a subsidy to the motor vehicle, the provincial debt occasioned by provincial expenditure on highways exceeding highway revenue should be paid off over a period by the motor vehicle.

(4) That the provincial debt for roads, closely approximates one-third of the present direct funded and unfunded net debt of the province, or $226,024,838, requiring annually an interest payment of $10,170,000. That an additional $2,120,000 annually would retire this debt in forty years, and provision should be made for such retirement.

(5) That all highway revenue should be expended on roads, or the retirement of road debt, and conversely highway expenditure should be limited by highway revenues, and that except in very special circumstances, a pay-as-you-go policy is desirable.

(6) That to pay the interest on present debt and provide for its retirement, maintain existing roads, and expend $17,000,000 annually on new construction, nine million dollars additional annual revenue is required, and to raise such an additional tax of three cents per gallon on gasoline and seven cents additional on diesel oil, is recommended.

(7) That such an increase in the gasoline tax will not have any adverse effect upon the tourist trade, or do more than create a temporary diminution in the rate of increase of fuel consumption.

(8) That no additional revenue be sought from motor licence fees, but that certain adjustments be made to wipe out anomalous and unfair conditions.

(9) That the basis of all motor vehicle licences be gross weight, with the rate per ton of weight increasing at a greater rate than the weight bracket. That higher than basic licence fees from heavier vehicles be fixed to yield seven per cent of all motor revenue, the Commission finding that approximately this amount of expenditure on roads at their present stage of development is occasioned by wider and heavier than normal vehicles.

(10) That all commercial vehicles of greater gross weight than 6,000 lb. be classified as transport vehicles, and be restricted to a zone extending twenty-five miles beyond their home municipality unless further licensed as long distance transport vehicles, or as public commercial vehicles, or public buses. Such additional licence to be twenty-dollars per vehicle for a long distance private transport vehicle, or for a bus, and ten dollars for each vehicle licensed P.C.V.

RECENT TRENDS IN STEEL MILL ELECTRIFICATION

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Abstract of paper presented at joint meeting of The American Institute of Electrical Engineers—Toronto Section and The Engineering Institute of Canada—Hamilton Branch, at Hamilton, Ontario, April 21st, 1939

During the past ten years, the overall production capacity of American Steel Plants has been increased by only about five per cent, and except for the two relatively good years of 1936 and 1937, the actual total annual output of all steel products has been below the average for the previous decade. However, the demands for improved quality of product and more economical production are just as insistent during slack periods as at times of peak operations; and even with lessened total demand, the markets in certain consuming industries and for certain classes of steel products have been greatly expanded. New construction during recent years, therefore, has been not so much in the primary iron and steel producing facilities as in the finish rolling and processing departments.

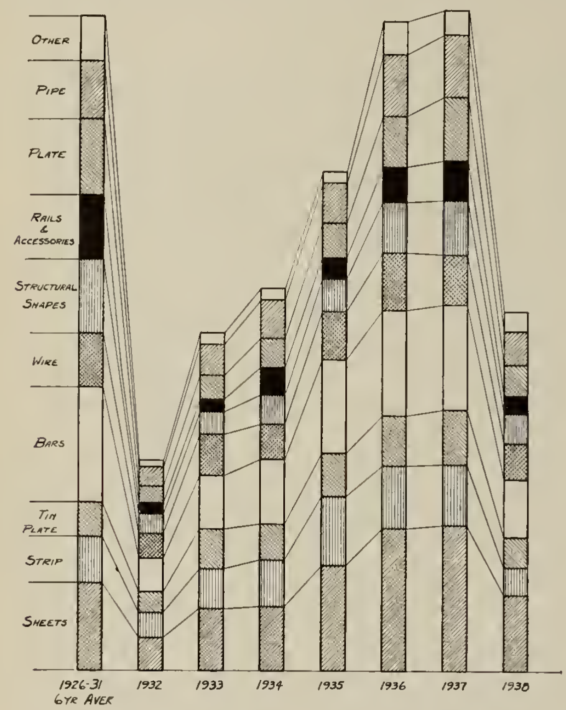

Fig. 1—Distribution of rolled steel products.

Figure 1 shows the distribution of rolled steel products to various classifications for the last thirteen years, and indicates the increased demand for sheets, strip, tinplate and other light, flat, rolled products, and lessened demand for rails, structural shapes, heavy plate, etc., for the railroad and building industries. This demand for increased tonnage of sheets, strip and tinplate, together with the revolutionary developments in the equipment and processes for manufacturing these light flat rolled products, have combined to cause the installation of many new hot and cold strip mills, and in a number of plants the installation of wide strip mills has necessitated the installation of large blooming or slabbing mills to supply the heavy slabs used as the raw material in the strip mills.

Blooming and Slabbing Mills

The first step in the production of the various rolled steel products is the rolling of ingots as cast from the open hearth steel furnace, to the form of blooms or slabs suitable for further rolling in the finishing mills. Recently installed strip mills produce strip 50 in. to 60 in. and even up to 94 in. wide, by several hundred feet long, and roll these long wide strips from slabs which may be 4 in. to 6 in. thick, 50 in. to 60 in. and in one case up to 72 in. wide, 8 to 15 ft. long, and weighing as much as 15,000 lb. The demand for these extremely large slabs has forced the development of improved types of blooming and slabbing mills, and during the past five years there have been installed some 9 or 10 mills which are primarily intended to produce large slabs for further rolling in wide strip mills.

Figure 2 illustrates a large two-high reversing slabbing blooming mill, having only horizontal working rolls, and equipped with manipulators by which the ingot may be turned between passes so that the edges as well as the wide surfaces may be worked on by the horizontal rolls. The extreme height and long screws enable raising the top roll 66¼ in., thus permitting the edging of extremely wide slabs. The mill spindles connecting the rolls to the driving pinions are 27 ft. 0 in. long so that the coupling angles will not be excessive. The mill rolls ingots of various sizes up to 26 in. by 66 in.—25,000 lb. maximum, and can produce slabs up to 62 in. or 64 in. wide. The mill rolls are 43 in. diameter by 100 in. long body.

This large reversing mill is driven by a 7,000 hp., 700 volt, 40/100 r.p.m., single unit, direct current, reversing motor. The motor will commutate peak currents up to 23,000 amp., corresponding to maximum torque output of 2,500,000 ft.-lb. The armature is 12 ft. in dia. and with shaft weighs nearly 90 tons. The total weight of the complete motor is over 450,000 lb. Power for the operation of the 7,000 hp. reversing motor is supplied by a five-unit flywheel motor generator set consisting of three 2,500 kw. 700 volt, direct current generators, a 6,000 hp., 6,600 volt, three phase, 60 cycle, 355 r.p.m., wound rotor induction motor, and a 180 in. dia., 150,000 lb. flywheel, to equalize the fluctuating power demand of the reversing motor and smooth out the load on the 6,600 volt power system. The reversing motor peak loads may reach 15,000 hp., but with the equalization provided by the flywheel and automatic liquid slip regulator control of the induction motor secondary, the maximum power system demand is limited to about 5,500 kw., and the average load under sustained rolling conditions is about 4,000 kw. The mill is capable of a maximum output of 250-300 gross tons per hour when rolling large slabs.

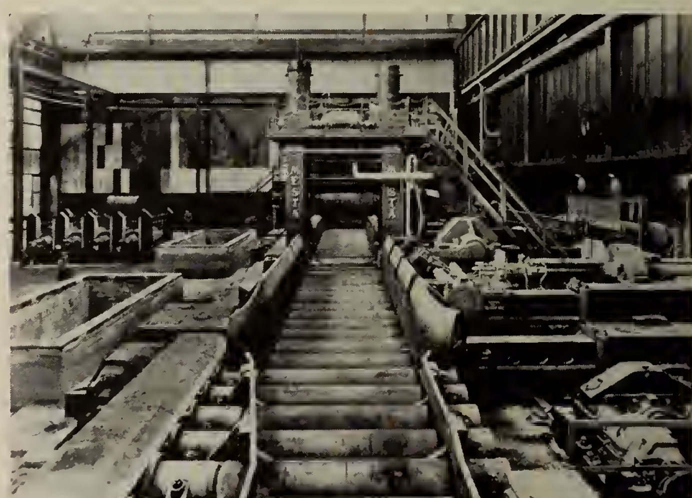

Fig. 2—46 in. Two-high reversing slabbing blooming mill for production of extremely wide slabs.

The rolling of wide slabs in a two-high reversing mill imposes very severe duty on the screwdown, due to the long screw movements to raise the upper roll before each of the edging passes and to again lower the roll after the edging passes. Screw speeds of 300 to 350 in. per min. are necessary in order to make these movements of 40 in. to 50 in. in reasonable time, and special lubrication of the screws and driving gears is necessary to avoid excessive wear and maintenance of the mechanical equipment. The electrical drive equipment must afford unusual flexibility to assure accuracy when making the small movements between the flat slabbing passes, as well as to provide the high speed required for the long movements before and after the edging passes. On most recent mills, variable voltage equipment has been selected as affording the greatest smoothness and flexibility of control, together with reduced maintenance of the electrical and mechanical equipment. The slightly higher first cost is more than offset by the improved performance and greater output, and reduction in maintenance. Variable voltage equipment has also been applied to the front and back main tables, manipulator racks, and slab shears, of several recently completed mills. In the center of Fig. 3 are shown the two variable voltage motor generator sets, each consisting of one 250 kw. and three 150 kw. generators, and 900 hp. synchronous driving motor, for the variable voltage power supply to the screwdown, table, manipulator rack, and shear motors, of the mill shown in Fig. 2.

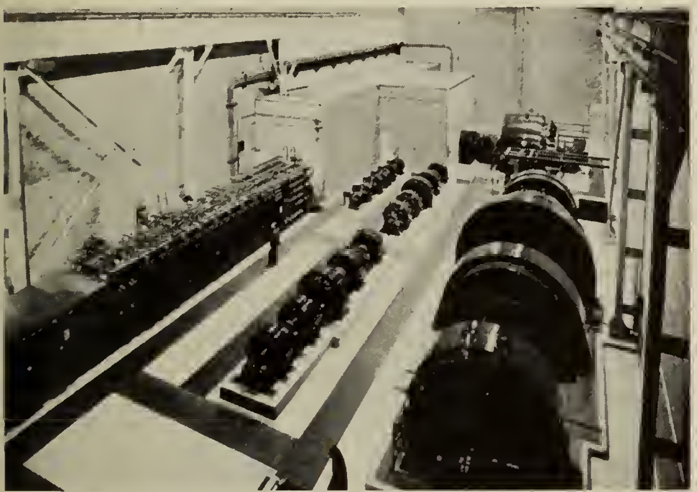

Fig. 3—Motor room for reversing mill shown in Fig. 2. The 7,500 kw. flywheel motor generator set in the right foreground, furnishes direct current power for the 7,000 hp., 700 volt, 40/100 r.p.m. reversing mill motor.

Universal type reversing slabbing mills, having both main horizontal rolls and auxiliary vertical edging rolls, have some decided advantages due to their ability to work on all four faces of the ingot without its having to be turned, but involve much more complicated and expensive mechanical and electrical equipment, and hence are justified only where extremely large outputs of wide slabs are required. Figure 4 shows the pulpit side of a recently completed 45 in. by 80 in. universal type reversing slabbing mill, and indicates the arrangement of the drive for the vertical edging rolls. The 3,000 hp. 60/180 r.p.m. edging rolls motor is located in the mill building, on a steel and concrete supporting structure some 25 ft. high. This motor is coupled to separate spur and bevel gear sets located at the top of the mill housing, and the connections to the vertical rolls are by means of universal couplings. This arrangement provides much greater strength than earlier designs where the bevel gears were mounted directly on the vertical rolls, enabling greater power to be transmitted to the vertical rolls, and also facilitating roll changing. The vertical edging rolls are 36 in. dia., and the main horizontal rolls are 45 in. dia. by 80 in. long body. The upper horizontal roll may be lifted 66 in. maximum to enable taking heavy reductions during the first two passes to crack the scale, with the ingot on edge, after which the ingot is turned on its side for the remaining flat passes. Ingots range up to 32 in. by 66 in.—45,000 lb., and are rolled to slabs up to 60 in. wide maximum.

Each of the main horizontal rolls is separately driven by a 5,000 hp., 40/80 r.p.m., 700 volt, direct current reversing motor, the two motors making up a 10,000 hp. twin-motor drive. The twin-motor drive for large reversing mills, eliminating the usual pinion stand, was developed by the Westinghouse Company about ten years ago, and two 10,000 hp. equipments were installed in 1929 and 1930 for the drive of a 54 in. blooming mill and 44 in. slabbing mill. Each of the 5,000 hp. motors for the original drives was built as a double armature unit, in order to reduce the frame diameter and keep the distance between the upper and lower motor shafts to a minimum. In the latest design for this new slabbing mill the 5,000 hp. rating of each motor is developed in a single unit, which is much cheaper to manufacture and is more efficient than the double unit machines, and can be built with only slightly greater distance between the upper and lower motor shafts. Figure 5 is a general view of the new slabbing mill motor room, showing the 10,000 hp. twin-motor drive in the middle, and the 10,500 kw. five unit flywheel motor generator set in the foreground. The 13,000 hp. combined capacity of the main and edging roll motors is the largest power ever applied to a single mill stand.

Hot Strip Mills

Most of the recently installed continuous hot strip mills have conformed in general arrangement to a fairly well standardized design, and variations have been in details rather than in the general arrangements of the roll stands and principal auxiliaries. The roughing train usually consists of four main mill stands, together with an auxiliary scale breaking stand preceding the first stand and vertical edging mills preceding each of the other three roughing stands. The finishing train consists of six main mill stands, together with one auxiliary scale breaking stand. In the roughing train the steel slab or bar is relatively short and the stands are spaced well apart, so that the bar is in only one main stand at one time, and these stands can therefore be driven by constant speed A.C. induction or synchronous motors. In the finishing train the bar has been greatly elongated, and the stands are spaced as closely as possible, so that the bar may be in several or all of the finishing stands at one time, and these stands must therefore be driven by D.C. adjustable speed motors to be able to properly match the relative speeds, and avoid looping or stretching the strip between stands.

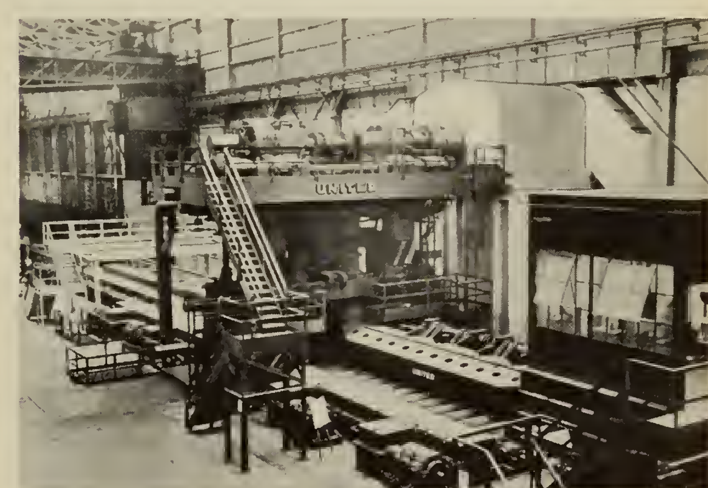

Fig. 4—Universal type reversing slabbing mill.

Figure 6 is a view of the motor room of a modern 56 in. wide continuous hot strip mill looking from the finishing end. In the background are four 3,000 hp., 6,600 volt, 60 cycle, synchronous motors driving the four roughing stands,

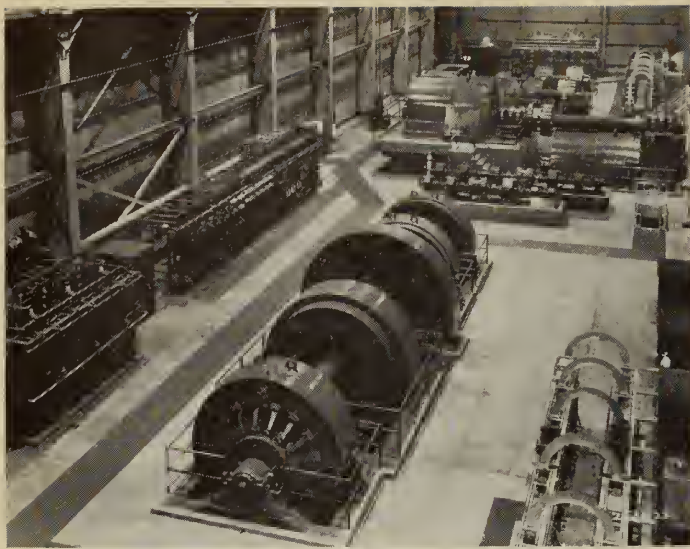

Fig. 5—Universal slabbing mill motor room. The main horizontal mill rolls are individually driven by two 5,000 hp., 700 volt, 40/80 r.p.m. direct current reversing motors, constituting a 10,000 hp. twin-motor drive. Power for the 10,000 hp. twin-motor main drive and 3,000 hp. edging rolls motor is furnished by the 10,500 k.w. flywheel motor generator set in the foreground.

and in the right foreground are six 3,000 hp., 600 volt, 200/400 r.p.m. direct current adjustable speed motors driving the finishing stands. Along the left wall, opposite the finishing stand motors, are the two 6,000 kw. synchronous motor generator sets which supply 600 volt direct current power for the finishing mill motors. The total combined rating of the main drive motors including the ten 3,000 hp roughing and finishing stand motors, and six smaller scale breaker and edger motors, is 31,550 hp. The maximum instantaneous power demand of the main and auxiliary electrical equipment is about 30,000 kw.

Larger 80 in. to 98 in. wide mills have main drive motors totalling from 40,000 to 43,000 hp.

The earlier hot strip mills were arranged to handle only

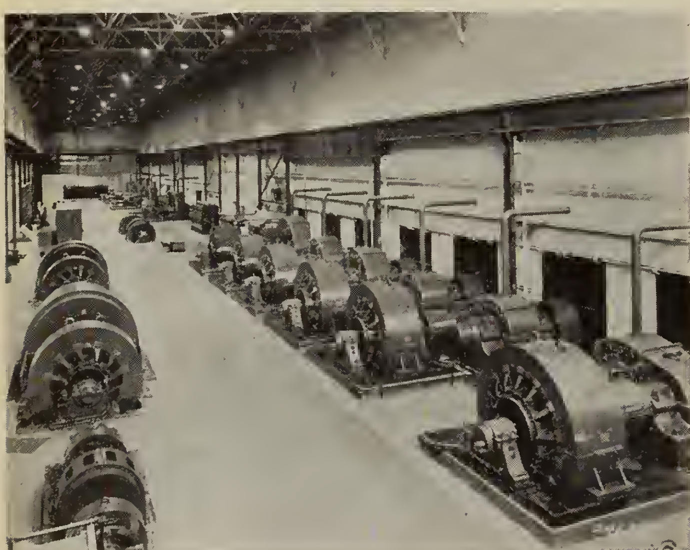

Fig. 6—Hot strip mill motor room showing four 3,000 hp. synchronous motors driving the roughing stands and six 3,000 hp. direct current adjustahle speed motors driving the finishing stands.

comparatively short slabs, and the roughing stands were geared to operate at quite high rolling speeds, so that the duration of the roughing passes was only a few seconds and the peak loads were very high as compared to the average load. Under such conditions these roughing stands were equipped with flywheels to equalize the peak loads and were most satisfactorily driven by wound rotor induction motors. In the more recent mills the rolling speeds of Stands No. 1, No. 2 and No. 3 have usually been selected much slower, and also the trend is toward the rolling of longer slabs in order to secure as long a strip as possible in one piece. Thus the duration of the roughing passes now may be 15 seconds or longer, and the peak loads are reduced because of the slower rolling speed. Flywheels are of little value where the load persists for more than six or eight seconds, and synchronous motors may, therefore, be successfully applied. A 56 in. mill and a smaller 44 in. mill each have all four roughing stands driven by synchronous motors, and synchronous motors also have been applied successfully to one or more of the roughing stands of several 56 in., 66 in., 77 in. and 80 in. wide mills. Synchronous motors have the advantage of higher efficiency, and lower first cost, and by proper control they may be used for power factor and voltage control.

The direct current finishing stand and the scale breaker motors on a large hot strip mill may total 25,000 hp. and be supplied from generators totalling 18,000 kw., and this entire capacity is concentrated on a 600 volt D.C. but not much longer than 100 feet. In case of a failure at any point

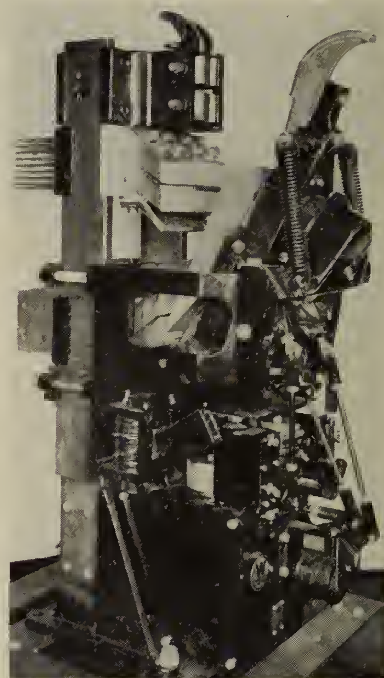

Fig. 7—6,000 ampere, 750 volt, heavy duty, air circuit breaker, for controlling generator and mill motor circuits.

in this compact system, the short circuit current may be 250,000 amp. or more, and special air circuit breakers and bus arrangements have had to be developed to withstand the stresses developed during such abnormal current flow. Figure 7 shows a 6,000 amp., 750 volt, single pole, heavy duty, air circuit breaker of the type developed for this service. The main and arcing contacts are arranged so that the flow of current through the breaker tends to increase the contact pressure and thus prevent burning of the contacts before the breaker is unlatched. Extremely rapid opening is secured by means of heavy springs and the blowout effect of the current flow, and the shock of opening is absorbed by a combination of pneumatic and rubber bumpers. The various parts are assembled on two rigid insulated steel posts, and the breaker is of the pedestal type for floor mounting.

Figure 8 is a composite section across the finishing end of the motor room for a 56 in. strip mill now under construction, and shows the relative locations of the power supply generators, finishing mill motors, circuit breakers, and buses. In this case the motor room is only 60 ft. 4 in.

wide, thus restricting the space between the motor and motor generator foundations for the finishing mill direct current control equipment to about 13 ft. 3 in. The main buses, therefore, are located inside the foundations underneath the motors and motor generator sets, in order to permit locating the air circuit breakers closer to the foundation walls and provide adequate passageway between the breakers. This arrangement also provides greater accessibility to the motor dynamic braking control panels, generator field and master control panels, and motor operated rheostats, which are located along he foundation walls between the main circuit breakers.

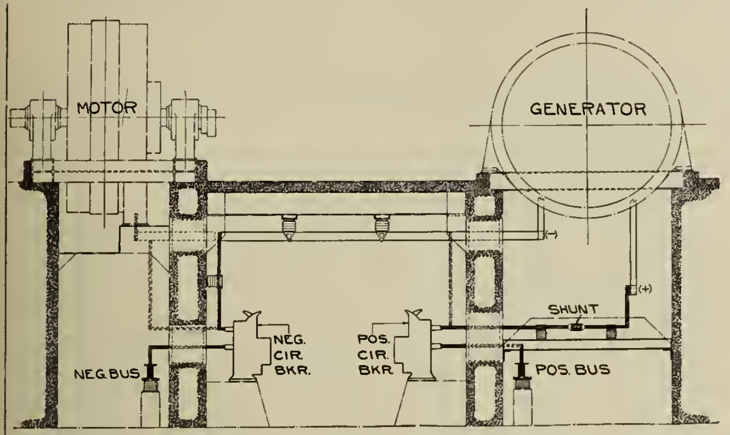

Fig. 8—Arrangement of circuit breakers, buses, and connections in hot strip mill basement control room.

Cold Strip Mills

The hot strip mill ordinarily produces strip ranging from .050 in. to .125 in. thick. In most modern installations the hot strip mill is paralleled by cold reduction strip mills, and a large proportion of the hot strip is cold reduced to the required finished thickness. Cold reduced strip for tinplate was first produced about ten years ago, and at the present time cold reduction mills provide more than 55 per cent of the total tinplate capacity of U.S. plants.

In considering cold strip mills, they may be classified as to type of mill whether single stand reversing or multistand tandem, and as to class of product whether for relatively heavy gauge and wide width for sheets as required for automobile bodies and fenders, metal furniture, refrigerator cabinets, etc., or light gauge narrow strip for tinplate.

Ordinary automobile sheets range from about .025 in. to .040 in. thick, and up to 80 in. wide, and in usual practice may be cold rolled in about three passes from .080 in. to .125 in. thick hot strip. Strip for tinplate is .008 in. to .012 in. thick, 24 in. to 36 in. wide, and in usual practice requires four or five cold reduction passes to roll from .060 in. to .080 in. thick hot strip. Mills for tinplate, therefore, are relatively narrow—usually 42 in.—have four or five stands if of the tandem type, and run at speeds of 1,500 r.p.m. or faster in order to provide the required output capacity of the light finished material. Mills producing sheet gauge material may range up to 98 in. wide, consist of only three stands, and usually run at speeds of about 500 to 600 r.p.m.

An extremely large 98 in. wide three-stand tandem mill and its mill and reel drive motors are shown in Fig. 9. This is the widest mill yet installed, and is capable of rolling strip up to 94 in. wide, such as required for automobile bodies and fenders, refrigerator cabinets, etc. The mill is geared for 800 r.p.m. maximum rolling speed. The No. 1 mill motor is 1,500 hp., 300/600 r.p.m., 600 volt, direct current, No. 2 and No. 3 mill motors are each 2,500 hp., 225/450 r.p.m. and the winding reel motor is 600 hp. 250/875 r.p.m. Variable voltage power is supplied by a 6,000 kw. synchronous motor generator set. The motors are located in the mill building without a protecting motor room, and are completely enclosed and ventilated by an air cooling and recirculating ventilation system installed in the basement control room under the motors.

The tandem type mills have large production capacity, but require large capital investment, and in some respects are not as flexible as the single stand reversible mills. A reversible type mill consists of a single mill stand, and two tension reels located one on each side of the mill stand. The mill and reel drives are reversible so that the strip may be unwound from one reel, passed between the reducing rolls, and rewound on the second reel—the mill rolls are then screwed down and the operation reversed so that the strip is unwound from the second reel, passed back through the mill, and rewound on the first reel—this reversible process being continued for as many passes as are required to effect the required total reduction. The two reel motors are controlled so that they operate alternatively as motor or generator, such that the machine connected to the winding reel on the delivery side of the mill functions as a motor to supply a portion of the rolling power through the tension exerted on the strip and wind the strip into tight coils, and such that the machine connected to the unwinding reel on the entry side of the mill functions as a regenerative braking generator, driven by the pull of the strip entering the mill, to exert a back tension on the strip. The front and back tensions are independently adjustable and under the roller's control, providing great flexibility, and making this type of mill adaptable to varying operating conditions.

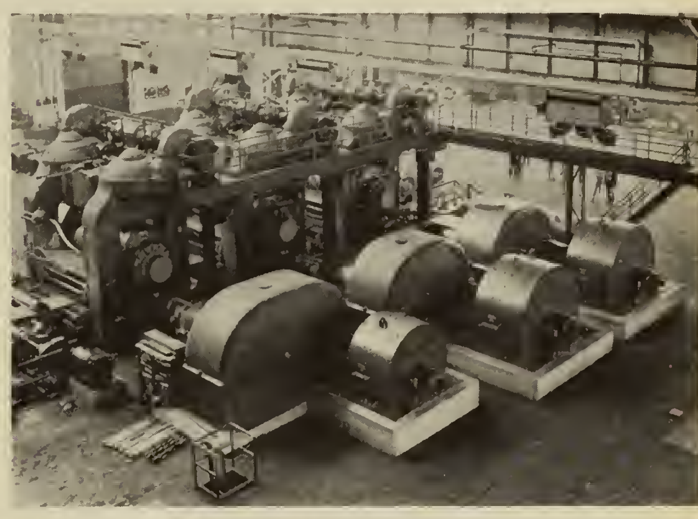
Fig. 9—98 in. wide three-stand tandem cold reduction strip mill. No. 1 mill motor is 1,500 hp., No. 2 and No. 3 each 2,500 hp, and the reel motor is 600 hp.

CALCIUM CHLORIDE IN CONSTRUCTION

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Paper presented before the Montreal Branch of The Engineering Institute of Canada, March 9th, 1939

What it is

Calcium chloride is a hygroscopic salt, that is, it readily absorbs moisture from the air. In addition, it is deliquescent, that is, it liquefies in moisture of its own absorption. The amount of water absorbed depends on the temperature and relative humidity of the air at the time. This relation is shown in Table 1.

Table 1

Temp. of	Relative Humidity	Hygroscopicity	
77	36	1.0	Pounds of water
77	60	1.6	taken up by one
77	70	2.0	pound of flake
77	80	2.8	calcium chloride
77	85	3.5	at different
77	90	5.0	humidities
77	95	8.4	

Calcium chloride is sold as a concentrated liquor, as solid in drums, or in flake form in moisture proof bags or steel drums.

How Manufactured

Calcium chloride is manufactured from limestone and common salt. These are both available in the southwest corner of Ontario and in the neighbouring state of Michigan.

Soda Ash and Calcium Chloride Process

The carbon dioxide is passed through a solution of salt brine and ammonia in vertical multi-ring contact towers, which have a resemblance, in a general way, to alcohol distilling equipment. This process is carried on in two stages, the first resulting in the formation of ammonium carbonate, viz.:

$$NaCl + 2NH_3 + CO_2 + H_2O = NaCl + (NH_4)_2CO_3$$

The next stage involves the further addition of carbon dioxide gas in separate "precipitating towers," which results in the deposition of sodium bicarbonate, which is separated by rotary filters, and subsequently dried to sodium carbonate, more commonly known as soda ash. The reaction is as follows,—

$$(NH_4)_2CO_3 + NaCl + CO_2 + H_2O = NaHCO_3 + NH_4Cl + NH_3 + H_2O$$

sod. bicar. (filtered off) — amm. chloride

The calcium hydroxide from the kiln operation is now added, in the form of a heavy "milk of lime," to the ammonium chloride, with the formation of calcium chloride and free NH_3, viz.:

$$2NH_3Cl + Ca(OH)_2 = CaCl_2 + 2NH_3 + 2H_2O$$

The ammonia is returned to the system for re-use, and the $CaCl_2$ solution is concentrated by evaporation.

Chemical and Physical Properties

The characteristics of calcium chloride which are valuable to the engineer are mostly physical, although the action on cements may be chemical. These characteristics are:

1. Effect on cements (acceleration of set).
2. Low freezing points of solutions (ice control and refrigeration).
3. Deliquescence (dust laying).
4. Thickness of absorbed films (consolidation).

Effect on Concrete

The addition of small quantities of calcium chloride to cement mortars accelerates the setting and increases the workability of the mix. The action appears to be due to an increased rate of emission of the heat of hydration of several of the compounds present in the cement.

The setting of concrete is affected very greatly by temperature, more so than some engineers realize. (See Fig. 1.). This chart was prepared to show the length of time required for standard and high early strength cements, both with and without calcium chloride to reach a strength of 2500 lb. per sq. in. at placing and curing temperatures of 40, 70 and 90 degrees F. It will be noted that setting times of untreated concretes varied from 4 days at 90 deg. F. to 14 days at 40 deg. F., also that the addition of calcium chloride reduced these times to two days at 90 deg. F. and about seven days at 40 deg. Similar acceleration was shown when used with high early strength cements. The action of calcium chloride was to decrease setting time by half with both cements at any temperature.

When temperatures fall below 40 deg., the hydration of cement is so retarded that standard specifications require heating of the concrete. Special measures are required to assure a rate of hydration of the cement that will develop early strength. This is assured by the addition of calcium chloride, especially in thin slabs where the heat may be readily dissipated. The increased rapidity of development of heat will compensate for some of the heat lost and will decrease the curing time, thus decreasing the time necessary for the use of protection.

The addition of calcium chloride also makes the concrete more workable. Owing to this increased workability the water cement ratio may be reduced, resulting in a higher strength concrete.

Successful curing of concrete requires control over the moisture content, as well as the temperature. The addition of calcium chloride to the mix reduces the moisture loss during setting and so improves the quality of the set as well as its speed.

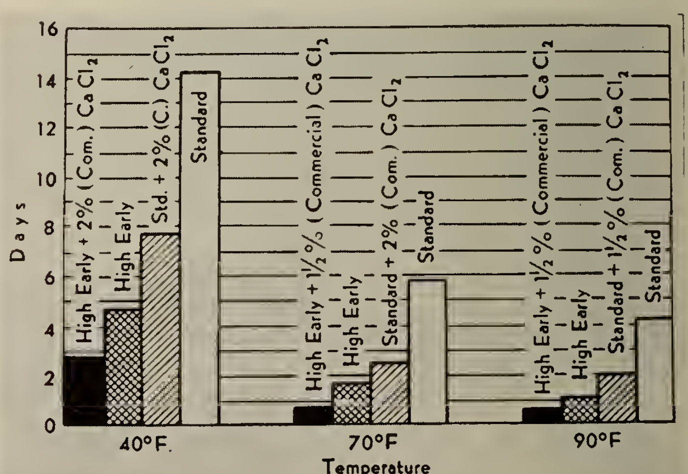

Fig. 1—Effect of curing temperature and addition of calcium chloride on length of time required for concrete to attain 2,500 lb. per sq. in. strength

The accelerated setting of calcium chloride treated concrete is of especial interest to companies manufacturing pre-cast concrete. The shorter time in the forms allows greatly increased production from a limited number of forms and also conserves space in casting yards.

Low Freezing Point of Solutions

Calcium chloride solutions have very low freezing points. Table II shows the temperature where crystallization occurs in calcium brines of various strengths.

This property of the material is used in two ways, first, for refrigeration brines and fire pail protection, and second, for ice control.

Table II

WORKING TABLE FOR CALCIUM CHLORIDE BRINE

Specific Gravity at 60 60 °F.	Salometer reading at 60°	Freezing Point °F.	Pounds of Brunner Mond 73-75% Solid Calcium Chloride per Imp. Gal. of solution at 60 °F.	Pounds of Brunner Mond 77-80% Flake Calcium Chloride per Imp. Gal. of solution at 60 °F.
1.02	11.2	+30.2	.31	.29
1.04	22.0	+28.0	.65	.61
1.06	32.8	+25.9	1.01	.95
1.08	42.8	+23.4	1.35	1.27
1.10	52.4	+20.3	1.70	1.60
1.12	62.0	+16.5	2.05	1.93
1.14	71.2	+12.0	2.41	2.27
1.16	80.0	+ 7.0	2.77	2.60
1.18	88.4	+ 1.4	3.12	2.93
1.20	96.8	— 5.8	3.49	3.28
1.22	104.8	—13.2	3.85	3.62
1.24	112.4	—21.3	4.21	3.97
1.26	120.0	—30.8	4.61	4.34
1.29		—59.8	5.17	4.86

Fire pails, barrels and tanks, when filled with calcium chloride solutions are much more efficient than when filled with plain water. It will retard evaporation in hot weather, prevent freezing in cold weather, and no mosquito larvae will live in the brine.

When used for ice control, calcium chloride also has several rôles; as a melting agent to remove ice, as an admixture with grits to provide traction and as a freeze preventative in coal and grit piles. In the melting of ice, calcium chloride is used to keep culverts and catch basins open, to remove ice from gutters and drain pipes, to release broken guard rail posts in frozen ground and to treat frost boils on roads. Where the sub soil is drainable and frost boils are caused by water trapped by ice sheets in the subbase these may be cured by driving a pipe down to the ice and filling this hole with calcium chloride. The calcium melts a vertical drain through the ice allowing the water to drain away, and the surface settles back without breaking. At the present time experimental work is being carried on, using blocks of solid calcium chloride to prevent the closing up of culverts and catch basins due to repeated thawing and freezing.

To prevent skidding on icy pavements calcium chloride is added to various types of grits, sand, screened cinders, etc., in order to embed these particles into the surface of the ice. The chemical is usually added to the sand at the time it is stock piled. The flakes then dissolve and coat each particle with a thin film of brine. When the sand is spread on the ice this brine melts small pockets under each grain, thus anchoring it in place. A small quantity of treated grit will give more traction and greater driving safety than a much larger quantity of untreated material.

The presence of the chemical in the stock pile prevents freezing and so keeps the supply of grit ready for instant use, regardless of temperature. Tests conducted at Kirkland Lake in northern Ontario showed that pit sand, treated with 40 lb. of calcium chloride per cu. yd. of sand, was free flowing at 40 deg. below zero and stuck to the ice quite successfully.

Coal in piles and cars often is frozen to such an extent that it can not be loaded or unloaded. Calcium chloride added to the coal will overcome the trouble either by preventing the freezing, if applied at first, or by thawing the coal, if the freezing has taken place.

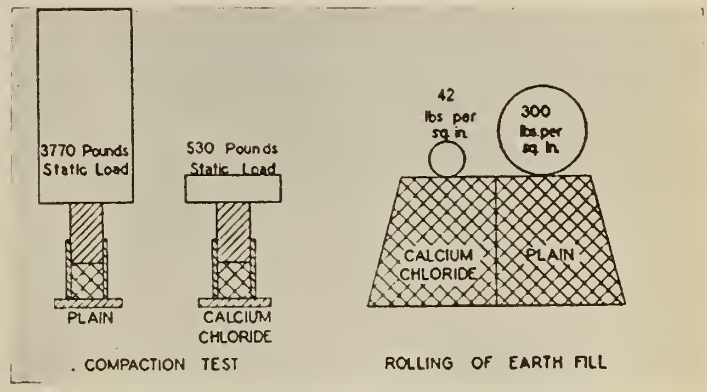

Fig. 2—Calcium chloride decreases compactive effort.

Deliquescence (Dust Laying)

Due to its deliquescence, calcium chloride enters the highway engineers' field as a dust layer. By far the largest tonnage of the chemical for many years has been used as a dust layer. Dust, perhaps the greatest nuisance of motoring, is present on all unimproved roads during dry weather, and the more the motor vehicle is used and the higher the speeds, the greater a nuisance dust becomes. A damp road is never dusty, so the first effort to eliminate dust was to dampen the surface by use of watering carts. This was so expensive that only short sections of urban streets were sprinkled and in warm weather these dried up in less than an hour.

When calcium chloride was spread on the road it drew water from the air and dampened the dust. Calcium chloride will not re-crystallize at ordinary temperatures, so this dampness remained for a long time.

The duration of the treatment depended on weather conditions, traffic, and the material in the road. Studies toward improving the quality of the dust laying naturally were focused on the road material because both weather conditions and traffic were beyond the control of the engineer.

Base Stabilization and Surface Consolidation

Early studies relative to the reduction of the dust nuisance with calcium chloride showed that treated roads had other advantages in addition to the elimination of dust. They were compact and hard. From this was developed the "stabilized road."

Stability is the power to resist motion, and this word was considered the best to describe the results shown by a calcium chloride treated road. Later the term was applied to many other types of road treatments.

The first quality of a stable material is that it must be well graded to secure density; it must have binding material to fill the minute voids in the fine aggregates, and this binding material must serve as a reservoir for the calcium chloride to keep it from being leached out by excess water. Moisture film is the real binder.

Moisture films have very definite thicknesses and the resultant density of a consolidated gravel mixture is dependent on these films. The film of a calcium chloride brine is very much thinner than that of pure water. Figure 2 was prepared to show the increased densities obtained by using calcium chloride in the mixture. The aggregate used must have sufficient strength and durability to carry the loads of traffic in all weather conditions.

Considerable research work has been done preparing specifications for stabilized roads and this type of construction is well established. However, the costs experienced were fairly high, in that large additions of new road metal were specified. Many of our roads had been gravelled for years and did not need this increased depth of metal to carry the existing traffic, so the type of construction now known as surface consolidation was developed in order to

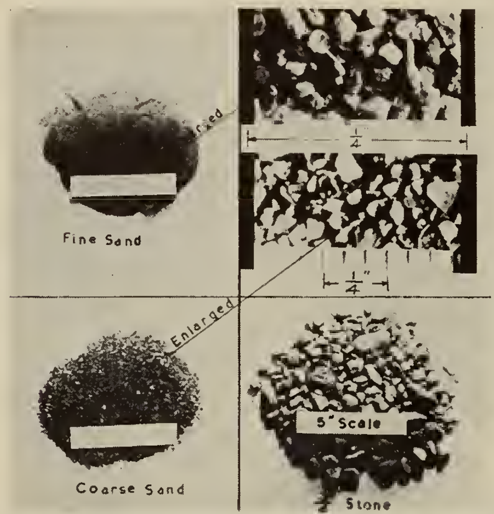

Fig. 3—Magnified photograph showing the voids in the sands.

profit by the experience gained from both stabilization and dust laying. This method should be described in detail because it contains all the information embodied in the other types of treatment.

Consolidation is a maintenance method in which binder soil obtained by cutting down the road shoulders is incorporated with loose stone on the road surface to produce a stable mixture and this mixture is shaped to an adequate crown and treated with calcium chloride. In areas where the shoulders do not contain binder soil this material should be imported.

The cost of this work varies from $250 to $500 per mile, but the average last year was approximately $270.00 per mile and this cost included calcium chloride, labour, and a small addition of binder soil or stone to improve weak spots which are present in practically all roads.

The use of calcium chloride on roads is now so universal that maintenance problems have become of equal importance to those of construction.

In high class stabilization the graded aggregates and binder are supplied under laboratory control, but I venture to suggest that 90 per cent of the calcium chloride stabilization of the future in Canada will be of the low cost type described above. In this work laboratory control is to a great extent replaced by visual control and trial and error methods.

Three materials are necessary for these consolidated surfaces, aggregate, binder and calcium chloride. If the work is to be done cheaply these materials must be of local origin so our specifications cannot be rigid. Let us consider them separately.

Aggregate

The aggregate should be as hard, durable and well graded as is available locally. The only point where the judgment of the foreman can be exercised is in the gradation. In many cases he may be able to improve the consolidating qualities of his gravel by mixing material from several pits, or from different parts of the same pit. One road may be mentioned where two pits were available at approximately the same hauling distance. The gravel from one was fragmentary in character, clean and of very uniform size. The other pit contained fine stone and loam. In fact, it was not much more than dirty, coarse sand. Roads built from either of these pits were unstable, but a road where alternate loads came from each pit and were mixed by grading gave a perfect example of stability. An operator who is able to recognize the materials he requires when he sees them is an invaluable asset to any road organization.

Binder

This is where the greatest field for education exists. Plastic index, liquid limit, etc., are familiar terms in the laboratory, but they are just words to the operator. Experience has proved that this man must be explained why binder is needed, how to recognize it, and how to use it.

Diagrams were prepared to show why a binder was needed. Figure 3 shows stone, 10 mesh; coarse sand, 40; fine sand, 40.

If some of the sand is very fine this mixture will appear to be stable.

The pictures show the error of this assumption. With a special camera and powerful spotlights supplied by the Biological Department of the University of Toronto these sands were magnified to sizes comparable with the stone.

On examination of the ¼ in. stone it is easy to show an operator that there are a lot of holes or voids in the pile. He will recognize that these holes are full of air and that air is an unstable road metal. The coarse sand, when magnified, very closely resembles the stone showing about the same proportion of voids. The fine sand shows an even greater percentage of voids, owing to the greater uniformity of size of the particles. After showing this picture to a nontechnical man it is not hard to persuade him that fine sand is not a binder and that something finer is needed.

What is Binder

Present day specifications show a steady downward trend in the requirements as to plastic index in binders. Experience has proved that with careful gradation binders with very low plastic indices are successful. This allows to class most surface soils as binder soil. Maintenance experience has shown that surface soils are more friable than pit clays and so more easily incorporated into the road surface. These surface soils, to a great extent, form the shoulders of secondary roads and so the cheapest source of binder available is the dirt from the shoulders and also from the cleaning out of the ditches. Shoulder soils which have no binding properties are usually of such a light, sandy texture

Fig. 4—A road suited for consolidation.

that they are easily recognized and the trained operator knows that in such cases he must import a binder.

There is another type of binder, not so easily recognized, which includes the non-plastic stone dusts. Good results have been obtained with limestones, calcites, iron ores and volcanic silicas. Also, there is the class of aggregate which, under traffic produces binders, which include the shales and schists. In standard laboratory tests, pit gravels should be tested for plasticity, after having been in the rattler. This would indicate the aggregate which are liable to change in characteristics after being exposed to traffic. The author has had experience with gravels which showed a low plastic index in the pits, but developed very soft, slippery surfaces under traffic. Also, other gravels produced a large amount of sand which reduced their plastic properties.

Calcium Chloride

This chemical is manufactured to rigid specifications. However, the quantity used and the methods of application are in the hands of the local authority. The minimum treatment should be one lb. per sq. yd. and the proper time to apply this is late in the afternoon or early in the evening in order to take advantage of the higher relative humidity which exists at sunset when the air is near the dew point.

Fig. 5—After consolidation.

A road which is in shape for consolidation is a road which has been gravelled in the past. Figure 4 shows a typical example.

The loose float produces clouds of dust and is in itself a serious traffic hazard.

Stabilized roads under traffic tend to disintegrate. It was found that the maintenance methods which suit stabilized roads are identical with the operations necessary to consolidate ordinary gravel roads. In other words, the maintenance of a stabilized road and the consolidation of an ordinary gravel road are relatively one and the same thing.

The function of a road is to carry the traffic tributary to its area in all weather conditions, and any money spent in excess of the amount necessary to do this is not justified economically. In many cases roads which had sufficient gravel to carry all local traffic were covered up by layers of stabilized gravel when all that was necessary was to stabilize what was there. In fact, the author knows of one road where in 1935, three miles were stabilized under excellent control. The next year when giving spring maintenance the engineer had his machines consolidate the next mile. During the following two years it was very difficult to see where stabilization ended and consolidation started. In other words, the consolidated section was stabilized without all the additional application of stabilized material.

This statement should not be taken as in any way antagonistic to the work done on stabilization because it is an outgrowth of stabilization. This means a lot to municipalities with small budgets. The author has talked to many municipal authorities who have studied stabilization and have said, "we cannot afford stabilization." In order to placate their citizens they add more gravel to their roads and still have rough, dusty surfaces, where, if they had used an equal amount of money to consolidate what they had, the result would have been surprisingly close to stabilization.

These remarks should not be confused with base construction because in base construction a foundation is prepared with sufficient strength to meet increased load requirements of the future and the addition of extra material may be justified.

Three terms are used with reference to calcium chloride application: dust laying, surface consolidation and stabilization. When these operations are properly carried out they give relatively the same result. If the material on a road is naturally well graded a dust laying treatment produces stability. If slight corrections are made to the existing surface called "consolidation" and followed by calcium chloride the result is stability, and if a complete new surfacing of stable gravel is added and calcium chloride treated, as in stabilization, the same result is obtained, "stability." Local conditions and finances dictate what procedure should be followed.

As previously mentioned, high shoulders and loose float are the two principal causes of trouble on our roads. These two factors supply their own remedy. If the shoulders are cut down and this material is mixed with the loose stone the result is a stable surface and improved drainage. Figure 5 shows what a road looks like when it has been consolidated.

The method used when a road is to be consolidated is as follows. An examination of the whole road is made to locate weak spots because it is seldom that a road is uniform over its whole length. Where there is evidence of soft spots in wet weather stone is added. Where shoulders do not contain binder soil this is imported. In extreme cases this binder soil should be mixed to sufficient depth to support the traffic, then the maintainer is put on the road. The outer end of the blade is set well down and forward to cut in binder soil. It will generally be found that this material contains a lot of gravel as well as binder. The blade should be set so as to produce the maximum rolling effect in order to improve the mixing.

The operator will soon learn how much shoulder material he will need to balance the loose stone on the road. Care should be taken in this work to build and preserve crown. If the crown is not at least ½ in. per ft., trouble can be expected from pitting. The A type cross section should be preferred.

Fig. 6—Method used for spreading calcium chloride.

The last operation is the application of calcium chloride. As mentioned earlier, the minimum treatment should be one lb. per sq. yd. and if traffic is over 500 vehicles per day this should be increased up to two lb. per sq. yd. Several applications should be made during the year, and in areas where frost action is serious the first application should be made after the surface has dried, but before the frost is out. This treatment toughens the surface and helps to minimize the frost breaks. A large amount of the calcium chloride used in Canada is applied with a box spreader suspended from the back of a truck, as shown in Fig. 6. This box has no agitator, but the vibration of the truck keeps a good flow of flakes. These boxes can be very cheaply made in the shop. The picture shown is in the Fraser Valley on the Pacific coast.

It may be stated that calcium chloride now ranks among the building materials and that its advantages offset by far its small added cost.

CONCRETE SURFACES FACED WITH GLAZED TILE

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Second Section of Report of the Committee on the Deterioration of Concrete Structures

The use of glazed tile and method of attaching it to concrete surfaces in repair work was probably first conceived and put into practice about 1924 by Mr. A. Griffin, M.E.I.C., Chief Engineer of the C.P.R. Department of Natural Resources, Calgary, who contributed an article on the subject under the heading, "Protection of Concrete Surfaces by Glazed Tile," which appeared in "Civil Engineering", published by the American Society of Civil Engineers, June, 1932.

Fig. 1—Typical case of disintegration. Soil strongly alkaline.

The following brief remarks result from collaboration with Mr. Griffin and the writer's personal observation at the time glazed tile was first used for the protection of concrete, and subsequently, as to its effectiveness and durability:

1. Concrete, aside from the aggregate, is made up of cementing materials which are soluble and inherently capable of taking part in chemical reactions. Therefore, it can be destroyed by water as a solvent, by the forces of freezing and other temperature changes acting on the absorbed water, by the forces of crystallization of substances in solution and by chemical reaction with substances in solution. No concrete is wholly impervious to water, but rich, well made concrete is more impervious than poor lean concrete, the porosity of the concrete varying with its density.

2. Disintegration of concrete generally begins at the exposed surface, increasing in depth as time goes by, and when exposed to such conditions as are found to exist in the semi-arid regions of Alberta, where temperature extremes vary from –40 deg. F. in the winter to 100 deg. F. in the summer and where there is much soluble matter (mainly sulphates) in the soil and water, disintegration has been noticeably rapid, particularly under the more severe alkali conditions to be found in the lower levels of valleys. Irrigation development tends to aggravate the condition, until possibly relieved by drainage.

3. Retaining walls, wing walls and more slender members holding soil strongly impregnated with sulphates on one side and water containing practically no injurious salts on the other—the water level fluctuating—will be subject to a condition whereby variable pressure heads will be created and there will be passage of water through the concrete in proportion to the extent of its porosity, and thickness, so that salts from the soil behind the wall will be carried in solution into or through it to the exposed surface where they will become concentrated by evaporation. (See Fig. 1.)

4. The depth of disintegration has been found to vary from less than one inch to the full depth of the wall and, except in a few cases where decay had completely destroyed the wall, concrete which had every appearance of being sound has been reached when the injured material has been cut away.

5. Repairs, by replacing the decayed concrete with sound material, may not be wholly or permanently adequate alone as it is possible that some degree of decay will exist in the old concrete, however sound it may appear, and the joint between the old and the new concrete may not be as strong as new concrete; but it has been found that the addition of a glazed tile veneer to the exposed face, placed either at the time of construction or when making repairs, is most effective in the protection of concrete exposed to severe conditions, whether frost or alkali. (See Fig. 2.)

6. Commencing about the beginning of 1924, repairs were made to various concrete structures, subject to severe alkali conditions, in one of the larger irrigation projects in Alberta. The structures in question were constructed in 1913 and 1914 when concrete specifications were not as good as they are today, and when transportation of construction materials to outlying points was more difficult. Nevertheless, it has subsequently been proved that however scientifically well made the concrete may be, its life under certain conditions of exposure will be very limited, and it is probable that had more been known about concrete and its uses in 1914, other materials or types of construction

Fig. 2—Large concrete drop repaired and faced with glazed tile in 1924.

Fig. 3—View of the same drop taken about six years later. Discoloration caused by dried algae.

might have been used where the worst alkali conditions were found to exist. (See Fig. 3.)

7. The following is a description of the tile facing and method of placing it:

(a) Ordinary 4 in. by 12 in. by 12 in. hollow glazed building tiles with web parts half cut through by knives specially placed in the die were procured at reasonable cost in carload lots as required. After delivery to the job, these were broken by several sharp blows of a light hammer into halves, each 12 in. by 12 in. with four ribs on one side. In order to improve the bond with the concrete the ribs and the ribbed face were roughened by suitable tools placed in the die at the time of manufacture.

(b) The procedure followed in placing the tile slabs was first to set up form supports about 3 in. wide on 12 in. centers (the slabs themselves constituting the forms) and as the concrete was poured the tile slabs were laid up, smooth side against these supports. The ribs of the tile were placed vertically so that the concrete could be more readily worked between and around them as it is important that there should be no pockets between the tile and the new concrete where an accumulation of water might freeze or otherwise contribute to deterioration. The bond between the concrete and ribs and roughened surfaces of the slabs has proved to be entirely satisfactory. (See Fig. 4.)

Fig. 4—Concrete outlet structure from a large reservoir repaired and faced with glazed tile in the fall of 1927.

8. The joints in the completed face averaged about one to two per cent of the glazed surface and although this is but a small area of the whole, it is possible that by the use of larger slabs, more accurately dimensioned than ordinary commercial tile, further decrease in the joint area can be effected.

Fig. 5—Closer view of the tile facing on the reservoir outlet structure.

9. Tests have shown the glazed tile to be highly impervious and in that respect it proves very satisfactory.Strength tests show that the 4 in. by 12 in. by 12 in. glazed tile will support a load of about 8,000 lb. on one face, but if greater strength were desired for some particular type of construction no doubt blocks of much greater strength could be manufactured.

10. Considerable improvement could possibly be made in the design of tile used for such purposes and if the demand were large enough no doubt the clay product industries could produce the shapes and sizes required. (See Fig. 5.)

11. The tile in the repairs mentioned was used only where it was likely that the exposed face would be saturated with moisture when winter set in, or where water moving through the concrete from the back-filled side would be likely to carry in solution salts that would become concentrated by evaporation at the exposed surface. The tile veneer presents a good finished appearance, and after 14 years of service the tile and the walls protected by it show very little evidence of deterioration or weakness. Inspection of the tiles late in the fall of 1938 showed all but two or three, which had become loose, to be perfectly sound.

12. While no actual cost figures are available for the tile in place, the cost of the glazed tile at the point of shipment was 10c per sq. ft. of surface, or 20c for one complete tile. Possibly some portion of the increased cost, using tile facing, would be offset by the reduction in concrete volume taken up by the tile and also some saving in form work, but this has not been computed.

WORLD'S HIGHEST RAILWAY

Has Diesel Locomotive Specially Built for it

An outstanding achievement of British engineering enterprise is the building of a Diesel locomotive to run on the highest railway line in the world, near La Paz, the capital of Bolivia.

The engine has now passed all tests, including the six-mile climb with a gradient of 1 in 14 along a series of sharp "S" curves from La Paz to the plateau 2,000 feet above the city and 16,000 feet above sea level.

Built for the Peruvian Corporation, it will operate on a circuit where conditions are so severe that engineers have hitherto believed them to be beyond the powers of such an engine, which they thought would prove so cumbersome and costly (compared with the present electric traction) as to be economically unworkable.

The Peruvian Corporation consequently placed a number of safeguards in their contract, and a firm in Leeds, Yorkshire, accepted the "challenge." The engine they built has now proved able to handle its load with ease at the highest altitudes of the tortuous mountain track and to be exceedingly economical on fuel.

Special features of the locomotive are: supercharged engine, 330 horse-power, with exceptionally large radiator to maintain an efficient temperature at high altitudes where air density and conductivity are greatly reduced; independently-fitted additional starting system, petrol-driven, to avoid any possible delay; and a quadruple system of brakes, working independently.

THE PUBLIC'S CONCERN IN INDUSTRIAL HARMONY

WILLIAM ALLEN WHITE*

Editor of "The Emporia Gazette", Emporia, Kans.

Paper presented before the Seventh International Management Congress, Washington, D.C., September 20th, 1938

In this discussion I am supposed to represent the public —the American consumer. He is a mythical character who never lived on land or sea, but for that matter, the capitalist is a myth and the worker's status is an economic hypothesis. It is trite to say that in America we are all more or less owners, all workers of high or low degrees, and certainly we are all consumers. We are all the children of John Q. Public, and our interests as members of the consuming public are after all our chief end and objective as citizens of our democracy. I, myself, who am speaking for the public, to-day own a little business which employs forty people, that requires a payroll of a thousand or twelve hundred dollars a week. But on the other hand I show up at my office as a worker at a quarter of eight every morning and go home at half-past five every evening, and once, more than fifty years ago, I was a practical printer who worked on a twelve-hour day. Therefore, I am probably a perfect type of the public, typically perfect because I am typically both labourer and capitalist. Therefore, if as a Consumer, I take my two aliases, Mr. Capitalist and Mr. Workingman, and knock their heads together in the next few minutes, remember that I am Eddy Bergen with a Charlie McCarthy on each knee.

Let me begin by telling you both, labourer and capitalist, that you have got us citizen consumers in a pretty sad mess. Every time we consumers think of what one of you has done we are dead sore at each of you until we begin to think of what the other has done. Let me start on capital, the employer. Not that he is more to blame than labour. But he is more responsible. He enjoys more freedom. He could have done better. You employers have wasted twenty years since the end of the World War. In those twenty years, a little intelligent self-interest, a little foresight—not much—would have solved equitably the problems that are now pressing upon us, problems that have been adjusted in haste and in the emergency of calamity. Take the eight-hour day. You knew that it was coming. Why didn't you men willingly, sensibly grant it? But no. You had to fight it, every inch, and make the consuming public think you were greedy—when you were not. You were just dumb—dumb to give labour a sense of deep antagonism. Take the old age pension and job insurance to cover seasonal and technological unemployment. A thousand voices rose across the land, telling you of the trouble ahead. What did you do? You put cotton in your ears, and if you could hear through the cotton you began yelling "Communism!" at the academician and the liberal politician and spokesmen of the consuming public. Everyone realized twenty years ago and more that sooner or later, with the pensions of the Civil War gone which took care of the aged until the World War, we should have old age pensions as a federal problem. Yet you employers let a generation of old people, unprovided for, begin to clamor for old age pensions and begin to listen to demagogues with silly panaceas. Then, having squandered your substance, you turned your men on the street in the days of the locust, and put into the hands of the most adroit politician America ever has seen the votes of ten million men whom your slipshod social viewpoint rendered jobless. If a dozen or twenty years ago you, Mr. Capitalist, had used the social sense of the average man in the street, this problem of unemployment and old age pensions would not be handing to your arch-enemies an organized subsidized class-conscious proletariat which can be voted to your destruction. By your sloth you created the particular head devil who is mocking you. He is your baby. You begot him two decades ago in the days of your youth when you were going to handle your business in your own way and no man could come into your shop and tell you how to run it!

Another thing that we should remember in this dark hour: As far back as 1920, and again in 1928, and again in 1932, the national platforms of the Republican and the Democratic parties demanded laws authorizing for workers "the right of collective bargaining with representatives of their own choosing." Those were the very words. It was the part of wisdom for a certain strong and militant organization of American enterprises to lend the force and wisdom of their organization to some law or extra-legal institution which then would have answered that widespread demand. But no, the organized American enterprisers balked like mules. When any one insisted before the depression that American workmen deserved as competent cooperation of government in bargaining with the boss, as Swedish workers have, as Danish workers have, or even as British workers have, what did you do? Did you listen to the warning voice of wisdom? No! The leaders in American industry called those who demanded for American labour what labour was getting in other democracies, dangerous radicals. Mrs. Dillinger's red network was thrown over the heads of those who were asking ten years ago for the things which both party platforms promised. And so the waters of progress were dammed up, and we all—labour, capital and consumer —got the dammed deluge when it broke, good and plenty. Need we ask whose fault it was?

Certainly the American Consumer was not to blame. He has been demanding industrial peace in this blessed country for twenty years. But you cannot get peace without justice. You cannot get justice with tear bombs, labour spies, police clubs and company unions—on one side—and sabotaging gangsters on the other. What you got when you silenced the voice of the American consuming public demanding justice, was the CIO and the labour racketeers, and the sit-down strike encouraged by a smiling and distinguished gentleman who holds the ace card in the political game. His lightest word of opprobium for you enterprisers large and small in his quest for votes is "economic royalists." And all capitalists big and little must listen and like it when he runs the gamut of invective against your kind. There's little you can do about it. Your friends were in power twenty years ago. And you chose to follow the counsel of reaction when the voices of the American people, if both party platforms mean anything, were calling for the establishment of genuine collective bargaining to give your country industrial peace with justice.

Now peace with justice is not impossible to-day. A just peace is harder to achieve to-day than it would have been for instance in the days of the Coolidge bull market or under the leadership of Herbert Hoover. But it still is possible. Private enterprise in industry survives in the Scandinavian countries with collective bargaining effectively channeled by fair laws and decent administration.

Let me make one more illustration of what I mean by the employer's recalcitrant reaction: Laws put on the state statute books thirty years ago or so, provided for a minimum wage for women in industry. They were operating widely, intelligently, equitably, peaceably under state supervision where it belonged. Did you, the masters of industry, accept it? Oh no! What you did was to call the advocates of minimum wage laws for women socialists or something worse and then rush into the Supreme Court and have those state laws invalidated. Then after the federal Child Labour Amendment was submitted in the days of Calvin Coolidge, with his approval, and after Herbert Hoover had publicly declared for it, and after platforms of scores of American social service organizations and associations had endorsed it, you bosses went raging into the state legislatures, wherever your associated industries were strong and fought the passage of that rather innocuous amendment. And what did you get again when you tried to establish industrial peace without justice in those two cases? You got the present wages and hours law, and bad as you seem to think it is, you certainly had this law coming. The law was generally considered by its opponents a kick—will you allow me to say—in the pants for American industry. But apparently that is where Americans all—labourers, bosses and consumers—keep their brains, and we got the kick where it would do the most good. Moreover so long as we think with our bile and reason with our sturdy copper intestines, in fact so long as we think in terms of lagging reaction, we are going to get a smack with the other side of the shield, which means the blistering biff of radicalism right where it will stimulate our mental processes.

Now then: We have, according to the sage pronouncements of Mr. John Lewis and President Roosevelt, thirteen million men walking the streets looking for work; a million more than were outcasts from industry in 1933 when Hoover stepped out of the White House. May I be permitted for a moment to drop into the vernacular and ask: "How come? Why have six long years passed with no solution for the problem of unemployment?" A year ago, it looked as though we might be on the way toward solving that problem. And then something happened, something quite foreign to the American tradition. Was it Communism? No! The number of Communists in this country is negligible and their influence is almost nil. They check themselves out. Was it Fascism? No! It was something worse than that. It was the class-conscious political activity of a large section of American organized labour. When left wing labour leaders instituted the sit-down strike with the assurance that they had government behind them, capital was scared out of a two years' growth. Capital turned tail and ran for preservation to the refrigerator and froze itself up, and that's what has happened to recovery. If capital was blind and mildly mad in its arrogance in the 1920's, certainly one wing of labour in this country has matched arrogance with folly. It is one thing to strive for a fair and equitable share of the earnings of industry and to demand it with whatever industrial weapon is necessary even to the strike and the orderly picket line. Your speaker happens to believe in the efficiency of the vertical union in mass production industry. It will have to come. But we don't need a revolution to get the vertical union. Labour need not go class-conscious. For labour to say in effect: "Down with all bosses! We'll run not only the shop but the whole country!"; for labour to go into the ballot box and emerge class-conscious against all bosses good and bad, that policy menaces the existing economic structure of American civilization. There can be no recovery so long as labour is politically class-conscious. The blessed Lord knows that capital has made its mistakes and is paying for them, paying through the nose.

But labour has been no Solomon. The proper business of a labour union is to get higher wages, better hours and good shop conditions for the workmen. But when labour en masse plunks its vote for its own party, then the spirit of party loyalty begins to obscure labour's objectives—high wages, short hours, decent shop conditions. Thus class-conscious labour leaders become more interested in their party welfare than in the fundamental objectives of labour unions. So we shall have the class-conscious political worker trading his vote not for the immediate objective of wages, hours and shop conditions, but for power for his political labour boss.

The political labour boss will ask the workers to swallow a whole ticket in order to dominate a whole government. He would turn a democracy into a contest between two class-conscious parties, a class-conscious proletariat and a class-conscious plutocracy. In that set-up where is the Consumer; where indeed is the compromise between labour and capital under the supervision of a middle-class? In short, with only two class-conscious political parties what becomes of democracy? The labour union militant and undefiled—yes; the vertical union and the closed shop? Yes. But a class-conscious labour party in a democracy—no! If labour insists upon maintaining its class lines of bitter intransigent hostility to all capital, the American middle class —old John Q. Public and his heirs and assigns—will not support labour.

But wait a minute: Let us not blame labour too much for a growing class-consciousness. We must not forget the arrogance of a class-conscious plutocracy which has functioned in our democracy since the Civil War, a small group but powerful. It turned to politics secretly. It has struggled against every measure that in any way cramped its aggressive development. The example of that small group probably gave labour its excuse for political action. That small heavily entrenched group did not hold the ownership of industry. The ownership of industry was nation wide, a popular economic democracy. The management of industry in this generation has been intelligent. It has tried to be fair. I take no stock in the nonsense about the "Sixty Families." They are as negligible in the real problem as the Communists. It was the control of industry, the banker control if you will, which too often made its legal department a political hierarchy and turned furtively to the control of politics in high places. That small group opposed every measure which would have softened the hardening crust of wealth aggrandizing in few hands. That small group in politics slowly but surely first disgusted the American people then angered them until in their wrath they turned in calamity to rampant, unchecked radicalism. Out of the crisis that came with the blunders of democracy emerged the class-conscious proletariat, somewhat subsidized and controlled by politicians at Washington. But let me say this to class-conscious labour. It should know that the same patriotic indignation which turned upon a federal class-concsious plutocracy and wrecked its power, will turn upon a class-conscious proletariat and deny its aims. For without the support of the American public, neither capital nor labour can thrive and prosper in this country. Progress will mark time until industry comes to its senses.

This is a middle class country and the middle class will have its will and way. For the middle class is the real owner of American industry. The middle class is also 80 per cent worker and the consumer of 80 per cent of American industrial production in the home market. The middle class thinks and feels chiefly as the Consumer. And before the middle class demands an increase in either interest for investors or higher wages for the worker, the middle class will demand fair prices and a stable industry. That means industrial peace. No peace is lasting until it is founded upon that essential equitable compromise between the contending forces—capital and labour—known as justice.

Justice to-day in American industry is no simple matter. It is hard to attain. Many different X's and Y's and Z's enter into the solution of the industrial equation. For instance, what is an honest intelligent definition of capitalization in terms of justice in any American industry today? Is all industry worth what it costs, or what it will bring, or the interest upon what it will earn? If so, what interest? And who shall suffer the loss of the liquidation of capital if liquidation becomes necessary to establish any over-capitalized industry as a going concern paying decent wages? Moreover, who shall decide these questions? Shall we call in government? Is there a practicable way without government interference by which any national industry suffering from industrial strife can call in representatives outside the industry—representatives of capital, of labour, of the consuming public, and enforce the fair findings of an unofficial board? How would such findings be enforced? Is public opinion outside government strong enough to make labour take less or capital give less by reducing its fixed charges and thus destroying the value of investments?

These questions must be answered. This problem must be solved. The answer must come, as far as it is possible, not from government control and direction of the arbitrament.

For government in the nature of things is political. And some tangles cannot be unsnarled by a count of noses. The minute we turn to government we turn finally to the ballot box. Alas, the ballot box has definite limitations. Men can solve large questions of right and wrong with the ballot. They can choose, if they have time and information, men who are reasonably honest and fairly intelligent. But industrial problems require delicate instruments. Industrial justice calls for rather erudite information and rather special judgments. If these problems too closely enter government which is directly related to the ballot box, the solution of the pending problem is bungled and democracy is menaced.

So far as possible this justice between the forces of capital and labour must be settled outside party politics. Wherever it is obviously necessary, it may be wise for the consuming public to demand that certain branches of American business put themselves through the wringer, reduce their capitalization, even writing off much of the bonded debt of these distressed industries. If any American industrial owner who is patently over-capitalized does not voluntarily reduce his fixed charges, the government will do it with taxes. Here is the bald problem: Shall American capitalists go bankrupt paying taxes to support the unemployed ? Or shall we wipe out some of our fixed charges and give the idle workers jobs ? Whether taxes or wages, it comes out of the same pocket. We are reaching a dangerous point. The rising flood of unemployment is slowly but inexorably eating into the income of the middle class. We cannot go on increasing the number of idle men who cannot be employed in certain industries—not many but conspicuous as they are now capitalized. Sooner or later—and I fear much sooner than we realize—we shall reach a point in the rising tide of the fixed charges in government where we shall not be able to collect taxes to pay those fixed charges of government. Then the government will man the wringer and God help the investor. No matter who turns the crank, Republican or Democrat, Fascist or Communist, the result will be the same. For it will have to be the same. With wages or taxes these idle workers must be fed. If the workers draw wages they will be free men. If they live on taxes, the government that feeds the unemployed will control their votes. It's human nature. Surely in private industry on this continent there is an adequate margin of operator's profit wide enough to keep American commerce afloat as a going concern, allowing for decent earnings, for living wages, for attractive prices to the consumer that will move the goods. And surely again America can produce brains in a free industry to solve this terrible problem somewhat outside politics without too much government aid or control.

And how worthwhile it is to do this immediate job that lies before us! No other institution on earth has such a large survival value in human happiness as democracy. The free man, whether worker, investor, or consumer, lies at the foundation of the democratic scheme of things. The ballot box is the free man's weapon. Free speech, a free press, the writ of habeas corpus, the right of trial by jury and freedom of conscience are the American's royal privileges which he should guard sacredly from abuse. In a world where these privileges are denied, every other freedom of man, every other blessing which nourishes the spirit of man is soon denied. It is easy enough to get out and fight a futile war to save democracy. But it will be hard for us, harder even than war for all of us, workers, investors, consumers, to make in peace those inevitable compromises that are needed to guarantee the maintenance of free institutions. We must all give a little. This hour has no time for the man who refuses to compromise even to his own hurt. Half of the civilized world to-day beyond our borders has surrendered the rights, privileges and blessings which democracy accords to free men. Should not the roaring waters of disaster, flooding ever nearer the feet of those who follow the tyrants, warn us to turn to the ways of peace with justice which are the only guarantees of freedom ?

Abstracts of Current Literature

Contributed articles based on current periodicals, papers and events

FOUNDRY COKE: AN INTERPRETIVE DISCUSSION

By B. P. Mulcahy in Fuel in Science and Practice, April, 1939.

Abstracted by A. A. Swinnerton, A.M.E.I.C.

The term "metallurgical" coke is used, at the present time, to include coke used both for blast furnace and cupola operation. The author states that the belief is incorrect that one coke can serve both operations equally well, and proceeds to describe each operation and detail the different requirements of each. He writes from the point of view of the producer of a coke made to fit the requirements of the foundry industry in contrast to the producer of coke for blast furnace operation.

In 1936, 31 million tons of coke were consumed in blast furnaces and about 2 million tons in cupolas, with a production in the first case of about 30 million tons of pig iron, and in the second case of about 16 million tons of cast iron.

Blast Furnace Coke Requirements

The fundamental purpose of the coke in this process is to serve the dual function of supplying heat and carbon monoxide to effect the reduction of the ore. It is desired also that these reactions shall take place in a relatively narrow zone, low in the furnace, in order to obtain the maximum reaction rates at this point and to prevent too high a solution loss higher up in the column "In general what the blast furnace requires is a coke that will burn rapidly and with intensity at the tuyeres, yet which has a strong structure and hard surface to resist abrasion and solution by CO_2 in the upper part of the stack." One of the most important differences between blast furnace and foundry coke is the size of the coke. The blast furnace can use and requires smaller-sized coke than the cupola.

Foundry Coke Requirements

Although there is a similarity in the fundamental principles of melting in the blast furnace and the cupola, it should be remembered that in operating the average cupola no provision is made for the recovery of the waste heat in the stack gases, iron and steel constitutes the charge of raw materials which are often charged by hand, and production capacities range from 10 to 150 tons per day. The blast furnace, on the other hand, uses elaborate equipment to recover the waste heat, ore is the raw material which is charged mechanically, and the capacities range as high as 1,000 tons daily production.

In describing the operation of the cupola, attention is drawn to the importance of the rate of coke feeding to maintain the proper bed height, as the selection and maintenance of the proper bed heights is probably the most important single factor in cupola operation. Strong structure is very important for foundry coke, because not only does it have to withstand severe impact during charging, but it must be sufficiently strong to withstand loading and transportation, unloading at the foundries, and transference to the charging floor.

The question of coke size and its relation to cupola operation is of extreme interest and importance, and has been the subject of some rather extended research. It has been suggested that the rate of combustion and melting are markedly affected by the coke size and the rate of air supply. Metal temperatures appear to be more sensitive to the variations in coke size than in the air blast above certain limits. The general opinion is that coke size seriously influences not only the general operating conditions of the cupola, but also the chemical composition of the iron. Coke reactivity is another important feature, and a coke with an excess of volatile matter burns too easily, which makes it difficult to maintain proper conditions in the cupola. Low ash content is, of course, equally necessary.

The existing A.S.T.M. specifications for foundry coke are as follows:—

Volatile matter	not over	2	per cent
Fixed carbon	not under	86	" "
Ash	not over	12	" "
Sulphur	not over	1	" "

It is apparently considered that the allowable limits for ash and volatile matter are too high, because a foundry coke just meeting these specifications would not be entirely satisfactory for cupola operation.

Domestic Coke Requirements

In spite of the fact that a great deal has been written advocating a "free-burning" coke for domestic purposes, this feature cannot be had in any coke, except at the expense of efficiency in its over-all combustion. Foundry coke, with its inherent properties of strength and low abradability, produces a clean uniformly-sized fuel which has proved eminently satisfactory for this service.

Present Methods of Testing Coke

The methods of testing coke are not discussed in detail, but the features that have become weakened due to improper technique are critically examined.

Correct sampling is, of course, very important, because the coke in an oven is not a uniform product, and these inequalities, in addition to the size of the pieces, make sampling somewhat of a difficult problem. The writer's company select 100 pounds of full length pieces and conduct all of the tests on this sample.

Shatter test. To the foundry coke producer the shatter test is probably one of the most useful of the tests employed at present for appraising the physical qualities of a coke. The results of this test are reported as the percentage that stays on a 2 in. screen after being subjected to this test.

Sectioning. A carborundum wheel is used for sectioning the coke samples for examination of the cell structure. It is felt that a great deal of information can be obtained from the longitudinal and cross sections. While only a visual inspection is used at present, it is hoped that some methods can be developed to translate the observed features into reliable indices.

Chemical Analyses. The recommended A.S.T.M. tests for the determination of volatile matter, ash, and sulphur are employed.

Specific Gravity and Cell Space. The A.S.T.M. methods are used, and these tests are conducted daily.

Future Possibilities of Foundry Coke Testing

The so-called physical and chemical indices of a coke are fairly well defined in the tests now available, but none of them sufficiently indicate the performance to be expected in the cupola. No two cokes have the same combustion characteristics, and although this is one of the most important characteristics of a coke, no reliable test seems to be in existence for determining this factor.

Tests which report only averages of many factors are not very satisfactory, and for this reason the following items are suggested for study because of their effect upon the degree of reactivity and shatter in a coke.

1. Cell size.
2. Cell wall thickness.
3. Types of carbon and their distribution.
4. Effect of residual volatile matter on reactivity.
5. Effect of ash composition on reactivity.

Some of these factors can be estimated indirectly, but it is felt that definite tests should be prepared to permit more reliable conclusions being drawn as to a coke's performance.

TWO-STROKE ENGINES

Diesel Railway Traction, June 9th, 1939

Abstracted by R. G. Gage, m.e.i.c.

Surprise is often felt at the small application of two-stroke engines to traction duties, particularly in view of the requirements of high power per unit of weight. Despite twice the number of impulses at any given speed, the two-stroke of equal cylinder dimensions and speed does not give anything like twice the power of a four-stroke. The incomplete scavenging which is possible in the short time available prevents the attainment of equal m.e.p.s. and moreover prevents the general run of two-strokes turning at the rotational speeds considered quite normal for railcar four-strokes. Since the abolition of the piston valve controlling the exhaust, and its replacement by a single poppet valve in the head, the speed of the Burmeister and Wain type of railway two-stroke has increased to 1,250 r.p.m. as a maximum, but the Winton engine, most used of all, is still limited to 750 r.p.m. The Junkers opposed-piston type of two-stroke, on the other hand, has been operated for years at 1,500 r.p.m., and the newest models have a power-weight ratio well below 10 lb. per b.h.p.—better than most of the pressure-charged four-stroke engines. All of the ordinary railway two-strokes—which in makes are limited to the Winton and Burmeister and Wain—have uniflow scavenging, with inlet ports round the liner and an exhaust valve in the cylinder head, and are thus in contrast to the majority of two-strokes for industrial and marine purposes. It is this attribute of the opposed-piston engine which has enabled the speed and output of the normal two-stroke to be increased during recent years. As in two-stroke engines the inertia forces are cushioned by the compression, high piston speeds can be used in conjunction with moderate rotational speeds, and with cast iron pistons; for example, the Burmeister and Wain type of engine running at 1,200 r.p.m. has a piston speed of 1,735 ft. per min. Heating of the piston crown and the underside of the cylinder head is the weakest point in the practical operation of two-strokes, because combustion occurs once every revolution, but mechanical considerations may be a limiting factor, e.g., the cylinder pressure acts uniformly downwards, and requires special attention to be given to the bearing lubrication system.

TUNGSTEN CARBIDE INCREASES THE LIFE OF GAUGES

La Machine Moderne, February, 1939

Abstracted by The International Power Review, May, 1939

Developments made in the grinding of tungsten carbide, now used for cutting tools, allows the adoption of this alloy for the manufacture of gauges. For this purpose it is necessary to finish the tungsten carbide with precision without excessive cost. Grinding stones containing diamonds and the proper technique of this kind of work enables this to be achieved.

Different gauges made from a single block or assembled from pieces have been established of Carboloy. The price of such gauges is about six times that of gauges of chromium plated carbon steel, but the long duration of the Carboloy gauges justify their higher price. The cost is due to their machining and not, as generally believed, to the price of the metal itself.

Large size gauges are generally fitted with tips of tungsten carbide.

Some Carboloy gauges have a duration of about 200 times that of carbon steel gauges, while their price is about ten times that of these latter.

Bearing bushes for holding camshafts in grinding machines are also made of Carboloy instead of steel.

MAGNA CHARTA

Mechanical Engineering, July, 1939

It may be the world of tomorrow that has sprouted on the unpromising mud flats of the Flushing meadows, but in the vast continuum of time no tomorrow exists without its yesterdays, and no hope lies in the dawn of a new day that was not born behind the sunset of the past. New shapes, new gadgets, new machines, new tools may owe their substance to the refined oxides of iron, subtly alloyed with elements whose virtues are a more recent discovery, but the ore comes from deposits laid down before man appeared upon the earth. Through the alchemy of science man may rearrange the molecules, building up and breaking down, may shatter even the atomic nucleus itself, make energy appear where there was mass, breathe life into inert matter, and ape Nature herself in regulating the processes of growth and decay. If through knowledge he has multiplied his powers and sought freedom, it is through disciplined intelligence that he must maintain them. Thus, although twelve hundred acres of cleverly conceived and executed exhibits at the New York World's Fair remind him of these powers and what they mean to him, the spirit of freedom is enshrined with impressive dignity in one small part of the British pavilion—a parchment written in an extinct language that only scholars can read but symbolic of a living force that has survived dead yesterdays and will persist in unborn tomorrows—the Magna Charta.

Men, women, and children approach it in a long respectful line, gaze upon it, and turn away—on their faces the impress of a variety of emotions. Among them, perhaps, is the refugee from countries where civil liberties are dead or denied; a cynic brought face to face with the essential significance of an age-long struggle; a child of liberty itself to whom political freedom has always been as natural an environment as the air he breathes; a humble member of an unprivileged race from whom constitutional guarantees are withheld; a youth for whom dead history has suddenly become alive; an intellectual zealot who cannot see that collectivist philosophies lead to the repeal of this great document; an emigrant from lands where bloodshed changed the masters of men's destinies and provided the form, but not the substance, of their liberties; a descendant of colonial pioneers whose forebears nurtured and fought for the preservation of political independence; a son of the British Commonwealth of Nations itself, proud of the heritage his ancestors bequeathed.

What divine inspiration led to the construction of this shrine, around which, in simple language, the essential guarantees of the civil liberties of a democracy are to be read ? To the left a painting depicts one of the great crises of those liberties, the refusal of the peoples' parliament to grant money to the minister of Henry VIII. To the right another shows one of the great triumphs of democracy, the coronation of George VI, the sublimation through the experiences and trials of representative self-government of the hereditary tyrant into a beloved monarch, of the divine right of kings into the divine rights of the individual.

Outside, somewhat to the south, atop a tall plinth, a seventy-nine-foot steel statue of the worker extends his hand aloft to grasp a red star, and appears to be stepping forward into space. To many this will symbolize another concept of liberty and emancipation won through bloodshed and the destruction of much that might have been saved. Around the two are grouped the pavilions of the nations whose peoples look either to the parchment and glorify the individual and his liberties or to the gigantic statue of a man and glorify the state and its complete authority. Between these two concepts of society men today divide their allegiance. In this atmosphere of the world of tomorrow, as everywhere in the world of today. This seven-hundred-year-old parchment holds renewed significance as the great charter of free peoples.

RAIL AND HIGHWAY COMPETITION IN ENGLAND

By W. L. Waters, M.E.I.C.

Abstract of paper presented before the American Society of Mechanical Engineers, Transportation Division, Metropolitan Section, New York, May 4th, 1939

The total motor vehicle taxation in England is at present about one-third more than the total cost of the highways and city streets, including new construction and interest on loans; and the new budget increases this taxation.

In 1928 the railways were authorized to operate on the highways, and they now have a financial interest in about one-third of the highway buses, and they own or control about one-tenth of the highway trucks. As a result of the activities of the railways highway bus service is now a well organized industry; but trucking is still in a chaotic condition due to competition and cut-rate truckers.

Highway buses are licensed as to routes and licences are only issued when a need for the service can be shown. Public haulage highway trucks are licensed as to the district to be served, and licences are only issued when adequate transport facilities are not available in the district. Licences for private trucks are granted as a matter of right. But sentiment is slowly developing that private trucking will have to be regulated. This is based on the idea that if public haulage is so restricted and regulated that private trucks take all the traffic, the public will demand that private haulage be also strictly regulated.

Conditions of vehicles, drivers, speed limits, hours of work, and conditions of operation for all vehicles are regulated by laws. But these laws are very difficult to enforce. Wages of public haulage vehicle labor are now regulated by a central board, and there is indirect control over the wages of private truck labour.

To meet highway competition the railways are permitted to make exceptional rates down to 40 per cent below standard rates without the approval of the Rates Tribunal, and special agreed charges, subject to the approval of the Rates Tribunal, to handle any large shippers freight, and such agreed charges seem to be anything the railway decides.

Since the war freight traffic has changed much, as heavy commodity exports have decreased, industries have been rationalized or re-located, new industries have been developed, population has shifted to the cities, and highway trucking has developed. Private automobiles, and to a lesser extent highway buses, have taken passenger traffic from the railways, so that it has been necessary to reduce fares, offer special excursion rates, develop luxury services, etc. The speed of both freight and passenger service, and the facilities offered, has also been much improved. The result of all these changes has been that railway net revenues have been reduced about one-third.

As a remedy for the conditions labour interests advocate that all transport, both rail and highway, be placed under a national transport board. If war develops this will probably result; but otherwise neither the public nor the railway companies are ready for this step.

In November, 1938, the railways officially asked to be released from the existing control of rates and freight classification regulations by the Rates Tribunal, so that they would have the same freedom as other forms of transport. This official request is possibly somewhat of a camouflage, as the railways are really more interested in having trucking rates controlled. The request is being considered by the Transport Advisory Council appointed by the Ministry of Transport to represent all interests, and negotiations between the railways, the highway interests and the shippers are proceeding satisfactorily. So it seems likely that the railways will in the near future obtain some relief from the pressure of unregulated highway competition.

INJURIES TO BEARINGS OF ELECTRIC MACHINES CAUSED BY ELECTRIC CURRENTS

By H. Schroder in Der Maschinenschaden, No. 1, 1939

Abstracted by The International Power Review, May, 1939

In order to prevent injurious effects to bearings caused by electric currents, supporting and thrust bearings of large electric machines are completely insulated from ground. Owing to influences, however, resulting from service, creep paths can develop which may render the best insulation ineffective. In the following the sources of danger are pointed out and suitable measures for the prevention of disturbances suggested.

If electric currents are set up in the bearings of electric machines, as the sources of trouble, in the first place, the journals, the brasses, the collar and any tilting segments can be suspected. The bearing current commences in the shaft and through the oil film of one of the bearings passes to the brasses, and from here through the housing to the base plate. From here it returns in the reverse succession through the other bearing to the shaft. Parallel to this the current tends also to find a circuit through the shaft ends of direct coupled driving machines. On their way to and from through the bearings, excepting the case when insulating pads are installed to obstruct their paths, currents pass steadily between the journals and the brasses which raise the temperature of the bearings and may lead to detrimental overheating apart from the injuries inflicted by these passages of current to the surfaces of the materials comprising the journals. Moreover, this refers to the well-known spotted cavities and rough places in the supporting metallic sufaces which appear in various degrees, sponge-like, on the circumference of the shaft. The removal of these defects generally necessitates extensive repairs.

To eliminate these dangerous influences, it is necessary to insulate completely at least one, but still better, both bearings from ground. This insulation is very complicated in view of the oil pipes, relays and electric wiring in connection with large bearings. It requires during installation as well as in the course of service, painstaking conscientiousness, irrespective of whether it concerns the insulation of a simple screw or the maintenance of the highly valuable insulating pad between the base plate and the housing, or the like.

It is recommended to measure the insulation and take readings during the installation of the machine, step by step. In case of an independent shaft, after its setting up has been completed, the readings "bearing to earth" should amount to 100 Megohms at a potential difference of 500 volts. In service it is inconvenient to repeat the insulation tests by individual insulation measurements on the parts of the bearing, nevertheless the bearing potential difference "bearing housing to earth" should steadily be checked. The magnitude of this voltage varies due to the combined influences of several causes affecting the rise of bearing currents. In most cases an alternating current voltmeter of 30 volts which can be changed over will suffice.

When the machines are in service, the instrument is connected across the bearing housing and earth. Should a potential difference exist between shaft and ground, a deflection will always be indicated. The reading of the measurement "bearing housing to earth" is subject to stray fields through the oil film. For this reason it is not the magnitude of the voltage itself that is decisive, but the fact that a deflection exists at all. If no potential difference existed between bearing housing and ground, this would indicate that creeping paths have established an earth connection.

With view of preventing injuries to machines, the origin of which is to be looked for in the bearing currents and creeping paths, the following readings should be taken.

(1) The bearings of electric machines should continually be examined in regard to the presence of bearing currents.

(2) The bearings should be kept free from creeping paths, conducting electric currents.

(3) In case of extensive overhauls, and everytime when opportunity offers itself, the insulation of the bearing should be checked by measurement. If the measurement indicates a difference from the original figure, it is, for the sake of preventing damage, indispensable to ascertain the fault through careful investigation even of places appearing "in perfect order". No effort should be too great in such a case, otherwise the safety of the whole set may be endangered and injuries might happen to such parts of the set the replacement of which would involve loss in time and money.

MAPPING IN THE TENNESSEE VALLEY

By T. P. Pendleton

The Canadian Surveyor—Proceedings of 32nd Annual Meeting of the Canadian Institute of Surveying, February, 1939

Abstracted by R. H. Field, a.m.e.i.c.

Engineering and other operations coming within the scope of activities of the Tennessee Valley Authority (established by Act of Congress in May, 1933) placed a sudden demand for accurate maps of the valley. The Tennessee river drains an area of 40,000 sq. mi., over which the rainfall is generally heavy, and contributes materially to the flood control problem of the lower Ohio and Mississippi rivers.

Some maps existed, notably reconnaisance maps of the Geological Survey, and a topographical survey of a narrow belt along the river, made by U.S. engineers in a study conducted in 1923. While this latter is of interest as being one of the earliest applications of air photographs for contouring (the photographs were used as plane-table sheets) it lacked control and therefore co-ordination. Hence the authority early realized that steps must be taken without delay to provide an adequate map of the valley. At first, due to the limited number of skilled topographers available, it was decided first to make a planimetric map of rather large scale, as being the best that could be produced at short notice to assist the engineers. Later, in 1936, investigations were conducted of stereoscopic methods for delineating contours, and after obtaining sufficient equipment and establishing an efficient organization, a good output of topographical maps was achieved.

Compilation of the planimetric map commenced in March, 1934, following receipt of the first air photographs from Washington. The large output desired necessitated the employment of help entirely unaccustomed to mapping, and hence modifications in the normal procedure. The office staff reached a maximum of 260 draftsmen in December, 1935. This force was recruited from unemployed architectural, electrical and mechanical draftsmen, who, it was found, could readily be instructed in simple map drawing. The force declined gradually, and was finally disbanded in December, 1936.

Radial line methods governed compilation, but difficulties were encountered in the more mountainous regions due to tilt errors. By the adoption of approximate systems of correction the accuracy was improved, but further trouble was experienced due to the effect of humidity on the cellulose acetate sheets on which compilation and inking were done. Efforts were made to compensate this error, and eventually master projections, applying to different humidities, were engraved on metal plates.

With the close of the planimetric programme and after the preliminary stereoscopic investigations, the Multiplex Aeroprojector was utilized for making the topographical maps. A scale of 1:7200 was adopted for compilation, and experiments commenced. At first old air negatives were used as a source for the pictures, but camera calibration data were lacking and the stereo models could not be made to fit the control. It was also found that the Aeroprojectors used had not been calibrated accurately by the makers. Methods were developed for re-calibration and successfully put into operation, whereby considerable errors were disclosed and corrected. With new air photographs, taken by properly calibrated cameras and used in the newly adjusted projectors, a high degree of accuracy was finally achieved. A few typical tests of the precision of the maps are given. In some cases profiles determined on the ground fit so well with those found stereoscopically that no appreciable errors are revealed. As a result of these tests the flying height was increased. It is now 11,800 ft. for maps with 20 ft. contours, and 18,700 ft. above ground in the case of 40 and 50 ft. contours—thus producing economy in both photography and control.

Later work involved cameras fitted with wide-angle lenses, resulting in still better performance. For instance, figures are cited showing that with a 4 in. wide-angle lens, 16 stereo models are needed to cover 60 sq. mi. while the older 8¼ in. lens required 48. The longer air base in the former case also increased the precision of stereo measurement.

The Chatanooga mapping office of the authority has separate rooms for each of its 15 frames of projectors, and 31 operators for these instruments, working on a two-shift day. Air conditioning equipment is being installed to reduce errors arising from dimensional changes in the plotting sheets arising from humidity. The monthly production per operator is 12 to 17 sq. mi. and some 2,500 sq. mi. had already been mapped with the Multiplex.

PRODUCER GAS FOR TRACTION

The New Gas Railcars of the French National Railways

By Henri Martin in Le Genie Civil No. 3, 1938

Abstracted by The International Power Review, May, 1939

The use of wood gas for driving internal combustion engines has made great progress during the last few years, particularly for motor vehicles. A consumption of 50 kg. of charcoal corresponds to 40 litres of petrol; the corresponding cost being 35 and 116 francs respectively.

The railways possess great quantities of replaced sleepers forming an excellent material for carbonization. The calorific power of charcoal produced from these sleepers of creosoted hardwood is of the order of 8,000 cal. per kg. with carbon contents of 92 to 93 per cent and only 2.4 per cent ash.

After preliminary trials which have given encouraging results the French National Railway Company has placed an order with Messrs. Etablissements de Dietrich for a series of three rail-cars fitted with gas producers to be fired with charcoal, the first two units of which have recently been put in service.

Car Body

The car body has a length of 22.50 m.; it is able to carry 54 seated and 46 standing passengers, plus 1,000 kg. of luggage, and is supported on two bogies, one of which is the motive bogie, having a wheelbase of 3.50 m. whilst the other is the trailing bogie, having a wheelbase of 3 m. only.

Total weight of the railcar: 32 metric tons empty, and 42 metric tons fully loaded.

Gas Producer

The gas producer plant, which is of the Panhard type, comprises three parts: the gas producer itself, arranged vertically towards the centre of the car, the cooler and the scrubbers arranged below the car body. The body of the producer is composed of two concentric shells, the inner one of which is fitted with fire bricks containing carborundum which are practically indestructable.

The charging hopper above the body of the producer has a capacity of two cu. m. and is able to hold 500 kg. of charcoal. A deflector through which a central opening is passing serves for distributing the fuel to any desired point of the furnace.

The air enters through the cowl of the draught fan, and passes first through the space between the refractory furnace and the external wall of the gas producer which is thus cooled.

The cooler consists of a horizontal layer of tubes welded into two headers.

The scrubbers, which are arranged in aluminium boxes, are operating entirely on the dry principle. The gases are passing in these coolers through cotton cloths stretched on metal frames. At the outlet of each scrubber a safety filter of very fine wire-mesh is provided, which only allows perfectly pure gas to pass through a mixing apparatus composed of a two-branch junction, one of the branches of which receives the producer gas and the other the air, the explosive mixture being thus produced automatically.

General Details

Engine—The engine, which is of the Panhard valveless type, has 12 cylinders arranged in V, each of 140 mm. bore and 160 mm. stroke, with a swept volume of 29.5 litres. The output capacity of the engine is 280 hp. at a speed of 1,750 r.p.m.

Gear box—This is of the Mylius type, with preselection and gears permanently in mesh; it contains five synchronized speeds and two outgoing shafts.

The reversing gear is arranged inside the gear box.

The operations of speed-changing, of disengagement of the main clutch and of synchronization are carried out by means of compressed air, whilst the putting in gear of the main clutch and of the various speeds is effected by the release of springs.

Performance—The maximum speed amounts to 120 km. per hr., the highest speed which can be kept up on an up-grade of 10 per mi. is 87 km. per hour.

The consumption of charcoal at full load is 0.410 kg. per hp.-hour, which corresponds to one kg. per km. and imparts to the rail-car a radius of action of 500 km.

The total length of time required for lighting is 10 to 15 minutes. A small petrol tank and a small carburettor enables the rail-car to effect manoeuvres in car sheds without having to light the gas producer.

The employment of producer gas rail-cars will render good service on lines of less importance on which frequent stoppages are required, particularly in the numerous forest regions of France. As regards long journeys carried out at a high speed, these are still operated by high-powered rail-cars operating on petrol or gas oil.

PROPER ILLUMINATION

Illuminating Engineering Society (London) Transactions, November, 1938

If the intensity of the surrounding light is less than six foot-candles as you start reading this, your lighting installation is below the minimum standards of the Illuminating Engineering Society (Great Britain), for casual reading. Among other activities the Society has endeavoured to gauge, in terms of foot-candles, the illumination requirements based upon good modern practice for the safe and easy performance of various tasks. The booklet "Recommended Values of Illumination" recently reprinted from the Transactions is a revised version of the original values prepared in 1936.

Tasks are differentiated, in order of effort, in seven main classes for which appropriate values of illumination are specified. The minimum specified for the lowest class—casual observations where no specific work is performed—is two foot-candles, a value considerably higher than might have been proposed some years ago. Subsequently an attempt is made to tabulate requirements of all types of buildings and interiors, detailed values of illumination being recommended for each room. For instance, students' homework requires between 10 and 15 foot-candles, hospitals' operating rooms between 15 and 25, drawing offices from 25 to 50. In the industrial field, the recommended values for machine-shops vary from six to 50 foot-candles according to the accuracy of the work.

It is emphasized that the figures in foot-candles refer to 'service values' and that care should be taken that the initial values are high enough to ensure maintenance of such values under normal working conditions. It is also recognized that these recommendations will require revision from time to time in order to take cognizance of new investigations and changes in practice.

MARITIME PROFESSIONAL MEETING

OF

THE ENGINEERING INSTITUTE OF CANADA

PICTOU, N.S., AUGUST 31st and SEPTEMBER 1st, 1939

Headquarters: PICTOU LODGE, PICTOU, N.S.

PROGRAMME

(Subject to minor changes)

WEDNESDAY, AUGUST 30th

12.00 noon **Registration** for those who come early.

THURSDAY, AUGUST 31st

9.00 a.m. **Registration**

10.00 a.m. **First Professional Session.**
Chairman—R. L. Dunsmore, M.E.I.C., Vice-President E.I.C.

Addresses of Welcome by the Representative of the Province of Nova Scotia and by Mr. Frank MacNeil, Representative of Pictou County.

Radio Hook-ups and Networks in Canada, by members of the technical staff of the Canadian Broadcasting Corporation.

Discussion: W. A. Winfield, M.E.I.C. (Halifax Branch). Aubrey Turnbull, A.M.E.I.C. (Saint John Branch).

Botwood Airport, by Donald Ross, Jr.E.I.C.

Discussion.

1.00 p.m. **Luncheon.**
Chairman: Prof. F. L. West, M.E.I.C. (Chairman, Moncton Branch, E.I.C.).
Speaker: Dean H. W. McKiel, M.E.I.C. (President E.I.C.).

2.45 p.m. **Sports**—Golf, Tennis, Baseball—J. J. Sears, A.M.E.I.C. (Halifax Branch).
Drives.

6.30 p.m. **Dinner and Dance,** Formal.
Chairman: Geoffrey Stead, M.E.I.C.
Speaker: Sir Wylie Grier.

9.00 p.m. **Dancing.**

FRIDAY, SEPTEMBER 1st.

10.00 a.m. **Second Professional Session.**
Chairman: W. S. Wilson, A.M.E.I.C. (Cape Breton Branch, E.I.C.).

Experiences in Steel Mill Design, by Mr. McKee, McKee Engineering Co.

Discussion.

Lions' Gate Bridge Substructure, by J. W. Roland, A.M.E.I.C., of Messrs. Monsarrat and Pratley, Montreal.

Discussion.

1.00 p.m. **Luncheon.**
Chairman: A. D. Nickerson, A.M.E.I.C. (Chairman, Halifax Branch, E.I.C.).
Speaker: Prof. D. C. Harvey of Dalhousie University, Halifax, N.S.

2.45 p.m. **Sports**—Golf, Tennis, Baseball, J. J. Sears, A.M.E.I.C. (Halifax Branch, E.I.C.).
Drives.

6.30 p.m. **Dinner**—Informal.

7.30 p.m. **Casino Night**—In charge of C. A. Fowler, M.E.I.C. (Halifax Branch E.I.C.).

LADIES' PROGRAMME

AUGUST 31st

Morning Drive around Pictou and interesting points in vicinity.

Afternoon Tea—Mr. D. R. Sutherland's cottage "Dunrobin" at Seacrest.

SEPTEMBER 1st.

Morning Open for sports, etc.

Afternoon Tea—Mrs. Michael Dwyer's residence "Birch Hill," Stellarton, N.S.

Note—These functions are open to both ladies and gentlemen.

Golf Course, Pictou Lodge, Pictou, N.S.

Editorial Comment...

ON TO NEW YORK

Recent events have impressed upon the public's mind, perhaps more strongly than ever before, the usefulness of technical men in a national emergency and it is assuring that the engineers of three great democratic countries should meet at this time of international uneasiness to discuss their common problems. Perhaps it is that the engineers of countries like Great Britain, the United States and Canada better understand the true significance of the art of engineering which is the methodical application of the principles of science to the advancement of civilization.

The British-American Engineering Congress which is taking place in New York next month should provide excellent ground for the technical men of governments and industry to make the connection between the recent advances in the art of engineering and the foreseen developments of the world of tomorrow. The fact that this Congress is held under the auspices of the principal engineering societies of the countries involved invests in this meeting a special importance and makes it an unprecedented event.

Apart from the social benefit that is to be expected from these contacts, the papers have been so designed as to provoke enlightening discussions. The subjects chosen, both in the civil and in the mechanical sections, are problems of present concern and the names of the authors are a guarantee that they will be treated properly.

In view of Canada's political and economic associations with Great Britain and the United States, it is a particular source of satisfaction that the Institute should have been invited to participate in this international gathering and it is hoped that all members who can reasonably do so, will take advantage of this opportunity of meeting distinguished brother engineers.

The coincidence of the World's Fair is another factor which should incite members to take the trip because this fair carries a particular appeal for engineers and scientists. Special arrangements have been provided in the programme for group visits to the grounds and free time has been arranged as well for individual rambling.

It is interesting to note that among the reservations which have been received at Headquarters, only a very small number are single. Members are taking their wives with them and in many cases the children. The Congress promises to be the outstanding social event for the Institute this year.

POST-CONGRESS CANADIAN TOUR

The Engineering Institute of Canada considers it a privilege to be permitted to participate in the British-American congress of engineers at New York, N.Y., September 4th to 8th, 1939, coincidental to the World's Fair. The Institute is particularly grateful to the two host societies. The American Society of Civil Engineers and The American Society of Mechanical Engineers—for the unique arrangements they have made for the social and professional events of the congress, all of which will further promote the friendly relationship which already exists among members of the engineering profession in England, the United States and Canada.

With a desire to contribute to this relationship and to the interest of the congress, the Council of the Institute has arranged for a post-congress tour to points of engineering interest in central Canada, to which members of the two British Institutions and their ladies are cordially invited. These arrangements have been made to fit in precisely with the tours that are to be made in the United States. It is the hope of the Institute that it may be host to a great number of visitors from overseas.

At each of the Canadian cities visited the officers and members of the local branch of the Institute will be hosts, and in Toronto they will be joined in this pleasant duty by members of the Ontario Section of the American Society of Mechanical Engineers and the Association of Professional Engineers of Ontario. It is the earnest desire of all hosts to make the visit pleasant and profitable for all visitors. The complete programme of this tour appears on page 375 of this Journal.

CANADIAN HOSPITALITY IN NEW YORK

Acting on the suggestion of Dr. T. Kennard Thomson, M.E.I.C., the Canadian Club of New York, quartered in the Waldorf-Astoria Hotel, has kindly extended club privileges to the members of The Engineering Institute who will attend the British-American Engineering Congress in September. The Secretary of the Club, Mr. A. W. J. Flack, has requested a list of the members attending in order that each may receive an individual letter of introduction to the Canadian Club.

THE MARITIME PROFESSIONAL MEETING

The professional meeting which is taking place in Pictou, N.S., August 31st and September 1st, is for the main purpose of affording the engineers of the Maritime Provinces an opportunity for a reunion. But the choice of the locality is such that it should attract, in this season, a great number of visitors from western points as well.

Pictou Lodge, overlooking the waters of the Northumberland Strait, has a natural setting which makes it one of the most attractive seaside resorts in the Maritimes. The invigorating climate of Pictou, where the days are comfortably warm and the nights refreshingly cool, is recommended as a diversion after exposure to hot summer weather elsewhere.

The Maritime branches are taking advantage of this professional meeting for celebrating the election to the presidency of the Institute of Dean McKiel, a resident member, who will be present.

It will be noted on the programme which appears elsewhere in this number that even if the emphasis seems to be on sociability, there will be sufficient time devoted to formal and informal exchanges of professional knowledge. At the two technical sessions to be held, four papers will be presented. These have been chosen to cover as wide a range of engineering subjects as possible.

The number of papers has been purposely limited to four so that more time will be left for recreation, which is made easy at Pictou Lodge. The facilities for golf, tennis, swimming, boating are excellent. Arrangements have been made for golf and tennis tournaments and other contests.

The advance registration is already impressive and this meeting bears the guarantee of a complete success.

PRESIDENTIAL VISIT TO WESTERN BRANCHES

The President has prepared the itinerary for his visits to the Western branches and the following dates may serve as preliminary beacons: Sault Ste. Marie during the week of September 18th, Winnipeg on October 1st, Calgary on October 13th, Vancouver on the 19th.

The schedule has been submitted to the branches involved for definite arrangement and complete information will be published in the September number of the Journal.

The President will be accompanied by Mrs. McKiel.

Reservations and inquiries in connection with the British-American Congress mailed after August 30th should be addressed to the General Secretary, Central Registration and Information Office, Low Memorial Library, Columbia University, New York, N.Y. Residence: Butler Hall.

CANADIAN TOUR PROGRAMME

September 11th to 14th

FOLLOWING THE BRITISH-AMERICAN ENGINEERING CONGRESS IN NEW YORK

(All times throughout this programme are Eastern Standard)

Monday, Sept. 11th, Niagara Falls

THE CIVIL ENGINEERS GROUP

The two congresses of civil and mechanical engineers will conclude on Friday, September 8th. The same afternoon at 2.30 p.m. from Pennsylvania Station, the members of the Institution of Civil Engineers ("civils") will go by train to Washington, D.C., where Friday evening and Saturday will be spent. (Headquarters—Wardman Park Hotel) Sunday morning the party will leave Washington Union Station by train at 7.40 a.m. and will arrive at Central Station, Buffalo, N.Y., Sunday evening at 7.15 p.m. At 7.30 p.m. the party will leave by special chartered buses for Canada, and will cross the Upper Niagara river by the Peace Bridge, and travel along the Niagara Boulevard, arriving at the General Brock Hotel, at Niagara Falls, at about 9.00 p.m. Baggage will be transported direct from the station at Buffalo to the rooms assigned in the hotel. The hotel, which is close to the Falls, will be the headquarters of the party until Tuesday morning.

Monday morning, September 11th, will be free for sightseeing, arrangements for which will be made by the Niagara Peninsula Branch of the Institute.

At 12 noon, the entire party, with the "mechanicals," will be the guests of the Hydro-Electric Power Commission of Ontario at luncheon at the Refectory in the Queen Victoria National Park. Dr. T. H. Hogg, M.E.I.C., Chairman of the Commission will preside and will address the guests.

At the conclusion of the luncheon, the party will be conducted by motor cars furnished by the Hydro-Electric Power Commission of Ontario, along the Lower Niagara, past the famous Whirlpool Rapids to the Commission's hydro-electric development at Queenston.

Following the inspection of the Queenston plant, the party will be conducted to Queenston Heights, where, about 4.00 p.m., tea will be taken with the "mechanicals" party—all as guests of the Niagara Peninsula Branch of The Engineering Institute of Canada. Following tea, the party will be returned to the General Brock Hotel.

Weather permitting, dinner will be served in the Roof Garden of the General Brock Hotel, which will be reserved for the purpose. An orchestra will be present for dancing. It is expected the Hydro-Electric Power Commission will arrange for a special night illumination of the Falls which can be viewed from the General Brock Hotel, and particularly well from the Roof Garden.

THE MECHANICAL ENGINEERS GROUP

On Saturday morning, September 9th, the "mechanicals" party will go by boat from New York up the Hudson river to Poughkeepsie, at which point it will board a special train for a day trip through northern New York State, arriving at Niagara Falls, Ont., at 9.40 p.m. The entire party will be conveyed by buses to the General Brock Hotel, where it will remain until Tuesday morning, September 12th.

Sunday is left free for church, golf, sightseeing, etc. Members of the Niagara Peninsula Branch of The Engineering Institute of Canada will be at the hotel to assist in any way that the guests may desire.

On Monday morning, September 11th, at 9.00 a.m., motor cars will be furnished by the Hydro-Electric Power Commission of Ontario for a trip along the Lower Niagara river, past the Whirlpool Rapids to the hydro-electric development at Queenston.

The party will be returned to the General Brock Hotel about 11.30 a.m. At 12 noon, the entire party with the Civils will be the guests of the Hydro-Electric Power Commission of Ontario at a luncheon at the Refectory in the Queen Victoria National Park.

At the conclusion of the luncheon, about 2.00 p.m., the Branch will conduct the party by buses on a special sightseeing trip past the famous flight locks of the Welland Ship Canal, through the fruit belt of the Niagara Peninsula to Queenston. The party will join the civils for tea at Queenston Heights as guests of the Niagara Peninsula Branch of the Institute, and will return to the General Brock Hotel about 5.30 p.m.

Tuesday, Sept. 12th—Hamilton

THE CIVIL ENGINEERS GROUP

At 8.00 a.m. special chartered buses will leave the General Brock Hotel for Hamilton, Ontario, passing the flight locks of the Welland Ship Canal, the thriving "garden city" of St. Catharines, the famous fruit belt of the Niagara Peninsula, and arriving at the industrial city of Hamilton at 9.45 a.m.

The entire party will be conducted by the Hamilton Branch of the Institute on a tour of the city and district, including a visit to the civic filtration plant, at the conclusion of which the party will join the "mechanicals" at the Royal Connaught Hotel, where, at 12 o'clock noon, they will be accorded a complimentary luncheon by the Hamilton Branch.

After luncheon buses will convey the party to the C.P.R. train which will leave the depot at 2.15 p.m. for Toronto.

THE MECHANICAL ENGINEERS GROUP

After breakfast at the General Brock Hotel, Niagara Falls, the entire party will be conveyed by motor car to the Canadian National Station and will depart for Hamilton by train at 8.10 a.m., passing through St. Catharines—the "garden city," and reaching Hamilton about 9.25 a.m. The party will disembark at the Jockey Club and will be conveyed by members of the Hamilton Branch on a tour of the city and district, including a visit to the civic filtration plant.

At 12 o'clock noon, the entire party will join the "civils" at the Royal Connaught Hotel for luncheon.

After luncheon buses will convey the party to the Canadian National train which will leave the depot at 2.40 p.m. for Toronto.

Tuesday, Sept. 12th—Toronto

THE CIVIL ENGINEERS GROUP

The C.P.R. special train will arrive at Sunnyside Station, Toronto, at 3.00 p.m., where the party will detrain for a motor trip around the city of Toronto as guests of the Toronto Branch of the Institute, the Ontario Section of the American Society of Mechanical Engineers and the Association of Professional Engineers of Ontario. Tea will be served at The Old Mill, and the trip will conclude at Hart House, University of Toronto, where dinner will be served at 6.00 p.m., to both the "civils" and the "mechanicals."

After dinner the guests will be conveyed to the Royal York Hotel and the balance of the evening will be free. The C.P.R. train will depart from the Union Station at 11.15 p.m. for Ottawa.

THE MECHANICAL ENGINEERS GROUP

The C.N.R. special train will arrive at Sunnyside Station, Toronto, at 3.24 p.m., when the programme for the rest of the day will be the same as for the "civils."

The "mechanicals" party will leave by train from the Union Station, Toronto, at 8.00 a.m., on Wednesday, Sept. 13th, for Detroit, Michigan, where they will arrive about 1.30 p.m.

Wednesday, Sept. 13th—Ottawa

Train arrives at Union Station at 7.10 a.m. Breakfast will be taken at the Chateau Laurier Hotel, reached by tunnel from the station.

The following alternatives have been arranged.

(a) All day available for visits to points of interest in the City, shopping, etc.

(b) A trip by special train or bus to the Gatineau River valley for a visit to three of the Gatineau Power Company's hydro-electric power stations, Paugan, Chelsea and Farmers.

Afternoon Tea

Afternoon tea at 4.00 p.m. at the Chateau Laurier Hotel as guests of the Ottawa Electric and Gas Companies (Frederick E. Bronson, M.E.I.C., president, and W. H. Munro, M.E.I.C., general manager).

Dinner

A formal Dinner at 6.30 p.m. at the Chateau Laurier Hotel as guests of the Dominion Government. The Honourable C. D. Howe, Hon.M.E.I.C., Minister of Transport, will represent the Government and act as official host.

Leave Ottawa at 4.05 a.m. on Thursday, September 14th, for Montreal.

Thursday, Sept. 14th—

Montreal, St. Maurice Valley, Beauharnois

Arrive at Windsor Station, Montreal, at 6.45 a.m.

The following alternatives have been arranged for morning and afternoon:

(a) Trip by special train to the St. Maurice Valley as guests of the Shawinigan Water and Power Company.

(b) Visit by bus to the Beauharnois development on the St. Lawrence River, as guests of the Montreal Light, Heat & Power Consolidated.

(c) All day available for visits to McGill University, Ecole Polytechnique, Art Gallery, shops and sightseeing.

Provincial Government Dinner

At 7.00 p.m., at the Windsor Hotel, a formal Dinner will be tendered by the Provincial Electricity Board, at which it is expected the Minister of Lands and Forests, Hon. J. Bourque, of Quebec, will represent the Provincial Premier, the Hon. Maurice Duplessis.

Some of the visitors will embark on the SS. "Duchess of Bedford" at Montreal, on Friday, September 15th, and others on the SS. "Empress of Australia" at Quebec, on Saturday, September 16th.

MEETING OF COUNCIL

A meeting of the Council was held at Headquarters on Saturday, June 24th, 1939, at ten o'clock a.m.

There were present: Vice-President H. O. Keay in the chair; Past-President J. B. Challies; Councillors W. F. M. Bryce, J. L. Busfield, A. Duperron, R. H. Findlay, H. A. Lumsden, H. Massue, B. R. Perry, J. A. Vance, E. B. Wardle; Treasurer deGaspe Beaubien; Secretary Emeritus R. J. Durley, General Secretary L. Austin Wright, and Mr. Louis Trudel. Past-President F. P. Shearwood was also present by invitation.

Vice-President Keay announced the death of Past-President Julian C. Smith, who had passed away that morning after a long illness. On the motion of Past-President Challies, seconded by Mr. Wardle, the following resolution was unanimously passed:

"The Council of The Engineering Institute of Canada deeply regrets the death of a distinguished Past-President, Julian Cleveland Smith. Eminent as an engineer, an administrator, and a public-spirited citizen, he was held in affectionate esteem by all who were privileged to know him or to work with him.

"While serving as Councillor and President of the Institute and later as Past-President, his wise counsel and personal influence were most valuable in promoting the welfare of the Institute and of the engineering profession in Canada.

The Council begs to offer to Mrs. Smith and the members of his family an expression of heartfelt sympathy."

The Committee on International Relations, acting on an inquiry which had come from the Joint Committee on Engineering Co-operation Overseas, made certain recommendations for closer co-operation with the British engineering societies, which were unanimously approved.

The membership of the Plummer Medal Committee was approved as follows:

J. R. Donald, M.E.I.C., Chairman
G. P. Cole, M.E.I.C.
A. G. Fleming, M.E.I.C.
F. M. Gaudet, M.E.I.C.
G. Ogilvie, M.E.I.C.

Past-President Challies reported that the Institute's participation in what had now been christened the "British-American Engineering Congress," to be held in New York in September, was proceeding very satisfactorily. The papers which The Engineering Institute had been asked to prepare were well under way; the arrangements for the post-congress tour in Canada had all been worked out in detail with the Institute branches concerned; the various functions promised last year, and underwritten by governmental bodies and private corporations, were now practically all arranged. A brochure was being prepared containing the details of the post-congress tour in Canada, and which would be made available to all interested members of the British Instutitions, also to members of Council and officers of the branches affected.

The Secretary reported that to date about one hundred and fifty registrations had been received coming from members as far apart as Halifax and Vancouver.

It was noted that the dates for the Maritime Professional Meeting had been changed to August 31st and September 1st, instead of August 30th and 31st. At the President's request it was decided that a meeting of Council should be held at Pictou Lodge, Nova Scotia, at two o'clock p.m., on Wednesday, August 30th, the day preceding the meeting.

It was unanimously resolved that a meeting of Council be held in the west, some time in October, during the President's visit to the western branches, the definite date and place to be decided upon by the President when his plans are completed.

The Secretary presented letters from the Secretary of the Winnipeg Branch of the Institute and from the Registrar of the Association of Professional Engineers of Manitoba advising that both of these bodies approved of the draft agreement for co-operation between the Institute and the Association, which had been submitted to them by Mr. Newell's Committee on Professional Interests, as a basis for further negotiation.

Past-President Challies, speaking as a member of the Committee on Professional Interests, requested that, as negotiations had advanced sufficiently that shortly consideration may be given to a final agreement, the committee be authorized to take the necessary action, under the provisions of By-law 76, leading to a final agreement between The Engineering Institute of Canada and the Association of Professional Engineers of Manitoba. This was approved.

The dates for the 1940 Annual General Meeting, as suggested by the Toronto Branch, were unanimously approved as Wednesday, Thursday and Friday, February 7th, 8th and 9th, 1940, the first day to be devoted to the Council meeting and the President's dinner.

The resignation of the chairman of the Publication Committee was received, also resignations from each of the members of the committee. These were accepted with regret, and a committee consisting of Past-Presidents J. B. Challies, F. P. Shearwood and O. O. Lefebvre, and Mr. C. K. McLeod, was appointed to act with the President in the selection and naming of a new committee.

Mr. Brian Perry referred to concessions which had been made to certain of the professions by the Income Tax Department, which were not made to engineers. The Corporation of Professional Engineers of Quebec had interested itself in the subject, and he wished to report what that body had done. The matter was referred to the Institute's Committee on Legislation for a report to the next meeting of Council.

One resignation was accepted; one reinstatement was effected; two Life Memberships were granted, and the names of three members were removed from the membership list.

A number of applications for admission and for transfer were considered, and the following elections and transfers were effected:

ELECTIONS

Members	9
Associate Members	11
Juniors	1
Students admitted	4

TRANSFERS

Associate Member to Member	1
Junior to Member	1
Junior to Associate Member	6
Student to Associate Member	1
Student to Junior	1

The Council rose at twelve fifty-five p.m.

CORRESPONDENCE

THE EDITOR,
THE ENGINEERING JOURNAL,
2050 MANSFIELD STREET, MONTREAL, QUE.

Dear Sir:

In the very excellent paper by P. C. Perry, M.E.I.C., "Stream Control in Relation to Droughts and Floods," published in The Engineering Journal, June, 1939, the reference to a source of information regarding the construction of earth dams might be modified.

There is at the present time in engineering literature no single publication treating in a measure of completeness the subject of earth dams in keeping with the present day practice of design and construction procedure. This applies most particularly to rolled fill dams, but is also true to a lesser extent for hydraulic and semi-hydraulic fill dams. The reason for this lies in the rapid development of knowledge in the field of soil mechanics, and the increasing application of this to earth dam problems, since the book written by Mr. Justin, and referred to in the paper, was published.

The range of information applicable to earth dam design and construction methods has broadened so rapidly in the last few years that one interested in the subject must refer almost entirely to periodical literature and to the reports of various engineering congresses and governmental dam building agencies.

Considering rolled fill dams only as the most common type, the best introduction to present day methods of construction is given in a series of articles by R. R. Proctor published in the Engineering News-Record, Aug. 31st, Sept. 7th, Sept. 21st, Sept. 28th, 1933.

A word of explanation giving the reason for my letter is perhaps in order. For some time I have been making a special study of the comparatively new field of soil mechanics and particularly insofar as this subject concerns the design and construction of earth dams and high retaining walls. H. G. Acres and Co., by whom I am employed, are at present engaged in the design and field supervision for a moderate-sized earth dam on the Grand river in Ontario. The work being done on this project is so arranged as to permit the full application of the available pertinent knowledge in the field of soil mechanics and earth dam design and construction. I have had so far every opportunity to apply such information and expect that the design and constructional control of the structure will be complete according to the best practice of the day.

You will understand me when I say that largely because of my special interest in earth dams at this time I felt I should enlarge upon what is really a very minor item in Mr. Perry's paper.

Yours very truly,
(Sgd.) R. C. MCMORDIE, A.M.E.I.C.

2201 Orchard Ave., Niagara Falls, Ont.,
June 21st, 1939.

THE EDITOR,
THE ENGINEERING JOURNAL,
2050 MANSFIELD STREET, MONTREAL, QUE.

Dear Sir:

I believe that the information set forth by Mr. McMordie will make a valuable addition to the discussion and will supplement the information I submitted concerning earth dam construction which was rather limited. Owing to the general nature of my paper I did not go into the matter of construction details at all fully and I am very glad that Mr. McMordie was sufficiently interested to make these suggestions.

Yours very truly,
(Sgd.) P. C. PERRY, M.E.I.C.,
Division Engineer.

UNION DEPOT, CANADIAN NATIONAL RAILWAYS,
REGINA, SASK.
July 3rd, 1939.

ELECTIONS AND TRANSFERS

At the meeting of Council held on June 24th, 1939, the following elections and transfers were effected:

Members

Beck, Edward Herbert, structural engr., National Research Council, Ottawa, Ont.

Brackinreid, Thomas William, B.A.Sc. (Univ. of Toronto), president, Phillips Electrical Works Ltd., Brockville, Ont.

Canning, Dow Vernon, B.Sc. (McGill Univ.), industrial control engr., Can. Gen. Elec. Co. Ltd., Peterborough, Ont.

Carlyle, Ernest J., B.Sc. (McGill Univ.), secretary-treasurer, Canadian Institute of Mining and Metallurgy, Montreal, Que.

Eddy, Harrison Prescott, Jr., B.Sc. (Mass. Inst. Tech.), partner, Metcalf & Eddy, 1300 Statler Bldg., Boston, Mass.

Henderson, Gordon G., B.A.Sc. (Univ. of Toronto), sales engr., Canadian Bridge Company Limited, Walkerville, Ont.

MacPherson, George Lucas, B.A.Sc. (Univ. of Toronto), asst. chief engr., engrg. development dept., Imperial Oil Limited, Sarnia, Ont.

Pollock, Francis Jones, B.A.Sc. (Univ. of Toronto), engr. in charge, trans. tower dept. drawing office, Canadian Bridge Company Limited, Walkerville, Ont.

Tomlinson, Carl Perkins, Ph.B. (Yale Univ.), vice-president, McColl-Frontenac Oil Co. Ltd., Montreal, Que.

Associate Members

Henderson, Dugald Campbell Macdonald, (Robert Gordon Coll.), asst. engr., sewer section, Dept. of Works, City of Toronto, Ont.

Laing, William Lowther, asst. engr., Mech. Dept., Dominion Bridge Co. Ltd., Montreal, Que.

Lillie, Herbert, Assoc. (Royal Tech. Coll., Glasgow), transformer engr., Bepco Canada Limited, Montreal, Que.

Margoninsky, Bruno Adolf, D.Eng (Technische Hochschule, Berlin), vice-president, Allied Consultants Limited, 2036 City Councillors St., Montreal, Que.

MacDonald, William Arthur, B.Sc. (Elec.), (N.S. Tech. Coll.), asst. to elec. engr., Dominion Steel & Coal Corpn., Sydney, N.S.

McPherson, Ross Cody, B.Sc. (Elec.), (Univ. of Alta.), engr. i/c commercial and industrial gas installations, Northwestern Utilities Ltd., Edmonton, Alta.

Mutchler, James Irving, B.Sc. (Agric.), (Univ. of Sask.), senior survey engr., P.F.R.A., Dept. of Agriculture, Regina, Sask.

Neil, Alexander Stewart, (Grad., Glasgow Tech. Coll.), engr., Precision Machine & Foundry Ltd., Calgary, Alta.

Peers, Arthur Francis, (Royal Naval Coll.), partner, Fraser & Peers, Quesnel, B.C.

Plant, William Albert, res. engr., Abitibi Power & Paper Co. Ltd., Smooth Rock Falls, Ont.

Smith, Joseph, (Royal Tech. Coll., Glasgow), asst. engr., Mech. Dept., Dominion Bridge Co. Ltd., Montreal, Que.

Junior

Weston, John Fillmore, B.A.Sc. (Univ. of Toronto), fabricating dept., Aluminum Co. of Canada Ltd., Shawinigan Falls, Que.

Transferred from the class of Associate Member to that of Member

Vance, James Alfred, (Univ. of Toronto), general contractor, 288 Light Street, Woodstock, Ont.

Transferred from the class of Junior to that of Member

Giles, B. H. Drummond, B.Sc. (McGill Univ.), vice-president, Canadian SKF Co. Ltd., Montreal, Que.

Transferred from the class of Junior to that of Associate Member

Acheson, Harry Ross Macdougall, B.Sc. (Univ. of Alta), supply engr., Spruce Falls Power & Paper Company, Kapuskasing, Ont.
Adams, Eric G., B.Sc. (McGill Univ.), M.B.A. (Harvard), engr., Coverdale & Colpitts, New York, N.Y.
Auld, James Robertson, B.A.Sc. (Univ. of Toronto), elect'l. engr., Canadian Industries Limited, Montreal, Que.
McEwen, Markland Neil, B.Sc. (C.E.), (Univ. of Man.), instr'man., Dept. of Highways of Ontario, Kenora, Ont.
Striowski, John Benjamin, B.Sc. (C.E.), (Univ. of Man.), asst. engr., gen. engrg. dept., Dept. of Transport, Ottawa, Ont.
Turnbull, Donald Orton, (Grad., R.M.C.), constrn. supt., Foundation Co. of Canada Ltd., Montreal, Que.

Transferred from the class of Student to that of Associate Member

Warnick, William Maurice, B.Sc. (Mech.), (Queen's Univ.), plate grill foreman, Dominion Foundries & Steel Ltd., Hamilton, Ont.

Transferred from the class of Student to that of Junior

Esdaile, Hector Milton, B.Eng. (McGill Univ.), service engr., Combustion Engineering Corporation Ltd., Montreal, Que.

Students Admitted

Adams, Jack Douglas, B.Eng.. (McGill Univ.), 2293 Wilson Ave., Montreal, Que.
Colby, Alan Rutherford, B.Sc. (Univ. of N.B.), 333 Charlotte St., Fredericton, N.B.
Dunn, John Rankin, B.A.Sc. (Univ. of Toronto), testman, Can. Gen. Elec. Co. Ltd., Peterborough, Ont.
McArthur, Alexander Arthur, (Univ. of Toronto), 25 Willowbank Blvd., Toronto, Ont.

THE WORK OF THE NATIONAL RESEARCH COUNCIL IN ENGINEERING

The twenty-first annual report of the National Research Council has been issued. The work of the Council falls naturally into two main divisions: the research investigations carried out in the laboratories at Ottawa, and the activities of the numerous committees that have been organized by the Council to investigate specific problems and sometimes to plan and direct research which may be carried on in the universities or other institutions having special facilities for studies in certain subjects.

Among the committees that function under the Council in many fields are: aeronautics, asbestos, coal classification and analysis, field crop diseases, fire hazard testing, forestry, gas research, laundry research, leather, magnesian products, metallic magnesium, radio, radiology, survey research, weeds, wool.

In the laboratories there are four main divisions: biology and agriculture, chemistry, mechanical engineering including aeronautics and hydraulics, and physics and electrical engineering. Supplementing these are a section on codes and specifications and the research plans and publications section. In addition there are the general administrative services necessary to such an organization.

Direction of the National Research Laboratories is vested in the President and all matters of policy are decided upon by the National Research Council, a body of 15 men appointed on the recommendation of the Committee of the Privy Council for scientific and Industrial Research, which in turn consists of seven members of the Dominion Cabinet presided over by the Minister of Trade and Commerce.

The Division of Chemistry has organized relations for research with the laundry and dry cleaning industry, the asbestos industry, the leather industry and, to a less extent, with the wool manufacturing and sugar industries. Much other work has basic industrial importance, e.g., work on paints, rubber and textiles.

One of the most striking pieces of work of the last few years relates to the utilization of waste natural gas. It has been found that by heat treatment in a furnace of a special but nevertheless simple design, the fraction of waste gas known as stabilizer gas can be made to yield three to four gallons of liquid motor fuel of the benzol type per 1,000 cu. ft. of gas. The striking result has now been secured that the residual gas from such heat treatment will yield six to seven pounds of carbon black. This combination process seems to have attractive commercial possibilities.

A distillation column has been developed that is of great interest to the oil-refining, synthetic chemical and coal-tar industries, as well as to other industries using distillation as a process. Noteworthy results have been obtained in researches on starch. In the corrosion laboratory problems ranging from the corrosion of laundry hot water pipes to that of hydro-electric power dam gates are being investigated.

The work on magnesian products in the laboratories has been very profitable to Canada. The magnesian products laboratory has not only made available to the Canadian metal industry better refractories, and a greater range of them, but it has shown that these can be produced from Canadian materials. An investigation of various domestic barks as sources of tannin for the leather industry has been carried on in the leather laboratory. In the rubber laboratory much has been done on the bonding of rubber to metal, including particularly the application to the manufacture of automobile engine mountings of a bonding material previously developed in the laboratories.

In the Division of Mechanical Engineering there are available a wind tunnel for the testing of aeroplane models, streamlined locomotives, and any other equipment in which air resistance is important, and a model-testing basin in which somewhat similar problems in regard to water may be investigated.

Five ship models have been tested during the year in the towing basin in connection with the design of private, and government vessels. In two instances it was found possible to make major improvements in the propulsive characteristics. A one-hundredth scale model of a stop-log emergency dam was tested to ascertain the forces likely to be met in the operation of similar full-scale structures. Engines, aircraft instruments, gasoline and lubricating oils have been tested for various branches of the Government service. Instruction is also given to members of the staff of the Royal Canadian Air Force in the testing, care and maintenance of the instruments used in their work.

In the Division of Physics and Electrical Engineering, the normal fundamental phases of work on sound, light, and heat, and the studies of electrical engineering are carried on concurrently with a steadily increasing amount of testing, examination and standardization of instruments. Advice has been given to a number of Government departments in connection with such varied matters as the acoustical treatment of rooms and buildings, apparatus for depth-sounding purposes, forest fire hazards, collection of insects, and methods of plotting results of aerial surveys. In the metrology laboratory, apparatus for the precise calibration of standard gauges for industry has been designed and built. A satisfactory heater for use in refrigerator cars in winter to prevent freezing has been developed and is being taken up commercially. New apparatus has been installed in the electrical engineering laboratory to provide high-voltage current and progress has been made in the precise regulation of voltage. Thousands of aircraft castings are being examined by X-ray methods and a 600,000-volt apparatus has been constructed to permit expansion of this work and for standardization of equipment for hospital use. Type approval of meters is being continued. The cathode-ray compass and direction finder, detection of fires through haze, estimation of forest fire hazard, vibration in aircraft, ultrasonic generators for depth sounding, problems in camera design for air photography, and spectroscopic analyses are some of the other matters under study.

Recent additions to equipment include an electric surge generator capable of developing a million volts for use in the testing of transmission line and other insulating material.

Radium preparations in large numbers are measured and certified in the radium laboratory. Recently a device for rapid testing of radium tubes for leakage was constructed and a method for measuring the radium content of barium-radium bromide preparations was developed.

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

An important delegation sailed on the "Empress of Britain" from Quebec on July 29th, to advance in London the Canadian facilities for meeting national defence requirements of the Empire. The delegation included the following engineers—**E. Holt Gurney**, **Paul F. Sise**, M.E.I.C., Major-General **A. G. L. McNaughton**, M.E.I.C., **P. S. Gregory**, M.E.I.C., and **J. M. Evans**, A.M.E.I.C.

W. F. Angus, M.E.I.C., has been appointed vice-president and member of the executive committee of the Royal Bank of Canada.

Elizabeth M. G. MacGill, A.M.E.I.C., has been appointed chief aeronautical engineer of the Canada Car and Foundry Company at Fort William, Ont. Miss MacGill, a Bachelor of Applied Science of the University of Toronto and a Master of Science in engineering of the University of Michigan, is the first woman in the Dominion to become a corporate member of the Institute.

Ernest Gohier, M.E.I.C., has been appointed director general of the Roads Department of the Province of Quebec. Upon graduation from McGill University in 1913, he became associated with the late F. C. Laberge of Montreal in civil engineering practice. Since 1914, he has been in private practice and he has acted as consulting engineer for the Montreal Metropolitan Commission, the Harbours of Quebec, Three Rivers and Chicoutimi and for several municipalities throughout the province of Quebec. He has also had extensive road construction experience and he is eminently qualified for the position to which he has recently been appointed. Mr. Gohier is the vice-chairman of the Montreal Branch of the Institute.

Lt.-Colonel Charles G. DuCane, O.B.E., M.E.I.C., of London, England, has recently been elected chairman of the Association of Consulting Engineers, in London, for the year 1939-40. Col. DuCane, who is well known in Canada, particularly in British Columbia where he was head of a successful consulting engineering organization, is now associated with the firm of Sir John Wolfe Barry and Partners, London. It will be remembered that he represented the Institute in 1931 at the Faraday Centenary Celebrations in London.

L. A. Thornton, M.E.I.C., has been elected to the Senate of the University of Saskatchewan, to represent jointly the Saskatchewan Association of Professional Engineers and the Saskatchewan Land Surveyors Association. Mr. Thornton, who is chairman of the Saskatchewan Power Commission since 1929, was recently made an honorary member of the Saskatchewan Land Surveyors Association.

Hector Cimon, M.E.I.C., is the new secretary of Price Brothers and Company Ltd., Quebec. Upon graduation from the Ecole Polytechnique in 1916, he joined the company of which he now becomes secretary. Mr. Cimon is an active member of the Institute, having been secretary-treasurer of the Quebec Branch from 1921 to 1924 and Councillor for the branch from 1930 to 1937.

J. Knox Davidson, A.M.E.I.C., has recently been promoted from the position of assistant manager and chief engineer of the Electric Reduction Company of Canada Limited, Buckingham, Que., to that of manager of an associated company, Albright and Wilson (Australia) Limited, in Melbourne, Australia. Since his arrival in Canada from Scotland in 1929, he has successively been connected with the Dominion Bridge Company, Lachine, Que., with the city of Brantford, Ont. in charge of the construction of a water filtration plant and, since 1932, with the Electric Reduction Company in Buckingham, Que. In Melbourne, Mr. Davidson will undertake the construction and subsequent management of a new chemical plant which will produce phosphorus compounds.

T. T. Irving, A.M.E.I.C., recently resigned the position of chief engineer of the Canadian National Railways, Central Region, Toronto. He has a record of forty years in railway engineering. A McGill graduate of 1898, he entered, at that time, the Grand Trunk system in Montreal as assistant to the resident engineer. He was closely associated with the work on the double-tracking of the Grand Trunk main line between Montreal, Toronto and Chicago. He was resident for four years and in 1902 was transferred to the Grand Trunk Western Division in a similar capacity. Since that time, he has been associated with practically every railway construction job of any importance, first as division and chief engineer in the Grand Trunk Western territory for two decades and, from 1924, in Toronto as chief engineer of the Central Region of the Canadian National Railways.

G. E. Blake Sinclair, A.M.E.I.C., of Ottawa, has recently been appointed by the Civil Service Commission to the position of inspector of National Parks and Historic Sites. Upon graduating in civil engineering from the University of Manitoba in 1922, he was appointed to the Geodetic Survey of Canada and engaged as a geodetic engineer in charge of survey parties from 1922 to 1936. He joined the National Parks Bureau in 1936 on general park and tourist administration work. His new position calls for inspection of existing and proposed National Parks and Historic Sites and administration and development of same.

Donald G. Ross, A.M.E.I.C., has been appointed chief engineer, maintenance of way, of the Newfoundland Railway in St. John's, Nfld. A graduate of Dalhousie University in 1922, he has been engaged in different construction projects. From 1925 to 1931, he was with the Fraser-Brace Engineering Company Limited on power developments on the Gatineau river, Que. In 1931, Mr. Ross was appointed assistant engineer with the Saint John Harbour Board, N.B., and when he recently resigned, he was resident engineer.

H. G. Conn, A.M.E.I.C., who is lecturer in mechanical engineering at Queen's University, is at present attending the summer session of the University of Michigan at Ann Arbor. He is working towards a Master's degree. Mr. Conn is the secretary-treasurer of the Kingston Branch of the Institute.

A. Trudel, Jr.E.I.C., has accepted a position with the International Foils Ltd., at Cap-de-la-Madeleine, Que. Upon graduating in mechanical engineering from McGill University in 1937, he entered the engineering department of the Canadian International Paper Company at Three Rivers.

Paul D. Normandeau, S.E.I.C., was among a group of sixteen young employees of the Canadian Car and Foundry Co. Ltd. who sailed on June 16th for England, where they will study aircraft production for a few months. Upon graduation from the Ecole Polytechnique in 1938, Mr. Normandeau was engaged as a sales engineer by the Armstrong Cork and Insulation Co. Ltd. in Montreal. Later in the same year, he joined the company with which he is now employed.

C. C. Cuthbertson, S.E.I.C., is employed as a chemist in the metallurgical laboratory of the Canadian Industries Ltd. in Toronto. After receiving the degree of B.Sc. in chemical engineering from Queen's University in 1938, he proceeded towards the degree of B.Sc. in chemistry, which he obtained this spring from the same institution.

Yves Décarie, S.E.I.C., is employed with the Sorel Steel Foundries Ltd., in Sorel, Que. Mr. Décarie, who was graduated this spring from the Ecole Polytechnique, has been very active during the last two years on the executive of the Junior Section of the Montreal Branch.

Obituaries

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

Job Ivan Boulian, A.M.E.I.C., lost his life by drowning, on July 16th in the lake of Two Mountains, Que. After visiting friends at Ste. Anne de Bellevue in the afternoon he went sailing, with his dog expecting to be back early. Upon his failure to return, a search party was organized and the following day, the boat was found ashore with the dog in it and the motor still running. It was only after four days of intense search that the body was discovered floating on the lake by two friends, C. N. Mitchell, A.M.E.I.C., and Mr. J. B. Craig.

Mr. Boulian was born at Mattawa, Ont., on August 9th, 1888. He received his engineering education at the Case School of Applied Science, Cleveland, and at McGill University, Montreal. During the war, he served as a lieutenant with the Eighth Reserve Battalion in England and with the Royal Canadian Engineers in Toronto. In 1919, he joined the Southern Canada Power Company Ltd. in Montreal and he occupied various positions as designer, field engineer and construction engineer. At the time of his tragic death, he was construction superintendent with the Power Corporation of Canada, Ltd.

Mr. Boulian joined the Institute as an Associate Member in 1927.

George Esplin Cross, A.M.E.I.C., died suddenly at his home in Westmount, Que., on June 12. He was born in Westmount in 1899 and received his early education at the Westmount High School. He obtained the degree of B.Sc. in mechanical engineering from McGill University in 1923. From that date up to 1926 he was employed with the George W. Reed Company in Montreal as an estimator. In 1926 he entered the structural department of the Dominion Bridge Company, Lachine, Que. He was appointed lecturer in mechanical drawing and geometry at the Montreal Technical School in 1931, a position from which he had just resigned at the time of his sudden death.

Mr. Cross joined the Institute in 1921 as a Student, being transferred to Junior in 1928. He was made an Associate Member in 1933.

George Edward Evans, A.M.E.I.C., died in Toronto on June 23rd. He was born in that city in 1860. He attended Upper Canada College, Toronto and Trinity College, Dublin, where he obtained the degree of LL.B. in 1881. He practised law until 1896 when he joined the Dominion Bridge Company as Toronto manager. He acted in that capacity for more than thirty years and at the time of his death he was still an adviser of the company.

Mr. Evans joined The Canadian Society of Civil Engineers in 1907 as an Associate Member.

Frederick Thomas Kaelin, M.E.I.C., died at his home in Montreal, Que., on July 27th. He was born at Schwyz, Switzerland, July 30th, 1874. After graduation from the Federal Technical University, Zurich, in 1899 he spent two years in the design of electrical machinery and one year in the operation of water power works in Europe after which he came to Canada in 1902 as draftsman for the Shawinigan Water and Power Company in Montreal. In 1905 he became designing engineer for Wallace C. Johnson, consulting engineer, at Niagara Falls, Ont. In 1907, he returned to the Shawinigan Water and Power Company as assistant chief engineer. In that capacity, he was responsible for the design of power houses and transmission lines. During three years, from 1915 to 1917, he was in charge of the design of electrical and mechanical equipment for the electro-chemical plant of a subsidiary company. In 1919 he became chief engineer of the Shawinigan Water and Power Company, a position which he held until 1930, at which time he became consulting engineer.

Mr. Kaelin's greatest achievement as an engineer was the invention of the electric boiler which bears his name and which plays a very important part in the generation of power, particularly for the pulp and paper industry.

Mr. Kaelin was admitted to the Canadian Society of Civil Engineers as a Student in 1904 and in the same year he was transferred to Associate Member. 1920 he became a Member of the Institute and in 1936 he was made a Life Member.

F. T. Kaelin, M.E.I.C.

Edward Thomson Wilkie, M.E.I.C., died on July 1st at his home in Toronto. He was born in 1858 in the Township of Ramsay, County of Lanark, Ont. He entered the service of the Canadian Pacific Railway in 1878 on location work and from that time up to 1889 he was actively connected with the railways development in the Prairie provinces. From 1889 to 1897, he was in private practice in partnership with the late Andrew Bell and then up to 1910 he practised for himself at Carleton Place. In 1910, he became chief engineer of the Toronto Suburban Railway. He was later employed in the electrical department of the Canadian National Railways in Toronto and stayed with this organization until his retirement some years ago. He was a former president of the Ontario Land Surveyors Association.

Mr. Wilkie was admitted as an Associate Member of The Canadian Society of Civil Engineers in 1904 and in 1916 he was transferred to Member. In 1934, he was made a Life Member of the Institute.

VISITORS TO HEADQUARTERS

Paul E. Cadrin, Jr.E.I.C., assistant division engineer for the Department of Highways of the Province of Quebec at Mont Joli, on June 24th.

Prof. George H. Herriott, M.E.I.C., Department of Civil Engineering, University of Manitoba, Winnipeg, on July 5th.

A. Larivière, M.E.I.C., Commissioner, Provincial Transportation and Communication Board, Quebec, on July 11th.

W. R. Manock, A.M.E.I.C., manager of the Horton Steel Works Ltd., Fort Erie North, Ont., and councillor of the Niagara Peninsula Branch, on July 11th.

C. W. Holman, A.M.E.I.C., teacher in the Technical and Commercial High School, Sault Ste. Marie, Ont.

A. G. W. Atwood, A.M.E.I.C., mechanical engineer of the Aluminum Company of Canada, Shawinigan Falls, Que., on July 13th.

Prof. Legget, A.M.E.I.C., assistant professor of Civil Engineering at the University of Toronto, on July 15th.

News of the Branches

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

LAKEHEAD BRANCH

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

The annual meeting of the branch was held at the Port Arthur Golf and Country Club, Port Arthur, June 29th.

Meeting opened at 6.30 p.m. The chairman welcomed members and their guests. Grace was said by G. H. Burbidge, M.E.I.C.

Minutes of the last annual meeting, financial statement, and reports by chairmen of the various committees were read and adopted.

Mr. Stevens, Principal of Upper Canada College, spoke briefly on **Education,** stressing the need for greater unity and co-operation between the different parts of Canada.

A slate of officers for the coming year was presented by the nominating committee. Moved by R. B. Chandler, M.E.I.C., and seconded by F. C. Graham, A.M.E.I.C., that the proposed slate of officers be accepted. Carried. The following were elected: Chairman, K. A. Dunphy, A.M.E.I.C.; Vice-Chairman, J. M. Fleming, M.E.I.C.; Executive, D. Boyd A.M.E.I.C., J. R. Mathieson, Jr.E.I.C., B. A. Culpeper, A.M.E.I.C., S. E. Flook, M.E.I.C., H. Olsson, A.M.E.I.C., Wm. H. Bird, A.M.E.I.C., E. A. Kelly, M.E.I.C., A. T. Hurter, M.E.I.C.; Ex-Officio, E. L. Goodall, A.M.E.I.C.;Secretary-Treasurer, H. Os, A.M.E.I.C.; Councillor, P. E. Doncaster, M.E.I.C.

The chairman, Mr. Goodall, gave a report of the past year's activities, and handed over the chairmanship to Mr. Dunphy.

Mr. Bird moved a vote of thanks to the outgoing executive, seconded by Mr. H. L. Davies.

Twenty-six members and guests were present.

LONDON BRANCH

D. S. Scrymgeour, A.M.E.I.C. - *Secretary-Treasurer*
Jno. R. Rostron, A.M.E.I.C. - *Branch News Editor*

At our May meeting a paper was given by Harry H. Angus, B.A.Sc., on the **New Mental Hospital** at St. Thomas, an account of which was published in the London Branch News of the June issue of the Journal.

As a sequel to this paper a visit of inspection arranged through the courtesy and kindness of Mr. McLachlin, engineer in charge of construction, was paid to this institution on Saturday, June 17th. About sixty members and guests availed themselves of this opportunity.

The tour was begun at the power house, with its heating plant, water supply and sewage tanks, etc. From there to the kitchens the party traversed the underground tunnel with its overhead system of service mains and pipes; particular attention being paid to the large insulated heating mains with their expansion joints. The kitchens, on ground level, with their up-to-date equipment were then inspected together with the refrigerating plant and stores, butcher's shop, etc. From there passage was taken through the large dining hall and cafeteria and on through the corridors serving the women's infirmary, to the southern limit. All the beds, furniture, etc., are up-to-date and substantial. The baths, toilets, etc., are all of the latest type and came in for special notice.

Part of the hospital is in occupation and this was not visited. The Nurses Home and staff residences on the west side of No. 4 Highway are still in construction. The grading of the grounds is also in progress.

The party returned to the power house and before breaking up, Mr. H. F. Bennett, M.E.I.C., chairman of the branch, expressed to Mr. McLachlin the thanks of the visitors for his kindness and their appreciation of his efforts in explaining all the various units.

SAGUENAY BRANCH

K. A. Booth, Jr.E.I.C. - *Secretary-Treasurer*

The 1939 annual meeting of the Saguenay Branch of The Engineering Institute of Canada was held at Arvida on June 9th, 1939.

The activities commenced with a visit through the plant of the Aluminum Company of Canada of which twenty-three members took advantage. About four o'clock twenty-five members made their way to the Saguenay Country Club where they participated in a round of golf. At 7.30 p.m. forty-five members and guests gathered at the Arvida Staff House for dinner and the annual meeting, with Adam Cunningham, A.M.E.I.C., vice-chairman, occupying the chair in the absence of M. G. Saunders, A.M.E.I.C., chairman. At the conclusion of the dinner, the chairman, in a very appropriate manner introduced the guest of honour for the evening, Dean H. W. McKiel, M.E.I.C., President of the Institute. The President in a very able manner discussed the engineering profession in general and engineering education in particular, on which point he was highly qualified to speak.

The chairman then called upon the secretary to read the minutes of the last meeting. Moved by A. W. Whitaker, Jr.E.I.C., seconded by A. G. Johnston, A.M.E.I.C., that the minutes be approved as read. Motion carried. This was followed by the reading of the annual report. Moved by J. Shanley, A.M.E.I.C., seconded by S. J. Fisher, M.E.I.C., that the report be adopted as read. Motion carried. A. C. Johnson, A.M.E.I.C., chairman of the nominating committee, who also acted as scrutineer, was requested to announce the results of the election of officers for the year 1939-40, and presented the following report: Chairman, Adam Cunningham, A.M.E.I.C.; Vice-Chairman, J. W. Ward, A.M.E.I.C., Executive Committee, Chas. Miller, A.M.E.I.C., W. P. C. Laboutillier, A.M.E.I.C.; Secretary-Treasurer, K. A. Booth, Jr.E.I.C.

G. F. Layne in a few well chosen words moved a vote of thanks to the retiring members of the executive committee, which was heartily approved by the members. In addition to the President, the guests for the evening included Mr. O. M. Montgomery and Mr. J. B. White of the Montreal office of the Aluminum Company of Canada Ltd.

VANCOUVER BRANCH

T. V. Berry, A.M.E.I.C. - *Secretary-Treasurer*

On the evening of May 17th, 1939, about sixty members of the Vancouver Branch and their friends visited the City of Vancouver Municipal Airport situated on Sea Island just south of the city.

Most of the members were in time to see the Trans-Canada Air Lines plane leave for Seattle, after which an inspection was made under the direction of Mr. William Templeton, Airport Manager, of the runways and administration building and equipment operated by the City of Vancouver. Later a Trans-Canada Lockheed 14 Transport, which was being prepared for a trans-continental flight, was viewed in its hangar. Many technical details relative to the machine were explained by Mr. J. Dalby, District Passenger Agent, and the technical staff of the Air Lines.

The Meteorological Building of the Department of Transport was next visited. Here the receipt of weather data by teletype and the plotting of these on weather maps was seen. The explanations by the staff of the many precautions taken in weather observation, the methods used and the accuracy of the results obtained, lead one to appreciate to what extent the science of meteorology has progressed in the last few years.

By courtesy of the Senior Officer of the Western Air Command, the members were permitted to visit the hangars of the Royal Canadian Air Force and catch a glimpse of their equipment. Escorted by an officer of the Air Force the visitors viewed new additions to the equipment of the Western Air Command and to hear first-hand the thrill of riding the wind in these modern thunderbolts.

CANADIAN ELECTRICAL ASSOCIATION CONVENTION

The forty-ninth annual convention of the Canadian Electrical Association was held June 21st to 24th at The Pines in Digby, N.S., with an attendance of 272 delegates. Good representation from the west as well as the east marked this successful convention.

The first technical paper presented was a discussion of **the National Research Council** high voltage testing and research laboratories presented by B. G. Ballard of the National Research Council, Ottawa. R. H. Mather presented a report of the C.E.A. Code Committee, describing the work of the committee which merited the wholehearted support of the delegates. In the evening of this same day J. S. Keenan and H. H. Rimmer of the Canadian General Electric Company Ltd. in their paper, **Our Common Objective,** pointed out the need of the whole industry for ntensified selling of the electrical idea.

On the second and third days of the convention, business sessions were held in the mornings at which committee reports were read and discussed. Chas. F. Wagner of the Westinghouse Electric and Manufacturing Company presented a demonstration paper which proved most interesting.

The following officers were elected for the 1939-40 term: President: J. E. Lawson; Vice-Presidents: G. A. Gaherty, M.E.I.C., McNeely DuBose, M.E.I.C., and W. C. Mainwaring; Executive Committee: George Kirlin, R. A. C. Henry, M.E.I.C., W. H. Munro, M.E.I.C., G. W. Lawrence, T. Alan Brown, A.M.E.I.C., A. L. Brown, J. H. Fregeau, A.M.E.I.C., A. C. Britain, J. B. Hayes, A.M.E.I.C.

COMING MEETINGS

Canadian Good Roads Association—Twenty-fifth Annual Convention, September 12-14, at Chateau Frontenac, Quebec City. Secretary-Treasurer, George A. McNamee, New Birks Building, Montreal, Que.

Canadian Institute on Economics and Politics—Eighth Annual Session, August 14-26, Geneva Park, Lake Couchiching, Ont.

Canadian Institute of Mining and Metallurgy—Twenty-first Annual Western Meeting, August 30th to September 1st, at the Hotel Palliser, Calgary, Alta.

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 Canadian Institute of Surveying:
Proceedings of thirty-second annual meeting, Ottawa, February 1st and 2nd, 1939.

Corporation of Professional Engineers of Quebec:
List of members, June, 1939.

The Institution of Mechanical Engineers:
List of members, March, 1939.

REPORTS, Etc.

The Institution of Mechanical Engineers:
The combustion gas turbine: its history, development, and prospects by Adolf Meyer.

Ohio State University Studies Engineering Series:
Physical properties of commercial dinnerware by J. H. Koenig (Engineering Experiment Station Bulletin No. 101).

Ontario Department of Mines:
Forty-seventh annual report. Toronto, 1939.

Purdue University:
The Purdue University experimental Television System, C. F. Harding, R. H. George, and H. J. Heim (Engineering Experiment Station Research Series No. 65).

Quebec Department of Municipal Affairs, Trade and Commerce:
Statistical year book, 1938.

U.S. Bureau of Mines: Methods of analyzing coal and coke; Analyses of Pennsylvania bituminous coals; Carbonizing properties and petrographic composition of washed and unwashed Lower and Upper Kittanning bed coals from Mines 72 and 73, Johnstown, Cambria County, Pa. (Technical Papers 8,590,595).

U.S. Geological Survey: Nickel content of an Alaskan basic rock; Geophysical abstracts 94 July-September 1938 (Bulletins 897-D, 909-C). A Monograph of the foraminiferal family nonionidae; Notes on fossils from the eocene of the Gulf province; Some linguloid shells from the late Devonian and early carboniferous rocks of Pennsylvania and Ohio. (Professional Papers 191, 193-B, 193-C). Floods in the Canadian and Pecos river basins of New Mexico May and June, 1937; Major Texas floods of 1935; Surface water supply of the United States 1937, Part 3, Ohio river basin (Water-Supply Papers 796-G, 823, 842).

University of Minnesota: An Investigation of motor gasolines by B. J. Robertson (Engineering Experiment Station Bulletin No. 13).

TECHNICAL BOOKS, ETC.

International Congress for Applied Mechanics, 5th, Sept. 12-16, 1938, held at Harvard University and the Massachusetts Institute of Technology. Proceedings edited by J. P. Den Hartog and H. Peters.
New York, John Wiley & Sons; London, Chapman & Hall, 1939. 748 pp., illus., diagrs., charts, tables, 11 x 9 in., cloth, $6.00.

Despite the lack of a subject index, this collection of articles by authorities on applied mechanics is a valuable contribution. The articles are roughly classified. The first large group, on elasticity and the properties of materials, is preceded by three general lectures on the mechanics of solids; the second large group, on mechanics of fluids, is preceded by three general lectures on fluid mechanics; and the third group contains papers on dynamics. The range of specific subjects is wide.

The Engineer and the Chemist, Their Careers and Their Education:
New York, The Polytechnic Institute. 48 pp., illus., 9 by 6 in., paper.

Engineering Terminology, Definitions of Technical Words and Phrases
By V. J. Brown and D. G. Runner. 2nd ed. Chicago, Gillette Pub. Co., 1939. 439 pp., illus., 9¼ by 6¼ in., cloth, $4.00.

This book defines the accepted meaning of a word or phrase as used in a particular branch of engineering. Fields covered include highways, streets, air conditioning, aggregates, steel marine, engineering economics, railways, et al. Several appendices include map standard symbols, Spanish-English terms, English-Spanish terms, English-German terms, standard conversion units, etc. The book is unique and helps fill a need of all engineers and those in the business and professional world who must deal with engineers.

Formulas for Stress and Strain
By R. J. Roark. New York, McGraw-Hill, 1938. 326 pp., figs., 9½ by 6 in., cloth, $3.00.

Nickel, Past and Present
By R. C. Stanley. Toronto, International Nickel Co., 1934. 74 pp., front, tab., charts, 9¼ by 6¾ in., paper.

Oil Shales of Canada
By A. A. Swinnerton. Reprinted from "Oil Shale and Cannel Coal," 1938, pub. by The Institute of Petroleum, 210-226 pp. illus. pamphlet.

Public Works Engineers' Yearbook 1939
Chicago, American Public Works Association, 1939.

A review and appraisal of the significant developments of 1938 in the public works field dominates the current number of this annual. Part one reviews the major events in public works and public works engineering, including streets and roads, sewage treatment, water works practice, street cleaning, refuse collection and disposal, traffic safety, street lighting, flood control irrigation and drainage, and field engineering. Part two is entitled Current Problems in Public Works and reports the discussions which took place at the Public Works Congress held at New York Oct. 3rd to 5th, 1938.

The Pulp and Paper Manual of Canada, 1939
Gardenvale, Que., National Business Publications Ltd., 1939.

This publication outlines the equipment required in the various woodlands and manufacturing departments combined with a consolidated catalogue of equipment and supplies available to the pulp and paper industry of Canada and Newfoundland with an extensive classified index of equipment and supplies.

U.S. Works.

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, of may be sent direct to the publishers.

AIR-CONDITIONING ENGINEERS' ATLAS

By C. Strock and C. H. B. Hotchkiss. New York, Industrial Press, 1939. 72 pp., maps, tables, 12 x 9 in., cloth, $2.00.

This publication presents, in condensed and readily usable form, the weather data needed by engineers in solving problems of heating and cooling. Eighteen maps of the United States, colored in zones, show the various phases of summer and winter weather which are of concern in the heating industry. Accompanying these maps are supplementary tables giving the data for the larger cities.

(THE) BIRTH AND DEVELOPMENT OF THE GEOLOGICAL SCIENCES

By F. D. Adams, Baltimore, Md., Williams & Wilkins Co., 1938. 506 pp., illus., diagrs., tables, 10 x 7 in., cloth, $5.00.

Dr. Adams traces the history of the geological sciences from the earliest period in which we have any written records in Europe, that of the early Greeks, down to about the year 1825, when historical geology became established. Where the subject requires it, its later history is sketched briefly. The book is based on wide and careful study of the original sources, is unusually well-written and interesting, and is attractively illustrated. It will be welcomed by geologists.

DIESEL HAND BOOK

By J. Rosbloom. 6 ed. Jersey City, Diesel Engineering Institute, 1939. 720 pp., illus., diagrs., charts, tables, 7 x 5 in., lea., $5.00.

In this practical manual for operators, fundamentals are presented in simple language. Engine details and auxiliaries and their action are described. The principal American types of engines are presented and practical advice is given on operation, adjustment and maintenance. The last section contains questions and answers for license examinations for both marine and land service.

ELASTICITY, Pt. 3. Structure, Strength and Chemical Action

By C. A. P. Turner, 22 East Gay St., Columbus, Ohio, 1939. 240 pp., manifold, diagrs., charts, tables, 12 x 9 in., lea., $5.00.

A science of thermo-elasticity is developed which explains the formation of the elements from aether, heat vibration, gravity and electrical energy, the mechanics of chemical combination, and co-ordinates the properties of materials of construction. In the first part thirty-three propositions are stated and developed, laying the groundwork for the following section which elaborates the subject of chemical combination, culminating in the development of the heats of formation of all classes of chemical compounds.

ELECTRICAL ENGINEERING EXPERIMENTS, Theory and Practice

By H. R. Reed and G. F. Corcoran. New York, John Wiley & Sons, 1939. 500 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $4.50.

This textbook is designed as an aid to instruction in electrical engineering laboratories. The text is divided into an introduction and seven sections: fundamentals; direct-current machines; alternating-current circuits, transformers; synchronous machines; induction machines; and electronics. For each experiment pertinent theory is given, laboratory exercises are enumerated, and results which might be obtained from the experimentally determined data are indicated.

ELECTRON OPTICS, Theoretical and Practical

By L. M. Myers, New York, D. Van Nostrand Co., 1939. 618 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $12.00.

Recent improvements in vacuum technique have brought to a practical point certain applications of electron behaviour, the relation of which to the science of geometric optics is discussed in this book. Following a chapter on analogies between light and electrons come chapters covering the electron trajectory, electron lenses and aberrations, the electron multiplier, vacuum technique, the electron microscope, and further applications. This volume is stated to be the first in English on this branch of vacuum physics.

ENGINEERING DRAWING

By H. H. Winstanley. London, Edward Arnold & Co.; New York, Longmans, Green & Co., 1939. 128 pp., diagrs., 11 x 9 in., cloth, $1.60.

This book is intended as a guide to the principles and applications of orthographic projection. The text material has been curtailed in order to present a maximum of drawing matter, and the exercises for each group of details are arranged in order of complexity. Many of the drawings have been made from working drawings supplied by various British manufacturers in order to demonstrate actual practice.

ENGINEERING OPPORTUNITIES

Ed. by R. W. Clyne; foreword by K. T. Compton. New York and London, D. Appleton-Century Co., 1939. 397 pp., illus., diagrs., 8 x 6 in., cloth, $3.00.

Twenty-six engineering opportunities are described in this non-technical survey of engineering activities in industry. The authors of the various chapters are experts in their individual fields, and in each case show the background of the industry, the present condition of affairs, and the possibilities for the future. A wide range of fields is covered for the assistance of those contemplating engineering as a career.

Introduction to CONTEMPORARY PHYSICS

By K. K. Darrow. 2 ed. New York, D. Van Nostrand Co., 1939. 648 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $7.00.

The principal advances of recent years in atomic and nuclear physics are described in this treatise and explained with the greatest fullness consistent with mathematics not more difficult than the elements of wave-mechanics. Topics discussed include the properties of elementary particles, the correlation of corpuscles and waves, the diffraction of electrons and X-rays by crystals, the phenomena of ionization and excitation, the interpretation of spectra, wave mechanics, and the art and science of transmutation. The new edition is much expanded.

MACHINE DESIGN

By S. E. Winston. Chicago, American Technical Society, 1939. 333 pp., illus., diagrs., tables, 9 x 6 in., cloth, $3.00.

The material selected for inclusion in this elementary textbook is that which the author considers most fundamental to the field of machine design in general. Theory, analysis, and factual information are given concerning bolts and screws, cylinders, riveted joints, shafting and keys, couplings, clutches, belts and pulleys, friction drives, gears, etc., There are many practical examples with detailed solutions.

PRESSURE GAUGES, Indicators, Thermometers, Pyrometers

By J. Smith. London, Constable & Co., 1939. 144 pp., charts, diagrs., tables, 7 x 5 in., paper, 2s.

This little manual gives a concise, clear account of the theory, construction and use of the ordinary instruments for measuring pressure and temperature, together with some data upon possible sources of error. Barometers, pressure gauges, steam and internal-combustion engine indicators, liquid-level indicators, thermometers and pyrometers are discussed.

PIPING HANDBOOK

By J. H. Walker and S. Crocker. 3 ed. New York and London, McGraw-Hill Book Co., 1939. 897 pp., illus., diagrs., charts, tables, 7 x 5 in., cloth, $6.00.

For the engineer interested in piping design this handbook provides authoritative and accessible data on all phases of the problem. In the revised edition important changes and additions have been made in the chapters on the metallurgy of piping materials, pipe, valves and fittings, heat insulation, steam power-plant piping, and oil piping. Abstracts and references embrace standards and codes of various technical organizations.

PRINCIPLES OF FLOTATION

By I. W. Wark, Melbourne, Australia, Australasian Institute of Mining and Metallurgy, publ. by Tait Publishing Co., Melbourne, 1938. 346 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, 21s.

The larger part of the information presented is the result of research work in Australia under the direction of the author, but important material from other sources has been incorporated into the monograph in order to increase its general value. Topics covered include physical principles, experimental methods, classification of reagents, activation, depressants, frothing, the treatment of sulphide and non-sulphide minerals, the influence of colloids, and the electrical properties of surfaces in relation to flotation. There is a large bibliography.

PRINCIPLES AND PRACTICE OF RADIO SERVICING

By H. J. Hicks. New York and London, McGraw-Hill Book Co., 1939. 305 pp., diagrs., charts, tables, 9 x 6 in., cloth, $3.00.

This practical book for those interested or working in the field is written with a minimum of mathematics. It shows how to install, test and repair radio receivers, giving not only step-by-step instructions in all the servicing procedures, but also a plain treatment of the necessary fundamental theory of electricity and radio.

PROBLEMS IN MECHANICS

By G. B. Karelitz, J. Ormondroyd and J. M. Garrelts. New York, Macmillan Co., 1939. 271 pp., diagrs., charts, tables, 9 x 6 in., cloth, $2.50.

The practical problems collected in this volume cover statics, kinematics and dynamics in a systematic arrangement, and are of a wide range of difficulty. They are preceded by a concise outline of the theorems which are used in their solution. Answers to nearly all problems are given.

REPORT OF THE ROYAL COMMISSION ON TRANSPORTATION, Province of Ontario, 1938

Toronto, Ontario, T. E. Bowman, 1939. 293 pp., charts, tables, 10 x 6 in., paper, $1.00.

This report deals at some length with the history and finances of highway development in the province of Ontario and contains careful estimates of the cost of roads to municipalities. Licensing and taxation are discussed with recommendations for the revision of the automobile tax structure. In addition, a thorough study is made of the economics of transporting goods and passengers over the highways.

INSTRUMENTS FOR TESTING CEMENT, SOILS AND PETROLEUM

"Instruments for Testing Cement, Soils, and Petroleum and Its Products" is the title of a new 164-page catalogue just published by the American Instrument Co., Silver Spring, Maryland. The Cement section includes instruments for testing portland cement, concrete, mortar, aggregates, lime, gypsum, etc. The Soils section deals with the testing of the mechanical stability of soils and includes the latest developments in instruments used by civil engineers, and subgrade and road materials testing laboratories. The Petroleum section is devoted to the testing of crude and refined petroleum, greases, compounds, gasoline, naphtha, kerosene, bitumen, asphalt, pitch, tar, paraffin wax, creosote, etc.

MECHANICAL POWER TRANSMISSION AND MATERIAL HANDLING APPLIANCES

Sixty-seven years of progress and development are reflected in the valuable 296-page "Data Book," recently published by The Plessisville Foundry, Plessisville, Que. The company was founded in 1873 and its remarkable growth, particularly during the past ten years, is well illustrated by the wide variety of products described in this book. While it is primarily intended to provide data relative to mechanical power transmission and material handling equipment, the book contains information covering other products of the company such as road building equipment, sawmill machinery, grain elevator equipment, etc. In addition, the book provides twenty-seven pages of useful engineering data. It is handsomely bound, well-illustrated with photographs and dimensional drawings of equipment, and efficiently indexed for convenient reference.

CARRYALLS

Two 8-page booklets just released by R. G. LeTourneau, Inc., of Peoria, Ill., one covering large capacity Carryalls, the other small capacity, describe by word and picture how 3- to 30-yard Carryalls handle a job from start to finish with controlled results in any kind of weather. Copies may be obtained from R. G. LeTourneau, Inc., and all Caterpillar dealers.

LEDLOY

A 4-page bulletin issued by Algoma Steel Corp. Ltd., Sault Ste. Marie, Ont., announces the production by this company of "Algoma Ledloy," a new lead-bearing, open hearth, free-cutting steel. This new steel is made in a wide range of analyses and in every analysis machinability is greatly improved and tool life is increased, while every desirable quality of the Open Hearth Steel is preserved.

TILE FLOORING

Building Products Ltd., Montreal, have issued two illustrated 8-page bulletins dealing with their tile flooring. The first is entitled "B.P. Flexible Tile Flooring" and contains general description of the product, recommended uses, specifications for installation and illustrations of the tile in colour. The second is entitled "B.P. Tile Flooring, Heavy Duty," and contains similar information.

FLANGE AND TAKE-UP UNITS

In an 8-page illustrated pamphlet designated "Catalogue 739," Stephens-Adamson Mfg. Co. of Canada Ltd., Belleville, Ont., describes their new flange and take-up bearing units which have been added to their "Sealmaster" bearing line. The Catalogue contains illustrations and dimensional drawings and tables.

FINE GRINDING AND PULVERIZING MILL

The "Mosley" air-swept attrition type mill for fine grinding and pulverizing dry materials is described in a 12-page booklet issued by Stephens-Adamson Mfg. Co. of Canada Ltd., Belleville, Ont. The booklet contains specifications and a description of the features of the mill and is well-illustrated by drawings and photographs. Copies may be obtained from the company upon request.

"S-A" BOILERS

The Foster Wheeler "S-A" Boiler is illustrated and described in a 4-page pamphlet issued by Foster Wheeler Ltd., St. Catharines, Ont. The pamphlet contains several illustrative photographs and sectional drawings and may be obtained from any of the company's offices by referring to Bulletin "SAC-139."

A contract for three of the type "S-A" steam generating unit has been awarded to the company by British-American Oil Company Ltd.—one for the Montreal refinery and two for the Toronto refinery of the oil company.

NEW COKE AND BLAST FURNACE PLANT

The new 130-oven by-product coke plant and the 1,000-ton blast furnace of the Great Lakes Steel Corp., on Zug Island, near Detroit, Mich., is described and illustrated in an attractive bulletin recently issued by the company.

DEAERATORS AND DEAERATING HEATERS

The Worthington Deaerating Heater and Deaerator are described and illustrated in a 6-page folder, Bulletin W-210-B24, issued by the Worthington Pump & Machinery Corp., Harrison, N.J. The company has also issued a 6-page bulletin, No. H-1200-B25, entitled "Worthington Heavy Duty Drifters" which illustrates and describes the various features of this equipment.

LIGHTNING PROTECTION DEVICES

"Lightning Protection at Lightning Speed with O-B Control Gaps" is the title of the eight-page bulletin No. 680-HK issued by Canadian Ohio Brass Company, Ltd., Niagara Falls, Ont. This bulletin discusses the problem of protecting power stations from lightning; tells what objectives were sought in the design of O-B control gaps; explains how these devices work; points out where they can be installed to the best advantage and gives complete catalogue information with a number of illustrations.

AUTOMATIC FLUE GAS ANALYZER

In line with the modern trend in the design of industrial products toward streamlining and the use of plastic material, The Hays Corporation of Michigan City announces a new "Orsatomat" or Automatic Flue Gas Analyzer.

The greatest change is in the tilting analyzing unit which is now composed of a transparent plastic instead of hard rubber as formerly. The new unit is smaller, lighter in weight and more compact. It is housed in a newly designed streamlined, pressed steel case along with a draft measuring and indicating unit. Both analyzing and indicating units are removable. If desired a flue gas thermometer may also be had to fit inside the case.

SYLVA-CRAFT WALLBOARD

A six-page pamphlet has been issued by British Columbia Plywoods Limited, Vancouver, B.C., describing their "Sylva-Craft" wallboard. The folder contains technical details and dimensions with illustrations.

HAULAGE UNIT

The Linn Manufacturing Corporation, Morris, N.Y., has announced a new type of haulage unit, known as the Model C-5, which can be instantly converted from track to wheel operation, or vice versa, merely by throwing a control lever mounted at the driver's position. Developed to fit the growing need for a vehicle of greater flexibility and broader utility, the C-5 is said to be ideally suited for road building and maintenance—all haulage problems of townships, counties and cities, including snow plowing—oil field haulage—coal mining—logging, and other industrial haulage needs. A descriptive four-page bulletin may be obtained from Mussens Limited, Montreal.

CONDUCTOR RANGE INCREASED ON SMALL STRAIN CLAMP

To permit a wider application of its smallest size Hi-Lite strain clamp, the Canadian Ohio Brass Company, Ltd., Niagara Falls, Ont., has redesigned the clamp to increase the range of conductors accommodated. With the new design, this clamp, without liners, will take 0.20 to 0.55-inch conductors. This range includes copper conductors from No. 4 solid to 4/0 stranded. The clamp with liners will take conductors from No. 4 A.C.S.R. to 2/0 A.C.S.R.

The redesigned clamp is equipped with three U-bolts and the active clamping section is approximately 7⅜ inches long, providing greater holding power and easier carriage of the cable. The radius of curvature at the entrance to the clamp is 3¾ inches, resulting in less stress in the cable at the critical section and less likelihood of damage as a result of vibration. The small Hi-Lite is furnished with a loop at the mouth of the clamp to which tackle used in pulling a conductor to final sag may be attached. This feature permits installation of the calmp in its working position It also eliminates the necessity of measuring insulators and cable and then making allowances for take-up of slack, both of which are a nuisance when stringing wire.

STEAM PUMPS

Darling Brothers have just issued a useful and attractive bulletin on Darling Steam Pumps, both vertical and horizontal. The bulletin is fully illustrated and contains, in addition to the usual specifications, tables of capacities for many of the most commonly used Darling pumps. Another excellent feature is the Pump Part lists with sectional diagrams for easy identification. The bulletin—No. 44B—may be obtained from Darling Brothers Ltd., 140 Prince St., Montreal, or any of their numerous branch offices.

AIRCRAFT INSTRUMENTS

With the recent addition of a gasoline-tank gauge, temperature gauge, pressure gauge, and a chronometric tachometer, Canadian General Electric Co. Ltd. is now in position to offer a complete line of aircraft instruments for indicating engine condition as well as the position of landing gear and flaps. All of these instruments make use of the d-c Selsyn (self-synchronous motor) particularly developed by Canadian General Electric for remote indication on aircraft.

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

During the last month we have had several requests for young civil engineers for temporary positions of from two to six months duration, some of which we were unable to fill. These vacancies were in the vicinity of Montreal, and we expect that there will be others.

There is also a scarcity of draughtsmen on reinforced concrete and structural steel.

If you are interested please register.

ELECTRICAL GRADUATE for a permanent position in a large manufacturing firm. Some experience preferred. Will not be entirely on electrical work but also on other engineering work. Apply, giving full particulars, to Box No. 1925-V.

MUNICIPAL ENGINEER, conversant with road construction, paving, construction and maintenance of sewers and water services, for a town in Ontario. Salary from $2,400 to $3,000 per year according to experience and qualifications. Send applications with full particulars to Box No. 1932-V.

CIVIL SERVICE VACANCY

Comp. No. 29176. Junior engineer for Jasper National Park, Department of Mines and Resources, Canada, at a salary of $1,800. **Duties:** To supervise engineering and maintenance work, such as roads and bridges; to make surveys and computations in connection with the work; and to perform other related work as required. **Qualifications:** Graduation in engineering from a University of recognized standing; at least one year of post-graduate experience in engineering work; junior membership in The Engineering Institute of Canada, or qualifications which would permit of such membership; good judgment; ability to deal with men; good physical condition. Examination: Oral. Candidates must give full particulars regarding their technical training and experience, especially as they bear on the qualifications for and duties of this class of position.

Application forms properly filled in must be filed with the Civil Service Commission, Ottawa, Ont., not later than August 22nd, 1939. Forms may be obtained at Headquarters.

NATIONAL RESEARCH COUNCIL VACANCY

The National Research Council announces a vacancy for a Senior Research Assistant in the Division of Chemistry at a salary range from $1,680 to $2,040. The initial appointment will be for a period of one year, subject to the requirements of the Council and to satisfactory service being rendered, following which it may be extended. **Duties:** To investigate under direction, problems concerned with the manufacture and testing of plastics, synthetic resins and materials related thereto; to assist in the design of test and control equipment; to perform other duties as required. **Qualifications:** The degree of Bachelor of Science, preferably in Chemical Engineering, or its equivalent, from a university of recognized standing, with some training in strength of materials, design and draughting; knowledge of and experience with simple machine shop practice, and at least 12 months' experience in the plastics or in some closely allied industry; **or** the educational qualifications as specified above with enough post-graduate research training to attain the degree of Master of Science or its equivalent. Preference will be given for post-graduate training most closely related to the work to be undertaken. **Applications** should be addressed to the Director, Division of Chemistry, National Research Council, Ottawa, and should reach him not later than the 31st of August, 1939. Applicants are requested to indicate any special qualifications which they may possess for work of the nature indicated. Application forms may be obtained from the Secretary-Treasurer, National Research Council, Ottawa. Should this for any reason prove inexpedient, applicants should submit a tabulated statement containing the following information: Name in full, date and place of birth, citizenship, period of residence in Canada, academic degrees and honours, positions held and other relevant items of training and experience, papers published with copies if available, languages read or spoken, married or single, height, weight and physical fitness, a recent photograph, date services available, names and addresses of three persons to whom reference can be made.

SITUATIONS WANTED

DESIGNING ENGINEER, M.Sc. (McGill), D.L.S., A.M.E.I.C., P.E.Q. Experience in the design and construction of water power plants, transmission lines, field investigations of storage, hydraulic calculations and reports. Also paper mill construction, railways, highways, and in design and construction of bridges and buildings. Available at once. Apply to Box No. 729-W.

ELECTRICAL ENGINEER, B.Sc., Jr.E.I.C. Eight months on installation of power and lighting equipment; three years as manager of sales and service dept. of an electrical firm; seven months as tester on power and radio equipment, one and a half years as inspector on electrical and power equipment. Interested in inspection or sales engineering. Available on short notice. Location immaterial. Apply to Box No. 740-W.

CIVIL ENGINEER, B.Sc., A.M.E.I.C., R.P.E. Age 48. Twenty-five years construction experience on railways, highways, bridges, dams, flumes, pipe lines and buildings. Expert on earthworks and transportation. Location immaterial. Apply to Box No. 841-W.

MECHANICAL ENGINEER, Jr.E.I.C., technical graduate, bilingual, age 36, married. Experience includes five years with firm of consulting engineers, design of steam boiler plants, heating, ventilating and air conditioning. Seven years with large company on sales and design of heating systems, air conditioning, steam specialties, etc. Available on short notice. Apply to Box No. 850-W.

CHEMICAL ENGINEER, McGill '34. Pulp and paper mill experience, production control, meter maintenance, and tests. Apply to Box No. 1222-W.

MECHANICAL ENGINEER, B.Sc., in mechanical engineering with six years experience in pulp and paper mill engineering and maintenance. Wishes employment in maintenance department as assistant to master mechanic or similar work. Can furnish references. Married. Available on short notice. Apply to Box No. 1694-W.

REFINERY ENGINEER, B.Sc. (E.E.), Man. '37. Experienced in supervising operations and maintenance of small refinery. 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. '31, A.M.E.I.C. Experience includes one year hydrographic surveying, two years municipal work, five years highway work. Familiar with all types of pavement, concrete design, bridge construction, sewer design and water layout, road construction. Available on short notice. Apply to Box No. 1815-W.

CIVIL ENGINEER, B.E., Jr.E.I.C., 28 years of age. Married. Desires position with reliable construction firm. Intends to make construction life work. Over five years experience on permanent highway construction, inspection, estimates and instrument work. Available on short notice. Apply to Box No. 1820-W.

TRAINING AS SALES ENGINEER desired by civil engineer, B.E., Jr.E.I.C. Single. Age 27. Has taken extensive additional study in education, particularly in psychology and personality. Experience consists of surveying, detailing, designing, and principal of a high school. Desires permanent position. Available on short notice. Apply to Box No. 1843-W.

SALES ENGINEER REPRESENTATIVE, B.A.Sc., C.E. Age 30. Contact in Northern Quebec mine belt. Interested in selling any kind of materials. Experience in heating and air conditioning. Speaks both English and French. Available at once. Apply to Box No. 1859-W.

CIVIL ENGINEER, B.Sc., S.E.I.C. Married. Six months surveying; mill site; water supply, power line location, earthwork, drainage, topographic. Have 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.

CHEMICAL ENGINEER, graduating Toronto '39. S.E.I.C. One and a half years general ore dressing laboratory work. One and a half years' general milling and assaying. Seeking a permanent position in chemical industry. Apply to Box No. 1867-W.

TECHNICALLY TRAINED EXECUTIVE, general experience covers organization and management in business and industrial fields; including sales, purchasing, productions, accounting and costing, also industrial surveys, reorganizations and amalgamations in the United States and Canada. B.Sc. degree in mechanical engineering. Married. Canadian. Apply to Box No. 1871-W.

MANUFACTURING EXECUTIVE, B.Sc. in mechanical engineering. Married. Canadian. Experienced in munitions manufacturing and other precision work. Apply to Box No. 1872-W.

SALES ENGINEER. Several years experience selling to industrial, mining and railroad organizations in Ontario and Quebec. B.Sc. in mech. engrg. Married. Canadian. Apply to Box No. 1873-W.

INDUSTRIAL DESIGNER seeks position, part-time employment or commissions. University graduate, A.M.E.I.C., long architectural designing experience. Apply to Box No. 1878-W.

CIVIL ENGINEER, S.E.I.C., McGill, '39. Age 22. Consistently high scholastic standing. Ready to adapt himself to any kind of work promising future advancement. Experience includes maintenance work in an industrial plant, surface exploration for minerals in northern Quebec, surveying, mapping, and selling. Excellent references. Present residence, Montreal. Available June, 1939. Apply to Box No. 1881-W.

CIVIL ENGINEER, B.Sc. Age 27. Married. Four years experience in highway work, including instrument work on preliminary surveys and construction, estimating and inspection. Prefers position with construction firm. Available at once. Apply to Box No. 1883-W.

CIVIL AND STRUCTURAL ENGINEER, B.A.Sc. (Toronto), A.M.E.I.C. Three years experience in plant engineering work entailing mechanical and structural design and supervision. Also two years on construction work. Desires permanent position with industrial firm or consulting engineer. Apply to Box No. 1893-W

CIVIL ENGINEER, A.M.E.I.C. Married. Ten years experience on railway location and construction. Twenty years on hydro-electric power and mill construction in executive capacity in charge of preliminary investigation, engineering, estimating, costs and purchasing. At present unengaged owing to the firm associated with discontinuing operations. Available at once. Apply to Box No. 1896-W.

MECHANICAL ENGINEER, B.E. (Sask. '38), S.E.I.C. Age 25. Single. Year's experience with large steel plant, general piping, fuel oil lines and storage tanks, surveying, draughting, furnace construction and operation, adjustment of automatic control equipment, testing. Considerable electrical knowledge. At present employed but available on short notice. Desires specialized position but will consider others. Apply to Box No. 1907-W.

CIVIL ENGINEER, B.A.Sc. (Toronto '09). M.E.I.C., R.P.E. Ont. and B.C. Age 50. Presently employed. Over thirty years experience: design, estimate and erection of structural steel, heavy timber and monolithic concrete; large scale surveys, maps, contours, railway and highway location, farm drainage. Apply to Box No. 1910-W

ELECTRICAL ENGINEER, B.Eng. (McGill '37). Age 24. Eighteen months experience in test department of big English electrical manufacturing firm. Returning to Canada in June. Would prefer design, sales, or practical work. Apply to Box No. 1911-W.

CIVIL ENGINEER, A.M.E.I.C., R.P.E. Age 48. Married. Fifteen years city engineer, fourteen years experience on design, construction, maintenance, road location, railways, underground, also experience in hardware, plumbing, heating, air conditioning. Desires steady position. Available on short notice. Apply to Box No. 1923-W.

ELECTRICAL ENGINEER, B.A.Sc. (Toronto '35). Age 27. Jr.E.I.C. Graduate of business college. Technical experience in aeronautics, comfort air cooling, refrigeration and communication equipment. Office experience, including shorthand, typewriting and correspondence compilation. Apply to Nox No. 1926-W.

CIVIL ENGINEER, B.Sc. in C.E. '39, S.E.I.C. Age 20. Three summers experience in land survey. Will undertake any work of an engineering nature. Location immaterial. Further details on request. Apply to Box No. 1943.-W

CIVIL ENGINEER, B.Sc., S.E.I.C. Age 31. Canadian. Interested in sale and production work. Speaks Polish, Slovak, Ukrainian. Apply to Box No. 1955-W.

ELECTRICAL ENGINEER, B.A.Sc. (Toronto '35), Jr.E.I.C. Married. Age 26. Experience—21 months with small company on factory service, and installation work of farm and commercial refrigeration equipment. Thirteen months on maintenance of construction tools and instruments, erection and service work on electric furnaces, office work on apparatus orders. Sixteen months of testing of various electrical equipment, and four months to date on transformer engineering, all with a large Canadian electrical manufacturer. Available on short notice. Technical work preferred. Apply to Box No. 1958-W.

ELECTRICAL ENGINEER, B.E. (N.S.T.C. '35). Age 25. Single. Three summers as paving inspector. One year selling, servicing and installing theatre sound equipment. Willing to go anywhere on short notice. Apply to Box No. 1959-W.

ELECTRICAL ENGINEER, B.Sc. (E.E.) Man. '37. Age 26. Two years experience with large manufacturing firm one year in factory work testing and inspecting, transformers, industrial control gear, fractional motors and large A.C. and D.C. rotating machinery. Three months in engineering dept. of wire and cable factory. Nine months in training course covering factory organization and production methods. References. Location immaterial. Available on short notice. Apply to Box No. 1961-W.

CIVIL ENGINEER. Experience in large scale factory production in an airplane or other plant, with a view to learning the business, desired by young man, single, age 25, S.E.I.C., having a B.Sc. degree with distinction in engineering, and advanced training in economics and business. Past work includes highway design, draughting, four years as advertising solicitor, and at present engaged in design and related work in the steel industry. Available on two weeks notice. Apply to Box No. 1962-W.

PRELIMINARY NOTICE

of Application for Admission and for Transfer

July 27th, 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 September, 1939.

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

BOUTILIER—ANDREW PRINGLE, of 226 Whitney Ave., Sydney, N.S. Born at Sydney, March 7th, 1909; Educ.: B. Eng. (Mech.), N.S. Tech. Coll., 1938; with the Dominion Steel & Coal Corporation, as follows: 1926-27 (6 mos.), in the steel mills as labourer, checker, leverman, 1927-30, roll-turning ap'tice; 1935-36, machinist helper; 1937 (4 mos.), sketching and dfting., coke ovens dept.; 1938 (4 mos.), fitter on constrn. of light oil recovery plant at coke ovens; 1938 (3 mos.), dfting.; 1939 (4 mos.), exhauster engr. at coke ovens; May, 1938 to date, lubricator engr., at steel plant.

References: W. S. Wilson, J. A. MacLeod, M. F. Cossitt, S. Ball, A. P. Theuerkauf, Wm. E. Bown, C. M. Anson.

FASKEN—JAMES ELGIN, of 614 Huron St., Toronto, Ont. Born at Neepawa, Man., June 22nd, 1913; B.Sc. (E.E.), Univ. of Man., 1937; 1937-39, with the Can. Gen. Elec. Co. Ltd., testing and inspecting, also design work.

References: E. P. Fetherstonhaugh, C. E. Sisson, W. M. Cruthers, A. B. Gates, D. Norman.

MARION—PAUL JEAN EMILE, of Montreal, Que. Born at Ottawa, Ont., Dec. 12th, 1910; Educ.: B.Sc. (Elec,), Clarkson College, Potsdam, N.Y., 1936. Licentiate of Philosophy, Ottawa Univ.; Six summers on land and water surveys, Federal Dept. of Public Works, Montreal; one summer, Public Archives, Ottawa, one year and a half, gen. constrn. work, International Nickel Co.; 1937 to 1939, power house operation, Shawinigan Water & Power Co., at present, res. engr. of the Mattawin Storage Dam.

References: J. Morse, H. Massue, W. R. Way, C. R. Reid, J. B. Challies, O. O. Lefebvre.

MOORE—JOSEPH HARRY, of Fredericton, N.B. Born at Moncton, N.B., June 4th, 1910; Educ.: B.Sc. (Civil), Univ. of N.B., 1933. S.M. in Civil Engrg., Mass. Inst. Tech., 1934; 1935-37, research at Cambridge Univ.; 1927-29, clerk, stenographer, rodman, C.N.R., Moncton; 1929-30 (summers), 2nd Lieut., R.C.S., Camp Borden; 1930-33 (summers), chainman, dftsman., Dept. of Highways of N.B.; 1934-35, engr. and asst. supt., Acme Constrn. Co. Ltd., Saint John, N.B.; 1937-38, struct'l. designer, Dominion Bridge Co.; 1938 to date, associate professor of civil engrg., Univ. of N.B., Fredericton, N.B.

References: F. O. Condon, H. J. Crudge, R. S. Eadie, C. S. G. Rogers, J. Stephens, E. O. Turner.

NOONAN—RICHARD, of 5620 Decarie Blvd., Montreal, Que. Born at Brandon, Man., Nov. 1st, 1911; Educ.: B.Sc. (E.E.), Univ. of Man., 1934; 1934 (summer), Winnipeg Electric Company; 1934-35, God's Lake Gold Mines Ltd., Winnipeg; 1935-37, graduate apprentice, and 1937-39, asst. to works mgr. of transformer dept., Ferranti Ltd., Hollinwood, England; at present, time study man for Canadian Vickers Limited, Montreal, Que.

References: E. P. Fetherstonhaugh, N. M. Hall, J. Hoogstraten, E. V. Caton, A. Sandilands.

STEPHEN—ALEXANDER JAMES, of 634 Richard Ave., Verdun, Que. Born at Ellon, Aberdeenshire, Scotland, Nov. 1st, 1910; Educ.: High School. Dfting and mach. shop practice at Montreal Technical School (night classes); 1934-37, factory training course, Crane Limited, Montreal. Core room, foundry, operating production machines, mill wright's and machinist's helper, etc. At present, dftsman., master mechanic's dept., Northern Electric Co. Ltd., Montreal, Que.

References: H. C. Spencer, R. H. Yeomans, W. C. M. Cropper, C. A. Peachey, H. Miller.

FOR TRANSFER FROM THE CLASS OF STUDENT

ANGEL—JOHN BARTLETT, of 146 Hamilton Ave., St. John's, Nfld. Born at St. John's, June 12th, 1913; Educ.: B.Eng., McGill Univ., 1935; 1930-35 (summers), constrn. work in Nfld., asst. engr. on Norcross Bartlett expedition and Peary Memorial Expedition, also at International Nickel Co., Copper Cliff; 1935-37, metallurgical engr., 1937, gen. supt., and July, 1937 to date, managing director, United Nail & Foundry Co. Ltd., St. John's, Nfld. (St. 1935).

References: J. W. Morris, A. J. C. Paine, R. H. Balfour, A. Stansfield, W. G. McBride, C. B. Archibald.

BRUCE—RODNEY, of Carleton Place, Ont. Born at Brooklyn, P.E.I., Dec. 25th, 1907; Educ.: B.Sc. (Mech.), Queen's Univ., 1936; 1929 (summer), highway constrn., Standard Paving Co.; 1931 (summer), concrete lab. asst., Rapide Blanc development, Shawinigan Engrg. Co.; 1935 (summer), underground work, Martin-Bird Mine, Larder Lake, Ont.; 1936-37, plant mtce., Brunner Mond Canada Ltd., Amherstburg, Ont.; 1937 to date, asst. plant and heating engr., Findlay's Ltd., Carleton Place, Ont. (St. 1936).

References: L. M. Arkley, A. Macphail, L. T. Rutledge, H. K. Wyman, W. M. Mitchell.

CANDLISH—FAIRLIE, of 102 Kenmore Blvd., Hamilton Beach, Ont. Born at Huntingdon, Que., May 27th, 1915; Educ.: B. Eng., McGill Univ., 1937; 1935-36 (summers), underground timbering, Wright-Hargreaves Gold Mines, and Siscoe Gold Mines Ltd.; 1937 to date, engrg. ap'tice., Canadian Westinghouse Company, Hamilton, Ont. (St. 1936).

References: G. W. Arnold, D. W. Callander, W. H. Cook, J. R. Dunbar, C. M. McKergow, J. J. Thwaites.

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*For 1939. †For 1939-40. ‡For 1939-40-41

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"Here the free spirit of mankind, at length
Throws its last fetters off; and who shall place
A limit to the giant's unchained strength,
Or curb his swiftness in the forward race?"

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INSTRUMENTAL AIDS TO PHOTOGRAMMETRY*

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SUMMARY—Air photography is exerting an important effect on photogrammetical instruments. Some of these developments—including a number of Canadian origin—are described. In many parts of the world photogrammetry is considered the paramount method of mapping. This is particularly true in Canada where so much territory is otherwise inaccessible. This paper is a conspectus of instruments and methods.

Introduction

This paper is written from the point of view of the engineer interested in the design and calibration of instrumental appliances, rather than from that of the mapping engineer, surveyor or optician. Furthermore, emphasis is placed upon apparatus found by actual experience to be of value under conditions obtaining in Canada. Therefore, only sufficient information is given on the more general aspects of photogrammetry, or on certain devices, to permit an adequate description of instruments of particular interest in the Dominion.

As a result of the advent of air photography the science of photogrammetry is in a rapid state of development, presenting numerous problems to many specialists. When one considers all the operations, ranging through the design of the camera, preparation of suitable photographic materials, adaptation of aircraft, etc., on to the production of the finished map, the immensity of the field is realized.

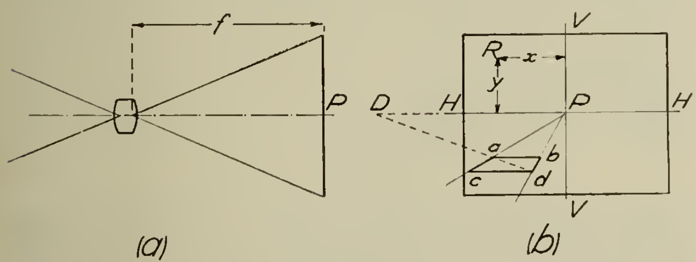

Fig. 1

To further the interests of surveying and photogrammetry in Canada, the National Research Council has established an Associate Committee for Survey Research, representative of the Government departments interested in the different aspects of the problem. Some of the equipment described below has been developed as a result of this co-operative effort.

Foundations of Photogrammetry

Quite early in the history of photography it was recognized that photographs were perspective projections of the landscape. Consequently it was not long before the possibility of applying the camera to surveying operations was tried experimentally. Colonel Laussedat, in France, is usually considered to be the first who made this application with any degree of practical success, and the importance of his work was at once recognized, particularly by military officers.

His fellow countryman, Captain E. G. Deville, (Surveyor General of Canada, 1885-1922, and Director-General of Surveys until his death in 1924), closely followed the development of Laussedat's work, and, as lenses and photographic materials were improved, was able to apply photo-surveying to the Rocky Mountains district. Deville's methods are still the most economical for mapping this part of Canada, and continue to be employed with few modifications by the Federal Department of Mines and Resources and the British Columbia Department of Lands and Forests [1].

Definitions

At this stage it may be well to explain a few terms we shall have occasion to employ in what follows.

In perspective geometry the *perspective centre* is the point through which pass all rays joining the object in space and its image on the plane of projection. In photogrammetry this point can usually be considered as the inner node of the camera lens.

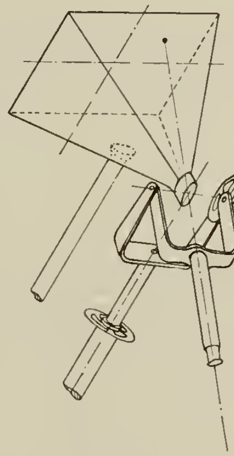

Fig. 2

In Fig. 1 let (*a*) represent a section through a camera and (*b*) the corresponding photograph. The rear node is at a distance *f* from the plane of the picture (the principal distance)—in photogrammetry we are nearly always concerned with objects at such distances that they can be considered at infinity, so far as the properties of the lens are concerned. The foot *P* of the line through the node, perpendicular to the picture plane, is the principal point; the line itself is the plate perpendicular. In the case of ground photography, with the picture vertical, a horizontal line *HPH* is the image of the true horizon, and contains the images of all points within the field of view which are at the same elevation as the camera. The line *VV* through *P* perpendicular to *HH* is the principal line, and contains the images of all points in the vertical plane perpendicular to the picture and containing the camera. *HH* and *VV* are vanishing lines for horizontal and vertical planes, respectively, parallel to the plate perpendicular. A horizontal square on the ground with one side parallel to the plate perpendicular, would register an image *a b c d*, where *a b* and *c d* are parallel to *HH*, and *c a* and *d b* produced pass

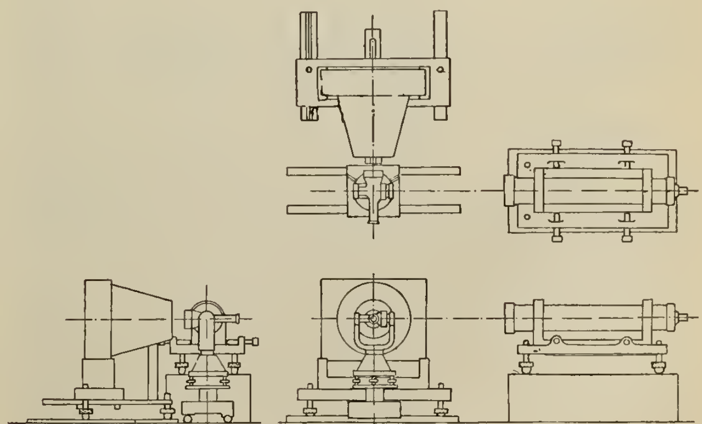

Fig. 3

*Based on paper presented before the American Association for the Advancement of Science at Ottawa, June, 27th, 1938.

through P. The diagonal $d\ a$, produced, cuts HH in D where $PD = f$. [1]

Furthermore, an image R registered on the photograph must correspond to an object contained in a vertical plane

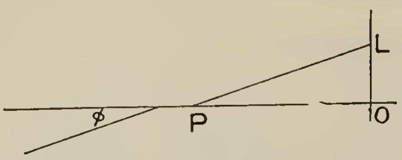

Fig. 4

which also contains the camera and makes an angle of $\tan^{-1}\frac{x}{f}$ with the plate perpendicular; and similarly, in a plane parallel to the horizontal and making an angle $\tan^{-1}\frac{y}{f}$ to the plate perpendicular. The horizontal and vertical directions measured by a transit at the camera station to R would be $\tan^{-1}\frac{x}{f}$ and $\tan^{-1}\frac{y}{\sqrt{f^2+x^2}}$ respectively.

Direction Measuring Instruments

Angular directions corresponding to the positions of images on photographs, may thus be obtained from the measurement of co-ordinates—in fact, most of the plotting of terrestrial survey photographs in Canada is done from admeasurement with the aid of fairly simple graphical systems and instrumental devices [1]. Alternatively the angular directions may be observed from the photographs directly by means of an instrument.

Photo-goniometer. The oldest direction instrument for this purpose is the photo-goniometer. As variations of this instrument are still in use, and as it forms an element in many automatic plotting machines, it will be described briefly.

A fixed dummy camera, Fig. 2, with lens of the same focal length (and preferably of the same distortion characteristics) as that employed in the actual photography, is used to hold the photograph. In front of the lens is a telescope mounted with horizontal and vertical circles as in an ordinary transit. It is not essential that the axes of these two circles intersect at the lens node, but they should be sufficiently close that no optical distortion occurs during observations. It is readily seen from the diagram that the circle readings, as the telescope is directed from point to point, give the relative angular positions of the light bundles originally forming the photographic images.

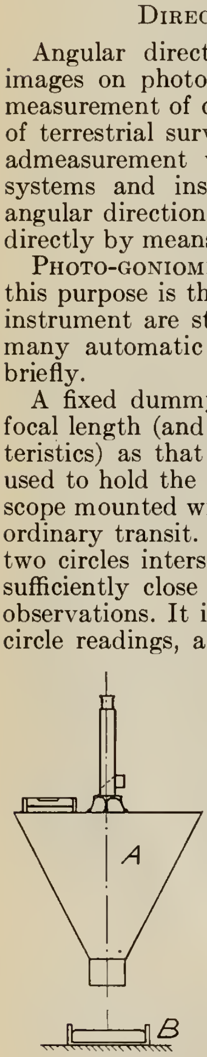

Fig. 5

Variations of the instrument are possible, and are actually employed in automatic plotting machines, e.g., the camera can be made movable and the telescope fixed, or the motions can be divided between them, but it is important that the correct interpretation be given to the measured angles. Neither is a lens necessary in the camera, if lens distortion errors are negligible or are compensated. This modification is not so convenient, however, as the telescope has to be continually focused to accommodate different viewing distances, and the axes of the circles must be made to intersect accurately at a distance from the picture equal to the principal distance of the camera [9].

It is also possible to devise instruments with pivoted arms moving in a single plane for measuring the angles obtained by means of the photo-goniometer. This principle was used in the well-known Zeiss von-Orel stereoautograph for the automatic plotting of terrestrial photographs, and has been adopted in machines for approximate plotting from vertical air photographs in Canada.

Cameras and Camera Calibration

Ground Cameras. The main requirements for a ground surveying camera are rigidity and means for ensuring the verticality of the plate at the time of exposure. The Deville surveying camera was of a simple type, and was used in conjunction with a small mountain theodolite [1]. In the latest developments the camera has been made smaller (rendered possible by improvements in photographic technique), is all metal, and fits into the standards of the theodolite alternatively with the telescope. Infra-red photography is also becoming standard practice, owing to the greater penetration power under certain atmospheric conditions prevalent in the districts concerned.

Air Cameras. Air cameras are a much more difficult problem. They are generally fully automatic in action, and employ roll film. Modern practice provides for as many as 650 pictures, each 9 in. square, to a single roll of film. Wide aperture distortionless lenses and efficient robust shutters are essential, and the present art of lens design permits an angular field-of-view up to 100 deg. to be realized. Multi lens cameras (in effect a bundle of cameras with the plate perpendiculars pointing in different directions) are in use to some extent, and will show as much as 120 sq. mi. of territory in a single photograph of 1:20000 scale, but most Canadian requirements can be met by the

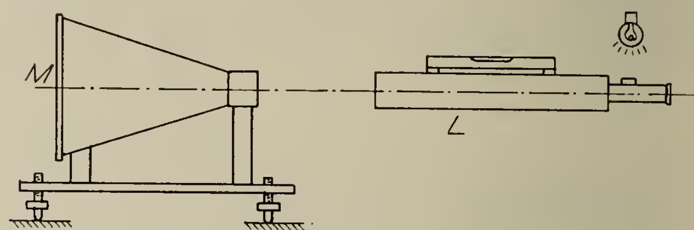

Fig. 6

employment of the relatively simpler and cheaper single lens cameras fitted with modern wide-angle lenses. Focal-plane shutters are undesirbale on account of the distortion they produce, due to the time lag between exposure at successive portions of the photograph.

It is not proposed to say much more about the design of air cameras, as they are produced commercially, and full descriptions are available in the makers' bulletins and other literature.

Camera Calibration. For most surveying purposes a knowledge of the camera constants is necessary. These include (1) principal distance, (2) lens distortion errors and (3) location of the principal point, either directly or by reference marks.

The first two can be determined with the aid of the apparatus shown in Fig. 3, which was developed in the National Research Laboratories, Ottawa, for the purpose. The following notes explain the procedure.

P, Fig. 4, is the rear node of a lens and OL the plane of the negative, O being the principal point of the camera or photograph.

A bundle of rays from a distant point makes an angle ϕ with OP and gives rise to an image L on the negative. In the ideal case angle OPL is equal to ϕ. Practically, if the distance OP be computed from the relation

$$OP = OL \cot \phi,$$

OL and ϕ being measured, the value of OP is found to vary with ϕ. As the position of the picture plane is fixed, it can be assumed that the position of the rear node, P, is not constant. For optical calculations the focal length of a lens is usually taken as the value of OP computed from equation (1) when OL is infinitely small, while for map plotting purposes it is general to determine an average value of OP for the whole or a considerable portion of the angular field covered by the photograph. In this case the residuals between the value chosen and the actual value of OP at specific points are usually smaller [9].

The practical effect of the variation in the value of the principal distance, OP, is to give rise to changes in the scale of the photograph which depend on the zone in which images fall. If some particular value, OP, is taken for the principal distance, and is assumed to apply to the whole photograph, images where the true principal distance is $OP + \delta$ will be displaced radially on the photograph by an amount $\delta \tan \phi$, to a first approximation, from their nominal positions. In the actual determination a rectangular glass plate engraved with two diametral lines, crossed by short lines accurately placed at centimetre intervals, is held against the glass focal plane plate of the camera with the aid of simple devices, which vary slightly with different forms of camera. The angle ϕ (Fig. 4) is then measured

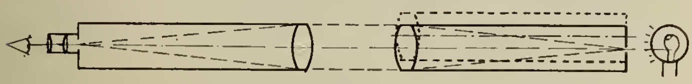

Fig. 7

with the aid of a theodolite reading to single seconds, measurements being made (in the distortion determinations) at each centimetre from O to the edge of the camera opening.

The camera is mounted with the axis of the lens horizontal on a stand supported by three footscrews (Fig. 3); two of these rest in grooved rails and the third is supported on a plane rail. Two round rails, approximately perpendicular to those supporting the camera-stand, bear a cast iron sliding member which supports the theodolite. Both the camera and theodolite stands are sufficiently massive that, with ordinary care on the part of the observer, observations are concordant and there is no necessity for clamping. Thus the theodolite can be placed quickly in the correct position to sight through the camera lens on to one of the graduation marks of the glass plate.

A collimator, serving as a reference azimuth for the angles measured, is arranged almost collinear with the direction of the rails supporting the theodolite, at about the same height as the axes of the theodolite telescope and camera, when all three axes are horizontal. The various adjustments required can be made rapidly to the necessary degree of accuracy. Concrete piers support the whole apparatus in a room subject to very small temperature fluctuations.

It is an advantage first to locate the intersection of the diametral lines on the graduated plate exactly over the principal point, which may be determined by one of the following two methods.

In Fig. 5 suppose the camera A to be placed with its axis vertical, and by means of a sensitive level vial, that the focal plane is made truly horizontal. A dish of mercury B is placed below the lens. A pointed piece of paper, or transparent marker engraved with a cross, is placed in the focal plane, close to the principal point. Light is reflected, say by a sheet of clear glass, through the mark down to the mercury. If the lens is focused for parallel light, an image of the mark will be seen reflected from the mercury surface. When this image coincides with the mark itself, the latter is at the principal point. A lens may be used to observe the coincidence, or better, a reflecting or auto-collimating eyepiece may be employed.

Ground survey cameras, or air cameras in which witness marks on the margins of the photograph are utilized to locate the principal point, are more easily tested by a second method, diagrammatically illustrated in Fig. 6.

A plane mirror M with front reflecting surface, is clamped with this surface in the focal plane of the camera, which is placed upon a foot-screw-supported stand, with the axis of the lens approximately horizontal. A precise level L, fitted with an auto-collimating eyepiece, is set up at about the height of the camera lens, which is then removed and the camera footscrews adjusted until the two sets of cross-wires seen in the eyepiece are made to coincide. Leaving the camera undisturbed, the lens is carefully replaced and the level is moved until the witness mark is in the field. If this mark is correctly set it should appear to be bisected by the cross-wire. The principal line can be located by repeating this operation with the camera turned exactly 90 deg. about the lens axis, or, if this is not practicable, the following method may be used.

Having found the position of the principal point, by means of the level and auto-collimating eyepiece, as just described, carefully remove the mirror and substitute a notched plate or other suitable marker, which can be used to locate the principal point by looking through the level. If the level now be removed and a plummet set up at some distance from the camera, so that its image in the focal plane, as viewed through a magnifier, falls on the principal point, the line of this image will be the principal line.

Tri-camera mount calibration. Oblique photographs for government survey purposes in Canada are now taken with three cameras fitted together on a special type of mounting developed by the Royal Canadian Air Force. This method permits three photographs to be exposed simultaneously, and is much better, from the point of view of the photogrammetrical engineer, than the older system in which a single camera was swung into three different azimuths, in turn [8].

The cameras are set to the correct angles of depression and azimuth with the aid of transits. A special stand supports the mount in flying position, and the camera depression angles are set by aligning the plate perpendiculars to the collimation axis of the transit, set at the correct angle. If the telescope be focused for infinity, the principal point mark will be visible when the telescope is directed along, or close, but parallel to the plate perpendicular. The dihedral angles between the vertical planes containing the plate perpendiculars are set by measuring in turn the azimuth of these planes with reference to a distant object. The line joining the transit to the object is just a convenient reference direction, all being required is that the parallax between successive transit stations at the point in question should be negligible.

By directing the transit telescope (or a level) horizontally through the camera lens, the points in the focal plane

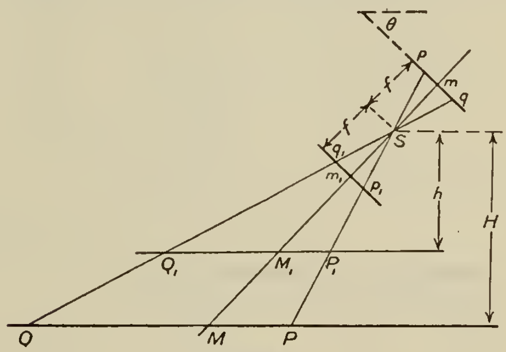

Fig. 8

where the true horizon is registered (with the camera set for the correct angle of tilt) can also be readily determined.

A Property of Collimators

In the foregoing, frequent reference has been made to the use of telescopes in connection with the calibration of cameras. For the benefit of engineers not familiar with optical instruments the following further explanation is given. Suppose two telescopes to be so focussed that the image of a distant object falls upon the cross-wires, and that they are then directed one upon the other, as indicated in Fig. 7. Remove the eyepiece of the right telescope and place a lamp so as to illuminate the cross wires. When the two lines of collimation are parallel the image of the illuminated cross-wires will be found to fall on the cross-wires of the other telescope. A small lateral movement of the right telescope, e.g., to the dotted position, will reveal no apparent displacement of the image so long as the parallelism persists. The effect may be considered as being due to the fact that the bundles of light rays in the space between the objectives are all parallel, arise from a single point at the focus of the one lens, and are brought to a single point at the focus of the other lens.

Furthermore, it will be found that if the right telescope be moved through a small angle, α, from its former position, the image of its cross-wire will move by an amount $F\alpha$ at the focus of the left telescope, F being the focal length of the left objective. This quantity, it will be noticed, is not dependent on the separation of the two telescopes.

These principles can be applied to many engineering problems besides those mentioned in this paper. Examples are the truing or aligning of machine foundations and beds, measurement of small angles, adjustment of surveyor's instruments, guiding of moving carriages, etc.

Plotting Instruments

The instruments utilized in plotting from photographs range from pieces of celluloid engraved with lines, or fitted with hinged arms, to complicated universal plotters like the Zeiss Stereoplanigraph, of which the cost is several tens of thousands of dollars. For a great number of cases simple appliances suffice, such as those described by Bridgland in [1]. One of these is worthy of comment, as it became a sort of bridge between the plotting of terrestrial and air photographs in the early days of the latter, and represents in its later form Deville's last important contribution to photogrammetry. This device, known as the Perspectometer, consists of a grid representing the perspective projection on the photograph of a network of horizontal squares on the ground. It is readily laid out from the application of perspective geometrical conditions, and may be photographed on to glass or celluloid. Laid upon a

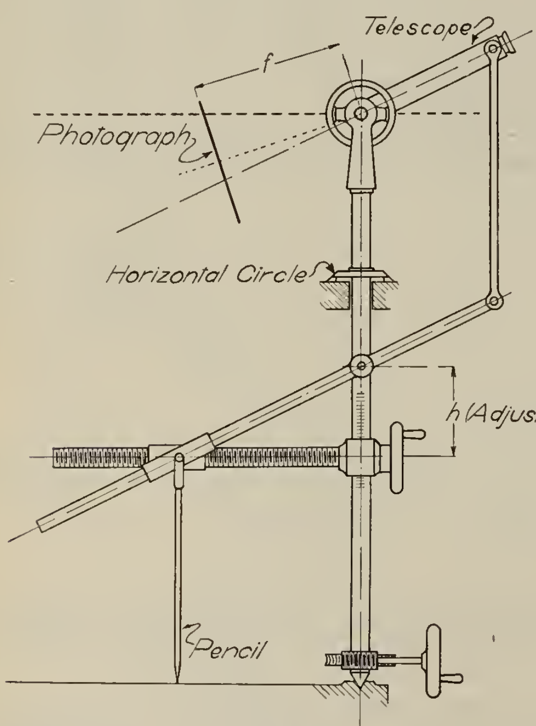

Fig. 9

photograph over level details such as lakes at a known elevation below that of the camera station, it permits the planimetric outlines and positions of these objects readily to be transferred to a drawing laid out to a system of projection. The perspectometer, originally utilized for terrestrial photographs, is readily adapted, and is extensively used, for the plotting of level country from high oblique air photographs, in which the image of the horizon is registered. An enormous area of such country—some 550,000 sq. mi.—has been plotted by this method in Canada for mapping to scales of one-quarter inch to one mile and less, since 1923 [5].

High-Oblique Plotter

The High-Oblique Plotter, due to Col. E. L. M. Burns, of the Department of National Defence, is also a convenient instrument for plotting the outlines and positions of features from high oblique photographs. It is quicker and more

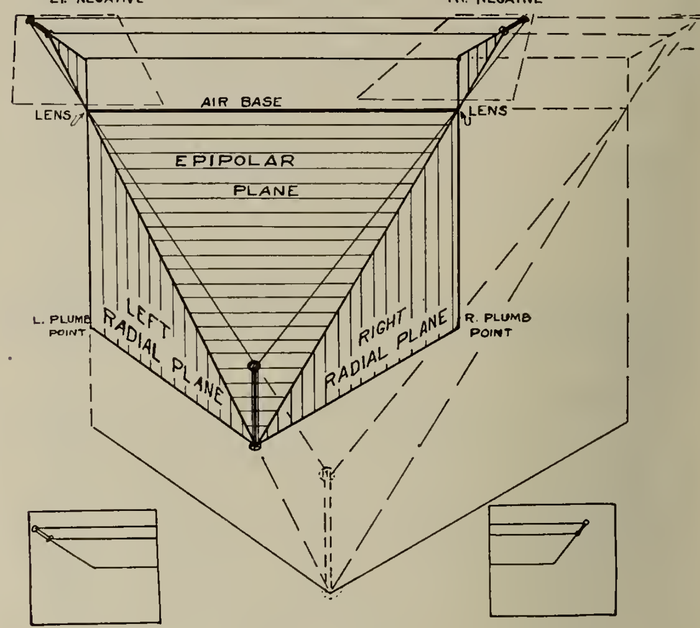

Fig. 10

accurate than the grids, and is also fitted for making angular measurements, as in the photo-goniometer, as well as for determining radial angles in the plane of the photograph (about the principal point). Figure 8 shows the elements on which the design of the machine depends, S is the lens of the camera at a height H above the ground, and pq is a section of the negative, perpendicular to the line $Sm=f$, through the principal point m. ϕ is the angle of depression of the photograph from true horizontality, QMP is a horizontal line on the ground. For positive photographs p,m,q, replaces pmq. Should a horizontal plane be interposed at a distance h below S, it is easily seen that the distances M,Q, etc., are proportional to MQ, etc., and rays from S intersect the plane to reproduce (at a scale $\frac{h}{H}$) the correct relative positions of details on the ground.

In the actual plotter, shown diagrammatically in Fig. 9, a telescope is mounted so as to rotate about intersecting vertical and horizontal axes, as in a transit, and, similarly, graduated circles are fitted for angular measurement. The photograph is clipped to a glass table, fitted in a graduated ring which can be rotated in its own plane for the measurement of radial angles. Adjustments are provided for setting the photograph at the correct tilt angle and distance from the intersection of the vertical and horizontal axes. By means of a parallelogram linkage a rod below the telescope is caused always to remain parallel to the latter. The intersection of the axis of this rod and the plotting plane is projected vertically downwards, where a pencil marks positions on paper pinned to the base of the machine. Scale is adjusted by setting the carriage containing a horizontal screw, slide, etc., to the desired height (h in Fig. 8) [3].

Stereo-photography

Where the territory photographed is not flat an orthogonal plan cannot be obtained from a single photograph. In vertical photography, for instance, objects at greater elevations, i.e., nearer to the lens, will register farther from the principal point than objects in the same vertical line, but at smaller elevations. It follows, that where relief is present, photographs of the same territory from more than one camera station are necessary to yield plan positions, as well as elevations, of features not contained in a single horizontal plane.

In the majority of cases stereo vertical photographs (i.e., photographs exposed with the picture plane nominally horizontal) are utilized. Usually these are taken so as to yield 60 per cent overlap in the direction of flight. Figure 10 illustrates the simple geometry of the problem of mapping from stereo vertical photographs.

Consider two consecutive photographs (a stereoscopic pair) to be restored to their positions in space at the instants of exposure. The line joining the two lens positions is the "Air Base," and the point vertically beneath the lens is known as the "Ground Plumb Point." On the photograph the image of the plumb point will be vertically above the lens, and, if the picture plane is horizontal, this image will fall on the principal point. Suppose there is a tower on the ground, registered on the overlapping portions of the two photographs, as indicated in Fig. 10. By simply drawing straight lines from the top and bottom of the tower through the lens positions, the images on the photographs can be easily located.

A vertical plane is determined by the plumb-point ray and the ray from a ground object, e.g., the base of the tower. These planes are marked "Radial plane" in Fig. 10. In the case of a vertical object the same radial plane contains the rays from both the top and bottom, and hence its image will be in the trace of the plane on the photograph, i.e., in a line radiating from the plumb-point image. Furthermore, it follows that the distortion of images on the photograph, as the elevations of the corresponding objects change, will be radial from the plumb point image, where

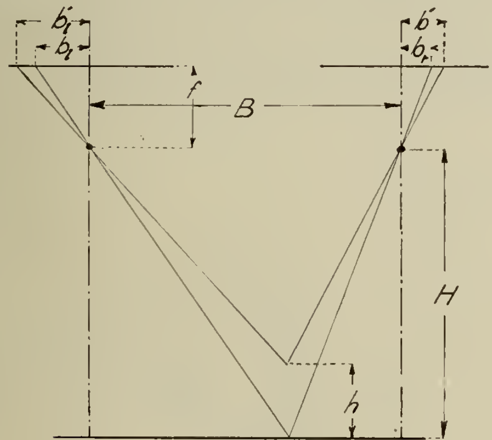

Fig. 11

distortion is interpreted as the change in the image positions from those in a photograph of a projection of the objects on a horizontal plane.

Parallax. Let Fig. 11 represent a section through two untilted vertical photographs, both exposed at a height H above datum.

If B is the air base, its projection on the datum plane will be represented on the photographs by two lines b_e and b_r. From simple geometrical principles it is seen that $b_e + b_r = \frac{Bf}{H}$, which is the sum of the x displacements of the images of a point in the datum plane from the respective principal points. It is the absolute parallax for points in the datum plane. In another plane, at h above datum, the absolute parallax is $\frac{Bf}{H\text{-}h}$. If h is small compared to H, the formula for parallax may be differentiated, and we have $dp = -\frac{BfdH}{H^2}$, which gives the parallax difference for small changes in elevation.

Stereo-plotting. Figure 10 suggests one method which might form the basis for the design of a plotting machine. If the photographs could be restored to their relative positions, as at the exposures, and two planes could be hinged about the respective plumb lines; then by causing the traces of the planes on the photographs to pass through the images of some ground feature the intersection of the two radial planes would determine the orthogonal pro-

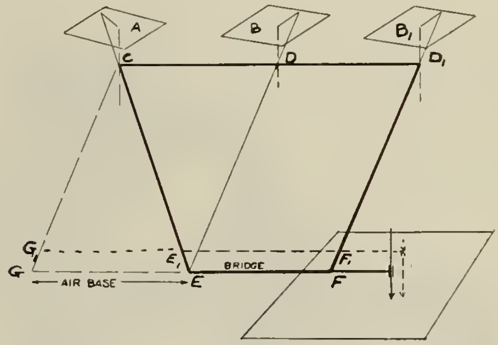

Fig. 12

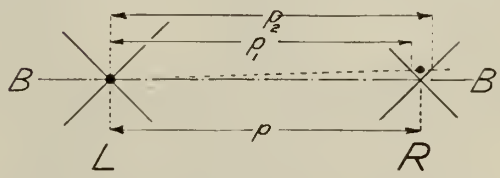

Fig. 13

jection of the feature. This is really the basis of the plotting method known as "Radial line" or "Principal point triangulation."

There is another method which can be visualized for mechanical plotting. If the light rays were embodied by universally jointing two rods at the respective lens positions, the positions of ground objects could be found by causing each rod to pass through the appropriate image of the object. In this case, plan positions are found by projecting the intersection of the rods, and elevations from the height of this intersection above datum. It will also be noticed that the two rods always lie in planes containing the air base epipolar planes—so named because the air base, if produced to cut the photographs, does so at points which are the images of the opposite camera stations.

In both systems of plotting, the scale can be adjusted by altering the length of the air base, which is apparent from the similarity of conditions if the right photograph be imagined as moved outward to the dotted position in Fig. 10.

Zeiss Parallelogram—In a plotting machine it is usually desirable to retain the photographs at a fixed distance apart, in the interest of design and operation, and this can be done by utilizing a device known as the Zeiss Parallelogram, owing to it having been employed first by Pulfrich and his assistants in the Zeiss Stereoautograph for plotting terrestrial stereo photographs [9].

In Fig. 12 let A and B be two air photographs restored to their correct relative positions, as imagined in Fig. 10. $C\ D$ is the air base, and $C\ E$ and $D\ E$ are rods for plotting some object E, as already explained in discussing Fig. 10. The length $C\ D$ determines the scale of plotting. If B be moved to a new position B_1, by extending $C\ D$ to D_1, and $D\ E$ be likewise moved parallel to itself to D_1F, and the ends of the space rods be joined by a link or bridge EF (parallel to CD), an inspection of Fig. 12 will show that any point on the bridge will plot the same relative positions for stereo images as the original point E. Inasmuch as E determines both plans and elevations, the whole bridge must be moved vertically when, to direct the upper ends of the rods on to the stereo images of a point, it is necessary to spread the rods in the epipolar plane. In other words, the bridge moves so that all points in it remain in horizontal planes as long as level detail is being plotted, but must be moved to a new elevation when there is a change in the elevation of the detail.

If a parallelogram is completed by drawing CG parallel to DE, GE is equal to CD, the length of the air base which fixes the plotting scale. GE, which is equal to the fixed length CD, minus the length of the bridge EF, is the inset of

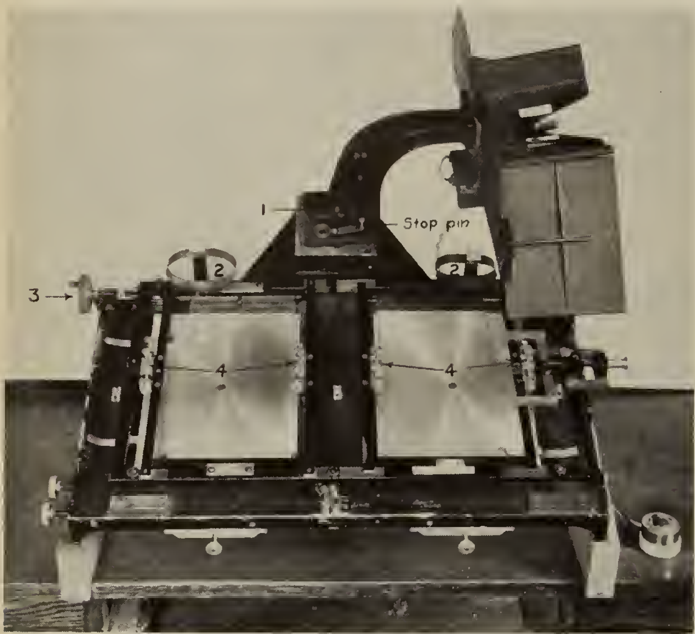

Fig. 14

the bridge. The plotting scale, with CD, fixed, is adjusted by altering the inset; for instance, if it be changed to G_1E_1, the bridge must be moved to a new position, E_1F_1, to restore the correct directions of the rods CE and D_1F. The inset is always equal to the length of the air base at the scale of plotting.

Stereoscopes

In order to view simultaneously the two images on a pair of stereo photographs, plotting devices generally utilize stereoscopic vision. We judge the distance of objects in our vicinity by the fact that, the closer an object, the greater the angle subtended at it by our "eye base." If, therefore, we can, by some artifice, cause the direction of light rays from two images of an object to enter the respective eyes at the same angles as when the corresponding object is at a definite distance from the eyes, the object will seem to be at that distance. Everyone is familiar with the three dimensional impression produced in this way with the aid of the ordinary stereoscope when viewing two photographs taken from different viewpoints. Similar effects are produced when a pair of overlapping air photographs are viewed stereoscopically. The ground features show up in correct relative relief, although there can be a distortion so far as the ratio of horizontal to vertical scale is concerned. In most cases met in photogrammetry this distortion is unimportant and, if heights are accentuated, may be an advantage.

Much useful information for the engineer, including the delineation of contours and the interpretation of details not recognizable on a single photograph, can be obtained simply by viewing a pair of photographs in this way, but for quantitative results additions to the stereoscope are required.

Parallaxes may be evaluated with the aid of a simple stereoscope by using markers placed over the images, and measuring the abscissae from the principal point (parallel to the air base), or the difference between abscissae for points at different levels. If this procedure be followed, and the marks be suitable and of similar appearance, it may be noticed that they tend to fuse optically into a single mark, which appears to rise or fall with respect to the ground as the markers are retracted or spread: when correctly spaced the mark will seem just to touch the ground. Hence the term "Floating mark" which is employed to denote this aid to parallax measurement.

Instead of placing the floating mark in the actual plane of the photograph, it may be inserted in the plane of the image of the photograph formed by a lens. This is the usual procedure where magnifying stereoscopes are employed, as in nearly all automatic plotting machines. For instance, in Fig. 12 if an optical arrangement were made consisting of a telescope at the upper end of each space rod, together with a system of reflectors and lenses, such that the two images on which the rods were directed could be seen simultaneously, one by each of the observer's eyes, and if each telescope were fitted with a suitable semi-mark, the floating mark system could be utilized to maintain the correct direction of the rods. For plotting contours the bridge would be held at a constant elevation, and the observer would then have to manipulate his controls in such a way, that, as he viewed successive portions of the photographs, the floating mark would continue to touch the ground.

Use of Stereoscopes. Where the ordinary Wheatstone stereoscope is employed, a network of lines ruled on glass plates, laid over the photographs, is often used in place of a simple floating mark. If the grids be furnished with a micrometer screw for measuring differential parallax, height differences between various points in the overlap can easily be calculated [7].

When the engraved lines are at 45 deg. to the air base direction, the simple stereoscope can be utilized for accurately determining the projection of the air base on the photographs. If one pair of grid lines is made to intersect near the principal point of one photograph, and the intersection of a pair on the other grid is placed over the corresponding image on the second photograph, a "breaking

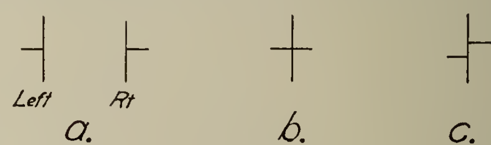

Fig. 15

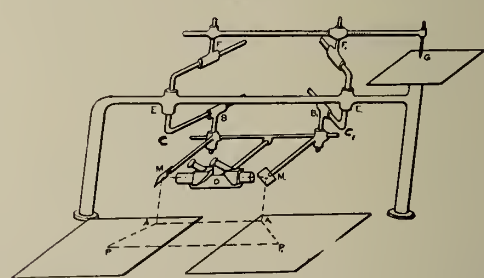

Fig. 16

up" or separation of the two sets of parallel lines into different horizontal planes seems to occur when the second photograph is rotated about its principal point, or is moved at right angles to the air base.

In Fig. 13 the dot over L represents the principal point of the left photograph, the dotted line BB is the desired direction of the air base, and the dot over R is the image on the right photograph of the same detail as the dot over L. The spacing of the two rigid intersections shown is p approximately the same as the distance between the dots. Under suitable conditions, the eyes regard stereoscopically the two dots, and when doing so the one pair of lines appears separated by a distance p_1, less than p, and the second by a distance p_2, greater than p, i.e., one set of lines is apparently below the ground and the other above the ground. This method is a very sensitive one for correctly orienting the photographs, but like other stereoscopic operations, depends for the best results on using lines or marks of the optimum distinctness for the class of photographs observed.

Figure 14 shows a stereoscope built for the Department of Mines and Resources, following the plans of the late A. G. Haultain. The Wheatstone mirror portion is turned to one side about the pin 1 from the viewing position to permit easy access to the photographs, which are placed on two tables and held in place by spring clips. Two screws, seen in the lower foreground, clamp the tables, which can then be rotated independently by the two screws seen to the lower left. The glass grids are mounted in a frame, and cover the overlapping portions of the two photographs. Screw 3 moves the frame and the two grids while the screw seen to the right moves the right grid relatively to the left one—this movement being indicated by a scale and vernier on the grid frame. Needle pointed plungers 4 permit the direction of the air base to be registered when the photographs have been correctly oriented, as explained above, by the use of the diagonal grid lines.

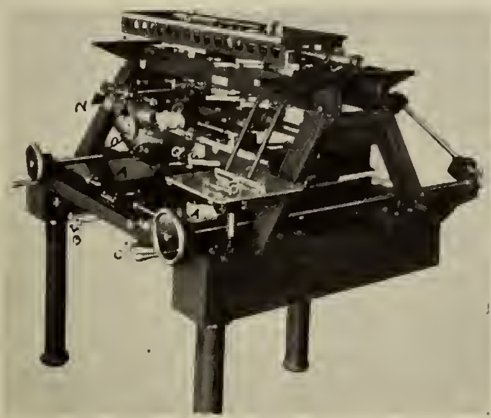

Fig. 17

In magnifying stereoscopes the best form of mark is probably that shown in Fig. 15, (a) is the actual appearance of the two marks, (b) represents the impression when the detail under observation is in correct correspondence, while (c) is the way in which lateral correspondence errors affect the appearance of the mark.

Radial line method of extending minor control—In the case of an ideal, utilted, vertical photograph, the traces of the radial planes, Figure 10, will be lines radiating from the principal points, which are registered on each photograph. For much small-scale plotting, tilts can be disregarded, and the angle between the air base and the line joining the principal point to some detail can be regarded as the true plan angle of the appropriate triangle [5]. By applying this principle it is possible to plot a network of triangles whose corners are the successive plans of the principal points and of the lateral control details chosen. The extension of these networks through strips of photographs forms a minor control for the plotting of detail. Ground control points should be located at the beginning and end of such strips to permit compensation of the errors arising from the assumptions made. United States photogrammetrical engineers go still further, and by means of the slotted template [6] in which the radial directions are punched in the form of slots, with studs fitting into the intersections of the slots, are able to compensate a number of parallel strips of photographs at the same time and reduce the errors of position to negligible amounts for many purposes.

Radial Positioner. Radial line mehods of extending minor control have been extensively employed in Canada. The usual procedure is to trace the successive air bases and the radial directions to the minor control points by simply laying a piece of tracing linen over the photographs, on which the base lines have already been laid off under the grid stereoscope.

Mr. B. W. Waugh, A.M.E.I.C., has devised a setting instrument, the radial positioner, of which a model was designed by the writer and built by the National Research Council for the Department of Mines and Resources, Ottawa, whereby more accurate coincidences can be achieved [10]. The photograph is clipped to a glass table (permitting artificial illumination from beneath) and the tracing cloth is stretched above it on a frame. A screw moves the photograph in one direction and a second screw moves the tracing cloth in a perpendicular direction, while the photograph can be rotated about its principal point with the aid of a tangent screw. The weight of the photograph holder is carried on three ball-bearings, acting as rollers, while it is guided by three more—forming a very simple, but effective constraint.

Thr Radial-stereoplotter. The radial-stereoplotter, proposed by Col. Burns, is an automatic machine for plotting from vertical photographs on the radial line principle. It was designed by the writer and built in the National Research Laboratories, Ottawa, and is in operation in the Geographical Section, Department of National Defence; the machine is shown diagrammatically in Fig. 16. The two air photographs are clipped to horizontal tables, provided with clamps and slow motion screws so that the air base can be made to lie along the line PP_1, according to the methods already described. A magnifying stereoscope D is employed to observe images, with the aid of the mirrors M and M_1. When the stereoscope is directed on the images A and A_1 of a ground detail, the radial arms BC and B_1C_1 are parallel to the radial direction AP and A_1P_1, respectively. The figure $AA_1\ P_1P$ may be considered as the projection, on a horizontal plane, of a Zeiss parallelogram (Fig. 12). A second pair of radial arms, moving about the pivots E and E_1 with the first pair, are fitted with a bridge FF_1, constrained to remain parallel to EE_1 (or PP_1). By altering the inset of this bridge at F, the plotting scale can be adjusted as explained in the discussion of the Zeiss parallelogram, and a pencil at G plots the plan positions of the points sighted to the scale desired. Figure 17 is a photograph of the plotter, which is fully described in reference [4].

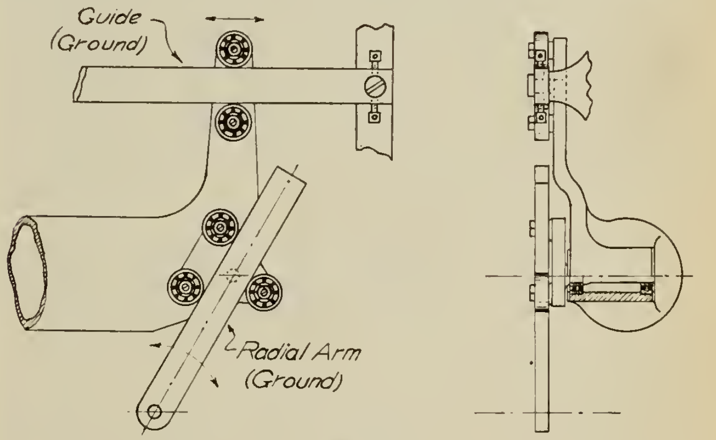

Fig. 18

A number of interesting problems arose in the course of the design and construction of this radial-stereoplotter. The most important was to devise a series of kinematic couplings such that the total variance or lost motion at the pencil when the direction of the stereoscope movement was reversed was much less than 0.1 mm.—the precision of drawing the pencil line. Also, in certain positions of the radial arms, the angular directions were such that unless the coefficient of friction was made very small, large frictional resistance would oppose movement, and give rise to strains in the machine as well as make operation difficult. Satisfactory performance was attained by making extensive use of ball-bearings, many of them functioning as rollers.

For instance, Fig. 18 represents a typical coupling, e.g., one end of the bridge of the Zeiss parallelogram. The radial arm itself revolves about a pivot, constrained by ball bearings. It engages with three ball bearings set on a triangular plate, as shown, which, again, is mounted on a spindle turning in two self-aligning ball bearings. Eccentric studs are used to mount the guide bearings, and this not only permits the correct alignment of the mating parts, but also allows a sufficient pre-loading of the bearings to eliminate backlash. In a similar manner the guide at the

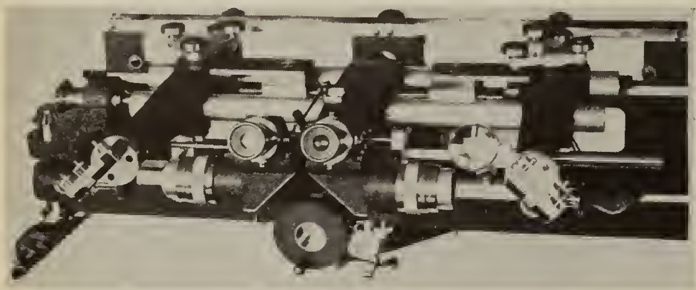

Fig. 19

rear, which constrains the bridge to move in a straight line along the upper carriage, consists of two ball bearings mounted on eccentric studs, and engaging with a ground rail.

Figure 19 is a photograph of the stereoscope carriage removed from the machine. Triangular plates and guides, similar to those shown in Fig. 18 may be seen in this photograph.

THE STEREOGRAPH. The radial line method of locating plan positions becomes indefinite as the radial planes approach the air base, and intersect at large angles. Actually, in the radial-stereoplotter, there is a sort of lune where precise plotting cannot be achieved. This figure covers the area where the angle between the radial arms is 150 deg. or greater. As the exact location of the plan of the principal points themselves can be plotted, this does not detract from the use of the machine for extending radial line control triangles, but it is desirable in a plotting machine to be able to locate at times the correct plan position of any point shown on the overlapped portion of a pair of stereo-photographs. Colonel Burns has accordingly proposed still another linkage, which, with slight modifications, has been made the basis of the design of a plotting machine just completed in the Instrument and Model Shops of the National Research Council at Ottawa. This new plotter is to be used by the Topographical Survey, Department of Mines and Resources, Ottawa. It was exhibited at the 1939 Annual Meeting of the Institute at Ottawa.

In it are being incorporated a number of improvements and refinements found desirable from extended experience with the radial-stereoplotter. It is expected that a paper will shortly be published describing the new instrument, called the "Stereograph."

UNIVERSAL PLOTTING DEVICES. For more exact work, e.g., large scale plots of relatively valuable territory, tilt errors can no longer be disregarded and approximate methods of plotting, such as those already touched upon, have to be supplanted by more rigorous ones. In Europe a number of devices have been put on the market for precision plotting. These, more or less, tend to solve the geometrical problem indicated in Fig. 10. They vary considerably in design —presumably, in many cases, to enable the designers to get around one another's patents. The best known mechanical machines are probably the stereo-planigraph, the aero-cartograph (not both produced by a subsidiary of the Zeiss firm) and the wild autograph. All these machines are very costly and it is doubtful if they could be employed economically for any mapping purposes in Canada under demand at the present time. Optical projection systems are represented by the Gallus-Ferber system [9].

A promising scheme for a mechanical plotter, which is really the second method for plotting discussed in connection with Fig. 10, has been proposed by Fourcade of South Africa. While simple compared to some of the better known plotters, it is exact and lends itself to a straightforward method of setting stereoscopic photographs into correct correspondence. There is a field in Canada for a machine of this type, in connection with government survey operations—partly for special large-scale maps of restricted areas, and partly for developing systems of control to increase the precision of the more economical (but necessarily approximate) systems of mapping now in use. A Fourcade machine has been donated by Imperial Oil Limited, and is now under construction for the Federal Government by Barr and Stroud of Glasgow, Scotland, and it is hoped that the instrument will shortly be received in Canada.

A plotter of the projection type which appears to be quite suitable for many mapping purposes in North America is the aero-projector multiplex, illustrated in Fig. 20. The action can be followed if one imagines the space rods mentioned in the second plotting scheme discussed with Fig. 10 to be replaced by rays of light projected from the photographs. Small projectors, together with reductions of the photographs and short focus lenses are used to bring the machine to a convenient size. Each projector can be set for alignment, swing, spacing, tilt, etc., so that the line of photographs can be brought to their correct relative positions as at the exposure instants, if there are four suitable control points in the first overlap. Alternate photographs are projected through red and blue filters, and the observer wears correspondingly coloured glasses—receiving a stereoscopic impression on the analglyph principle. The actual plane of projection is at some distance above the plotting table, to allow for relief. Small discs or tables which can be adjusted in height, are used to receive the projection, and one of these is provided with a central dot and a plot-

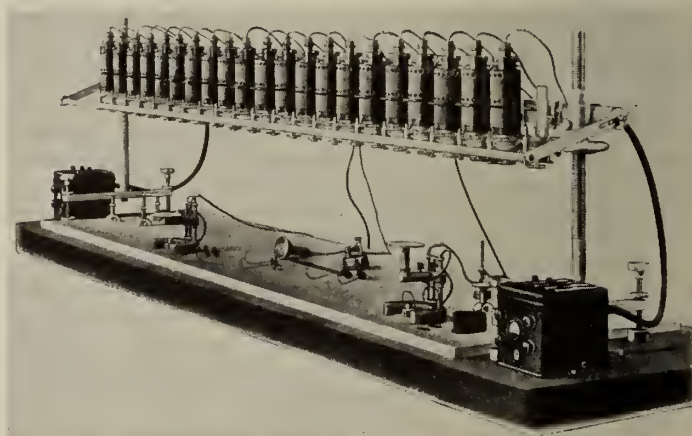

Fig. 20

ting pencil. Contours are plotted by moving the dot in such a way that it appears to remain at the surface of the space model [2].

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THE DEVELOPMENT OF METEOROLOGICAL SCIENCE

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Meteorologist, Weather Bureau, Kenyon Airfield, Lethbridge, Alta.

Paper presented before the Lethbridge Branch of The Engineering Institute of Canada on February 11th, 1939

Man has always been interested in the weather, and it is not surprising that from the earliest times he has tried to foretell what the weather would likely be. In course of time a great mass of superstitions and legends in connection with the weather grew up, and it was not until the discovery of the barometer in the seventeenth century that meteorological thought began to take its place in scientific literature. Even at that time it was discovered that the barometer sometimes read high and sometimes low, and that with a low barometer there was usually stormy weather and with a high barometer fine weather.

Weather forecasting was attempted by the reading of the weather glass as it was called, and all the signs that we have on our home dial barometers such as—stormy, very stormy, rain, change, fine, very dry—were all the eighteenth century predictions, and have been continued ever since. Very little progress, however, was made in meteorological work until about the middle of the last century, when the introduction of the telegraph made it possible to receive observations quickly and chart them on maps.

No attempt was made at forecasting, only the weather conditions by means of symbols being printed on the map. By 1868 lines of equal pressure were added. This discovery created very great enthusiasm for the study of meteorology and the production of weather maps.

Governments the world over were then being called upon to establish weather services for the benefit of shipping. It was only in 1872 that a meteorological service was established in this country with Sir Frederick Stupart as Director.

Forecasting services, however, were not established without encountering the violent prejudices of the scientific men of the time and even the Royal Society of London forbade the publication of forecasts for many years, as they considered that one who would give a weather forecast was no better than a charlatan.

Fortunately for the scientist there were those who believed in the possibilities of meteorology and the great service that could be rendered to the commercial life of the country. Time has more than justified their faith, the meteorologist has come into his own.

Every morning at 05.30MS and every evening at 5.30MS observers in 250 weather stations from Mexico to the Arctic, on ships on the Atlantic and the Pacific Oceans, take weather observations.

They read maximum and minimum thermometers, the wet and dry bulb thermometers, the barometer, the wind velocity and direction, calculate the relative humidity, and the dew point, note the percentage of cloudiness, kind and direction of movement of clouds, measure the amount of precipitation if any has occurred during the preceding twelve hours, and observe any special phenomena such as thunderstorms, hail, winds of gale force, fog, or other happenings. This information is converted into a telegraphic code message and sent to the central offices at Toronto and Washington. These two centres exchange their information. Within 45 minutes to one hour after the observations have been taken, over this vast region, they have all been received and charted at the various forecast centres in Canada and the United States.

I might state that messages are sent in code, not because of a desire for secrecy but because of economy and efficiency. The code itself is rather interesting and I quote a sample to show how much information can be contained within a few words. Here is a message received recently from Edmonton: *Roofer Melody Marfin Seeming Citrine Eight.*

Roofer means that the pressure is 29.78 and the temperature 34 deg.

Melody signifies that it is cloudy at the time of observation and the wind south at 8 m.p.h.

Marfin says that the barometer, after falling slightly, less than .03 has held steady and the maximum temperature for the day 36 deg.

Seeming records that 0.56 in. of snow fell.

Citrine denotes that the clouds are cumulus, cover 9/10 of the sky and are moving from the west.

Eight means that the visibility is over 12½ mi.

Words found in the code are such oddities as cellgown, bedbug, forget, hatband, fishfag, meanfoe and mudfuss. *Bedbug* means that the pressure is 30.14 in. while the temperature is 10 deg. Inside an hour London, Berlin, Rome, knows it is *bedbug at White River or forget at The Pas.* Thus weather is flashed.

So much for the mechanics of observing the weather, it is now time for the forecaster to give his attention to the weather chart and all the information plotted thereon. He can see the pressure significantly increasing at strategic points. He can note where are the accumulations of cold air. Once such an advance is under way, smashing on with sub-zero force and a barrage of snow, he can foretell its behaviour here and effects there.

The observations that are charted on the weather map are all taken at the surface of the earth, except the cloud, that is, our observations are taken at the base (a very irregular one) of the atmosphere in which we live. To attempt to solve our problem we must know what is going on throughout the atmosphere in regions where the weather processes are in operation.

The outbreak of the war led, for a time, to a complete interruption of the exchange of weather reports between nations in Europe. The forecast work was to a large extent paralyzed. Two Norwegian scientists named Bjorknes (father and son) are credited with the development of an entirely new system of weather forecasting known as the "Polar Front System." We now believe there are two great currents operating at least in the temperate latitudes that determine the character of our weather. These currents are known as the Equatorial and the Polar. As the name implies, the equatorial is very warm and generally moisture laden. On the other hand, the polar current is cold, and being from polar regions is very dry. These currents have very different characteristics and very different properties. It is along the line of separation of these two currents that all our storms and bad weather occur.

There is perhaps more truth than we ever realized when we speak of weather as a war of the elements, for are not these two great currents very much like two immense armies, one the army of the south, the other the army of the north. The southern army represented by the equatorial current impinges along the warm front and drives back the cold air, at the same time the warm air flows up over the top of the cold air. As this warm air rises higher and higher we get first of all the low hanging heavy cloud and precipitation, then farther out the middle clouds, then still farther out the cirrus or thin high clouds.

It has always interested me very much to hear with what joy the geologist tells about his great discoveries as to the age of the earth, going back to hundreds of millions of years; then there are the physicists—how they enjoy telling us of the very small particles with which they deal; the astronomers excite our admiration when they inform us of the great depths to which they can penetrate the universe, and tell us that light trave ling 185,000 miles a second for one hundred million years is only now reaching us from some of the distant stars.

All this surely makes the meteorologist envious, and he wonders if he has to deal in any way with quantities of these magnitudes.

Dr. John Patterson, Controller of the Meteorological Service of Canada, has made some calculations to see how much air would pass through a cross section of a square mile, a mile along the surface and a mile high, for a wind of twenty miles an hour flowing at right angles to it. It happens to work out to one hundred million tons per hour, and if the energy contained in it could be all converted into power, it would be the equivalent of a million horse-power engine. A mile is a very small distance on the face of the earth, and I might say that twenty miles an hour is about the average wind here in Lethbridge, forty to fifty mile winds being quite commonplace.

In all great transportation systems some motive power or engine is necessary and in examining the situation we find that our atmosphere is wonderfully like an immense steam engine in which the sun is the source of heat; the tropical regions, the boiler where the water is evaporated; the poles, the high mountains; and the tropopause, the cold region or condenser that furnishes the means whereby the water vapour is recondensed into rain or water; and in the light of that, the problem for the meteorologist is to find out the workings of this great atmospheric engine and transportation system. What are the physical processes that are going on in the atmosphere to produce the weather as we have it ? Knowing these physical processes we should then be in a position to more accurately forecast what is likely to happen.

It will be of interest to note some of the aids that the Meteorological Service is rendering to the industrial and commercial life of the community.

Weather services were organized primarily for the warning of the approach of violent and dangerous storms and gales, and this is one of their great functions. It is of the utmost importance for all small coasting and fishing vessels and small craft that ply along our coasts that they should know beforehand of the approach of bad weather.

Agriculture is vitally interested in the weather. It is on the weather that success of agricultural operations depends. A knowledge, therefore, of the weather and climate is one of the essentials in these days of intense competition for the successful pursuit of agriculture. There are 900 stations taking weather data for agricultural purposes in Canada.

Entomologists tell us that the control of insects, fungi, and all diseases that prey on crops are governed very largely by the weather, and they are asking the meteorologists to furnish them with the weather conditions in order that they may know best how to control these outbreaks. The more accurate knowledge they can get of the weather conditions and of the probable course of the weather the more efficiently can they attempt control measures and predict outbreaks.

At certain seasons of the year we have early frost that ruins crops and causes tremendous damage. By suitable warnings, the growers have the means whereby they can protect their fruits or products against the frost. Perhaps the greatest organization of this kind is the Frost Warning Service in California. Canada is developing the same kind of service in the Okanagan and Kootenay fruit growing country. Fruits are subject to damage by frost at a very critical period in their growth. Being warned of the approach of the frost by the Weather Bureau the orchardists keep oil heaters and smudges burning during the period of danger.

The Meteorological Service is being asked to forecast the type of weather that is conducive to forest fires and to the production of fire hazards. When these are likely to occur special precautions are taken.

It might nterest you to know that special forecasts at certain seasons may be obtained from the Meteorological Service. At Medicine Hat where three large flour mills are located it is necessary that at least once a year the mills be opened up during periods of sub-zero temperatures for the purpose of killing the insects peculiar to the milling industry.

It requires at least three days for a successful "freeze out process" and a period of twenty-four hours to open and drain the heating system. For the past nine years forecasts have been given to these milling companies when sub-zero temperatures were likely to prevail for periods of not less than three days, and I might say that so far the forecasts have worked out one hundred per cent.

The last and greatest development that has taken place in meteorological science is in connection with aviation. It is recognized that an efficient weather service is one of the essential features for the successful operation of air routes. It has been said that with the development of aviation meteorology has come into its own.

Prior to 1928 there was no organized weather service for aviation in Canada. However, in that year in anticipation of the visit of the R-100 and the inauguration of an airmail service, the organization of an aviation section was commenced and a small technical staff recruited. For a period of two years, 1930 to 1932, a weather service was given for the prairie air mail service. When this service was discontinued part of the staff was retained and formed the nucleus on which to build in anticipation of the re-establishment of an air mail service.

The real organization of an aviation section began in 1936 in preparation for the Transatlantic Air Service, and was further accelerated a year later with the inauguration of the Trans-Canada Airlines.

It is probably difficult for the layman to realize the organization and staff necessary to enable the Meteorological Service to take, transmit and analyze the immense number of observations that have to be taken from a region extending from the Atlantic to the Pacific, and provide a service twenty-four hours a day every day in the year.

The high-speed planes make it urgent that weather conditions prevailing across the country should be immediately available to the pilots at all times. It is therefore necessary that centres be established at strategic points along the route.

At present there are forecast centres at Vancouver, Winnipeg and Montreal. However, it is understood that before many months have passed Lethbridge will be the headquarters for a staff of expert forecasters.

One of the essentials for successful weather service is rapid communication from one point to another, in order that weather data can be collected very rapidly and distributed just as quickly.

For this purpose teletype machines are installed at all forecast centres, aeroplane stops and intermediate radio range stations so that there is direct communication from one end of the country to the other throughout the whole twenty-four hours. Connection is made with the United States teletype circuits—Vancouver to Seattle and from Toronto to Buffalo.

The pilots and airways dispatchers require to know the weather along the route at all times, and, to furnish this, observations known as hourly sequences are taken and transmitted over the teletype immediately. Each radio station broadcasts its own weather and that of adjacent stations.

One of the most interesting and not the least important duty of the observer is the taking of pilot balloon observations. These observations are taken four times a day for the purpose of determining the direction and velocity of the winds aloft. This information is very valuable to the airman insomuch that he can plan to fly at levels where the wind is most favourable. Pilot balloon observations are also made at night, lanterns lighted with candles or electric lights are attached to the balloon and followed in flight through a specially constructed theodolite.

All observations as well as the upper air data obtained by pilot balloons and aeroplanes are assembled at each of the forecast centres and analyzed according to the Norwegian methods, and forecasts issued for the portion of the route for which each centre is responsible. These forecasts, generally valid for a period of about eight hours, give the weather expected at the terminal stations and on the route, together with an estimate of the wind velocities and directions at the flying levels. The pilots are also informed whether icing conditions are likely to be experienced, where they may expect to cross fronts, if any, and the type of weather that is likely to prevail during the crossing.

It is the duty of the observer to watch the weather very carefully and if a decided change takes place between the hourly sequences he must send in a special observation. This again is broadcast to the pilot.

In addition to issuing forecasts, the forecasters at each of the centres are always on duty to discuss the weather situation with the pilots and dispatchers before they plan their trips, and for consultation with anyone requiring weather information.

When Dr. Patterson was in this city a few days ago he intimated that it was the intention to do all forecasting for Alberta and part of Saskatchewan from the Lethbridge station and that regional forecasts would be given, which means that instead of the forecasts for the whole of Alberta, this station will be giving detailed forecasts for much smaller areas.

KING MINE No. 3 SHAFT AND EQUIPMENT

By J. G. Ross and Staff in The Canadian Mining and Metallurgical Bulletin, July, 1939

A very interesting account of the sinking and equipment of a large mine shaft is presented by Colonel J. G. Ross, manager, and members of the staff of the Asbestos Corporation of Canada Limited.

This recently completed shaft, known as the No. 3, replaces a temporary shaft sunk by the company following the adoption a few years ago of underground methods of mining asbestos. The temporary shaft and incline were within the orebody, whereas the new shaft is located well outside the deposit.

Designed to permit hoisting of 4,000 tons of ore in 16 hours, with a generous allowance for delays, the shaft has five compartments, and is sunk to an initial depth of 1,150 feet. It is steel timbered, chiefly to eliminate the possibility of bits of wood getting into the finished fibre. The company's engineering and operating staff designed and supervised the work.

The work of collaring the shaft and of sinking through 65 feet of clay and boulder overburden was also carried out by the company, while the contract for sinking the balance of the shaft through 1,088 feet of rock was given to Messrs. P. Harrison and C. M. Beck of Val d'Or, Quebec. The contractors took over on July 8th, 1937, and completed their work, including cutting and timbering stations, on March 2, 1938, making the remarkably good time of 143 days for a shaft of this size. The shaft crew of 59 comprised a shaft captain, 45 miners, three hoisters, three deckmen, one mechanic, four timbermen, one hoistman, and one deckman.

Sinking of the shaft cost $84.79 a foot for labour, $35.28 a foot for explosives and other stores, $60.00 a foot for steel timber and its installation, and $6.30 a foot for drills and steel.

The skip-loading equipment consists of two measuring pockets, each with a capacity of seven tons of ore. The flow of ore into the pockets is controlled by two patented chain-gates, one gate being installed in each of the two upper chutes of the measuring pockets. The skips are of aluminium alloy construction, the weight of the skip being 7,485 lb. The permanent headframe is an all-steel structure, 140 ft. high, and is covered with asbestos-sheet siding. The hoists are completely equipped with safety devices, including Model "D" Lilly controllers which will automatically stop the hoist if the operator disregards warning signals. Large glass windows are provided in the control room so that the hoist operators may have a clear view of the control equipment from the hoist platforms. To illuminate the hoist room six 750 watt, 70 deg. angle, aluminium floodlight projectors are used.

UNIT SUBSTATIONS

C. G. LEVY

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Paper presented before the Montreal Branch of The Engineering Institute of Canada on March 16th, 1939

SUMMARY—Among present trends in distribution system design is the use of smaller substations, with tangible results in improved system characteristics and lowered system costs. Factory-built unit substations, being applicable to practically every type of system, enable this trend of design to be carried out with ease and economy.

In October, 1937, the output of firm energy by the Canadian Central station industry reached an all-time high, at a value which was very nearly equalled in December, 1938. This indication of the progressive nature of our country means that more use is being made of electricity by the industrial consumer who finds it instantly available and readily controllable, by the domestic consumer who finds that it saves his eyes and beautifies his home, and by the commercial consumer who finds that it enhances his

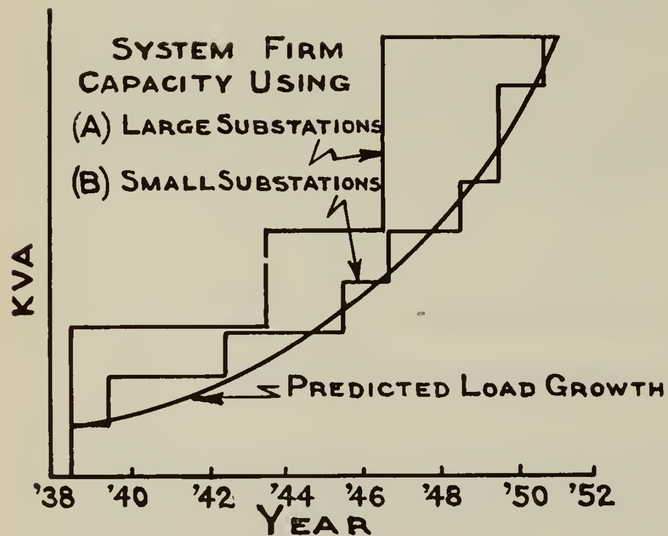

Fig. 1—Comparison of system firm capacities for predicted load growth

store and attracts customers. More use is being made of electricity because it relieves mankind of many burdensome tasks such as pumping water, cleaning rugs, polishing floors and washing clothes. In fact because of this greater use of electrical energy, mankind has more leisure time for cultural advancement and greater enjoyment of life.

As a necessary accompanying factor, however, increasing electrical loads represent real work for the utility engineers because they must modify and enlarge their system to supply the additional energy. If the load grows sufficiently, system changes will be required all the way from the massive generator in the power house to the unnoticed distribution transformer on the pole.

That is not an easy job, because Mr. Consumer has rightfully come to expect much of our utilities. He expects continuity of service so that his lights don't go out as he sinks into his favorite armchair and picks up his book for an hour or two of relaxation. Another thing he expects from this utility is proper voltage supply so that his lamps will give the correct illumination and efficiency for which they were designed, and at the same time, will not burn out too quickly. If he uses an electric range, he expects proper voltage so that it will operate with reasonable speed to have his meal ready on time. He expects continuity of supply and close voltage control because in the past he has been receiving them. In the future, therefore, the utility must provide these growing loads with at least the degree of service that prevails at present.

In addition to growing loads, there is another tendency which has become apparent in recent years, and that is the trend toward lower energy rates. All this means that our utility must paradoxically supply additional loads with a high degree of continuity and voltage control and at the lowest possible cost.

This trend towards increased use of electricity and lower energy rates has resulted in greater emphasis being placed on the design of electric distribution systems and has intensified one of the greatest problems facing distribution engineers. This is to provide a high degree of service and to do so at a cost which is in keeping with the financial returns.

There is one trend in distribution design which has resulted in better service at lower cost, but to assist in gaining a full appreciation of this trend, a brief review of the component parts of an electrical system is in order.

The output of the generator or generators is fed into a bank of transformers which increases the voltage in order that the energy may be economically transmitted to a point nearer the ultimate user. At the receiving end of the transmission line is a second bank of transformers which reduces the voltage to the sub-transmission level, at which value the energy is carried to the distribution substations. This sub-transmission voltage is generally between 11,000 and 33,000 volts. In the case of systems where the generating station is located close to the load, the transmission line is not needed, but in most systems distribution substations are used to reduce the voltage to 4,000 volts at which level the energy is carried along the streets to distribution transformers on the poles. The distribution transformers in turn lower the level to 115 volts, at which voltage the energy is used in the homes of the consumers.

While all parts of the system are vitally important, the remainder of this paper will be devoted to that section of the system which includes the sub-transmission line, (perhaps 13,200 volts), the distribution substation and the 4,000 volt feeders emanating from that substation. Particular emphasis will be placed on the distribution substation.

In the past, the necessity for manual supervision has meant that large substations with radial feeders were built to serve a large area. Since it was not economical to have an operator at each of a number of small substations, large substations with large transformer banks were used, having many heavy feeders emanating radially into a large territory. This necessity for serving a large area from one substation required the use of feeders, some of which are long, some short, some of which carry heavy loads and some of which are lightly loaded. Varying length and loading has meant that it was necessary to use induction voltage regulators on each feeder, in order to keep the voltage at its proper value day and night, and thus assure every consumer of proper voltage supply.

In the past these radial substations have done an excellent job in supplying energy to many consumers, but now as loads grow and existing facilities become overloaded, it is necessary for distribution engineers to consider the possibility of a better way to supply energy, and so often a decision must be made as to whether a new large radial substation should be built or whether other methods should be adopted. When this decision must be made, there are a number of factors to be considered. For instance, before building a large station, possible load growth in the future must be accurately predicted so that this large station can be placed near the centre of that load. If it is not, the long feeders which are necessary cause excess voltage drops and unnecessary losses. When large transformer banks are used, capacity must be put in, sufficient to take care of future, rather than present loads and excess capacity even over the value of the future load must be installed in order to provide for possible emergency conditions, that is, when some of the equipment may be out of service. Thus, by providing large capacity to take care of future loads and to act as a spare in case of emergencies, it is necessary to invest a considerable amount of money in this large substation. If the investment is considered on the basis of the cost per kva. of the load carried at present, which after all is a very reasonable way to consider it, the costs are quite high.

There is a method which will reduce the system cost, however, and that is the use of smaller substations. This has become possible in recent years because of the development of unattended stations, so that now it is by no means necessary to keep an operator at each station. Rather than using one large station to serve a given area as shown in Fig. 1A, it is now possible to locate smaller substat ons nearer the load as shown in Fig. 1B, so that advantage is taken of the economy of transmission at a higher voltage. That is to say, the energy is carried at 13,200 volts right to the load centre rather than being carried to a large station at 13,200 volts and then the rest of the way at 4,000 volts. This means that expensive runs of 4,000 volt conductor of heavy cross-section are done away with resulting in an improvement in voltage conditions and reduced losses because of the lower current necessary at the higher voltage. With the substation located at the load centre, feeders need be but a fraction of their former length, and those emanating from one substation, being in the same load area, are more likely all to carry the same type of load. With shorter feeders, more uniformly loaded, use can be made of regulation with its economy over individual feeder regulators. Bus regulation simply means that one piece of voltage regulating equipment is used for all the feeders coming out of the substation rather than using one set of induction voltage regulators on each feeder. This results in a saving in cost.

Earlier in this paper, increased service continuity was mentioned. It can easily be seen that if any faults occurred on one of these short feeders, only the consumers con-

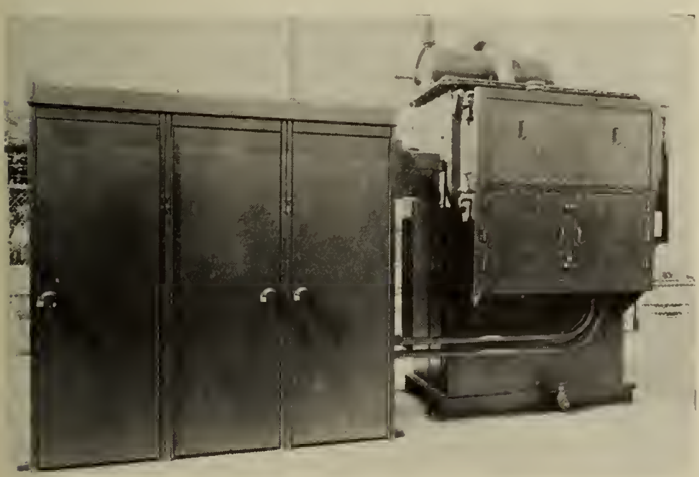

Fig. 2—A 1500 kva. 60 cycle, unit substation

nected to this one short line would be affected, whereas if the long feeders were used, a fault would mean the dropping of the complete load on that feeder so that many consumers would be affected, with resultant loss of convenience to the consumer and a loss of load to the utility.

With a large radial substation it is necessary to predict load growth so that the substation can be built near the anticipated centre of that load. It is easily seen that this is not necessary when small substations are used, because an additional substation can be added when and where the load develops without the necessity of running a long 4,000 volt feeder with its attendant voltage drops and energy losses. With a large station, it is necessary, also, to install sufficient capacity to take care of future loads. Here again it can be seen that with the small substations it is only necessary to add additional units when the load develops. Fig. 2 further illustrates this point. An area was considered in which it was expected that the load growth would increase along the curve shown. This meant that with the conventional radial system, it was necessary to install large blocks of capacity to keep in advance of the actual load, whereas with smaller substations, capacity can easily be added but a short time in advance of the expected load. The prediction of load growth is one of the most difficult tasks with which the distribution engineer is faced. No matter how much foresight is used, it often happens that the load growth does not develop as anticipated, and due to the increased popularity of one neighborhood over another, or to other factors which cannot be foreseen, this load growth may level off rather than increase. Suppose this happens between 1947 and 1948 on the curves. In this case the conventional radial substation would have tied up in it a large investment which would not be necessary to serve the load and which would only mean additional cost of system operation with no corresponding financial returns. Using smaller substations, however, if the load growth does level off, the only change from expected plans will be that further units will not be purchased. In this way a considerable investment will be avoided and system carrying charges will not increase.

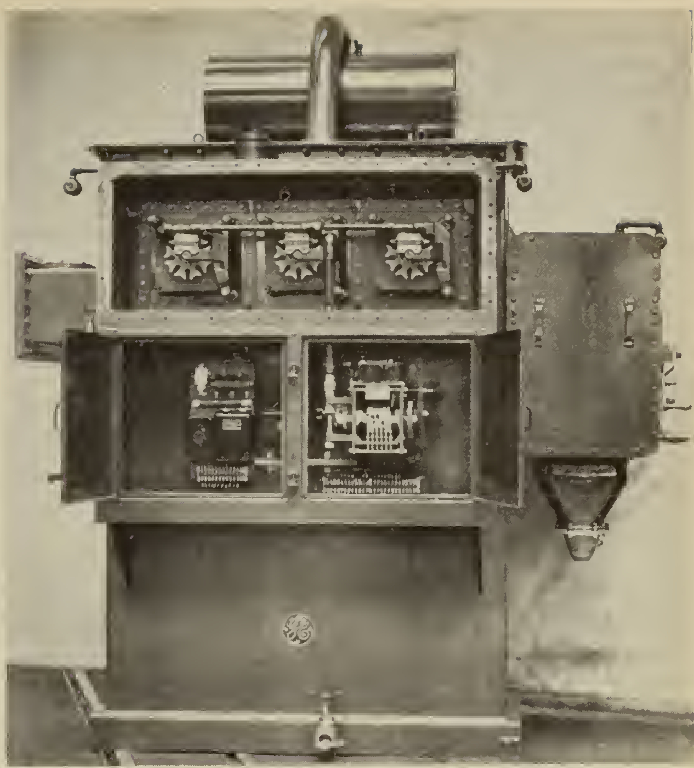

Fig. 3—The transformer section of a unit substation showing the load ratio control equipment

There is another point to be considered which is not shown, and that is the fact that these curves represent firm capacities, and do not show the excess capacity which it is necessary to keep on hand for emergency conditions. It so happens that this extra capacity is a relatively large percentage of the conventional radial system capacity, while with small substations this capacity need not be so great, because these small substations are applicable to types of systems which inherently have reserve capacity.

Factory Built Substations

The above gives the reasons why the modern trend in distribution system design is towards the use of smaller substations. In order to meet the demand which has grown up for these small substations at a minimum cost and in a form which can be readily specified and easily installed, the manufacturers have developed the unit substation. Unit substations have taken many forms with many different kinds of connections, and Fig. 3 shows a typical installation. This substation, the same as many which are in use throughout the United States, consists of a three-phase transformer stepping down from 13,200 volts to 4,330 volts. In order to utilize the economy of increased capacity through air pressure cooling, this transformer could have been quipped with cooling fans installed on the outside to give a capacity of 2,000 kva. as against the 1,500 kva. capacity when the fans are not used. In order to take advantage of the economies of bus regulation rather than regulation of each individual feeder, this transformer is equipped with "load ratio control," sometimes called "tap changing under load." By this means, constant voltage may be maintained regardless of the variation in the supply voltage and regardless of the load on the feeders. This allows greater flexibility in the design of the sub-transmission system, in addition to affording economies over individual feeder regulators. The transformer low voltage leads are connected through a throat to the switchgear unit on the left. Inside this switchgear unit are the feeder breakers with their necessary relays for over-current protection and for reclosing, so that for faults of a temporary nature service will be automatically restored in a few seconds.

Figure 4 illustrates the transformer part of a similar unit substation, with the load ratio control equipment visible

Fig. 4—The interior of one circuit breaker compartment

in the open compartments, and Figure 5 shows the inside of one of the breaker units in a somewhat similar unit. Visible are the breaker, current transformers, and gang-operated and interlocked disconnecting switches. The latter are in a separate compartment from the breaker in order to remove the possibility of accidental human contact with them.

Figure 6 is an outside view of a unit substation which steps down from 33,000 volts, brought in by cables terminating in a cable entrance box on the right hand side of the transformer, to 2,300/4,600/8,000 Y volts for the distribution feeders which consist of underground cables. At the right is the transformer with its cooling radiators, its load ratio control equipment mounted on the side, and the conservator mounted on top for protection of the oil. The loads are brought through the throat connecting the transformer and switchgear assemblies, and inside the latter are one transformer breaker, four feeder breakers and the necessary

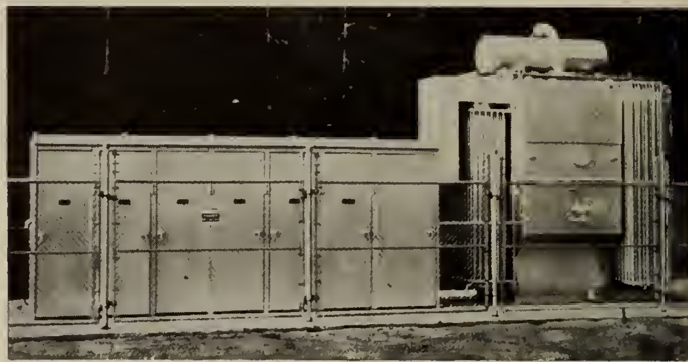

Fig. 5—A 3000 kva. 60 cycle, unit substation with five circuit breakers

relays, breaker operating mechanisms and auxiliary equipment. It can be seen that this substation harmonizes well with its surroundings and, in addition to its neat appearance, provides safety to the public because no live parts are exposed.

Compared with a conventional small outdoor distribution substation, these unit substations take less space and thereby reduce real estate charges. When leads are brought through cables into cable entrance boxes, the complete metal enclosure and the neat appearance allow them to be installed in a residential district without the expense of a building which might otherwise be necessary. Unit substations may be easily ordered because one specification will cover the complete unit without the necessity of ordering many small pieces of equipment such as transformers, induction voltage regulators, circuit breakers, current transformers, and disconnecting switches. Duplicate units may be even more quickly ordered. Installation of a unit substation is a relatively simple matter since it is only necessary to prepare a concrete pad with incoming cables, place the transformer in place and the switchgear unit in place, connect them together and to the cables, and the unit is ready for final inspection. Overhead lines rather than cables may be used when complete metal enclosure is not required.

If the load shifts, it s a relatively simple task to move the unit substation to a new location. Compare this with the effort of moving a conventional outdoor station piece by piece or of rendering obsolete an existing brick housing and building another one.

Application

Unit substations are applicable to almost every type of system. Figure 7 shows some of the various forms in which they may be used. No. 1 is a type which has been used in radial distribution systems. The power comes in at 13,200 volts, is stepped down to 4,000 volts and is fed out to a radial feeder which has no supply on the other end. This type of unit is often used to serve small suburban loads. No. 2 represents the type of unit substation which is used in the primary network. It consists of a transformer with load ratio control, a transformer breaker and four feeder breakers. As the term primary network may not be familiar to all, it will be explained later in more detail. No. 3 shows the type of unit substation which may be used to serve a load consisting of three feeders, and supplied from two transmission circuits. This arrangement is sometimes known as a "spot" network and provides increased continuity of service over a straight radial system because on the failure of one primary feeder, the whole load may be carried by the other feeder and its associated transformer. No. 4 shows practically the same unit, but in this case the transformer circuit breakers are on the high voltage side of the transformers, and the substation is suitable for application to a circuit in which the power is fed to a number of such units located in a loop. If any one part of the primary system fails, that part may be isolated by the opening of the breakers and power will then be fed around the other way in the loop. In the case of No. 3, the reactance of the transformers serves to limit the short circuit current which the breakers may be required to interrupt, while in the case of No. 4 this is not true. Therefore, the breakers of No. 4 must have a higher interrupting rating, and are more expensive. Number 5 shows a similar arrangement, except that in this case there is only one transformer. Number 6 shows an arrangement of unit substations to form a radial distribution substation. In this case, the primary power supply comes from three separate sources, so that if any source fails, the total load of the 9-4-kv. feeders may be carried by the other two transformers with their associated source of supply. This is a means of maintaining service even when a fault occurs on one sub-transmission feeder as would be the case with an overhead feeder if lightning were to strike that feeder.

These diagrams have all been simplified to the extent that the load ratio control is not shown. This equipment is being used, however, in practically every case.

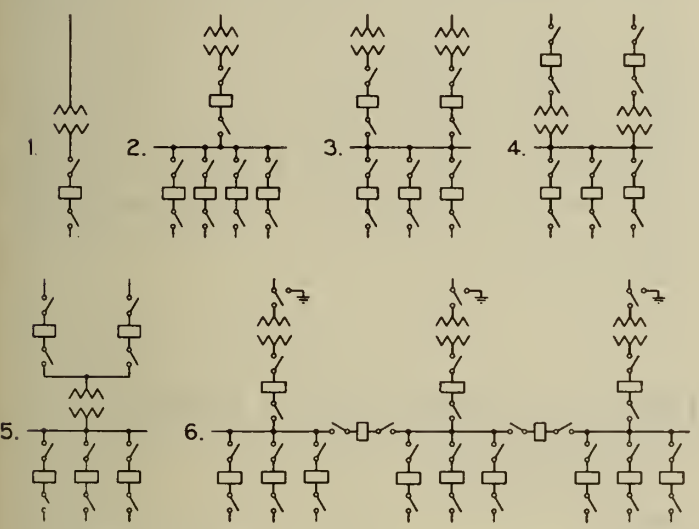

Fig. 6—Some of the forms in which unit substations are used

Primary Networks

Unit substations have been supplied in all of the above forms, but practically fifty per cent of the units sold have been of the type shown in No. 2 and are used in the primary network system. Figure 8 shows a simple, three-dimensional sketch of a small three-unit primary network. It will be noticed that there are three sub-transmission lines coming from the receiving station at say 13,200 volts and stepping down through three unit substations to the 4,000 volt network system. There is some similarity between this primary network and the more familiar low voltage secondary network which is used in the downtown sections of many large cities. The latter, however, consists of transformers, usually supplied at 13,200 volts, stepping directly down to 120/208 Y volts. This low voltage secondary network system provides the very maximum of service continuity and good voltage conditions in a heavily loaded downtown district, but for application in the less heavily loaded residential districts, becomes too expensive. It was to overcome this expense, and still give a high degree of service, that the primary or medium voltage network was developed, and is in successful use in the residential and industrial sections of such cities as Boston, Brookline, Cambridge, Philadelphia, Louisville, Rochester and many others. Whereas the low voltage secondary network parallels the transformers at 120/208 Y volts, the primary network parallels them at 4,000 volts, to form a network of 4,000 volt feeders to which the distribution transformers are connected.

Compared with the older radial systems which have been used to supply these residential and industrial loads, the primary network system will provide better service, that is, it will give closer voltage control and improved continuity. Due to local conditions, the primary network cannot be applied to every distribution system at a lower cost than the radial type of distribution, but in most locations considered it will show a saving in addition to having better operating characteristics. Savings have been reported in some cases as high as 20 per cent over the radial system.

Voltage conditions are better with the primary network system because each feeder is supplied from both ends. If the voltage conditions along a 4,000 volt feeder are represented by a long flexible, steel rod, then the effect of a radial system with the feeder supplied at one end only, is obtained by holding the steel rod firmly at one end. When this is done, it is found that the far end of the rod, representing the voltage level at the end of the feeder, sags considerably. The effect of a primary network is obtained by holding the steel rod at both ends and the resulting sag in the middle representing the maximum voltage drop is seen to be only a fraction of the former sag.

This analogy works out in practice, where it has been found that the variation in voltage along the feeder will be very small. The dips due to motor starting current will also be small because that starting current is fed from two or more sources in parallel rather than coming through a long radial feeder.

The primary network gives improved continuity so that lights don't go out and electric clocks don't stop. This is true because any fault on the 13-kv. sub-transmission system, in the case of this small network we are considering, will drop out one transformer by the opening of the transformer breaker, thus leaving the network itself connected to the remaining two sources of supply. These are designed to have sufficient capacity to carry the total load. In addition

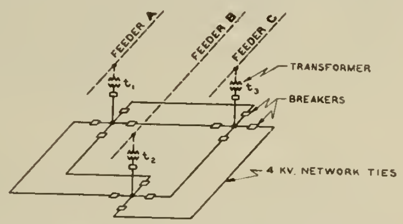

Fig. 7—A three unit primary network

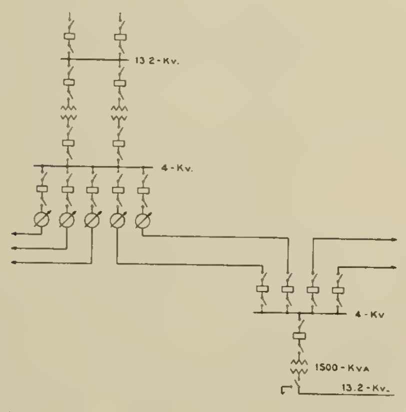

Fig. 8—Relieving an overloaded conventional substation

to this, the 4-kv. feeders are much shorter than in the radial system, so that if a 4-kv. fault occurs, considerably less load will be dropped, because the breakers at each end of the faulty section will open to isolate that section from the rest of the system.

The primary network in most locations has a lower cost, because long and expensive 4-kv. express feeders have been done away with, and 13-kv. feeders with smaller cross-section conductors have been used in their place. The small size of the substations means that small inexpensive lots may be purchased and, where this is not possible, the units may be located underground. As explained before, units may be added when and where the load grows, thus avoiding the necessity for accurate load predictions, and avoiding the loss if the actual load does not grow as predicted. In many cases the use of a primary network system will remove the necessity for replacing overloaded 4-kv. copper since the current in a conductor will be considerably less when the load is fed from both ends. Low losses are an inherent feature of the primary network, partly because of the increased transmission at 13-kv. rather than 4-kv. and partly because each small feeder is fed from both ends rather than one end.

In some locations, due to local conditions, a modified radial system, that is a radial system using small substations, will be less expensive than the primary network, but in practically all cases, both are considerably less expensive than the conventional radial system, and both give better service.

For areas of low load density, unit substations with one feeder breaker have been used in a modified form of primary network. In this network all 4,000 volt lines are connected solidly together and faults are allowed to burn themselves clear. The only relaying consists of reverse power so that a faulty sub-transmission line is cleared, while there is no overcurrent relaying for 4-kv. faults.

In some cases, an abrupt change is made from an existing radial system to a new primary network system, but in most cases primary networks are started more gradually. Often a start is made as shown in Figure 9 when it is necessary to relieve an over-loaded radial substation. In this case, energy is brought into the conventional substation at 13,200 volts by two sub-transmission lines, and is stepped down to 4,000 volts at the substation bus. From there it goes through individual feeder regulators out through, in this case, five feeders. Assuming that the two righthand feeders are at present overloaded, then some means must be taken to relieve them. The unit substation forms an ideal means of accomplishing this end, for by supplying additional power at 13,200 volts to a 1,500-kva. unit substation and feeding this power in at approximately the centre of the overloaded feeders, the overloading is removed, voltage conditions are improved, and a start is made toward a primary network. As load grows, additional unit substations may be added and tied in with the present station and with the unit substation which is already installed, thus forming a primary network and providing both the operating company and the consumer with all of the benefits incident to this type of distribution.

It is because of these advantages that one user of the primary network said, "A study of the above factors (these advantages) shows quite definitely such a decided superiority of the network over the radial system of distribution with regard to economy, simplicity, continuity of service, voltage regulation, standardization of equipment, provision for load growth, etc., and adaptability to areas of any load density, that whenever it becomes necessary to make any extensive changes in the existing distribution system or plan a new system, careful consideration should be given to the possibility of installing a 4,000 volt network."

That is the statement of a user of the primary network system. While there are others who do not quite share all his views and enthusiasm on this subject, practically everyone agrees that small substations should be used whether their application be in a radial system or in a network system, and in either system the unit substation combines neatness of appearance, safety to the public, and low installed costs.

THE INFLUENCE OF TECHNICAL PROGRESS UPON SOCIAL DEVELOPMENT

KARL T. COMPTON

President of the Massachusetts Institute of Technology, Cambridge, Mass.

Paper presented before the Seventh International Management Congress, Washington, D.C., September 21st, 1938

That our national health, prosperity and pleasure largely depend upon science for their maintenance and their future improvement, no informed person would deny." This opening sentence in the 1935 report of the Science Advisory Board to President Roosevelt epitomizes the judgment of that body of fifteen prominent scientists, engineers and medical experts on the present day influence of technical progress upon social development.

It is not only scientists who hold this view. Nineteen years ago the American Federation of Labor expressed the same conviction in the following resolution.

"Whereas, the increased productivity of industry resulting from scientific research is a most potent factor in the ever-increasing struggle of the workers to raise their standards of living, and the importance of this factor must steadily increase since there is a limit beyond which the average standard of living of the whole population cannot progress by the usual methods of readjustment, which limit can only be raised by research and the results of research in industry:

"Resolved, by the American Federation of Labor in convention assembled, that a broad programme of scientific and technical research is of major importance to the national welfare. . . . ."

Facts in support of this thesis are overpowering. Eighteen of the new industries which have grown directly out of scientific research within the average lifetime of those here today provide one-fourth of all the employment in the United States. The majority of the products now manufactured by electrical companies were unknown fifteen years ago. It is estimated that ninety-five per cent of our chemical industry is based on fundamental discoveries made in university laboratories. A report of the Brookings Institution outlines the basic procedure necessary for economic recovery as the application of scientific methods to improve quality and decrease cost of production and to develop new products. It says that the basic necessity is to encourage science, encourage capital, and remove the artificial restrictions of regulations. Even in agriculture, perhaps the oldest of man's arts, technology has created new markets by developing transportation and storage facilities, has met the threats of food shortage for expanding populations by technical improvements in soils, seeds and farming methods, and is seeking to develop new industrial uses for farm products in order to use the surplus which can now be produced.

So I could continue to quote fact and expert opinion, but I think this is unnecessary. We may accept the fact that technology has created enormous employment and wealth, has vastly increased opportunity and has greatly reduced the hazards of sickness, famine and suffering. If all this be granted, however, there still remain many aspects of the influence of technical progress upon social development which challenge attention. I shall mention briefly four of these aspects.

(1) *The Bogey of Technological Unemployment.* In recent years much discussion has centered around technological unemployment,—the loss of work due to obsolescence of an industry or use of machines to replace workmen or increase their per capita production. Are machines the Genii which spring from the Aladdin's Lamp of Science to supply every need and desire of man, or are they Frankenstein monsters which will destroy man who created them ? Startling examples of both viewpoints can be given. I shall only try to summarize the situation as I see it, as follows:

If we look at industry *as a whole,* without inquiring into particular cases, we conclude that technological unemployment is a myth, because statistics show no decrease in the fraction of our population gainfully employed during the last few generations in which machine production has become important. This is because technology has created so many new industries and has so greatly increased the market for many commodities by lowering the cost of production to make a price within reach of large masses of purchasers.

In individual instances, however, technological unemployment may be a very serious social problem,—as in a town whose mill has had to shut down, or in a craft which has been superseded by a new art. Here the fact that technological unemployment does not exist as measured by overall statistics is of small comfort to the families whose wage earners have lost their jobs.

I believe that two principles should guide us in these matters. Improved products and services should be made available to the public, and not forcibly estopped to protect any entrenched business or any group of workers who would be thrown out of jobs by the change, but with this proviso: the change should be made in a manner to afford generous protection to the workers affected by it. This is a definite job for management, in which efficiency should be tempered by humane considerations (an attitude which, I believe, makes for real efficiency in the long run).

Various methods are available for reducing the shock of technological changes, such as retraining workers, gradual change-over to fit the normal turn-over of personnel (as followed by the telephone companies in introducing automatic switching), pensions and unemployment insurance, efficient employment agencies for labor exchange, cooperation between industries of a community to synchronize layoff in one company with new employment in another, etc.

In any case, I believe that the fundamental criterion for good management in this matter, as in every other, is that the predominant motive must not be quick profits, but best ultimate service of the public. This is a topic in itself which deserves much elaboration, but I must leave it to your own thoughts for interpretation and application.

(2) *Technological Progress and Culture.* In discussing the influence of technical progress upon social development there is a natural tendency to emphasize only the material products of technology, forgetting that social development is more an intellectual and spiritual than a material process, and overlooking the influence of technology on the cultural aspects of society. What, therefore, is the cultural influence of technology ?

The first point which strikes one, in a long range view, is that man's achievement in every age has been made possible by, and limited by, the tools at his disposal. These limitations are, in fact, recognized in the names attached to the various stages of civilization, such as the Stone Age, the Bronze Age, or the Age of Steel.

The second significant fact is that technical progress has created opportunities for cultural development, by affording the necessary time and facilities. In the ancient "golden eras" when art, literature, law and philosophy made great advances, these were possible because the Egyptians, Greeks or Romans possessed slaves or, in the Renaissance of Europe, serfs, who performed the menial tasks and produced the wealth which gave time and energy for intellectual and artistic pursuits to a fortunate few. Granting the intellectual greatness of Aristotle, his achievements were certainly enhanced by his freedom from ordinary work and by the services of ten thousand research assistants, put at his disposal by King Alexander to bring him information of all sorts from all parts of the world.

In our day and generation, machines and mechanical power have taken the place of slaves in producing that large per capita productive power which makes possible time and money for education, recreation, pensions, short hours of labor, literature and news from all parts of the world, and travel. In the United States the mechanical power used is equivalent to an average of the full time work of fifty slaves for each person.

Thus technical progress has afforded opportunities for cultural improvement. To some extent these opportunities have been utilized advantageously. We wish they were utilized better, and this again is a challenge to management, as well as to education and religion.

(3) *The New Demands on Technology.* A survey of present day social problems discloses some very definite directions in which technology can assist toward their solution.

Some millions of people want work,—respectable, creative, remunerative, permanent employment, and not temporary makeshift jobs or doles, or the dangerous device of producing war materials beyond reasonable requirements for defense.

All, including I believe the administrators of the great relief agencies, and with the only possible exception of a few selfish politicians, would like to see it possible for the government to withdraw from the business of unemployment relief through the creation of new employment in the regular channels of industry, agriculture and commerce. The ideal goal is reduction of federal relief, as rapidly as regular employment can take up the slack, down to a minimum which will take care of unavoidable cases of technological unemployment in the transition period between jobs and will use this labor in the improvement of the public services and facilities for which the government is responsible.

Floods, droughts, dust storms and encroaching soil erosion have focussed attention on needs for safety and conservation on a very large scale. Acts of Congress and studies of the National Resources Committee attest the concern over problems of this type.

Without giving more examples, perhaps we can summarize by saying that the unemployed want work; industry wants profits; agriculture wants new uses for its products; national resources ought to be more wisely used; natural hazards should be curtailed; labor wants shorter hours and higher pay; all the people want more wealth, lower income taxes, better health and comfort, additional facilities and commodities.

Every one of these desirable social developments can be realized only through the action of two forces, the force of better technical developments and the force of better management. Better technical developments call for scientific and engineering research, training of research workers, adequate funds and facilities, and time. Better management, whether in business or in government, provides adequate attention to scientific research, and requires better understanding of problems, wiser formulation of policies and greater efficiency in their execution. How to achieve such things is, I believe, the greatest of all the problems before this Congress.

(4) *Principles of Management.* You, the members of this International Management Congress, are experts in man-

agement, whereas I am by profession a scientist. My few years of experience as executive officer of an educational institution do not qualify me as an expert in management, for college faculties manage themselves and college trustees manage the business. From time to time a college president may be like a drop of oil in the machinery, or a flashlight in the dark, or a signpost at the crossroads, or a dentist in his office, or a prophet crying in the wilderness. But, when things are as they should be, there is no friction to require oil, no darkness to require light, no bad teeth to be extracted, the faculty already knows the best way at the crossroads, and everybody is exploring the wilderness. So I cannot presume even to suggest how management problems can best be understood, wise policies formulated and efficient execution assured. At most I can only venture to suggest certain general principles of management which seem to me to be fundamental.

The first of these is that management is an essential attribute of decent group life. Without it there is chaos, discord and ineffectiveness. Without it there is no security; and complete freedom from controls does not give liberty but rather the worst of all subjugations, anarchy without protection. But with management comes orderly procedure and directed coöperative effort so that the group becomes greater than the sum of the individuals which compose it. Undoubtedly the increasing complexities of modern life, due largely to technological progress, require a continually increasing degree and quality of group management.

The second principle is, at first glance, the antithesis of the first. It is that wise management involves the minimum of control and supervision consistent with reasonably smooth, coördinated and properly oriented operation. It is an evolutionary principle that, as individuals or groups grow in their ability to accept responsibility, the controls imposed on them are relaxed in order that they may accept and discharge responsibility. In this manner they develop their own powers and increased the contributions which they can make to their social group. This is a basic principle in training young animals and children, in training young executives and in developing divisions of an organization.

The greatest of all management problems today is to determine the most advantageous balance between these two principles. How much management should be exercised and to what extent should it be centralized ? The question arises in business and in government.

In industrial organization, in America at least, the pendulum is swinging definitely in the direction of less centralization of management, as well as of capital and of operating plant. The reason is that experience has shown too great centralization of control to be inefficient and also hazardous. The great desire of business now is to develop personnel who can wisely discharge responsibility and take initiative, rather than to depend upon an army of obedient hard-working, but unimaginative employees taking orders from the boss.

Large groups always evolve more slowly than small groups, so it is not strange that governments in many parts of the world today are rapidly moving in the direction of increasing the scope of management and its greater centralization, sometimes even into the hands of one individual. This was the trend of our industrial organizations a couple of generations ago. A fair evaluation of this tendency in governments discloses that it has in many cases come about from natural causes, such as insoluble complications resulting from the great war, or the previous relaxing of controls before a perplexed people had developed the power to accept the concomitant responsibilities, or for other reasons. As was the case in overdeveloped industries, the dangers in this movement in governments lie in such factors as present or future mismanagement on a large scale, disregard of the rights of other groups in the confidence and ambition of their present strength, failure to develop enough independent leadership within the group, inefficiency and inability to secure any true evaluation of results or policies because of suppression of criticism.

The dangers confronting the less centralized democratic governments, on the other hand, are likely to be indecision in crises, inconsistency of policies, inefficiency in operations continual necessity of compromise between groups. We of democracies, however, believe that in the long run there is strength even in these apparent weaknesses, because they guard against rash actions, they develop the average intelligence and responsibility of the whole population and the whole setting encourages individual development and free enterprise. We find justification for our belief in the record of economic prosperity, high standard of living and fundamental happiness of the people in those countries where democracy has been a spontaneous development from within, not imposed from without.

There are very important questions of management on a large scale facing most of the people of the world today. Our brethren in some countries are putting their faith in the highly centralized management of dictatorships and authoritarian states. Our brethren in other countries, and we in America, have put our faith in a form of government definitely designed to serve and not to manage the citizens and to give maximum opportunity for free initiative and free expression. This situation offers a great opportunity to watch the results of the two sharply contrasting theories of management as an experiment on a colossal scale. God grant that our observation of this experiment be not interrupted by any action that will do irreparable damage to all people in both groups.

My final suggestion of a principle of management is the outgrowth of my contacts as a scientist. Experience has amply demonstrated a fact that, at first sight, seems surprising. It is that the most significant technological advances have not come out of direct efforts to make them, however well organized, but as unexpected by-products of scientific work undertaken for quite other objectives,—usually for the satisfaction of scientific curiosity. Organized, directed effort is very effective in perfecting the details of a product or its production, but not in its initial discovery. This contrast is greater the more epoch-making is the new discovery.

The logical reason for this is not hard to understand. Really epoch-making discoveries are relatively unpredictable in advance. The practical solution to a difficult problem may come from any one of a multitude of directions. Really new ideas do not come to order, and are not pulled out of a hat, and who can tell in whose brain they will germinate ? If an industrial research laboratory had been established a century ago to improve lamps, it would have investigated inflammable oils and gases, wicks, chimneys and refractories. Not conceivably would it have paid attention to the leakage of electric charges through the air or to the behavior of magnets, wires, acids and frogs' legs. Yet from these actually came the modern lighting devices.

I believe that the same logical and psychological principles operate in the field of management generally. A highly centralized and organized form of management may be very effective in performing the specific functions assigned to it in the manner stipulated by headquarters, but it is not a favorable type of organization in which to take advantage of the potential genius inherent in the group which, if given opportunity, may produce better leadership, develop more advantageous objectives and more effective operations.

So I believe that experience, logic and human psychology all support the view that that type of management is most likely to be successful in the long run which directs and inspires but does not too rigidly control, which offers large opportunity for initiative and for criticism, which has faith in the mass judgment of an intelligent group and in the genius which may appear in unexpected quarters. It is qualities like these which are basic to the type of management which has found favor and success in this country, in the home, in business and in the organization of our government itself.

Abstracts of Current Literature

Contributed articles based on current periodicals, papers and events

THE BROWN-BOVERI TESTING APPARATUS FOR GEAR WHEEL MATERIAL

By A. Meldahl in Engineering, July 21, 1939

Abstracted by R. H. Field, A.M.E.I.C.

The straining of gear wheel material is unique in many respects, and the stresses involved are high. The Hertz formula, applied to the tooth faces of turbine gears, gives stresses of 200 to 250 tons per sq. in., while in automobile and aeroplane practice values up to 500 tons are reached. As, in addition to the rolling, there is a considerable amount of sliding (the velocity of which may reach 50 ft. per sec.) it is an astonishing fact that ordinary steel surfaces, neither hardened nor polished, will stand such treatment, provided they are sufficiently lubricated. The reason suggested is that the contact time for every point is very brief, and before the next contact it is adequately cooled and lubricated. Blok has shown that the temperature of gear teeth may rise by 100 deg. F. during the passage through the point of contact, giving evidence of stresses of such magnitude that failure would be rapid if they persisted. From all this it follows that comparison with other branches of engineering is of little avail to the gear designer.

Small gears may be tested to destruction, and experience gained thereby, but this practice is undesirable in the case of expensive turbine gears, which, moreover, must have a much greater life expectation than gears used in automobile or aero engines. Accordingly, a fairly simple apparatus was designed whereby test specimens of different materials could be subjected to treatment similar to that experienced by a gear tooth. The specimens are cylindrical in form and are shrunk on two parallel shafts. Sliding is accomplished by fitting eccentric involute gear wheels to the shafts. One test piece then runs at a constant speed while the other leads through one-half turn and lags through the other half turn, thereby simulating gear tooth action, e.g., on a driving face the sliding motion is always away from the pitch line. Hence the corresponding arcs of the specimens are called "addendum" and "dedendum."

While the tests so far reported are stated to be incomplete, a few results are given. Carbon steel, nickel steel and chromium steel were tested at 1,000 r.p.m. under a load of 1,700 lb. per linear inch. Pitting occurred very soon, but only on the dedendum arc, and even when the pressure was increased by making specimens with the addendum arc less than half the width of the dedendum arc, no trace of pitting was observed on the addendum arc. Later, new coupling gear wheels were fitted, having 12.5 per cent eccentricity in place of the original 9.4 per cent and the behaviour of the test pieces was entirely different. Softer specimens now seized within 15 to 30 minutes in the zone of maximum sliding, in place of lasting several hours, and both test pieces were equally attacked, there being no difference between the behaviour of the addendum and dedendum arcs.

However, with test pieces of different hardness seizing generally took place between the dedendum arc of the softer and the addendum arc of the harder piece.

It was found that when a pitting crack developed, the material in the pit seemed to be lifted out bodily. Careful running-in seemed to prevent seizing, and the use of more viscous oil (cylinder oil) gave the same result, while the use of transformer oil increased the risk of seizing. Moreover, very thin oil caused large pits (3/16 in. to 1/4 in.), ordinary turbine oil 1/16 in. to 1/8 in. while heavy cylinder oil reduces the size to 1/64 in. to 1/32 in. The pit size seemed to be the same for hard as for soft steels. No explanation is offered for these phenomena, but further tests are necessary and publication is promised.

The article is illustrated by photographs of the machine and of some test pieces as well as microphotographs of typical pitted surfaces produced in the tests.

FUNDAMENTALS OF COMBUSTION IN SMALL UNDERFEED STOKERS

By C. A. Barnes in Fuel in Science and Practice, May-June, 1939

Abstracted by A. A. Swinnerton, A.M.E.I.C.

Small underfeed stokers (60 lb. of coal or less per hr.) as used for residential heating have gained increasingly rapid acceptance during the last five years. They are widely used and can successfully handle all ranks of coal from anthracite to lignite.

Despite their successful adaptation to such a wide variety of coals, difficulties are encountered with certain types of coals. The solution of these difficulties has been hampered because only the overall results of the process of combustion have been known, and information on the details of the process of combustion within the fuel bed have been lacking.

The purpose of the investigation reported in this paper was to study the process of combustion in an underfeed stoker in the light of the present developed theories of underfeed combustion. It was sponsored jointly by Bituminous Coal Research Inc., and the Batelle Memorial Institute.

Combustion studies with a small underfeed stoker were carried out, using high temperature coke and bituminous Pennsylvania coal. Combined thermocouple and gas sampling probes suitable for use in stoker retorts were constructed by means of which it was possible for the first time to obtain, simultaneously, temperature and gas composition data at various positions in the fuel bed under normal stoker operation and at known overall burning conditions. New information was obtained on temperature gradients and maximum temperatures, position and extent of the zones of rapid burning, air penetration, ash and clinker formation, the effect of varying air rates, etc., all of which should aid in improving the design of stoker retorts. It is also expected that the increased knowledge of the combustion process will help in predicting the operation of underfeed stokers using other coals of known burning characteristics and will result in more efficient use of the fuel used.

The data that have been obtained lead to the following general conclusions:

1. The combustion of coal and coke in a small underfeed stoker is not a stable process even under the conditions of continuous operation. The burning rates for different portions of the fuel bed are continuously oscillating about some equilibrium value.

2. Combustion in the fuel beds of both coal and coke fires is not symmetrical with respect to the centre of the retort. At all normal rates of air supply there is an excess of air at the front of the retort and a deficiency at the centre and usually at the back also. Increasing the air rate increases the overfire air without necessarily improving the combustion in the fuel bed itself.

3. The maximum temperatures in the fuel beds of cokes were found in the centre of the retort and ranged from 3,000-3,100 deg. F. The maximum temperatures of the coals normally ranged from 2,400-2,800 deg. F. The zone of the high burning rate for the coals in one case extended as an annular ring around a cone of comparatively cool fuel at the centre of the retort and in the other varied from the centre to near the edge of the bed according to the channeling that existed at the time of measurement.

4. The thickness of the combustion zone ranged from 3½ to 5 in. for the coke and 3 to 9 in. for the coals. The ignition level for one coal varied from 2 to 4 in. below the top of the retort at the edges to well above the top of the

retort at the centre. The ignition level for coke was less curved and was generally near the top of the retort. Increasing the percentage of excess air decreased the thickness of the combustion zone and for coke raised the ignition level with respect to the top of the retort.

5. Fuel beds of different size lots of coal were practically the same, indicating that the removal of the finer sizes from caking coals does not materially affect their burning characteristics during periods of continuous operation.

6. The rate of heating of the surface of fuel fed to the ignition level during periods of continuous operation was computed at 250 deg. F. per minute. Rates of heating during the "off" periods were 100 deg. per minute at one-half inch to 20 deg. per min. at one inch below the ignition level. Any tendency for the more rapid rate of heating to give more and stronger coke during periods of continuous operation is offset by the higher burning rates and by the feeding fuel breaking up the coke formed. "Off" periods favour the formation of coke trees.

7. Underfeed stokers do not burn coal and coke strictly on the underfeed principle but on a combination of the underfeed, cross feed, and overfeed burning. Actually a very small percentage may be underfeed burning. The extent to which the different types of burning occur with any fuel has not been determined but is a function of the stoker design and of the feed and air rates.

8. Due to the variable extent of the different types of burning that occur in the retort of an underfeed stoker the overall operation cannot be predicted from the findings in an ideal fuel bed.

9. Coke may burn in an underfeed stoker to give a uniformly incandescent topped fuel bed or a fuel bed characterized by an area or areas of unignited fuel at the top of the bed near its centre.

10. Microscopic studies of unburned coke particles from remains of quenched fires show that in the cooler part of the bed, at the edge of the fire or above the ash and clinker zones, the combustible may be gasified so as to leave the skeleton structure of the ash behind. In the burning zones that have a temperature above that of the fusion point of the ash, the ash fuses and forms microscopic globules.

11. There is an optimum tuyere area for any particular fuel and desired range of burning conditions. Too large an area gives no proper control of the air admitted, and too small an area results in too high air velocities for the air entering the retort, causing undesirable clinker formation.

12. Considerable crushing and segregation occur between hopper and retort and there is considerable variation in the amount of fuel fed to different parts of the retort and these factors tend to non-uniform combustion. However, the selective sizing of stoker coals to narrow limits increases the cost and should be avoided if satisfactory operation can be obtained without doing so.

CLEANING OF COAL BY HEAVY LIQUIDS

Abstracted by A. A. Swinnerton, A.M.E.I.C.

M. G. Driessen in The Engineer, June 2nd and 9th, 1939

Before coal can be sold it must be separated from the undesirable constituents with which the coal, as mined, is inevitably associated. The process of cleaning the raw coal is termed washing, and this term may also be used to include dry cleaning by pneumatic methods. Until a few years ago coal was generally cleaned by water washing. More recently dry or pneumatic cleaning has been used but this type of cleaning is not discussed in this article.

Wet washing systems may be classified as follows: (a) Older systems, 1. Jig washing; 2. Rhéolaveur process. (b) Modern heavy liquid process, 1. Washing in homogeneous liquids heavier than water (Lessing Du Pont and Bertrand); 2. Washing in suspensions (Chance, Barvoys, Tromp, Staatsminjen-Loess).

Older Systems (Using Water Only)

Jig Washers. This system is still the most widely used in England and on the Continent. The raw coal consisting of a mixture of coal and shale is supported on a perforated plate and completely covered by water. The mixture of coal and shale is caused to rise and fall alternately by means of ascending and descending currents of water. By this means a partial classification, according to gravity, of the different materials is effected.

Rhéolaveur Process. As in the jig washer the layers of material to be separated are caused to be stratified and to lie one upon the other in order of descending specific gravity. The classification is not effected by a pulsating current of water but in a trough washer. In this system also those portions of the material with high specific gravity tend to collect in the bottom of the trough, and, as in the jig washer, in addition to the necessarily imperfect separation, there is also the difficulty of correctly separating the superimposed layers.

Heavy Liquid Processes

The basic principle of this group of washing processes is what is best described by the term "float-and-sink." In these processes the layers are completely separated in the wash box because the lighter coal floats on the liquid and the heavier shale sinks to the bottom. It thus becomes possible to separate the coal and shale by means of a scraper and bucket elevator or some similar device.

It is evident that a separating medium must be used having a density between that of coal and shale. Theoretically the simplest solution of this problem lies in the use of a homogeneous liquid.

This method has been applied in England by Lessing using calcium chloride solution as the heavy medium, in America by the du Pont Company using tetra-bromethane and penta-chlorethane; and in Belgium by Bertrand using calcium chloride solution. Although the principle may appear to be simple, difficulties arise due to contamination by the heavy and viscous liquids used and the necessity for the recovery of these washing liquids.

Of all the washing processes using a medium of high density only those using suspension have become established, and are in operation in several collieries. This is due to the fact that the dilute suspension formed by rinsing the cleaned material can be concentrated by thickeners.

The Chance sand flotation process is the oldest and best known of the washing systems operating with suspension. It is used largely in America and England. The wash box is in the form of a cone having its upper portion cylindrical. At different depths beneath the surface the cone is provided with nozzle rings by means of which an upward current of water is set up. This current is able to hold fine sand in suspension, and in this way creates a "heavy liquid" the specific gravity of which is regulated by the quantity of water admitted. In spite of all precautions, the suspension is not perfectly homogeneous and a completely static separation has not yet been achieved. The advantages of the system are the low viscosity, so that coal down to 1⁄16 inch can be treated, and the ease with which dilute suspensions can be thickened.

The Barvoys system has been developed in Holland and in place of the sand employed in the Chance process, a suspension of clay and barytes is used. The advantage of this suspension over the sand-water mixture is that the velocity of settlement of the clay and baryte particles is so small that no upward current of water is necessary to keep them in suspension. By comparison with the Chance process this system achieves a truly static liquor and static separation can be expected. To maintain the suspension only barytes needs to be added periodically as the supply of clay is maintained by that recovered from the coal.

The Tromp, another Dutch process, uses a rapidly settling suspension consisting of an aqueous dilution of finely powdered magnetite, the grain size being intermediate between that used in the Chance and Barvoys systems. This process uses a horizontal current flow in contradistinction to the vertical current in the Chance cone. The comparatively quick settling of the relatively large magnetite particles is used to obtain a higher specific gravity in the lower layers of the wash box. By this feature it becomes possible to separate the coal, middlings, and shale. This method has the advantage that magnetite is cheaper than barytes and the amount lost in the process is also less.

The Staatsminjen-Loess System, which has been developed at the Dutch State Mines, uses a material called loess in its suspension system. This loess is a sand-bearing clay which is widely distributed over the earth's surface. The important feature of this material is that the viscosity of a suspension having a specific gravity of 1.4 to 1.5 is very much less than that of a corresponding suspension of clay, which is so high as to prevent the satisfactory separation of coal and shale. The loess suspension is also sufficiently stable to require no upward current in the wash box. The coal and shale withdrawn from the washer carry away a quantity of the loess suspension, which is removed by rinsing. The diluted suspension is treated in a thickener of the cyclone type, in which it is possible to separate the sand grains from the clay suspension. The thickened sand suspension is then returned to the wash box with a lowered viscosity, which counteracts the increase in viscosity of the liquid in the wash box which is due to the admixture of clay introduced with the coal. In this way the wash box liquor is maintained at the required density and stability without a progressive increase in viscosity. The author claims, therefore, that the loess process combines the stability of the Barvoys suspension with the easy and selective settling of the Tromp process.

The reason for the introduction of these newer processes is that washing processes which are based on static separation, by means of a heavy liquid of prescribed density, yield the maximum amount of clean saleable coal with a definite average ash content.

FREON, A NEW COOLING MEDIUM

Le Genie Civil, September 17th, 1938

Abstracted by The International Power Review, May, 1939

Freon is a fluid which for some years has been tried as a substitute for the three cooling media most frequently used up to the present, in compression cooling machines, i.e., ammonia, sulphur dioxide and carbon dioxide. Freon may be considered as an ideal cooling medium.

The following notes are based on a lecture by M. Dénebaude.

The chemical formula of Freon is CCl_2: Fl_2:, i.e., it is dichlorodifluoromethan. Investigations concerning Freon have been started by the Belgian chemist, Swarts, who referred, in 1924, to the favourable characteristics of Freon. Systematic investigations carried out by Dr. Midgley, led, in 1930, to the final acceptance of Freon as a cooling medium.

Freon is a liquid between —15 deg. C. and +30 deg. C. at atmospheric pressure; its latent heat is 5.178 cal. per kg. at —15 deg. C. and 15.4 cal. per kg. at +30 deg. C.; the critical temperature is 111.7 deg. C.

The smell of Freon is faint and rather agreeable; the gas and the vapour are colourless; the vapour is incombustible and it does not form an explosive mixture with air. Freon has no irritating or toxic effect.

The leakage of Freon may be easily detected by leading the suspected air into the colourless flame of a special alcohol lamp through an orifice at the lower part of the burner. Near the flame there is a copper piece attacked by Freon, thus giving copper chloride and fluoride, which give the flame a special green colour. In this way a 1/1000th part of Freon in the air may be detected.

The production of Freon in the United States is based on carbon tetrachloride, acting on antimony trifluoride in a tank at a pressure of four kg. per sq. cm. Then the Freon is separated by fractional distillation to 98 per cent purity. Further purification is accomplished by treatment with sodium.

IMPROVED PERFORMANCE OF MACHINES AND TOOLS BY USE OF HARD CHROMIUM PLATING

By W. Pfanhauser in Fachzeitschrift Eisen, No. 18, 1938

Abstracted by The International Power Review, May, 1939

The chromium hardening of metallic surfaces is obtained by galvanic deposition of a chromium coating on the surface to be hardened. The surface hardness of the chromium approaches that of a diamond. Chromium coating resists wear and chemical influences; it is elastic and it may be applied in any thickness.

These features make the chromium plating process particularly suitable for surface hardening of gauges, shafts, journals, bearing bushes, valves, drills, cutters, etc.

Chromium plating increases the resistance to wear of the treated pieces and their life may be increased to 8 to 10 times that of non-treated tools. Even worn gauges may be reconditioned by chromium plating. In the case of tools, the chromium plating offers an additional hardness which increases the resistance to wear. The low friction coefficient of chromium plated tools facilitates the escapement of chips and prevents metallic pieces adhering. The chromium plating of tools decreases considerably the machining time for cast iron, non-ferrous metals, slate, marble, wood, bakelite and ebonite. Before chromium plating, the tools are hardened to 50-60 Rockwell. The hardness of the chromium coating attains 65-70 Rockwell. In case of precision tools, the tool is first preliminarily ground, afterwards chromium-plated and finally it is ground to the exact dimension.

HIGH-TENSION ELECTRIC HEAT STORAGE

Revue du Chauffage Electrique, 1938, p. 53

Abstracted by The International Power Review, May, 1939

In various countries in which hydro-electric power is distributed in a large extent, as in Switzerland, Norway, Canada, etc., electric boilers and electric heat storage devices are often used in order to utilize power generated at night. For this purpose G. Roux suggests the storage of high-tension energy by the dry process, avoiding the expensive transformers and their losses, as well as the deterioration of metal wire resistances.

This principle is attained by means of resistances formed by suitable crushed ores, located between refractory walls and heated by the electric current which flows through them. Investigations have proved that the magnetite (Fe_3O_4) is best suited for this purpose, but other oxides may also prove useful. The grain size of magnetite is chosen with respect to the fact that the resistance varies inversely to the grain size. For instance, a three-phase storage device absorbing 100 kw. at 6000 v. and one million calories, consists of eight tons of ore, the weight of the grains varying between 25 and 75 grams each.

The ore is located in columns (for instance with a sectional area of 5 dm^2 and a height of 1.5m.). These columns are placed on grates upon air ducts.

The resistances are connected in series by means of electrodes placed into the ore, to the high-tension line. The heat generated in the resistance columns is stored and it may be regenerated by air flow directed through the columns by fans. The hot air for building heating must be conditioned, i.e., filtered, moistened, etc.

The resistance of the ore columns decreases when temperature increases, but the resistance becomes asymptotical when 500 deg. C is reached. Therefore, when starting, a small number of columns is sufficient and, when the current intensity reaches a certain value, a bimetallic relay, through which flows the controlled current, operates a mercury switch, thus causing the de-excitation of the contactor closing the circuits of the following columns according to their respective temperature rise. A time switch opens and closes the circuit at predetermined times.

The thermal efficiency of these storage devices is in excess of 95 per cent.

Editorial Comment...

CANCELLATION

The British-American Engineering Congress has been cancelled. With the sickening suddenness that is so frequently associated with important happenings, arrangements which have been underway for over a year, have been set aside. A day full of cablegrams, long distance conversations and emergency meetings concluded with the far reaching decision that in the face of war, the time was not propitious for such a meeting.

A hopeful note has been sounded by the American and English societies. All messages contain the word "postpone." The hope is expressed by all that the Congress plans may be taken up again and carried through to completion in the not far distant future. The Institute sincerely joins in this expression of a desire for peace and the opportunity to study together the developments and the problems of the profession and the promotion of international good-will.

To the American Society of Civil Engineers and the American Society of Mechanical Engineers, the Institute expresses its appreciation of the herculean task which they had already accomplished. The amount of thought and effort involved in planning and preparing for such a Congress can only be appreciated by those who were closely associated with it, yet it is apparent to anyone that this cancellation has nullified a great undertaking and wasted many months of intensive endeavour. That this effort and expense should have been expended in the plans to entertain engineers from England and Canada is a real tribute to the American societies. It was indeed a pleasure to look forward to the privilege of being their guests.

The final message from the American Society of Civil Engineers referred to the cancellation of sailings of the English delegation and the decision to abandon the Congress. It concluded with the words "We have not the heart to try to carry on while they are distressed." This sympathy from fellow engineers is very heartening and will be appreciated in Canada as well as in England. We hope, with all our hearts, that shortly we may be permitted to join with them again in a common effort.

ACHIEVEMENT

Developments in flying occur so rapidly these days that before one has grasped the significance of a new attainment, something else is reported that renders the previous record almost obsolete. Nevertheless the arrival in Montreal of the Imperial Airways flying boat *Caribou* on August 7th with 1,050 pounds of mail has a significance that will not be lost no matter how many improvements may follow on its heels. The permanent establishment of a system of overnight transportation with the Old Country opens up entirely new fields. No small part of the importance of this system is the link it makes with the United States. An extension of the service to Australia, which is already planned, will indeed bring the Empire closer together, and provide facilities which seem, even in these modern times, almost fantastic.

In two details at least the flight made aerial history. It was the first time that a sea landing has been made by a transatlantic air boat by night. This occurred at the end of the run at New York. It was also the first time that a transatlantic plane has been refuelled in the air and on her route. The *Caribou* left Southampton for Foynes where she stopped for an hour and twenty minutes. From there she took the air with enough fuel to last 16 hours, the planned duration of the flight. However, when she was in the air she contacted a "flying tanker," made out of a converted Harrow bomber, and in 16 minutes took on another 800 gallons, sufficient to last another seven hours.

All this is very interesting even to the general public but it is particularly so to the engineer. Surely this attainment is an engineering triumph. There is no phase of it that has escaped the hand of the engineer. From the design of the engine and plane, to the landing basin which terminated the journey, it is a product of engineering skill and ingenuity, and is something of which to be proud. It is a perfect example of the theme established for the British-American Engineering Congress "Engineering aids world progress."

THE YOUNG ENGINEER IN ENGLAND

An interesting announcement has been made by the Institution of Civil Engineers that a conference on engineering education and training will be held in London, England, in February, 1940. Sir Clement D. K. Hindley, K.C.I.E., M.A., President-Elect of the Institution will be the President of the conference.

The July, 1939, issue of Civil Engineering and Public Works Review indicates that the conference will consider many phases of the subject which parallel those on which the Engineering Institute has already started investigation through its committee on the Training and Welfare of the Young Engineer. The discussions of the conference will be followed with interest by members of the Institute. The results of the investigations should make a real contribution to the subject. H.F.B.

PRESIDENTIAL VISIT TO WESTERN BRANCHES

President McKiel has announced the itinerary for his western trip. Each branch is arranging its own programme, details of which are not yet available at Headquarters. A regional meeting of Council will be held in Calgary on October 14th, at which the western activities of the Institute will be thoroughly discussed. It is hoped that councillors, past councillors, branch chairmen and other active officers of all the western branches will be able to attend. The President will be accompanied by Mrs. McKiel.

Following is the itinerary:

Arr.	Fort William	10.15 p.m. (E.S.T.)	Thur.	Sept.	28
Lve.	Fort William	9.35 p.m. (C.S.T.)	Sat.	Sept.	30
Arr.	Winnipeg	8.40 a.m. (C.S.T.)	Sun.	Oct.	1
Lve.	Winnipeg	9.45 a.m. (C.S.T.)	Thur.	Oct.	5
Arr.	Regina	5.55 p.m. (M.S.T.)	"	Oct.	5

Visit Moose Jaw on October 7th and return to Regina that evening.

Lve.	Regina	11.55 p.m. (M.S.T.)	Sat.	Oct.	7
Arr.	Saskatoon	6.50 a.m. (M.S.T.)	Sun.	Oct.	8
Lve.	Saskatoon	5.00 p.m. (M.S.T.)	Tues.	Oct.	10
Arr.	Edmonton	6.50 a.m. (M.S.T.)	Wed.	Oct.	11
Lve.	Edmonton	8.00 a.m. (M.S.T.)	Fri.	Oct.	13
Arr.	Calgary	1.15 p.m. (M.S.T.)	"	Oct.	13

Visit Lethbridge on October 16th, and return to Calgary that evening.

Lve.	Calgary	8.45 a.m. (M.S.T.)	Tues.	Oct.	17
Arr.	Banff	11.25 a.m. (M.S.T.)	"	Oct.	17
Lve.	Banff	11.35 a.m. (M.S.T.)	Wed.	Oct.	18
Arr.	Vancouver	8.45 a.m. (P.S.T.)	Thur.	Oct.	19
Lve.	Vancouver	10.30 a.m. (P.S.T.)	Sun.	Oct.	22
Arr.	Victoria	3.10 p.m. (P.S.T.)	"	Oct.	22
Lve.	Victoria	4.30 p.m. (P.S.T.)	Wed.	Oct.	25

MARITIME MEETING

A short account of the Maritime Professional Meeting has been transmitted by telegram in time to appear in the September Journal. A full account will appear in October.

The meeting was exceptionally well planned and every detail worked out perfectly. The registration was 110, which is considered very satisfactory in view of the disturbing news from Europe. Vice-President Dunsmore, chairman of the committee, made the opening remarks, and Hon. J. H. MacQuarrie, Attorney General of the province, welcomed the members on behalf of the Government.

R. L. Dunsmore, M.E.I.C.

President McKiel spoke at the luncheon on Thursday, August 31st, on the work of the Committee on the Training and Welfare of the Young Engineer. The luncheon was presided over by C. S. G. Rogers, A.M.E.I.C. At a special afternoon session the subject was discussed thoroughly and a resolution was adopted urging all branches to appoint special representatives to co-operate with this committee.

The dinner was under the chairmanship of Geoffrey Stead, M.E.I.C., and the speaker was Sir Wylie Grier, President of the Royal Canadian Academy who spoke interestingly on his adventures in portrait painting.

The social programme and the events for ladies rounded out the first day to the pleasure and satisfaction of everyone.

Word has also been received that the following message was telegraphed to the Hon. MacKenzie King: "Members of The Engineering Institute of Canada assembled in session at Pictou, N.S., this morning unanimously adopted resolution expressing their confidence in the governments of the British Commonwealth and pledging the complete support of the members of the Institute to the Government of Canada in the emergency which has just arisen, signed, H. W. McKiel, President, Louis Trudel, Assistant Secretary."

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

PERSONALS

M. W. Maxwell, A.M.E.I.C., previously industrial commissioner for the Canadian National Railways in the United States with office at New York, has been appointed commissioner of development and natural resources for the National system with headquarters in Montreal. Mr. Maxwell graduated from the University of New Brunswick with the degree of B.Sc. in civil engineering in 1912 and entered the employ of the Canadian Northern Railway, Mount Royal Tunnel and Terminal as draughtsman. In 1913 he was appointed assistant engineer and remained in this position until 1915 when he took up work with the Forest Products Laboratories for six months prior to joining the Canadian Engineers, First Tunnelling Company as Lieutenant. He was promoted to the rank of Major and awarded the Military Cross before the conclusion of the war when he returned to Montreal to the Forest Products Laboratories as engineer in charge of timber tests. Since 1923 he has been with the Canadian National Railway, first as assistant engineer in the bureau of economics, then special representative and later natural resources engineer with headquarters in New York. In 1932 he was appointed to the position from which he has now been promoted.

F. V. Seibert, M.E.I.C., is now superintendent of development and natural resources of the Canadian National Railways at Winnipeg where he has been located since 1930 as superintendent of natural resources. Mr. Seibert graduated from the University of Toronto in 1912 with the degree of B.A.Sc. and obtained considerable experience in surveys in Alberta. In 1917 he entered the Royal Air Force. After the war he was engaged in investigation of reclamation of waste areas in the western provinces. In 1922 he entered the Department of the Interior on Topographical Surveys, Ottawa. After two years in this position he was transferred to the Natural Resources Intelligence Branch and in 1929 was made supervisory mining engineer of the department.

K. A. Dunphy, A.M.E.I.C., is now division engineer with the Canadian Pacific Railway at Winnipeg having been transferred from Fort William where he had held a similar position. Mr. Dunphy has been in the employ of the Canadian Pacific Railway Company since 1909 first as rodman and transitman on maintenance and was located at Medicine Hat and Calgary, Alta. Later he was resident engineer at Calgary and at the Vancouver terminals. From 1914 to 1920 he was division engineer and bridge and building master at Souris, Man., and in 1924 was appointed division engineer at Brandon, Man., where he remained until 1930 when he was transferred to Fort William.

C. H. Fox, M.E.I.C., formerly engineer of the water service and of the Winnipeg terminals division of the Canadian Pacific Railway, has been appointed district engineer for Saskatchewan with headquarters at Moose Jaw. Mr. Fox joined the C.P.R. in 1902 as a junior in the construction office. In 1909 he graduated from McGill University with the degree of B.Sc. in civil engineering. The following year he became resident engineer at Fort William after receiving his Master of Science degree from McGill University. From 1912 to 1916 he was assistant division engineer of the Manitoba Division and from 1916 to 1918 division engineer of the Portage Division. After a year with the Canadian Engineers with the rank of Lieutenant he reentered the company as division engineer at Regina and Saskatoon and in 1920 was made assistant district engineer at Winnipeg. In 1923 he was appointed to the position from which he has just been promoted.

Louis Trudel, A.M.E.I.C., assistant to the General Secretary, was married at Ste. Hyacinthe on Saturday, August 26th, to Miss Francoise Brodeur.

VISITORS TO HEADQUARTERS

Rodney Bruce, S.E.I.C., assistant plant engineer, Findlay's Ltd., Carleton Place, Ont., on July 26th.

C. G. Moon, A.M.E.I.C., of St. Catharines, Ont., on July 26th

L. A. Badgley, A.M.E.I.C., Department of Buildings, City of Toronto, on July 31st.

W. B. Haselton, S.E.I.C., of Beebe, Que., on Aug. 2nd.

Obituaries

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

Norman Berford McLean, M.E.I.C., died at his home in Beloeil, Que., on August 19th, 1939. He was born at Cornwall, Ont., on January 15th, 1872. After his graduation from the Royal Military College, Kingston, Ont., in 1892, he entered the government service as assistant engineer of the Soulanges Canal. In 1898 he became assistant engineer of the Department of Public Works and remained in this position until 1901 when he became a member of the River St. Lawrence Ship Channel staff. In 1912 he was promoted to the position of resident engineer. From 1915 to 1918 he was with the 124th Battalion overseas. After some time with the Department of Marine and Fisheries in Sorel and in Ottawa he was made assistant chief engineer of the River St. Lawernce Ship Channel and in 1930 was made chief engineer. He held this position until some time before his death.

Major McLean joined the Canadian Society of Civil Engineers in 1899 as an Associate Member becoming a full Member in 1919. On March 23rd, 1937, he was made a Life Member of the Institute.

IDA LILLIAN McMARTIN

The Engineering Institute lost a real friend and a faithful servant in the sudden death of Ida McMartin. Miss McMartin had been on the Headquarters staff for twenty years, and in that time had built up an acquaintanceship with the membership which will make her departure a personal loss to hundreds of members.

Her principal work was in the employment department, and many members will recall her kindly and helpful interest in the story of their unemployment, or their desire for a better situation. Employers, too, will remember her intelligent handling of their inquiries for engineers. Her efforts have placed a host of members in good positions, and have satisfied the needs of dozens of employers.

For many years she looked after all membership records, and in this way, along with her contacts through the employment department, she built up a knowledge of the membership which seemed to include every member—new and old. Her mind was itself a veritable filing system, and she could produce without consulting the files almost any detail of information that was required. Even the handwriting of members became so familiar to her that from it alone she could identify the authors of hundreds of letters that came to the office. She will be greatly missed by her fellow workers and in the affairs of the Institute. Miss McMartin died on August 28th, 1939.

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 Association of Professional Engineers of the Province of British Columbia:
Year Book, 1939.

The Association of Professional Engineers of the Province of Ontario:
Year Book, 1939.

The Institution of Mechanical Engineers:
Proceedings, Vol. 140, 1938.

The Institution of Mining and Metallurgy:
Transactions, Vol. 47, 1938.

The New Zealand Institution of Engineers:
Proceedings, Vol. 24, 1937-38.

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

REPORTS, ETC.

Ontario Hydro-Electric Power Commission:
Thirty-first Annual Report, 1938.

Quebec Bureau of Mines:
Annual Report, Pt. C, 1936.

Toronto Harbour Commissioners:
Annual Report, 1936-38.

University of Illinois: Papers presented at the Second Conference on Air Conditioning, 1939, the Surface Tensions of Molten Glass, Papers presented at the Twenty-sixth Annual Conference on Highway Engineering, 1939. (Bulletin, Vol. 36, Nos. 76, 81, 86.)

U.S. Geological Survey: Spirit leveling in Missouri, Pt. 5 Southwestern Missouri, 1896-1937 (Bulletin 898-E); Geology and Water Resources of the Mud Lake region, Idaho; Surface Water Supply of the United States, 1937, Pt. 8 Western Gulf of Mexico Basins; Surface Water Supply of Hawaii, July 1, 1936, to June 30, 1937. (Water Supply Papers 818, 828, 835.)

TECHNICAL BOOKS, ETC.

Technical Methods of Ore Analysis for Chemists and Colleges:
By A. J. Weinig and W. P. Schoder. 11th ed. N.Y., Wiley and Sons, 1939. 325 pp., plates illus., 6 x 9½ in., cloth, $3.75.

Road Bridges in Great Britain:
London, Concrete Publications, 1939. (Reprinted from Concrete and Constructional Engineering, Jan.-April, 1939.) 161 pp., illus., 6¾ x 9¾ in., paper.

The Life and Work of William Cawthorne Unwin:
By E. G. Walker. London, Unwin Memorial Committee, 1938. Front. plates, 239 pp., 5¾ x 8¾ in., cloth.

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) ELECTRIC POWER INDUSTRY. Development, Organization and Public Policies
By J. Bauer and N. Gold, with the technical co-operation of A. E. Shaw. New York and London, Harper & Brothers, 1939. 347 pp., tables, 10 x 6 in., cloth, $3.50.

This non-technical presentation of the public aspects of the industry is intended for engineers and economists, and also for the general reader. The development and importance of the electric power industry are discussed, private organization and management are described, and the problems of public policy and control are considered. A select bibliography is included.

ESSENTIALS OF ALTERNATING CURRENTS
By W. H. Timbie and H. H. Higbie. 2 ed. rewritten. New York, John Wiley & Sons, 1939. 377 pp., illus., diagrs., charts, tables, 8 x 5 in., cloth, $2.25.

This book covers only that material which the authors consider essential that the worker on alternating-current appliances shall know. In this revised edition, new devices and methods of using them have been introduced and new applications of known devices are presented. Current practice is now represented, as in the treatment of motors and control apparatus. Many problems and numerical examples are included.

INDUSTRIAL ELECTRICITY
By J. M. Nadon and B. J. Gelmine. New York, D. Van Nostrand Co., 1939. 607 pp., diagrs., charts, tables, 9 x 6 in., cloth, $3.00.

Designed for those who intend to make electrical work in industry their vocation, this textbook contains not only the fundamental principles of electricity and magnetism, but also information concerning their application to present-day equipment. The more specialized topics include connecting methods and operating characteristics of electrical machines and controls, electronic devices, and electric welding.

INDUSTRIAL ELECTRICITY, Direct-Current Practice
By W. H. Timbie. 2 ed. New York, John Wiley & Sons, 1939. 635 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.00.

This book was written to meet the demand from technical schools for a textbook covering the important principles of electrical science as applied to modern industry. It explains how direct-current electricity is generated, transmitted and used, and affords a foundation for the study of the application of alternating-current electricity to present-day practice. Fundamentals are stressed and each chapter is followed by a condensed summary and a group of problems.

Great Britain. Mines Dept., Coal Mines Act, 1911: REGULATIONS AND ORDERS RELATING TO SAFETY AND HEALTH.
1939 ed. 199 pp., tables, 10 x 6 in., paper, 1s. 6d. (Obtainable from British Library of Information, 50 Rockefeller Plaza, New York, 45c.)

This volume is intended primarily as a book of reference for mine officials, students of mining, etc., and contains, with a few exceptions, all the orders and regulations which are of general application in relation to matters of safety and health in the working of mines. Topics covered include first aid and rescue methods, lighting, mechanical equipment, fire-fighting, signalling apparatus, explosives, and certificates of qualification for various jobs.

ROAD RESEARCH AND EXPERIMENT SPECIAL REPORT No. 2. MACHINERY AND ITS USES IN CONCRETE ROAD CONSTRUCTION

By F. N. Sparkes. Great Britain, Dept. of Scientific and Industrial Research and Ministry of Transport. London, His Majesty's Stationery Office, 1939. 25 pp., illus., diagrs., tables, 10 x 6 in.. paper, 1s.

This report embodies the information available at the Road Research Laboratory on the objects of, and advantages to be derived from, the use of machinery in the construction of concrete surfacings, with reference to British, American and German practice. The machines and processes are described.

RURAL WATER SUPPLY AND SANITATION

By F. B. Wright. New York, John Wiley & Sons, 1939. 288 pp., illus., diagrs., charts, tables, 8 x 6 in., cloth, $2.50.

The subject matter of this textbook covering the development of water supply, plumbing, and sewage disposal systems for rural homes and farms is divided into two parts. Part I contains instructions for doing practical jobs. Part II provides the necessary information concerning theory, equipment and methods, and reference is made from Part I to Part II for information relative to any particular job.

S.A.E. HANDBOOK

1939 edition. New York, Society of Automotive Engineers, 1939. 776 pp., illus., diagrs., charts, tables, 9 x 6 in., flexible, $5.00.

This edition, revised to January, 1939, contains 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. Some sixty changes from the 1938 edition are noted.

(The) STEEL SQUARE, How to Use Its Scales, How to Make Braces, Roof Construction and Other Uses

By G. Townsend. Chicago, American Technical Society, 1939. 96 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $1.25.

The carpenter's steel square is described with an explanation of the various markings and their uses. Instruction is also given on the use of the square in the construction of wood-framed buildings with particular detail in regard to roof construction.

SWIMMING POOL STANDARDS

By F. W. Luehring, introduction by J. F. Williams. New York, A. S. Barnes & Co., 1939. 273 pp., tables, 9 x 6 in., cloth, $5.00.

Following a historical survey of the swimming pool the author presents various laws, rules and regulations as set up at different times by State boards of health and other governing bodies. Detailed information is given concerning modern standards for swimming pools in educational institutions, covering all accessory activities. A glossary and a large bibliography are included.

(A) TEXTBOOK OF GEOLOGY, Pt. 1, Physical Geology

By C. R. Longwell, A. Knopf and R. F. Flint. 2 ed. rev. New York, John Wiley & Sons, 1939. 543 pp., illus., diagrs., charts, maps, tables, 9 x 6 in., cloth, $3.75.

The contents of this general textbook comprise description of the earth's features and discussion of the processes by which they are altered. Rock formation, erosion methods by wind and water, deformation of the earth's crust, glaciers, volcanoes, earthquakes, etc., are important subjects considered. Definitions and descriptions of minerals and rocks are appended, and there is a brief introduction to the study of topographic maps.

THE THEORY AND PRACTICE OF REINFORCED CONCRETE

By C. W. Dunham. New York and London, McGraw-Hill Book Co., 1939. 529 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $4.50.

Approaching the subject from the viewpoint of the practising engineer, the author of this new text presents in a simple, understandable manner the theories upon which is founded the design of most ordinary types of re-inforced-concrete structures. The basic requirements and procedures of practical construction are also given full consideration. There are many illustrative problems.

(The) THEORY OF FUNCTIONS

By E. C. Titchmarsh, 2 ed. New York, Oxford University Press, 1939. 454 pp., tables, 9 x 6 in., cloth, $8.50.

These introductory chapters to various branches of the theory of functions are intended to bridge the gap between the elementary textbooks and the systematic treatises. Chapter topics include infinite series, analytic functions, residues, analytic continuation,the maximum-modulus theorem, conformal representation, power series, infinite functions, differentiation, Lebesgue integration, and Dirichlet and Fourier Series. There is a bibliography.

TOOL MAKING

By C. B. Cole. Chicago, American Tech nical Society, 1939. 413 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.50.

The first half of this book describes the tool-maker's personal tools, shop equipment, heat-treating methods and equipment, blueprints and sketches. The last half is devoted to actual tool-making processes, and its value is increased by the presentation of many typical jobs, including finished working drawings.

USES AND APPLICATIONS OF CHEMICALS AND RELATED MATERIALS

Ed. by T. C. Gregory. New York, Reinhold Publishing Corp., 1939. 665 pp., 9 x 6 in., cloth, $10.00.

Over 5,000 chemicals, drugs, metals, oils, etc., are listed alphabetically under their common names, each accompanied by a broadly classified list of present uses and potential applications. English synonyms, corresponding foreign names, and some patent references are also give. At the back of the book the synonyms and cross references are listed alphabetically.

WHO INVENTED THE TELEPHONE?

By W. Aitkin. London and Glasgow, Blackie and Son, Ltd., 1939. 196 pp., diagrs., 8 x 5 in., cloth, 5s.

The major part of the material contained in this review of the history of the telephone consists of references to or extracts from technical literature. Much of the information presented in regard to the early inventors and their claims has been gathered through consultation of many contemporary documents, and is not generally known.

COMING MEETINGS

Canadian Good Roads Association—Twenty-fifth Annual Convention, September 12-14, at Chateau Frontenac, Quebec City. Secretary-Treasurer, George A. McNamee, New Birks Building, Montreal, Que.

Canadian Institute on Economics and Politics—Eighth Annual Session, August 14-26, Geneva Park, Lake Couchiching, Ont.

Canadian Institute of Mining and Metallurgy—Twenty-first Annual Western Meeting, August 30th to September 1st, at the Hotel Pelliser, Calgary, Alta.

Canadian Institute on Sewage and Sanitation—Sixth Annual Convention, October 19th and 20th at the Royal Connaught Hotel, Hamilton, Ont. Secretary-treasurer, Dr. A. E. Berry, Ontario Department of Health, Parliament Buildings, Toronto.

CANADIAN TRADE INDEX

The 1939 edition of Canadian Trade Index, published by the Canadian Manufacturers' Association, provides buyers and sellers with a useful directory of the products made in Canada and the names of the manufacturing firms.

The book contains 842 pages of commercial information distributed in five sections. (1) An alphabetical list of Canadian manufacturers with addresses, branches, export representation, trade marks and brands. (2) A directory of Canadian manufacturers, classified according to the products made and alphabetically arranged. (3) A directory of producers, shippers and exporters of agricultural products and allied lines. (4) An alphabetical list of the French names of the products listed in Part 2 with the corresponding English names. (5) A special export section which is a survey of Canada's export trade and gives details of government services, export procedure, financing, statistics and a list of definitions of abbreviations used in foreign trade transactions.

This edition includes over 200 new manufacturers. It is a useful auxiliary for executives, sales departments and purchasing agents.

Industrial News

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

HIGH-SPEED, TWO-STAGE, AIR-COOLED COMPRESSORS

A recent addition to the well-known "XVH" and "ES" compressor lines manufactured by Canadian Ingersoll-Rand is the type 40 air-cooled, two-stage, single-acting machine for V-belted and direct-coupled drive. Five sizes are available, rated from 122 to 360 cubic feet of free air per minute actually delivered. They use Timken anti-friction main bearings and the highly efficient C-I-R channel valves. 870 r.p.m. is the normal operating speed.

These machines are not intended for use where the duty is to be heavy and continuous. They are ideal as stand-bys, or for night service in industrial plants to permit shutting down the main daytime plant, or on intermittent service with automatic start and stop control; or for installation outdoors, in unheated buildings, or where circulating water is not available, scarce, or expensive, or where there is any danger of freezing. Its light weight and the fact that it can be "knocked down" and packed in convenient-sized boxes also makes the type 40 ideal for aeroplane or mule-back transportation to new or isolated mining properties, remote construction enterprises, for lighthouse service, etc.

A new bulletin, form K-330, is completely descriptive. Copies can be obtained on application to the Canadian Ingersoll-Rand Company Limited, 800 New Birks Building, Montreal, or any of its branches throughout Canada.

PUMPS

United Steel Corporation Limited announce the publication of a new catalogue on Nor-Sand Pumps, which has been produced in collaboration with the inventor of the Nor-Sand Pump and the publication contains valuable engineering data which will be of practical assistance in making pump selections.

The new catalogue deals extensively with the Nor-Sand Centrifugal Pump, which has been specially designed to overcome the difficulties encountered in handling pulps containing abrasive materials. It also contains considerable information of value with regard to Nor-Diaphragm Pumps showing tables which are of particular interest to those engaged in the mining industry.

Those interested in securing information on pumps may get copies of this new Nor-Sand Pump Catalogue by directing inquiries to United Steel Corporation Limited at any of the following offices:—Toronto, Montreal, Haileybury and Kirkland Lake.

STOKER CONTRACT

The Manitoba and Saskatchewan Coal Company have awarded to Foster Wheeler Limited a contract for a Harrington travelling grate stoker. This installation is desiged for standard duty, handling lignite "Bug Dust" as fuel.

OVERHEAD ELECTRICAL EQUIPMENT FOR MINES AND INDUSTRIES

Canadian Ohio Brass Co. Ltd. have compiled and issued a catalogue of 160 pages dealing solely with their mining and industrial products. The book is prefaced with nine pages outlining the development of the company and illustrating its various manufacturing facilities. The products are arranged under nine different headings, i.e., feeder and trolley materials, catenary materials, control devices, locomotive equipment, locomotive head-lights, rail bonds, third rail insulators and automatic couplers. With the many products illustrations and dimensional data, the catalogue should be of great value to purchasers of this type of equipment. The title of this catalogue is "Mining and Industrial Catalogue No. 22" and may be obtained by writing to the company at Niagara Falls, Ont.

THE ENGINEERING CATALOGUE—1939

The seventh annual edition of The Engineering Catalogue has been issued and is now being distributed to all engineers, architects and industrial executives whose duties require the specifying or purchasing of engineering equipment, building materials and supplies.

This catalogue service was established under the auspices of The Engineering Institute of Canada in 1932, and following the completion of the fifth edition publication rights were transferred to N. E. D. Sheppard, A.M.E.I.C., under an agreement whereby the Catalogue would be continued, maintaining the same high standard of production which featured the earlier issues.

Each succeeding year has witnessed a steady and substantial increase in the number of products illustrated and described in the Catalogue and the number of manufacturing organizations represented in its pages. The present volume surpasses any previous issues in this respect and contains over 350 pages of exceedingly useful reference data. In addition to an extensive section devoted to the description of a wide variety of products, the 1939 Catalogue contains a completely revised Products Index of 88 pages and a Directory of 48 pages in which the products of 4,130 individual firms are listed under approximately 3,000 products classifications, requiring over 22,000 entries.

Two new features have been incorporated in the present volume. The first is the use of distinctive cover designs which are permitted where any individual firm uses eight or more pages to describe its products. The second feature is a Classified Index to the Directories of Consulting Engineers and Engineering Services.

The dependability of the data published in this Catalogue and the convenient arrangement of its contents have been largely responsible for its general acceptance as the principal source of reference for information relative to equipment and materials available in Canada.

Copies of the Catalogue may be secured, as in previous years, by any member of the Institute whose work involves the specifying or purchasing of equipment and materials.

REPORTS OF THE DOMINION BUREAU OF STATISTICS

The Mining, Metallurgical and Chemical Branch of the Dominion Bureau of Statistics have recently issued the following:

Automobile Statistics, 1938:

Annual statistical report of the automobile industry for 1838 including manufacturing, imports and exports, retail sales, financing, registrations and revenues from motor vehicles.

Machine Shops in Canada, 1937:

A special report of statistical data relative to the machine shop industry.

ELECTRIC TOOLS

The complete 1939 line of Thor portable electric tools is described in an attractive 48-page catalogue just issued by the Independent Pneumatic Tool Co., 600 West Jackson Blvd., Chicago, Ill. The book, which is divided into four major sections, gives complete descriptions, specifications and prices on the entire Thor line of universal type electric drills, drill stands, screw drivers, nut setters, tappers, saws, hammers, grinders, polishers, sanders, heat guns, electric tool accessories, etc.

PHASE SHIFTER

Canadian General Electric announces a new Phase Shifter for testing watthour meters at 50 per cent power factor.

The phase shifter operates from a 115-volt single-phase supply and can be supplied for either 25- or 60-cycle circuits. It is designed with a capacity to deliver 115 bolts and a power factor of 50 per cent (within the limits of accuracy required for meter testing) to a potential circuit which includes a potential transformer, the voltage coil of a portable standard and the voltage coil of one meter under test. The number of meter current coils in the circuit or the magnitude of current in the current circuit does not in any way affect the operation of the phase shifter.

SUSPENDED MAGNETS

A new bulletin, No. 25-A, has been issued by the Stearns Magnetic Mfg. Co., Milwaukee, Wis., makers of magnetic separators and magnetic power transmission devices, describing the company's line of suspended magnets and supplying information concerning various applications.

SELF-REGULATING BATTERY CHARGER

A new completely automatic and self-regulating electronic battery charger called the Phano-Charger has been developed by Canadian General Electric for charging and maintaining storage batteries used in sub-stations, hospitals, public buildings, and other places for standby service, control power, and emergency lighting. By using industrial-type metal phanotron rectifier tubes, moving parts are eliminated, thus assuring long life for the equipment and practically silent operation. The chargers are available in three sizes: 4.5 amperes and 12.5 amperes to operate from a single-phase power supply, and 25 amperes to operate from a three-phase a-c supply.

HIGH BAY LIGHTING UNITS

Designed for use with incandescent lamps for general lighting of high bay areas in foundries, machine shops, power plants, receiving and shipping departments, sheet metal works and similar locations, a new high bay aluminum reflector is now available from the Canadian Westinghouse Company, Limited.

The "Locklite" principle of attaching industrial reflectors has been applied to this high bay unit, which consists of two parts: a hood and a receptacle into which the reflector with lampholder fits. When the lugs on the neck of the reflector lock into the slots of the hood, by giving the reflector a clockwise turn of 60 degrees, the electrical connection is made.

These high bay units are ideal for lighting high narrow interiors where general conditions make it necessary to mount the units at great heights. They concentrate light distribution on working surfaces and do not waste illumination on upper side walls.

OUTDOOR-TYPE INDICATING SECONDARY FUSE

A new outdoor-type, indicating secondary fuse has been announced by Canadian General Electric Co. Limited for transformer secondary protection or banking, and isolating service-entrance faults. Corrosion resisting materials are used throughout and the fuse-link is totally enclosed in a compact, weather-tight housing of Textolite. A fiber inner tube forms the fuse chamber.

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

During the last month we have had several requests for young civil engineers for temporary positions of from two to six months duration, some of which we were unable to fill. These vacancies were in the vicinity of Montreal, and we expect that there will be others.

There is also a scarcity of draughtsmen on reinforced concrete and structural steel.

If you are interested please register.

MUNICIPAL ENGINEER, conversant with road construction, paving, construction and maintenance of sewers and water services, for a town in Ontario. Salary from $2,400 to $3,000 per year according to experience and qualifications. Send applications with full particulars to Box No. 1932-V.

SITUATIONS WANTED

DESIGNING ENGINEER, M.Sc. (McGill), D.L.S., A.M.E.I.C., P.E.Q. Experience in the design and construction of water power plants, transmission lines, field investigations of storage, hydraulic calculations and reports. Also paper mill construction, railways, highways, and in design and construction of bridges and buildings. Available at once. Apply to Box No. 729-W.

ELECTRICAL ENGINEER, B.Sc., Jr.E.I.C. Eight months on installation of power and lighting equipment; three years as manager of sales and service dept. of an electrical firm; seven months as tester on power and radio equipment, one and a half years as inspector on electrical and power equipment. Interested in inspection or sales engineering. Available on short notice. Location immaterial. Apply to Box No. 740-W.

CIVIL ENGINEER, B.Sc., A.M.E.I.C., R.P.E. Age 48. Twenty-five years construction experience on railways, highways, bridges, dams, flumes, pipe lines and buildings. Expert on earthworks and transportation. Location immaterial. Apply to Box No. 841-W.

MECHANICAL ENGINEER, Jr.E.I.C., technical graduate, bilingual, age 36, married. Experience includes five years with firm of consulting engineers, design of steam boiler plants, heating, ventilating and air conditioning. Seven years with large company on sales and design of heating systems, air conditioning, steam specialties, etc. Available on short notice. Apply to Box No. 850-W.

MECHANICAL DRAUGHTSMAN, 12 years experience in mechanical and structural draughting and general mechanical design, including recently perfected new type Diesel head. Married. Age 37. B.Sc. in mechanical engineering. Employed steadily but desirous of good opportunity in Diesel or general mechanical field. Apply to Box No. 1081-W.

CHEMICAL ENGINEER, McGill '34. Pulp and paper mill experience, production control, meter maintenance, and tests. Apply to Box No. 1222-W.

MECHANICAL ENGINEER, B.Sc., in mechanical engineering with six years experience in pulp and paper mill engineering and maintenance. Wishes employment in maintenance department as assistant to master mechanic or similar work. Can furnish references. Married. Available on short notice. Apply to Box No. 1694-W.

REFINERY ENGINEER, B.Sc. (E.E.), Man. '37. Experienced in supervising operations and maintenance of small refinery. 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. '31, A.M.E.I.C. Experience includes one year hydrographic surveying, two years municipal work, five years highway work. Familiar with all types of pavement, concrete design, bridge construction, sewer design and water layout, road construction. Available on short notice. Apply to Box No. 1815-W.

CIVIL ENGINEER, B.E., Jr.E.I.C., 28 years of age. Married. Desires position with reliable construction firm. Intends to make construction life work. Over five years experience on permanent highway construction, inspection, estimates and instrument work. Available on short notice. Apply to Box No. 1820-W.

TRAINING AS SALES ENGINEER desired by civil engineer, B.E., Jr.E.I.C. Single. Age 27. Has taken extensive additional study in education, particularly in psychology and personality. Experience consists of surveying, detailing, designing, and principal of a high school. Desires permanent position. Available on short notice. Apply to Box No. 1843-W.

SALES ENGINEER REPRESENTATIVE, B.A.Sc., C.E. Age 30. Contact in Northern Quebec mine belt. Interested in selling any kind of materials. Experience in heating and air conditioning. Speaks both English and French. Available at once. Apply to Box No. 1859-W.

CHEMICAL ENGINEER, graduating Toronto '39. S.E.I.C. One and a half years general ore dressing laboratory work. One and a half years' general milling and assaying. Seeking a permanent position in chemical industry. Apply to Box No. 1867-W.

TECHNICALLY TRAINED EXECUTIVE, general experience covers organization and management in business and industrial fields; including sales, purchasing, productions, accounting and costing, also industrial surveys, reorganizations and amalgamations in the United States and Canada. B.Sc. degree in mechanical engineering. Married. Canadian. Apply to Box No. 1871-W.

MANUFACTURING EXECUTIVE, B.Sc. in mechanical engineering. Married. Canadian. Experienced in munitions manufacturing and other precision work. Apply to Box No. 1872-W.

SALES ENGINEER. Several years experience selling to industrial, mining and railroad organizations in Ontario and Quebec. B.Sc. in mech. engrg. Married. Canadian. Apply to Box No. 1873-W.

INDUSTRIAL DESIGNER seeks position, part-time employment or commissions. University graduate, A.M.E.I.C., long architectural designing experience. Apply to Box No. 1878-W.

CIVIL ENGINEER, S.E.I.C., McGill, '39. Age 22. Consistently high scholastic standing. Ready to adapt himself to any kind of work promising future advancement. Experience includes maintenance work in an industrial plant, surface exploration for minerals in northern Quebec, surveying, mapping, and selling. Excellent references. Present residence, Montreal. Available June, 1939. Apply to Box No. 1881-W.

CIVIL ENGINEER, B.Sc. Age 27. Married. Four years experience in highway work, including instrument work on preliminary surveys and construction, estimating and inspection. Prefers position with construction firm. Available at once. Apply to Box No. 1883-W.

CIVIL AND STRUCTURAL ENGINEER, B.A.Sc. (Toronto), A.M.E.I.C. Three years experience in plant engineering work entailing mechanical and structural design and supervision. Also two years on construction work. Desires permanent position with industrial firm or consulting engineer. Apply to Box No. 1893-W

CIVIL ENGINEER, A.M.E.I.C. Married. Ten years experience on railway location and construction. Twenty years on hydro-electric power and mill construction in executive capacity in charge of preliminary investigation, engineering, estimating, costs and purchasing. At present unengaged owing to the firm associated with discontinuing operations. Available at once. Apply to Box No. 1896-W.

MECHANICAL ENGINEER, B.E. (Sask. '38), S.E.I.C. Age 25. Single. Year's experience with large steel plant, general piping, fuel oil lines and storage tanks, surveying, draughting, furnace construction and operation, adjustment of automatic control equipment, testing. Considerable electrical knowledge. At present employed but available on short notice. Desires specialized position but will consider others. Apply to Box No. 1907-W.

CIVIL ENGINEER, B.A.Sc. (Toronto '09). M.E.I.C., R.P.E. Ont. and B.C. Age 50. Presently employed. Over thirty years experience: design, estimate and erection of structural steel, heavy timber and monolithic concrete; large scale surveys, maps, contours, railway and highway location, farm drainage. Apply to Box No. 1910-W

ELECTRICAL ENGINEER, B.Eng. (McGill '37). Age 24. Eighteen months experience in test department of big English electrical manufacturing firm. Returning to Canada in June. Would prefer design, sales, or practical work. Apply to Box No. 1911-W.

CIVIL ENGINEER, A.M.E.I.C., R.P.E. Age 48. Married. Fifteen years city engineer, fourteen years experience on design, construction, maintenance, road location, railways, underground, also experience in hardware, plumbing, heating, air conditioning. Desires steady position. Available on short notice. Apply to Box No. 1923-W.

ELECTRICAL ENGINEER, B.A.Sc. (Toronto '35). Age 27. Jr.E.I.C. Graduate of business college. Technical experience in aeronautics, comfort air cooling, refrigeration and communication equipment. Office experience, including shorthand, typewriting and correspondence compilation. Apply to Nox No. 1926-W.

CIVIL ENGINEER, B.Sc. in C.E. '39, S.E.I.C. Age 20. Three summers experience in land survey. Will undertake any work of an engineering nature. Location immaterial. Further details on request. Apply to Box No. 1943.-W

CIVIL ENGINEER, B.Sc., S.E.I.C. Age 31. Canadian. Interested in sale and production work. Speaks Polish, Slovak, Ukrainian. Apply to Box No. 1955-W.

ELECTRICAL ENGINEER, B.A.Sc. (Toronto '35), Jr.E.I.C. Married. Age 26. Experience—21 months with small company on factory service, and installation work of farm and commercial refrigeration equipment. Thirteen months on maintenance of construction tools and instruments, erection and service work on electric furnaces, office work on apparatus orders. Sixteen months of testing of various electrical equipment, and four months to date on transformer engineering, all with a large Canadian electrical manufacturer. Available on short notice. Technical work preferred. Apply to Box No. 1958-W.

ELECTRICAL ENGINEER, B.E. (N.S.T.C. '35). Age 25. Single. Three summers as paving inspector. One year selling, servicing and installing theatre sound equipment. Willing to go anywhere on short notice. Apply to Box No. 1959-W.

ELECTRICAL ENGINEER, B.Sc. (E.E.) Man. '37. Age 26. Two years experience with large manufacturing firm one year in factory work testing and inspecting, transformers, industrial control gear, fractional motors and large A.C. and D.C. rotating machinery. Three months in engineering dept. of wire and cable factory. Nine months in training course covering factory organization and production methods. References. Location immaterial. Available on short notice. Apply to Box No. 1961-W.

LARGE SCALE PRODUCTION EXPERIENCE in an airplane factory or other plant, with a view to learning the business and a permanent position, desired by young man, single, age 25, S.E.I.C., having a B.Sc. degree with distinction in engineering and advanced training in economics and business. Past work includes highway design, draughting, four years as advertising solicitor, and at present engaged in design and related work in the steel industry. Available on two weeks notice. Apply to Box No. 1962-W.

ELECTRICAL ENGINEER, B.Sc., E.E. '37, age 23, single, Canadian. Experience includes one year in large electrical factory, testing large and small motors, generators and transformers; also one year and a half on sales engineering work. Interested in permanent position with a good future. Would consider any location. References available on short notice. Apply to Box No. 1981-W.

PRELIMINARY NOTICE

of Application for Admission and for Transfer

August 26th, 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 October, 1939.

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

DICKIE—FRANK EVANS, of Chateauguay Basin, Que. Born at Shediac, N.B., Dec. 20th, 1887; Educ.: B.A., Acadia Univ., 1909; M.A., Columbia Univ., 1912. Completed part of chem. engrg. and mech. engrg. courses at Columbia; 1913-14, chemist, Canada Cement Company; 1914-15, technical asst., Aluminum Co. of America, Niagara Falls, N.Y.; 1915-17, i/c technical control, and 1917-26, asst. supt. of plant, Northern Aluminum Co., Shawinigan Falls; 1926-27, supt. of smelter, Aluminum Co. of America, Arvida; 1927-28, engr. on design of electric furnaces, Holcroft & Co., Detroit; 1928-29, engr. i/c installn. and operation of electric furnaces, Bohn Aluminum and Brass Co., Detroit; 1930-31, consultant on design of aluminum plants, Soviet State Aluminum Trust, Moscow; 1937 to date, engr. i/c design of new smelter equipment at Shawinigan, surveys for new plant locations in India and Canada, and at present, technical asst. to the President, Aluminum Co. of Canada Ltd., Montreal, Que.

References: McN. Dubose, J. E. Thicke, A. Cunningham, A. C. Johnston, H. R. Wake, C. St. J. Wilson, J. R. Donald.

HASKEN—JAMES ELGIN, of 614 Huron St., Toronto, Ont. Born at Neepawa, Man., June 22nd, 1913; Educ.: B.Sc. (E.E.), Univ. of Man., 1937; 1937-39, testing and inspecting, also design work, Canadian General Electric Co. Ltd.

References: E. P. Fetherstonhaugh, C. E. Sisson, W. M. Cruthers, D. Norman, A. B. Gates.

MYRA—ALLEN, of Avenue B, Imperoyal, N.S. Born at Lunenburg, N.S., July 7th, 1908; Educ.: B.S. in Chem. Engrg., Lehigh Univ., 1931; 1934-36, lab. asst., 1936-38, research chemist, and 1938 to date, foreman of chemical treating processes, Halifax Refinery, Imperial Oil Limited, Dartmouth, N.S.

References: R. L. Dunsmore, G. W. Christie, J. D. Fraser, A. G. Tibbits.

McKAY—DONALD WILSON, of London, Ont. Born at Woodstock, Ont. Feb. 14th, 1914; Educ.: B.Sc. (Mech.), 1938; Summer work: 1934-35, rodman, checker, Dept. of Highways, London; 1936, lathe hand, Carson's Machine Shop, London, 1937, steamfitter, Ford Motor Co., Windsor; June, 1938, to date, junior engr., Dept. of Public Works of Canada, London, Ont.

References: H. F. Bennett, J. P. Carriere, D. H. McDonald, L. M. Arkley, D. S. Ellis.

PAPOVE—WILLIAM WASIL, of Toronto, Ont. Born at Kamsack, Sask., Dec. 3rd, 1912; Educ.: B.Sc., Queen's Univ., 1938; 1938 (3 mos.), testing, Canadian Marconi Co.; 1936, 1938, 1939 (4 mos.), dfting., designing and redesigning, Northern Petroleum Corpn.; at present, assembling electric fence controllers, W. C. Wood Co. Ltd., Toronto, Ont.

References: L. T. Rutledge, D. M. Jemmett, L. M. Arkley, D. S. Ellis, C. J. Mackenzie.

SHARPLES—WILLIAM HENRY, of 3055 Sherbrooke St. W., Westmount, Que. Born at Quebec, Que., Nov. 16th, 1904; Educ.: B.Sc., McGill Univ., 1925. R.P.E. of Quebec; 1923-24 (summers), junior field engr., LaGabelle hydro development; 1925-33, dftsman., Power Engineering Company, on all phases of design and constrn. of hydro-electric power stations; 1928-29, bldg. inspr., Queen St. substation, Shawinigan Engineering for Quebec Power Co.; 1933-38, design of plant for Canada Carbide Co.; 1938 to date, structural steel designer, Shawinigan Engineering Company, Montreal, Que.

References: J. A. McCrory, R. E. Heartz, A. B. Rogers, A. L. Patterson, J. D. Stott.

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References: M. Macgillivray, W. J. Johnston, R. G. Barbour, D. C. Macpherson, C. A. Laverty, G. H. Gillett, A. A. Turnbull.

McDOUGALL—JAMES LYLE, of St. Catharines, Ont. Born at Kintore, Scotland, July 9th, 1906; Educ.: 1922-29, Gordon's College, and Aberdeen University. Graduate, Inst. Mech. Engrs.; 1922-23, with Barry, Henry & Cook, 1923-28, Alex. Wilson Aberdeen Ltd., 1928, C. F. Wilson and Co. Ltd., 1928-29, John M. Henderson & Co. Ltd.—ap'ticeship—shop experience—plate and structural—fitting—turning and erection, then four years drawing office, detail and design—air compressors, heavy oil engines, cranes, stone and woodworking machy., etc.; 1929-32, Price Bros. & Co. Ltd., mech. engr. and dftsman., paper mill mtce. and mach. design; 1932-33, Plessisville Foundry, design of contractors' and roadmaking machy.; 1933, same position as before with Price Bros. & Co. Ltd.; 1933-34, Sherbrooke Machineries Ltd. and Improved Paper Machinery Corpn., design and service engr., pulp and paper mill machy.; 1934, old position with Price Bros.; 1934-36, mtce. engr., Somerville Paper Boxes Ltd.; 1936-37, mech. engr., gen. mill work, Spruce Falls Power & Paper Co. Ltd.; at present, mech. engr. on mill mtce. and design, Ontario Paper Co. Ltd., Thorold, Ont. (Jr., 1930).

References: M. H. Jones, C. G. Moon, A. J. Grant, G. F. Layne, A. Cunningham, C. H. Champion, J. W. Porter, F. W. Bradshaw.

TREMAIN—KENNETH HARDLEY, of Montreal, Que. Born at Windsor, N.S., Mar. 7th, 1905; Educ.: Grad., R.M.C., B.Sc. (Elec.), McGill Univ., 1929; 1928 (3 mos.), mech. repair dept., Laurentide Paper Mill; 1929-31, mech. repair dept., and 1931-32, asst. to master mechanic, Belgo Paper Mill, Shawinigan Falls; 1935-36, salesman, 1936-37, sales mgr., The Elias Rogers Co. Ltd., Montreal and Toronto; 1937, sales mgr., insulation divn., Alfred Rogers Limited, Toronto; June, 1937 to date, manager, Rogers Montreal Limited, Montreal. (St. 1928, Jr. 1935.)

References: C. V. Christie, W. B. Scott, A. L. Patterson, J. M. Evans, L. F. Grant, H. E. Bates, R. E. Jamieson.

FOR TRANSFER FROM STUDENT

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References: W. P. Copp, C. M. McKergow, A. A. Ferguson, L. R. McCurdy, H. R. Theakston, E. Brown.

ROSS—GEORGE, of 7201-104th St., Edmonton, Alta. Born at Edmonton, Alta., May 15th, 1914; Educ.: B.Sc. (Civil), Univ. of Alta., 1938; 1938-39, demonstrator, C.E. Dept., Univ. of Alberta; summers, 1936 to 1939, instrumentman and office engr., City of Edmonton, Engrg. Dept. (St. 1937.)

References: H. R. Webb, R. S. L. Wilson, W. E. Cornish, A. W. Haddow, F. A. Brownie.

SCOTT—JAMES MUNRO, of 190 Fraser St., Quebec, Que. Born at Quebec, Oct. 29th, 1916; Educ.: B.Sc. (C. E.), Univ. of N.B., 1937; 1937-39, instr'man., N.B. Dept. of Public Works; 1939 (Mar.-Aug.), plant engr., Gulf Pulp and Paper Co., Clarke City; August, 1939, to date, temp. asst. engr., Federal Dept. of Public Works, Quebec, Que. (St. 1937.)

References: A. B. Normandin, A. Dick, R. E. Cumming, S. J. H. Waller, D. S. Scott.

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"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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RESERVE OCCUPATIONS

**Statement issued by the Honourable N. McL. Rogers,
Minister of National Defence**

Printed in THE ENGINEERING JOURNAL by request.

In response to the hundreds of requests received by the Government from individuals and industries for information as to how they can best be of service in the present emergency, the Minister of National Defence has authorized the issuance of the following statement:

Under a system of voluntary service in the Armed Forces there is a probability, having regard to the character of the Canadian people, that many men with the highest qualifications of all sorts will seek active service. The problem is thus presented of ensuring that industry is not deprived unduly of the skilled engineers, mechanics and other trained workers, on whom rapid expansion of production depends, by reason of their enlistment in or appointment to commissions in the Armed Forces.

The Department of National Defence, anticipating this problem, has placed restrictions on the enlistment of certain classes of workers, who will be required in large numbers for the prosecution of Canada's war effort, in the production of munitions and other industrial supplies. These restrictions apply to those who are skilled in particular trades or crafts or who have other qualifications, such as university training in medicine, engineering, agriculture and other sciences that can be used to advantage in the national interest.

It is becoming more clearly understood that, in addition to the material requirements of Canada's Forces, very large supplies will also be needed from Canada to supplement production in Great Britain and other parts of the Empire. It is in recognition of these anticipated requirements for skilled workers in industry that the Department of National Defence has issued instructions to recruiting officers providing that skilled tradesmen are not to be enlisted in a military unit except in the classes and then only in the numbers required by the particular unit establishment. It is provided that every effort must be made to place men in those corps for which they are best adapted by their civil vocations.

As regards eligibility of recruits the Department has also ruled that graduates of Canadian or other universities or colleges in the medical, engineering or other scientific or technical professions are not to be enlisted. The same provision applies also to ex-cadets of the Royal Military College and to ex-cadets who hold certificates from the Canadian Officers Training Corps, bankers and chartered and other accountants are also included.

While the foregoing statements apply to recruiting for the Army, similar regulations apply to enlistments in the Navy and Air Force.

In cases where heads of factories or other industries feel that key members of their staffs have been taken by the military authorities unnecessarily, they should communicate at once with the recruiting officer in charge of the unit in which their men have been placed. Should their representations to him not result in a satisfactory solution of their problem, the matter should then be taken up by the factory head with the local Army, Navy or Air authorities concerned.

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ADVANCES IN CONSTRUCTION METHODS AND EQUIPMENT

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An account of the advance in construction methods in Canada can best be presented by giving a brief history of construction projects that have been carried on at various periods in the development of the country. This history falls naturally into four periods each of which was characterized by intensive activity of a particular type. During the first and second periods we find the country working toward the improvement of transportation and communication by the construction of canals and railways. The third period reflects the industrial development that began toward the end of the 19th century and the growth in urban population, which almost doubled between the years 1900 and 1920. During this period the larger centres of population changed radically in character and the demand for industrial power and for light stimulated an intensive development of the water power resources of the Dominion. In the fourth period we find the emphasis again on transportation, the development of automotive equipment having brought about the enormous growth in highway construction that has taken place during the last few years.

Fig. 1—Queenston-Chippewa development, 1918 to 1922. Battery of Drills working in Rock Cut

THE PERIOD OF CANAL CONSTRUCTION

The provision of a more satisfactory means of communication and of transportation between the widely scattered centres of population was the first need of the young and growing country. For more than two centuries the waterways had supplied the only transportation routes. Thriving settlements had sprung up along the St. Lawrence as far as Montreal, easily accessible from the sea, and beyond to Ste. Anne at the mouth of the Ottawa. Communities had also developed along the Ottawa, one of the great trade routes, and in Upper Canada around the blockhouse forts that had been built at strategic points on the shores of the Great Lakes. But between Upper and Lower Canada the rapids of the St. Lawrence interposed a barrier that, less than a century ago, made the journey between Toronto and Montreal, both at that time towns of some consequence, a difficult and hazardous undertaking. It is only natural that the construction of canals should first have taken the attention of the Canadian people.

The records of the early attempts to improve navigation around the rapids of the St. Lawrence are very meagre. There is an interesting account of an early effort to overcome the difficulties of navigation between Montreal and Lachine in which it is related that in 1700 the Gentlemen of the Seminary of St. Sulpice undertook to improve the Little St. Pierre River and to make it navigable for canoes from its mouth to Lake St. Pierre, a shallow body of water lying about halfway between Montreal and Lachine, and to open a cut from the lake to a point on the St. Lawrence above the worst part of the rapids. A notarial contract for the work was passed between the contractor Gedeon de Catalonge and M. Dollier de Casson, Superior of the Order of St. Sulpice, for the excavation of a canal 24 arpents long, 12 feet wide at the surface of the ground and of varying width at the bottom according to the depth of cutting. The water flowing in the canal was to be at least 18 inches deep at the period of lowest water in the St. Lawrence. The contractor got to work with picks and shovels and two-wheeled carts, hand drills and black powder and prosecuted the work for four months when he failed due to the fact that more of the cut than he had anticipated was in solid rock. Attempts were made from time to time to finish the work but it was never completed and it was not until 1825, when the first Lachine Canal was built by the Government of Lower Canada, that the hazards of navigation in this section of the river were overcome. This canal was nine and one-half miles long and contained five masonry locks 24 feet wide by 100 feet long, with 4½ feet of water over the sills.

The introduction of steam navigation on Lake St. Louis and the Ottawa River in 1919 gave a great impetus to the efforts for the improvement of the waterways. Following the War of 1812 the Royal Engineers were unfavourable to the construction of canals along the International section of the St. Lawrence River as being too exposed to attack from the United States. Another factor that may have influenced them in their advocacy of the alternative route up the Ottawa to Ottawa, then known as Bytown, and from there down the Rideau to Lake Ontario at Kingston was the wholesome respect which engineers, as well as the rivermen, held for the St. Lawrence. In this connection it is related that Mr. T. C. Keefer, who later became one of Canada's outstanding engineers and the first President of the Canadian Society of Civil Engineers, as a young engineer on the construction of the Cornwall Canal, made the suggestion that several miles of canal construction be saved by building an earth dam 35 feet high and about one-quarter mile long between the lower end of Sheek's Island and the mainland across one of the minor channels of the

Fig. 2—La Gabelle development, 1922, Concreting Methods. Typical of this period concrete was transported from the mixing plant in special concrete cars or buggies and distributed by chutes from the concreting towers

river thus converting the "snye" into a deep, navigable channel. His suggestion was turned down for the reasons, among others, "that the St. Lawrence is on too grand a scale to admit of the probable result of interference with it to be even approximated by the use of formulae fairly applicable to ordinary streams" and "that all dams are insecure." The construction of the Rideau Canal in 1832 and of locks on the Ottawa at Grenville, Carillon and Chute-à-Blondeau in 1834 established this as the route between Montreal and Toronto until the opening of the Cornwall Canal in 1843 and of the Beauharnois Canal in 1846 diverted most of the traffic to the St. Lawrence.

By the completion of the Beauharnois and Cornwall Canals, the enlargement of the Lachine Canal in 1848 and the reconstruction of the Welland Canal about the same time, a waterway of nine foot draft was provided from Montreal to the head of the Great Lakes. One of the objectives of the canal system, however, was not fully realized for before this work was completed the American railroad systems that had developed so rapidly during this period diverted to American ports a good deal of the traffic that the Canadians had expected their canal system to handle. It was soon realized that they would have to develop in Canada this new method of transportation that could function in winter as in summer and that was not confined to any one river valley for its commerce.

The Railroad Period

The first railroads, however, were mere adjuncts to the already established water transportation. In 1832 a charter was granted to the "Company of the Proprietors of the Champlain and St. Lawrence Railway" for a line from Laprairie, across the river from Montreal, to St. Jean at the head of the rapids on the Richelieu. A water transportation route already existed from St. Jean up the Richelieu, through Lake Champlain and down the Hudson to New York. The railroad was completed in 1836. The rails were of wood with running surfaces of flat iron bars which had the unfortunate characteristic of turning up at the ends under very moderate use. The promoters of the enterprise evidently were not over-optimistic for the railroad was operated the first year with horses for motive power. But its success warranted the importation from England of a steam locomotive the following year. The year 1847 saw the construction of a railroad between Montreal and Lachine as a portage road around the Lachine

Fig. 3—Rapide Blanc Development, 1931 to 1934. Unloading cement from special semi-trailer truck into bin at mixer plant

Rapids and five years later an extension, the Lake St. Louis and Province Line, was built from Caughnawaga to Mooer's Junction where it connected with American roads and provided a direct route between Montreal and New York.

By 1850 two hundred miles of railroads were in operation in Canada and six hundred and twenty-eight miles were under construction. This period and succeeding periods of activity were followed, however, by long periods of almost complete stagnation, due partly to difficulties in financing and partly to political intrigue. At the time of Confederation the Maritimes had no direct rail connection with the rest of Canada and the commerce of the Canadian west was still handled by shipping on the Great Lakes.

All of this early work was done by very primitive methods and an almost entire lack of equipment. Earth was excavated by pick and shovel and transported in wheel-barrows, in two-wheeled carts or in waggons with loose plank bottoms

Fig. 4—Rapide Blanc Development, 1931-34. Concreting Trestle and Travelling Derricks. The concrete was unloaded from the belt into hoppers located at intervals along the trestle and handled from there to the forms in two-yard buckets by the travelling derricks. These derricks also served for the powerhouse erection

for dumping. Hand drilling and black powder were used in rock excavation. The locks of those canals that were built by private interests were built of materials nearest at hand and most easily worked. They consisted of rock-filled timber cribs in the construction of which the woodsmen had become expert. The Government canals, however, had masonry locks, the cut stone for which was handled into place by small hand operated cranes. It is related that the Royal Engineers imported miners from Cornwall to quarry and dress the stone for the locks of the first canals constructed in 1780 around the Cascades, Cedars and Coteau Rapids.

It is probable that no power equipment of any kind was used in Canada until early in the seventies. There seems to be some confusion in this regard, one report stating that a steam shovel built in 1837 by Wm. S. Otis was used on the construction of the first Welland Canal, which, by the way, was completed in 1829, and another report stating that the first steam shovel used in Canada was employed on the construction of the third Welland Canal in 1874-75. This is reported to have been a shovel built in 1841 by John Souther in Boston. It is possible that the Otis shovel was used prior to this on work done at about the time of the construction of the second Welland Canal, which was completed in 1846, but no clear record of this exists. At any rate, it is apparent from the records that even as late as 1875 most of the work was done with small tools and hand methods.

A great step in advance was taken when the construction of the Canadian Pacific Railway's transcontinental line was inaugurated in 1881. This ambitious undertaking, calling for great skill, determination and courage in its execution was carried out at a speed never previously attempted in Canada. During the year 1882 on the section between Oak Lake and Calgary 478 miles of main line track were completed together with 28 miles of sidings.

Steam shovels were used in the cuttings, the excavated material being loaded into waggons and hauled to embankment or to the disposal dumps. Horse-drawn graders and scrapers were strung out across the prairie for hundreds of miles following close upon the heels of the locating engineers. The base of operations was Winnipeg, from which point supply trains were dispatched on regular schedule. Each train carried complete material for one mile of track, ties, rails, splice-bars, spikes, telegraph poles and bridge material where required. When the train reached the end of steel it was unloaded alongside the track, the ties were transported beyond the end of steel in waggons and spaced along the right-of-way, the rails, carried on a rail car, were laid on the ties by hand and the spiking gang followed.

The difficult section along the north shore of Lake Superior was begun in 1882 and completed early in 1885. Supplies for this section were forwarded by boat from Owen Sound and distributed at depots along the shore. From the depots the supplies were transported to the right-of-way by waggons over rough portage roads. In the rock cuts on this section and in the mountain section steam drills were used except in the more advanced locations where hand drilling had to be resorted to.

The completion of this great task within five years of its inauguration was due to the thoroughness with which the construction work was planned and organized and is a tribute to the persistence, the courage and the administrative ability of the men at the head of the enterprise. In one respect this work was years in advance of the usual procedure on construction work in Canada. It is only within recent years that as a usual thing construction methods and procedure in the field have received the careful planning and close attention to detail that characterized this undertaking.

The quarter century following the opening of the west by the Canadian Pacific Railway was a period of rapid growth and expansion in agriculture, in mining, in industry and in commerce. It was marked by the improvement of the inland waterways, the extension of the railways, the establishment of a diversified industrial development and a remarkable growth in both urban and rural population. To meet the increasing demands for speed and improved quality in construction, contractors introduced more efficient and more powerful equipment on their work. The large construction job of this period was characterized by miles of construction track, large numbers of dinkey locomotives and side dump cars, steam shovels, drag lines and hoists. The development of the automobile toward the end of this period and the consequent improvement in the manufacture of the internal combustion engine has gradually brought about an increase in power and mobility in construction equipment that has almost revolutionized construction methods.

Hydro-electric Development

The Dominion of Canada, rich in other natural resources, possesses an especially valuable asset in her water powers. Stimulated by the remarkable expansion in manufacturing that began in the first decade of the 20th century, the building of hydro-electric developments became one of the major construction activities of the country. Between the years 1922 and 1926, for instance, developments aggregating more than 2,000,000 hp. were in course of construction. During the first ten years of this period the growth in installed capacity was fairly uniform at the rate of about 80,000 hp. per year. Between 1911 and 1931 the increase in capacity aggregated more than 5,000,000 hp. and since 1931 the growth has been maintained at an average rate of 300,000 hp. per year, the installed capacity at the end of 1938 being approximately 8,200,000 hp..

The largest project constructed during this period was the Queenston-Chippewa Development of the Hydro-Electric Power Commission of Ontario at Niagara Falls. Work was begun in 1918 and completed in 1922. This development has an installed capacity of 550,000 hp. at a head of 305 feet.

The project takes its water from the Niagara River at the mouth of the Welland River about two miles above the falls and diverts it to a point about five miles

Fig. 5—Highway Work in Ontario, 1918. Operation of Quarry, Hamilton-Dundas Road

below the falls through the lower reach of the Welland River and an artificial canal a total distance of 13½ miles. Its construction involved the dredging of approximately 4,000,000 cu. yd. of earth in the Welland River, the excavation of 9,000,000 cu. yd. of earth and 4,000,000 cu. yd. of rock from the canal and the placing of 410,000 cu. yd. of concrete.

The construction methods employed were typical of the period. Excavation in the Welland River was carried out by a 3-yd. dipper dredge and a cableway operating a 3-yd. clamshell bucket. The dredge dumped into scows which were towed out to the Niagara River and unloaded. The cableway had a span of 800 feet between a 60-ft. tail tower and an 80-ft. head tower both of which travelled on railroad trucks on parallel double tracks. The material from the cableway was dumped on a spoil bank along the north side of the river. The bottom of the cut was 30 feet below the water surface.

Most of the canal cut is through solid rock with an over-burden varying in thickness up to 80 feet. The maximum depth of cut was 145 feet. As the overburden, which was very fine in some places and contained a considerable amount of groundwater, could not be depended upon to carry heavy concentrated loads, the use of large drag lines for stripping was out of the question and for this reason it was desirable to carry the heavy excavating equipment throughout on the rock surface. This required shovels with

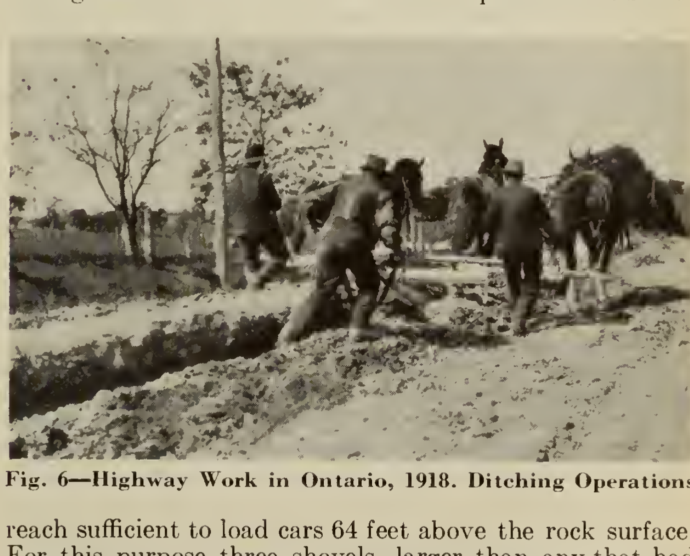

Fig. 6—Highway Work in Ontario, 1918. Ditching Operations

reach sufficient to load cars 64 feet above the rock surface. For this purpose three shovels, larger than any that had been built up to that time, were purchased. One of these shovels had a 90-foot boom with a 58-foot dipper stick and a 5-yard dipper. The other two were equipped with 80-foot booms, 54-foot dipper sticks and 8-yard dippers.

A pilot cut was first made by a standard railroad shovel along one side of the canal prism. This provided a level berm on which were laid tracks for the dump trains which

Fig. 7—Highway Work in Ontario, 1918. Concreting Bridge Abutment

served the big shovels. The excavated material was hauled to the dump in 20-yd. air-dump cars in eight or ten-car trains drawn by electric or steam locomotives.

The rock section of the canal is lined throughout to a height of 34 feet with plain concrete which varies in thickness from a minimum of six inches to a maximum of 24 inches. This, together with the lining of the fore-bay and the construction of the intake and of the power-house, required the placing of 410,000 cu. yd. of concrete. The concrete generally was mixed in central mixing plants located conveniently near the parts of the work which they served and distributed and deposited in the forms by means of chutes. In the case of the canal lining the mixing plants travelled with the lining machines, the cement and concrete aggregates being brought to them on cars operating on the tracks which had been provided at the top of the rock cut for serving the shovels.

The methods used in the construction of the Welland Ship Canal, which was carried on during this same period, were practically the same as those used in the construction of this development. This work initiated in 1914, was closed down for two years during the war, begun again in 1919 and completed in 1931. It involved the excavation of 48,000,000 cu. yd. of earth, mostly by dredging, and 8,862,000 cu. yd. of rock and the placing of 3,258,500 cu. yd. of concrete.

Since the completion of the Queenston-Chippewa Development we have seen the steam engine gradually displaced by the gasoline and the diesel engine. The steam dinkey has given place to the gasoline locomotive which itself has to a large extent been replaced by the motor truck and the tractor. The development of the caterpillar tread has made possible the elimination of miles of construction track that were essential in work on soft ground. Radical changes have taken place in the making, transporting and placing of concrete. The use of chutes, which was almost universal at that time, has been found too often to result in concrete of poor quality, especially in hydraulic structures and has been replaced by other methods which provide closer control and permit the use of a considerably dryer mix.

There has been during the last few years an increasing mechanization of the large construction job. This is well illustrated in the construction of the Shawinigan Water and Power Company's Rapide Blanc Development which was completed in 1934. This development has an installed capacity of 160,000 hp. at 112 ft. head. It is located on the St. Maurice River 110 miles above the Shawinigan Company's principal development at Shawinigan Falls. This site was ten miles from the railroad and inaccessible by any means of transportation. In view of the necessity of transporting very heavy pieces of equipment, especially the four transformers weighing 100 tons each, as well as the huge quantities of construction materials, serious consideration was given to the construction of a railway over the rugged terrain between Rapide Blanc Station on the C.N.R. and the site, but after comparative studies had been made it was apparent that a paved road and motor transportation would not only be more economical but would also provide a better means of access after the plant was put into operation.

The river at the site of the development runs through a narrow valley between steep, rocky hills. This made for economy of materials but the restricted space available for the construction plant necessitated a more careful study than usual of the plant layout and equipment and an exacting analysis of construction methods and the sequence of operation. As it turned out the compactness of the construction plant was conducive to economy in its operation.

All of the construction plant and materials and the power-house equipment were shipped by rail to the siding at Rapide Blanc station and transported from there, a distance of ten miles, by truck or trailer over the motor road which was built to the site of the development. This road has a width of 20 feet of which a ten-foot strip on the right hand side is paved with concrete for the loaded trucks and the balance is surfaced with gravel. The maximum adverse grade is 5 per cent inbound and 6 per cent outbound.

More than 250,000 tons of equipment and materials including the sand for the concrete were transported over this road at an average cost of less than five cents per ton mile, which includes maintenance on equipment. Standard trucks and trailers were used except for the transportation of cement and the special 100-ton trailer purchased for the hauling of the transformers. The cement was received at the siding in bulk and unloaded from the cars into a cement silo by bucket conveyor. It was transported to the job in special 10-ton steel tank semi-trailers from which it was dumped into the cement bin at the top of the mixer plant.

The hill on the west side of the river rises abruptly from the water's edge so that the only space available for the location of the construction plant and the camp was on the east side. This necessitated the construction of a permanent bridge across the river at a point about a half mile below the dam to meet the motor road which comes in on the west side. As the power-house is located across the west side of the river channel, it was not necessary to design this bridge to carry the heavy power-house equipment.

The by-pass channel through which the flow of the river was diverted during the construction of the intake section of the dam and the power-house substructure was located along the east bank. The bulk of the excavation came from this part of the work. The rock was sound and most of it

Fig. 8—Highway Work in New Brunswick, 1937. Heavy Earth Cutting Near Perth Using Dumptor and Gas Shovel

was crushed for concrete aggregate. Mucking was done by power shovels into steel skip boxes which were hoisted by derricks and dumped into six-yard side dump cars. These were hauled in six-car trains by gasoline locomotives to the crusher plant or to a spoil bank on the side of the river below the tail-race.

Upon completion of the by-pass channel and its control works the water was diverted to the east side of the river and work on the intake section of the dam, the power-house and tail-race, proceeded with. The excavated materials from this section of the work were transported in 10-ton steel body dump trucks, the shovels loading directly into the trucks.

The crusher plant consisted of a 42 in. by 48 in. jaw crusher and two 14 in. gyratories which reduced the rock to a maximum of 4 in. The rock was carried from the crusher plant by belt conveyor to the storage pile where it was hoisted by bucket conveyor to a belt conveyor on the top of the steel trestle which distributed it along the pile. From the storage pile the rock was drawn off through chutes in a tunnel to a belt conveyor which carried it to a bin at the top of the mixed plant.

In the part of the St. Maurice Valley in which this development is located deposits of sand of suitable quality and in sufficient quantity for a large development are of rare occurrence. We were fortunate in locating near the motor road two pits from which we were able to obtain a sufficient quantity. The first of these was about two miles from the dam site and furnished about 40,000 cu. yd. or a little more than one-third of our requirements. The balance was obtained from a pit 8½ miles from the job. The sand was dug by power shovel and loaded into a bin from which it was transported by belt conveyor to a central screening plant. The waste materials were carried by belt conveyor to the spoil bank and the good sand loaded into trucks from a bin and transported to the storage pile near the mixer plant. From the storage pile it was carried by conveyor to a bin at the top of the mixer plant. The sand pits contained so much unsuitable material that in order to obtain the 110,000 cu. yd. of sand required it was necessary to dig and handle more than 200,000 cu. yd. of material.

The mixing and placing of concrete were carried on under the supervision of a concrete technician who was directly responsible to the head office and whose staff kept a continual check on the quality of the work. The grading of the sand and the consistency of the mix were checked at frequent intervals and 8 in. by 16 in. test cylinders were taken at least twice a day and tested in the concrete laboratory. The concrete was mixed in two 2-yard mixers which dumped into steel hoppers. From the hoppers the concrete was transported by belt conveyor on a steel trestle along the axis of the dam. It was unloaded from the belt by movable trippers into hoppers located at intervals along the trestle and handled from the hoppers to the point of deposit by derricks and two-yard bottom dump buckets. For a job of this size, requiring the placing of upwards of 200,000 cu. yd. of concrete, this method of transporting and placing the concrete worked out very economically and permitted a very rigid control over the quality of the concrete deposited in the forms.

Highway Construction

As the development of the internal combustion engine and of automotive equipment has almost revolutionized construction methods, the production of the automobile, which was largely responsible for this development, has itself resulted in the enormous growth in highway construction that has taken place during the last twenty years. Not only has there been a spectacular advance in construction methods and technique in highway work since the various provinces inaugurated their highway programmes a little more than twenty years ago but it is in this field that the most rapid advance in construction equipment has taken place.

Up to the year 1920, and in some of the provinces for several years after that, highway work consisted almost entirely of improving existing roads with little attempt at changing alignment or grades. The power equipment that had been in use on other types of construction work for a good many years was heavy and cumbersome and unsuitable for the lighter work involved in highway construction of this period. The road surfacing usually was gravel or, in the Province of Ontario in districts where suitable gravel could not be obtained locally, water bound macadam. Most of the grading was done by horse-drawn blade graders, by drag or wheeled scrapers or by hand. When the haul was too long for scrapers the material was dug and loaded by hand into dump carts or wagons and transported to place. In some cases steam traction engines were used to haul scarifiers or the wheeled scrapers and toward the end of this period gasoline tractors began to be employed on this work.

Prior to 1920 in Quebec and Ontario some of the main highways were paved with bituminous macadam and a few miles of concrete pavement were laid. Where rock for the macadam was available along the highway local quarries were opened up and equipped with small crushers and screening plants. Frequently the rock from the quarries was supplemented with field stone. The crushed stone was spread on the grade by hand and compacted with 10-ton or 12-ton steam rollers and the bituminous material applied by a horse-drawn spreader.

Fig. 9—Highway Work in Quebec, 1938. Caterpillar Tractors with 12-Yard Track Type Waggons Disposing of Boulders and Clay from 1½-Yard Shovel

Fig. 10—Highway Work in Ontario, 1938. Grading with Carryall

No sooner had highways been improved that it was apparent that they were inadequate for the traffic that was developing. Better surfaces were required, more gradual changes of grade, the easing or entire elimination of curves. The heavy work frequently involved in these improvements and the necessity for speed in construction brought a demand for more powerful and more mobile equipment. To meet this demand new machines have been developed and old machines have been made more rugged.

Highway work in Canada to-day is as thoroughly organized and mechanized as other types of construction. The use of the motor truck permits of the establishment and economical operation of large central plants for the receipt and preparation of road-building materials and a closer control of the resulting product.

The improvements that have been made in grading and in excavating equipment, in paving and in finishing plants have provided the highway builder with tools that enable him to do work that a few years ago would not have been economically feasible.

ADVANCES IN THE DOMESTIC USES OF ELECTRICITY IN CANADA

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Paper prepared for presentation at the British-American Congress, New York, September 4th-8th, 1939

The position of Canada in the field of electric power production is a remarkable one.

With a population of only 11,000,000 we have close to 8,500,000 hp. of generating capacity installed in our central stations.

Our per capita electrical installation is exceeded only by Norway and by Switzerland.

This condition was brought about by a number of favourable factors:

(a) Canada is lavishly endowed with natural resources and it possesses a fine system of great rivers capable of development for power purposes.

(b) Canadians have set about developing their natural resources with characteristic energy and they have been spurred on in this undertaking by the fine example set by the great Republic which shares a common border with us for 4,000 miles.

(c) A large influx of foreign capital, attracted by Canada's great latent wealth, has taken place steadily throughout the history of the development of our power industry.

But, as there must always exist unfavourable factors in all manner of human endeavour, we have had to overcome several serious handicaps. For example, we are not favoured with good coal deposits strategically located with respect to our industrial centres. We do have, however, potential water power resources amounting to roughly 40,000,000 commercial hp.

The more favourable sites near the centres of use were developed first without too many physical difficulties but, ultimately, we had to go farther afield and surmount physical barriers in the form of great distances and difficult transportation problems through rugged, wooded, sparsely settled country.

The result has been that 98 per cent of Canada's electrical power supply is furnished by hydro-electric plants and extensive high voltage transmission systems are spread all over the country and are growing steadily.

We have approximately thirty hydro-electric plants each having an installed capacity greater than 50,000 hp. and roughly half of these have a capacity greater than 100,000 hp. Transmission of large blocks of power 100 to 300 miles is not unusual.

When we look at these developments in retrospect, we take a certain pride in them and we feel that the high relative position occupied by Canada in the realm of electric power development justifies the following presentation, a brief outline of the broader aspects of the domestic uses of electricity in our country.

Industrial and Domestic Services in Perspective

In dealing with the subject of domestic and farm usage of electricity one must view it in its proper perspective. After all, it takes many hundreds of domestic customers to use as much power as a medium size factory, hence, were it not for industrial requirements for electric power, the large plants and extensive transmission and distribution systems which we now have would not and could not have been economically sound and, consequently, domestic electrical service could not be made available as extensively, nor as economically, as it has been.

In the early days of the industry plants were built primarily to supply industrial loads and domestic service was considered somewhat of a necessary evil. Farm electrification was regarded as a wild utopian dream. However, after some thirty years our ideas have changed radically Industrial loads are still the mainstay of the industry, but domestic service has come into its own through the multiplication of appliances with consequent increased use of power, and farm electrification has ceased to be a dream.

At present the installed generating capacity in Canada is used up approximately as follows:

	Hp.	Per cent
(a) Pulp and Paper industry	1,800,000	22
(b) Mining	810,000	10
(c) Other industries and municipal services	3,940,000	48
(d) Domestic, farm and commercial lighting	1,640,000	20
Total	8,190,000	100

While 20 per cent of the available capacity is used for lighting and appliance service, the use in kwh. for this class of service is not more than 8 per cent of the entire Canadian output because of the comparatively low load factor of domestic service.

The Use of Electricity for Domestic Service in Canada

The growth of domestic and rural electrical service in Canada is illustrated by the following table:

Table 1—Growth of Domestic Service in Canada

Year	Customers in Per Cent of Total Population	Average Consumption per Customer
1914	* 7.45	* 190 kwh.
1922	10.0	* 594 "
1925	11.5	* 838 "
1930	12.9	1131 "
1935	12.8	1262 "
1937	13.5	1338 "

*Estimated.

The annual consumption of 1,338 kwh. per domestic customer in 1937 is certainly high since it is 71 per cent larger than the corresponding figure of 781 for the U.S.A. Just as in the case of the United States, however, there is a very wide variation in the average consumption in the various parts of the country. The lowest and highest consumptions occur in the provinces of Prince Edward Island and Manitoba, the figures being 491 kwh. and 3,963, respectively, that is a 1 to 8 variation.

Mere statistics can be very dry and we do not wish to burden this short paper with rows of monotonous figures. We wish to show, however, that an analysis of the wide variation in average consumption throughout Canada and a study of the underlying causes for such variations lead to some interesting and valuable observations.

Table 2 shows the progress achieved as at 1937 in each of the nine provinces.

Beginning at the bottom of the table we find Prince Edward Island a very small province, almost entirely rural, the largest city having a population of under 15,000. The customer saturation is low, the consumption is the lowest and the average domestic rate the highest.

The next two provinces, New Brunswick and Nova Scotia, are not highly industrialized. There are two cities of approximately 50,000 population, three of 20,000 to 25,000 and all others are under 10,000. The power systems are lightly loaded, although they cover an extensive territory, that is the customer density is low. This condition is not favourable to low cost service, a fact reflected in the average rates.

In these three Maritime provinces it is obvious that conditions have been such that the growth of domestic service has not been as rapid as elsewhere. The sales efforts and other methods employed to popularize electrical appliances have been on a par with the rest of Canada, except Ontario and the City of Winnipeg. The power is distributed in part by publicly owned systems and in part by private power companies. They do not overlap but they are close enough to create keen competition. The comparatively low energy consumption is largely influenced by inherent physical and economic factors.

Table 2—Domestic Service in Canada by Provinces

Province	Per cent of Canadian Total Pop.	Cust.	Kwh.	per cust. year	cts. per kwh.
Ontario	33.4	44.0	58.5	1,779	1.51
Quebec	28.2	27.1	13.2	652	3.06
British Columbia	6.8	9.6	6.7	933	2.81
Manitoba	6.5	5.1	15.1	3,963	1.03
Saskatchewan	8.4	3.1	1.8	798	4.98
Alberta	7.0	4.1	1.8	578	5.28
Nova Scotia	4.9	3.9	1.6	545	4.84
New Brunswick	4.0	2.8	1.2	565	4.76
Prince Edward Island	0.8	0.3	0.1	491	6.84
Total or Average	100.0	100.0	100.0	1,338	1.96

Saskatchewan and Alberta

The province of Saskatchewan is almost exclusively a wheat growing area. There are two cities of approximately 50,000 population, one of 20,000 and all others have less than 10,000 people.

The farms are large and comparatively far apart. Such farms as are served by electric lines use a fair amount of power.

In contrast with the rest of Canada nearly all of Saskatchewan's power is produced by fuel burning plants.

In the boom years 1923-1929, when the Saskatchewan population was comparatively prosperous, the use of electricity in the home increased very quickly. Since 1930 there has been but little growth.

It is rather remarkable that a province which is largely rural, that has a low density of population and that produces its current with comparatively small fuel plants should have an average consumption of 798 kwh. and an average annual bill of $39.73, with a rate of 4.98 cents per kwh.

Alberta has wheat farms, grazing lands and limited industrial areas. The consumption is low and the rate high for approximately the same reasons as in New Brunswick and Nova Scotia.

The five provinces we have dealt with so far have among them only 14.2 per cent of the customers and take 6.5 per cent of the total domestic output in Canada. Their relative importance is, therefore, very small in the field of electrical power usage in Canada.

Manitoba

The case of Manitoba is very interesting. In that province 6.5 per cent of the total Canadian population use 15.1 per cent of the total energy used for domestic service, an average of 3,963 kwh. per domestic customer.

It is obvious that the growth in the use of domestic electricity has not been normal in that province, probably due in some measure to the lack of local wood or coal resources and the consequent high cost of competing forms of fuel.

The majority of domestic consumers in Manitoba are concentrated in the Winnipeg area which has a population of approximately 350,000, or half that of the whole province.

Power is supplied by two district utilities in active competition, the municipally owned City of Winnipeg Hydro-Electric System and the privately owned Winnipeg Electric Company. Each has its own hydro-electric plants, transmission lines and distribution systems. The distribution lines overlap to some extent although they are not on the same streets.

The history of the keen, and at times bitter, competition between the two systems has no doubt resulted in the sale of more appliances and the popularization of the use of electricity and a consequent decrease in the domestic rates.

The results of these unusual circumstances have been rather remarkable. Approximately 60 per cent of the domestic customers use ranges or heating appliances and 50 per cent use flat rate water heaters.

Six times as much energy is used for cooking, heating and water heating as for other domestic uses. The average rate for water heaters is approximately 0.4 cents per kwh. and the average rate for all domestic loads is approximately 0.9 cents.

The above facts explain why the average consumption in Manitoba is so high and the rates so low and it also shows that local conditions have a great bearing on the growth of domestic load.

British Columbia

This province at the western extremity of Canada has the highest saturation of domestic customers in the Dominion, a high consumption per customer and the fourth lowest rate. Here again local conditions are largely responsible for these results. British Columbia is a very rugged, mountainous area and there are but few farms. Nearly all the population is gathered in and around Vancouver (300,000 population) and Victoria, and a few medium sized towns along railway lines, so that a very large proportion of the population is within easy reach of power lines—hence the high customer density. The utilities are practically all privately owned. The climate of Vancouver, Victoria and Prince Rupert, the principal coastal cities, is mild, a factor which favours the use of electric ranges and electric heating appliances.

Ontario and Quebec

These two provinces have 71 per cent of all the domestic consumers in Canada and the energy used is 72 per cent of the total. The majority of industrial establishments in Canada are located in these two provinces.

Quebec

Over one-third of the population of Quebec is concentrated in the district of Montreal, the metropolis of Canada, with a population estimated at 1,200,000. There are also a number of thriving industrial centers scattered over the eastern part of the province. The high industrialization of the province is reflected in the fact that the rural population is only 37 per cent of the total population.

Outside of a few isolated municipal systems, all power used in Quebec is distributed by private companies.

Quebec ranks fifth among provinces in domestic consumption with a figure of 652 kwh. per year per customer.

During the 1920-1930 decade when the use of electricity increased at a great rate throughout North America, the private companies in Quebec followed closely the sales and promotion methods developed in the U.S.A. Results in the use of power for domestic purposes were gratifying but the increase was nevertheless limited by the economic factors, such as ample supplies of low cost wood for fuel in the rural areas, and extensive use in the cities of coal gas for cooking and water heating.

For municipally owned systems in rural districts, a grant of 55 per cent of the total capital cost is now available from the Provincial Government.

The largest distributors of power in Quebec began experimenting with rural electrification at an early date. Although these results showed that the revenue to be expected was not high, yet 1,050 of the 1,400 parishes in the province are wholly or in part electrified, with 20,000 out of 141,000 farms receiving the benefits of electrical service.

Recently, low cost rural lines using light but strong conductors, such as copperweld-copper, have given a new impetus to rural electrification in Quebec. Since 1935, the Provincial Electricity Board and its predecessor, the Quebec Electricity Commission, have granted authorization for the construction of 1,155 miles of rural distribution lines. During 1938, a total of 366 miles were proposed and authorized in 50 counties of the province, at an estimated total cost of $575,000.

The National Electricity Syndicate, a body recently formed by the Provincial Government, is proceeding actively with the development of a hydro electric system to serve mining areas in the Abitibi district of the province. It is expected that this power project will serve as the nucleus of a larger provincially owned power system to serve other areas in the province at present not supplied with power and to assist in the improvement of the large undeveloped natural resources of the province.

Ontario

This province is the most populous of Canada. Its southern part is highly industrialized and includes a large but compact first class prosperous farming area. The extreme south central part of the province is well known for its famous "Fruit Belt" in what is known as the Niagara District, which district embraces approximately 75 per cent of the whole of the activities of the Hydro-Electric Power Commission of Ontario.

As early as 1910 the policy in respect of electric utility ownership was practically settled with the formation of the Hydro-Electric Power Commission of the Province of Ontario. From its inception, the Commission has extended its activities unceasingly and it has gradually absorbed practically all remaining privately owned companies except one important system in Northern Ontario.

To-day the "Ontario Hydro" has an annual energy output of approximately seven billion kwh. and a peak load of nearly 1,500,000 hp.

One of the most potent factors of the rapid growth of rural service in Ontario was the decision made in 1921 by the provincial government to subsidize rural line extensions to the extent of one-half of their cost. With such a grant for rural line construction, the Commission found that it could build self-supporting lines in low customer density areas.

It should be noted that under "Rural Service" the "Hydro" includes so called "Hamlet" service. The number of customers which can be classed as strictly "farmers" in the whole province is now over 45,000. The total number of farms in the province is estimated at 200,000 but the Commission estimates that hardly more than 75,000 of these can be supplied with power on an economical basis under present conditions.

The Commission, with the help of the provincial Government, has also fostered rural electrification by means of loans to farmers to pay for the cost of services, wiring and appliances on farmer's premises. These loans have to be repaid, of course, so that they are not in the nature of a subsidy but nevertheless they help in the electrification programme.

Table No. 3, which follows, shows the growth of rural power service in the areas served by the Ontario "Hydro":

Year	Peak Load Hp.	Miles of Primary Line	Number of Customers
1921	—	—	—
1922	1,000	300	2,000
1923	3,000	700	4,000
1924	5,500	900	10,000
1925	7,500	1,200	13,000
1926	11,000	1,900	17,000
1927	14,000	2,900	23,000
1928	18,000	3,800	30,000
1929	23,000	4,900	36,000
1930	29,000	6,800	44,000
1931	34,000	8,100	54,000
1932	37,000	8,900	61,000
1933	37,000	9,200	63,000
1934	39,000	9,300	64,000
1935	43,000	9,800	67,000
1936	47,000	10,700	73,000
1937	57,000	12,500	83,000

At the end of 1935 more than 444,582 homes in Ontario (out of a total number of 475,000 customers served by the Power Commission) had some form of electric appliance in use. In this great number of homes, there were in use at that time:

Appliances	Number	Per cent of Saturation
Ranges	129,696	27.27
Hot plates	71,027	14.93
Washers	190,574	40.07
Vacuum cleaners	137,361	28.88
Water heaters	75,707	15.91
Grates	31,099	6.54
Air heaters	139,041	29.23
Ironers	7,960	1.67
Irons	444,582	93.48
Refrigerators	59,886	12.59
Toasters	254,295	53.47
Grills	44,387	9.33
Furnace blowers and oil burners	18,225	3.83
Air conditioners	1,158	0.24
Radios	326,805	68.71

Conclusions

Two principal conclusions may be drawn from this short analysis:

First: Canada with its strategic location, its abundance of natural resources and water powers, in particular, and its progressive spirit has developed a great electric power industry and this, in turn, has resulted in an extensive use of electricity for domestic purposes.

Second: While artificial means of fostering the use of electricity, such as aggressive sales and education campaigns, experiments and subsidies for rural electrification, etc., are very useful and have in fact been of great help, nevertheless local conditions and limitations have an important bearing on the ultimate results.

Note—This paper has been prepared in collaboration with J. R. Desloover, A.M.E.I.C., of the technical staff of the Provincial Electricity Board, Montreal, and with the assistance of other members of the staff. This co-operation is hereby gratefully acknowledged.

THE FUNDAMENTALS OF PILE FOUNDATIONS

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SUMMARY—In the following paper several types of pile foundations are discussed. They are somewhat schematic in character but are, nevertheless, designed to show the fundamental principles regarding the reciprocal action between the ground, the piles and the structure supported by them. Naturally in practice there are all kinds of transitions from one type to another, so that each foundation problem presents an individual case the solution of which depends upon an application of the principles set forth below.

It is not the intention of the author to deal with the exploration of the ground by means of borings. This, in itself, is a topic of magnitude and considerable importance. For intelligent foundation design, the character of the various strata should be known to a considerable depth below the proposed construction in all cases and in particular where pile foundations are contemplated. It is assumed, therefore, that suitable borings have been taken and that the depths and character of the various strata are known in advance. Without this knowledge the rational design of foundations is hopeless.

The choice of the use of piles for a foundation rests primarily on the necessity for a reduction in the anticipated settlement of the structure to be placed on the ground, as compared to what that settlement would be without piles. It becomes necessary to consider, therefore, whether, in a certain case, the placing of piles will decrease, have no effect on, or even increase the settlement, and to estimate, roughly at least, how much this effect will be.

In order to do this, it is necessary, first of all, to understand clearly how the piles support the load and the reciprocal actions between them and the soil which surrounds them, as well as the mutual effects caused by one on another. For when a pile is driven into the ground more than the mere presence of the pile must be recognized. The soil itself is modified and added influences are brought about on neighbouring piles already present. Piles do not support their loads by themselves alone but merely serve to transmit the load from the structure into the surrounding ground.

When a pile is driven into the ground, the soil which surrounds it is displaced and compressed. The sum of the volume of soil displaced and the amount of the compression is approximately equal to the volume of the pile. The amount of each of these individual items is dependent on the character of the soil. For sand in the dense state, the displacement forms the total amount, and, in fact, due to the expansion of the sand in being displaced, often exceeds the volume of the pile. In some cases, it is impossible to drive a wooden pile undamaged into dense sand. On the other hand, when the sand is in the loose state, the displaced material is less than the volume of the pile because the jarring action of the driving causes a decrease in volume of the sand and with it a compression as well. In nature all variations between these two extreme cases will occur.

As the pile is forced down into the soil, in its effort to displace the surrounding material, a lateral expansive force is exerted which is balanced by the reactive force of the soil against the surface of the pile. This reactive force, according to the teaching of soil mechanics, is made up of two parts which change with time, the sum, however, remaining perhaps somewhat constant. As is well known, this pressure is supplied in part by the water phase and in part by the skeleton composed of the soil particles. With permeable materials, such as sand, the pressure exerted by the water phase disappears very rapidly on account of the ease with which the water can flow away from the surface of the pile under the hydrostatic stress difference set up when the pile is driven. This permits an immediate development of the frictional resistance of the pile surface with the soil, for this resistance is dependent on the pressure exerted by the soil skeleton on the pile. On the other hand, with very impermeable soils, the development of the frictional resistance takes place only slowly with time and, in fact, only as fast as the pressure against the pile surface is transferred from the water to the soil skeleton.

The driving of piles into clay soil results in some compression and a considerable amount of displacement, unless the forces causing the penetration act slowly. In order that the clay soil be compressed, the water must be displaced from it and in highly impermeable soil this process can proceed only very slowly. The other alternative is a displacement of the clay upwards around the piles as has often been observed. Driving in soft clay may be quite easy but if a rest period of several hours or even a few days, which gives the time necessary for the water phase to allow some of the pressure to be transferred to the soil skeleton, further driving can be resumed only with difficulty, as experience has often shown.

Classification of Piles

Piles may be classified in several ways but for our present purpose a functional classification is requisite. On this basis, we have to distinguish between three main classes:

a. Friction or floating piles;
b. Bearing piles;
c. Consolidation piles.

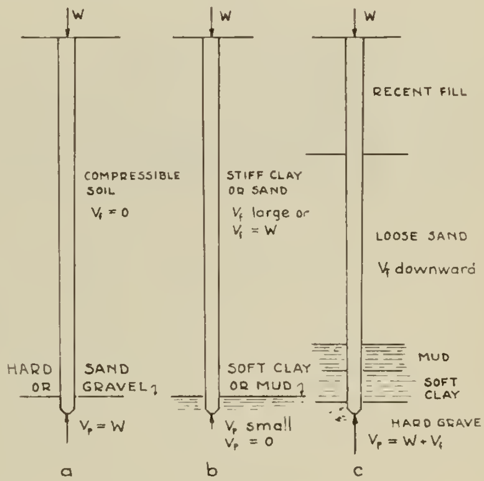

Fig. 1

A friction pile supports the load, which comes upon it, by the action of surface friction along the cylindrical surface of contact of the pile with the soil in which it rests. This friction force is passive in character, and is induced only as required to maintain equilibrium. It has a threshold value which may change with time. There is, of course, some direct compressive resistance developed at the point of the pile but, with this type, such resistance to further penetration is relatively small and is, therefore, to be neglected. There are certain types of pile in which a bulb is purposely formed at the end in an attempt to increase the point resistance, and in such cases the resistance so brought about may be taken into account. Friction piles are far less effective than is generally supposed and their value is often in no proportion to their cost.

In contrast to a friction pile, a bearing pile carries its load as a column. The point resistance is large and usually assumed equal to the entire load on the pile. In such cases, the strength of the pile, dependent on the material, is to be taken into account, and where the pile passes through a considerable depth of semi-liquid material, which can offer little lateral support, the pile may have to be considered as a long column. These considerations may, and usually do, limit the carrying capacity of piles of this sort.

Theoretically at least, consolidation piles are not supposed to carry the load of the footings directly but have for their purpose the consolidation of loose soil into a more dense stratum which, in its improved condition, is capable of supporting the footings which rest upon it. Such piles, therefore, may be placed not only beneath the footings but alongside of and between the footings as well.

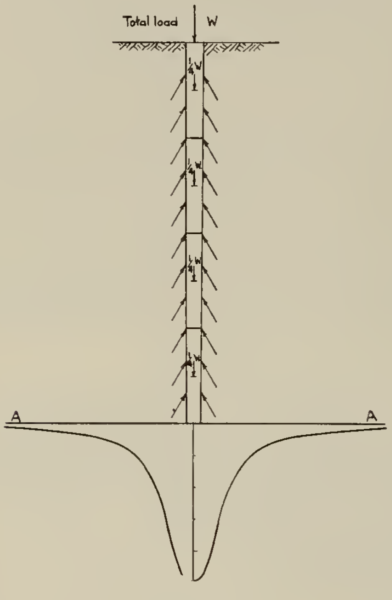

Fig. 2

The Purpose of Piles

The action of the piles is, on the whole, always to transmit the load from the structure to a stratum, at some distance below the soles of the footings, which is capable of supporting the load without excessive settlement. In this way, a certain amount of compressible soil is by-passed, so to speak, and the settlement, due to its compression, which it would contribute as a fraction of the total settlement, is thereby eliminated. It is important to have some idea of the relative amount of settlement thus eliminated, for it often turns out that it amounts to such a small percentage that the value of friction piles, especially from an economic standpoint, is often very much in doubt. Moreover, in certain cases the presence of friction piles may actually increase the ultimate settlement of the structure, so that the cost of the piles has not only been wasted but an undesirable result has been produced as well.

The Statics of a Single Pile

From the condition for static equilibrium we have

$$V_f + V_p = W$$

in which V_f and V_p are the vertically upward forces due to surface friction and to point resistance, respectively, and W is the vertically downward load on the pile. We have no means of knowing how the frictional force is distributed, in any particular case, along the pile. Obviously the system of forces is statically indeterminate and it is expedient to fall back on some simple assumption regarding the distribution of V_f along the pile. Coupled with this condition for equilibrium is the condition of continuity of the pile itself which is called the "condition of compatibility"; i.e., the deformations of the soil must be consistent with the fact that the pile remains whole.

Whatever may be the distribution of frictional force along the surface of the pile and of direct force at the point, the condition of compatibility must be satisfied as well as that of static equilibrium. The recognition of this condition is of considerable importance for a proper understanding of the functional relationship between the pile and the earth in which it rests. The mechanical properties of the two materials, that of the pile and that of the soil, are widely different and from a relative point of view the pile may often be considered as incompressible. If, then, the point of the pile rest on a hard impenetrable stratum, none of the available frictional force along the pile will be mobilized. On the other hand, if the point rest on a soft or easily penetrable stratum, even though some resistance to penetration be offered, a sufficient amount of the frictional force will be mobilized to maintain equilibrium. Moreover, from the compatibility condition, the soil below the footing which rests on the pile receives a portion of the load dependent on the settlement of the pile into the earth. Obviously, for bearing piles, the direct resistance offered by the surrounding soil is practically nil, while for floating piles, and for those driven for the purposes of consolidation of loose sand, the soil may be called upon to support a considerable portion of the total load. On the other hand, highly compressible soils permit only a small amount of the available friction to be mobilized and in such cases, even though

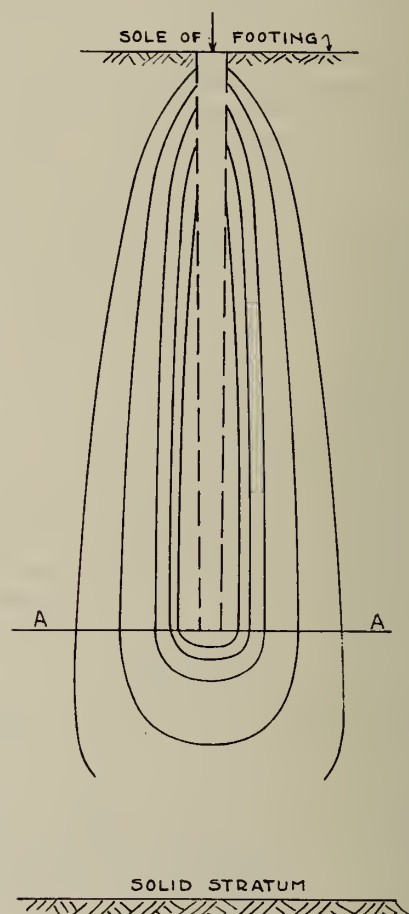

Fig. 3a

considerable frictional force is available, most of the supporting force must come from the resistance to penetration at the point.

The ideas stated above are illustrated in Fig. 1. In case *a*, if the hard stratum resists point penetration, then none of the available friction is mobilized, $V_f = O$ and $V_p = W$. In case *b* the other extreme is illustrated, the point rests in a soft stratum which offers little or no resistance to penetration $V_p = O$ and $V_f = W$. This is an example of incorrect judgment, the pile should not penetrate into the soft clay stratum but should stop short of it by a few feet. Case *c* shows an example of downward friction on the pile. The mud and clay stratum is compressed by the recent fill and the downward movement of the fill, which rests on it, is resisted by the friction along the pile so that the point must support not only the load of the structure above but also the downward drag of the surrounding earth fill and consolidated sand. Other interesting cases could be shown but these will suffice to illustrate the principles under discussion.

In what follows we shall assume that the frictional force is uniformly distributed along the pile. This is indicated in Fig. 2, which shows the pile divided into several sections, in this particular case four.

One-quarter of the total load is taken as acting on the earth at the height of the centre of each section and by the use of a suitable formula, Boussinesq's for example, the normal unit pressure on the horizontal plane through the point of the pile has been computed and plotted. The results have then been combined to give the resultant distribution curve as shown. By computing such values for different horizontal planes, both above and below the point of the pile, we can obtain a series of pear-shaped surfaces representing contours of equal vertical pressure, isobars, as shown in Fig. 3a. These graphs are known as pressure bulbs. This puts in evidence the spreading out of the load carried by a friction pile at the level A-A. Assuming that there is no movement of the pile through the soil, the settlement is confined, therefore, to the compression of the soil between A-A and the solid stratum below, and thus depends on the compressibility and thickness of this layer.

In the same way the isobars may be obtained for the distribution of the pressure below the point in the case of a bearing pile. These are shown in Fig. 3b.

For the sake of illustration, a soft stratum has been shown below the hard layer in Fig. 3b. By taking the points at which the top of the soft stratum cuts the isobars, the distribution of pressure on it may be approximately determined.[1] Piles driven not so deep, in this case, might be more effective by allowing a greater spread of pressure at the depth of the soft stratum. This, however, depends on the relative depth of the stratum to the horizontal dimensions of the structure to be supported and will not be considered further.

The important item to be noticed in Figs. 3a and 3b is that the compression of the layer of soil between sole of the footing and the level A-A has been eliminated by the presence of the pile. If this be large as compared with the compression of the soil below A-A, in the case of Fig. 3a, then the pile is of value. However, this is often not the case, and as a consequence, friction piles are often of little value in reducing settlement, as already mentioned.

Pile Groups

Piles are seldom, if ever, used singly but rather always in groups more or less closely spaced. It becomes necessary, therefore, to consider not only the interaction between the pile and the earth but also the reciprocal effect of one pile on its neighbours. When piles are driven in a group the pressure bulbs not only become modified by the lateral pressure from neighbouring piles but they tend to overlap as shown in Fig. 4.

It will be seen from the sketch that the pressure bulbs of the individual piles merge into a large pressure bulb for the whole group.

It is well known that when a load, distributed over an area, is applied to a compressible soil, points near the centre of the area settle more than those near the perimeter. With this fact in mind, the reasons for which will not be discussed here, it is easy to see that the middle one of the three piles shown in the sketch will settle more than its neighbours. This is one of the reasons why the supporting power of one pile in a group is less than it would be for that pile apart from the group. A well-known fact which has been shown to be true by test! Of course the load on each of the three piles will be approximately the same; i.e., one-third of the total load, but the group will settle more under that load than if there were but one pile with one-third the total load.

[1] The presence of the soft layer will affect the shape of the pressure bulb.

For reasons which will not be discussed, it has been estimated that the depth of soil involved in the major portion of the settlement of a structure amounts roughly to one and one-half times the width of the structure. This is called the "zone of effective settlement." If this be assumed correct, it is obvious that, for very deep deposits, floating piles will be of little value unless they have a length approximately equal to this depth of the zone of effective settlement. For example, for a bridge pier 10 ft. wide, piles 15 ft. long may be of value, whereas, on the same soil, piles 15 ft. long under the mat foundation of a building 100 ft. wide would be of little value in reducing the settlement of it. This important fact, now widely recognized as a fundamental principle for design, was first pointed out by Terzaghi. Obviously piles below the building to be equally effective would have to be of the order of 150 ft. in length. Their use is, therefore, precluded. This, then, forms a second reason why a group of piles will settle more under the same load per pile than will a single pile.

Provided there is no lower compressible stratum, bearing piles resting on a hard stratum will exert little reciprocal influence on one another. They, therefore, behave as individuals in the group.

Thus, it will be seen that:

1. In the case of bearing piles, the total carrying capacity of a group of piles will be equal to the carrying capacity of a single pile multiplied by the number of piles in the group.
2. In the case of friction piles, the total carrying capacity of a group of piles will not be equal to the integrated value based on the capacity of a single pile but may vary greatly and must be arrived at by some other process.
3. For consolidation piles there is no relation between the number of piles and the load to be supported. The required number of piles is determined by the effect on the consolidation of the ground. The driving of too many such piles will result in an ultimate breaking up of the ground with a consequent loss of supporting power.

In the above, "carrying capacity" is assumed to mean that load which a pile will support continuously without

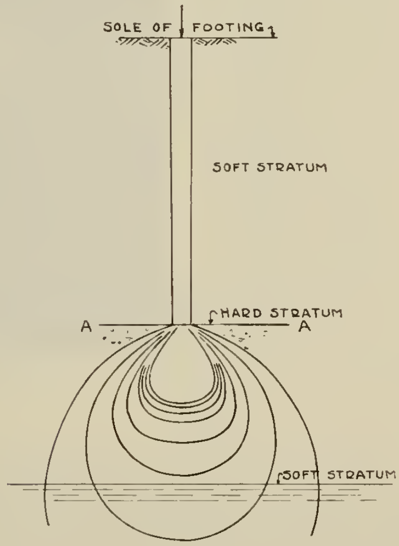

Fig. 3b

exceeding some pre-assigned amount of settlement. Such permissible settlement may vary greatly according to the character of the proposed structure.

When piles are driven into the ground the physical properties of the soil are affected and these effects may, in turn, have an influence on the piles already driven. As already mentioned above, the soil is consolidated and also displaced laterally and vertically. Piles, already in place, find themselves also displaced and this movement must be anticipated and allowance made for it. The lateral displacement effect is well known and is dealt with by a proper sequence in driving. The vertical displacement is not so often recognized. With clayey soils, the elevation of each pile after it is driven should be carefully determined and after all of the piles have been driven they should be carefully checked for change in elevation. Those which are found to have risen due to the driving of neighbouring piles should be driven again to a firm bearing. Even with cast-in-place piles upward displacement may be present and should be checked.

More recently, it has been recognized that certain clay soils are strongly affected by the jarring action of the heavy blows during driving. The clay becomes remoulded and in such condition, due to facilitated drainage, tends to undergo further consolidation due to its own weight. Such cases may result in a greater settlement than if the clay had been left in an undisturbed state because of the downward drag of the consolidating clay on the piles.

From what has been said above, it will be seen that the settlement of a pile foundation rests primarily on two factors:

1. Movement of the pile through the soil in which it is suspended;
2. Consolidation of the soil mass which lies below the level of the pile points.

In regard to the first item, an estimate may be made based on Table I adapted and modified somewhat from a similar table given in a recent book by Kögler and Scheidig.

TABLE I

Soil Type	Surface Friction (Lb. per sq. ft.)	Point Resistance# (Tons per Pile)
Sand or gravel	500	25
Stiff clay	300	5
Soft clay or silt	150	1
Mud wet	50	0
Muskeg or fill	20	0

#A point 10 in. in dia. is assumed.

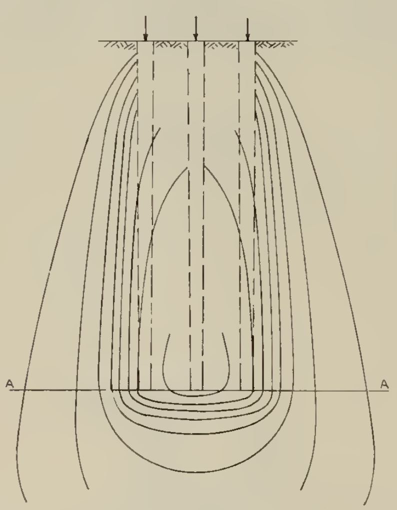

Fig. 4

Table I is based on a factor of safety of about two. It should be used only as a guide and with due regard to the principles already stated, especially that of compatibility. For example: bearing piles driven through silt on to a dense sand and gravel stratum will support safely a load of 25 tons per pile. No allowance is made for the friction force of the silt for little or none can be mobilized. On the other hand, a 25-foot pile of 12 in. average diameter in a stiff clay should be capable of supporting a load of 25 tons. By themselves these figures do not assure a reasonably small settlement of the structure for the second item plays an important part as well as the first. Lacking more definite information in any case the table can be used for design purposes in conjunction with other computations regarding the consolidation of the strata below the pile points.

Pile Driving Formulae

From time to time a number of formulae for the so-called "safe load" on a pile have been brought forward. These pile driving formulae are usually dependent on such information as the height of fall of the hammer and the penetration of the pile under the final blow along with other data which may be taken as parameters in any particular case. In all such formulae, it is assumed that the static resistance offered to the load of the structure is equal to the dynamic resistance to driving and on the validity of this assertion rests the validity of the formula. There is, however, no reason why this relationship between static and dynamic resistance should exist. It has been found that in the case of sand soil there appears to be an empirical relationship of this sort, but this is a rather uncommon case and in general the equality is not even approximately true. Some loading tests on piles, where ground conditions were favourable, have shown that the more highly developed of the driving formulae will give a good value for the carrying capacity of a single pile.

However, it has already been pointed out that piles are not used singly in building foundations. Tests have shown that a single pile, already tested by itself, sank considerably under the same loading when it became incorporated as one of a group under a similar loading test. If, then, the formula gives the carrying capacity for the single pile, it may not do so for that pile when it forms one of a group.

In addition to the above, no pile driving formulae can take into account the time element which has been recognized as a very important factor in settlement. It has already been pointed out that in any case the settlement is conditioned by two main items of which the second is by no means the least important and which no pile driving formula can take into account even in the relatively few cases where it can be applied.

In addition to the above, there are certain practical difficulties, on the medium-sized job, which render the dependence on such formulae inconvenient. Plans must be made and designs carried out, and these should be well in hand before actual construction starts. It is an expensive undertaking to transport a pile driver to the site, excavate a suitable pit, drive a pile and measure its penetration for the sake of information which may be quite untrustworthy. Such expenditure would be much better made for taking suitable borings. An intelligent design for the foundation can then be carried out. To find out what the carrying capacity of a pile will be during the construction period is of little real value, apart from the delusion which may afford the engineer a certain satisfaction based on blissful ignorance.

The statements of the fundamental principles which have been set forth above are based on the principles of mechanics coupled with the observed behaviour of soils. Many illustrations could be cited in support of them but it has been thought well not to present these because of the considerable additional amount of written description and diagrams which would be involved in so doing.

THE DOMES OF ST. JOSEPH'S BASILICA, MONTREAL

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Paper presented before the Montreal Branch of The Engineering Institute of Canada, March 2nd, 1939, and before the Ottawa Branch, October 5th, 1939

The dome, the design and construction of which is discussed in this paper, is the crowning feature of the Basilica of St. Joseph, and the most prominent, as well as the newest, landmark of the Montreal district. The top of the cross, set on top of the dome, is 26 ft. higher than the top of the illuminated cross erected some years ago on Mount Royal, and 90 ft. higher than the summit of Mount Royal itself. When it is considered that the top of St. Joseph's cross is 218 ft. above the top of the Westmount mountain, on whose northerly slopes the Basilica is built, it can be understood just how prominent a feature the dome must be.

Historical

The Basilica of St. Joseph is the creation, through the numerous donations of pilgrims, of the Reverend Brother André, a member of the religious Order of the Holy Cross, to whose college of Notre Dame des Neiges he was attached. In 1904, Brother André built, with his own hands, a small chapel on the slope of the Westmount mountain facing the college, which soon became famous as a shrine where miraculous cures were effected. The fame of the shrine grew so great that it was necessary to build a larger chapel, and the present shrine, a species of crypt or ante-chapel to the later church, was completed in 1917. At the same time, the plans of the Basilica, whose entrance rises from the roof of the crypt, were started and, in 1924, its construction commenced. Dependence upon the offerings of pilgrims made construction work slow, and, in 1929, work ceased completely, with the reinforced concrete frame and walls of the church built up to the level of the side-aisle roofs, only a few feet below the level of Surrey Gardens, the street on top of the mountain immediately in the rear of the Basilica.

It was the natural hope of all that Brother André would be spared to see the Basilica finished, but his death, in January 1937, occurred before construction could be resumed. Very soon after his death, however, the work was resumed by the Order of the Holy Cross. The original architects were Messrs. Viau and Venne, both of whom are now dead. The work of completion was put in the hands of Messrs. Tourville and Parent, architects, with the Reverend Dom Paul Bellot as consulting architect. Messrs. M. Cailloux, H. Labrecque, and G. J. Papineau, of the firm of Associated Engineers Limited, were retained as consulting engineers for the design and supervision of the superstructure.

Fig. 1—St. Joseph Basilica as it Now Appears

Design

The original plans had contemplated a structural steel frame to carry the structure above the level of the side-aisle roofs, and this frame had already been designed. New studies, on modified plans of the new architects, showed that it would be possible and more economical to build the whole of the superstructure in reinforced concrete, which material was adopted for the finished structure. Both the inner and outer domes were designed as thin concrete shells.

Domes of large size have been built at many times in the history of civilized man but, since these have generally been of brick or stone masonry, they have been extremely heavy and correspondingly thick. The dome of St. Peter's at Rome is 139 ft. in dia. and 10 ft. thick at the springing. That of S. Maria del Fiore, at Florence, also 139 ft. in dia., has a thickness of 15 ft. at the springing, and, like St. Peter's, is sub-divided in its upper part into two shells. The dome of St. Sophia's at Constantinople consists of a single shell with a diameter of 115 ft. and a thickness of 8 ft. at the springing. Others again, such as St. Paul's of London and the Invalides of Paris, have an interdome carrying the outer shell and the lantern. The large thrusts from these heavy domes have had to be resisted, as at St. Sophia's by heavy buttresses, or as at St. Paul's by chains encircling the drum, but all required enormous columns for their support.

The construction employed at St. Joseph's Basilica is very different. The inner and outer shells of the dome are 63 ft. 8 in. apart at their crowns, and it was desirable, and proved most economical, to leave this large interdome space free, except for the stairways to the crown of the dome and the lantern. The domes, themselves, are thin shells of reinforced concrete, the outer 7 in. thick and the inner 5 in. thick, or about 1/200 of their maximum diameters. Had the domes been surfaces of revolution instead of sixteen-sided polygons in plan, it would have been possible to have made them thinner. The architects' original design for the outer dome had been an eight-sided polygon, but it was found that that form would introduce unreasonably heavy bending stresses in the shell. It is proposed to build up the octagonal form on the outside of the main dome with falsework, thereby providing a space for ventilation and the installation of pipes and conduits to serve the lantern and cross. Each of the domes rests on a polygonal beam supported on columns braced together that are, in turn, supported on eight main beams. The construction is shown in Figs. 2 and 3.

Design Calculations

For purposes of design, each dome was divided into a series of latitudinal zones, 8 ft. in depth measured along the arc, and each resting successively on the others from the springline to the crown. Figure 5 is a half section of both domes taken on the centre line of any face, showing the zones, the lanterns, and the supporting beams. The assumption was made that these zones received the loads from those above, and distributed them to those below, uniformly along the imaginary polygonal joints that separated them. The thickness of the shells, however, was too small to develop any appreciable resistance to bending along the meridian, so that all forces tending to burst the domes outward in the lower portion had to be resisted by hooping around the circumference. To this extent, the domes differed from true arches.

Since the domes were completely symmetrical, it proved necessary only to design one pair of opposite faces. The method of calculating the stresses is as follows:

Considering any voussoir V (Fig. 5) being one face out of any zone, it receives, on its upper edge, the resultant A of all the forces from the voussoir above. Along its lower edge, it receives the reaction B of its own resultant force on the next lower voussoir. Both of these forces, A and B, are tangent to the curve of the dome and central to its thickness at their points of application and, by hypothesis, uniformly distributed along the joint. The voussoir is also subjected to the vertical dead and live loads C, and the horizontal force D resisting the tendency of the dome to burst outward at the springing or collapse at the crown. These forces, compounded, give a closed force polygon for each voussoir, as shown in Fig. 5, and in Fig. 7 for the whole dome. It should be noted that the diagrams consider the total forces on each voussoir.

To these forces must be added the wind force W, normal to each voussoir, as shown in Fig. 7. The Montreal Building By-laws prescribe a normal wind force, per sq. ft. of surface, of $P = \frac{60 \sin L}{1 + \sin^2 L}$: where L is the angle that the exposed surface makes with the horizontal. This formula produces a force varying from 30 lb. per sq. ft. for a vertical surface to zero for a horizontal surface. In the design of the dome, a normal suction on the leeward side was assumed, equal to one-half the pressures calculated for the windward side. Since all but one pair of faces are at any time oblique to the wind, all were designed for the maximum forces, as calculated for one pair.

Figure 7 shows the graphical calculation of the wind loads for one pair of opposite faces. First, the forces on the whole of the lantern and cross were computed and their resultant, R_1^T, found. This resultant was proportioned between the faces of the dome, as shown in Fig. 7, giving the force R_1, and that, in turn, was replaced by the horizontal forces and vertical couple shown as acting on the crown ring. In a similar manner, the resultant, R_2, all of the wind forces on the dome, and its reactions on the supports, were found. Those reactions, added to the wind forces on the drum, give the resultants, R_3 and R_4, for the windward and leeward sides respectively, whose reactions, carried down through the bracing system, give the wind loads on the main supporting beams. The figures give the forces in kips, and it can be seen that they are of no mean magnitude. The resultant wind load, on the whole of the cross, lantern, dome, and drum, amounts to 650,000 lb., and has a point of application 70 ft. above the main roof of the Basilica.

Returning to the design of the dome shell, the horizontal force, D, on each voussoir is distributed over the entire width of the face, as shown in Fig. 5. At each corner, half of the load from each of the adjacent faces is concentrated. The resultant force is resisted by the forces T_A and T_B, within the surface of the dome and those, in turn, are resisted by horizontal hooping for tension stresses, or by compression on the concrete of the shell where compressive stresses exist. Again, due to the departure of the dome from a surface of revolution, it has a tendency to deflect outward in the centre of each face and inward at the corners, to resist which tendencies reinforcing steel had to be provided.

The design of the inner dome was similar, except that it did not involve the consideration of wind load.

The reactions of the domes are transmitted to beams spanning between the sixteen trussed frames placed at the

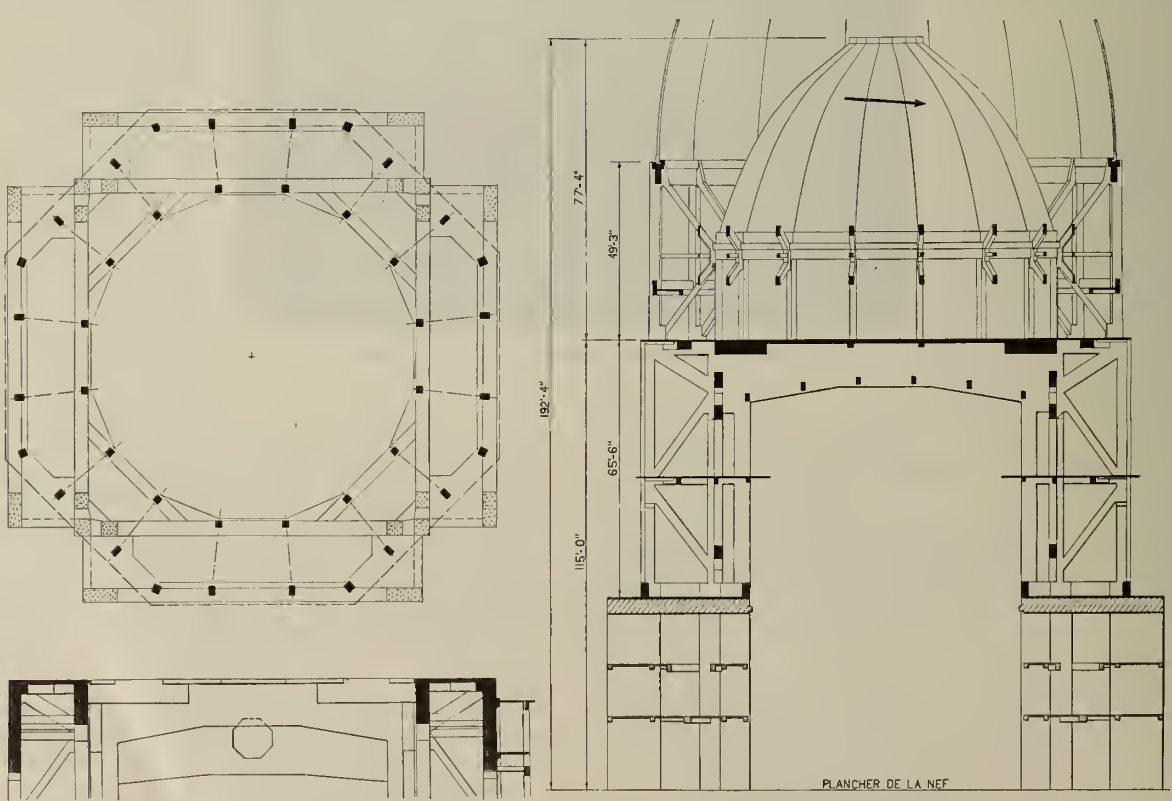

Fig. 2—Plan and Elevation of Columns and Wind-bracings of the Domes

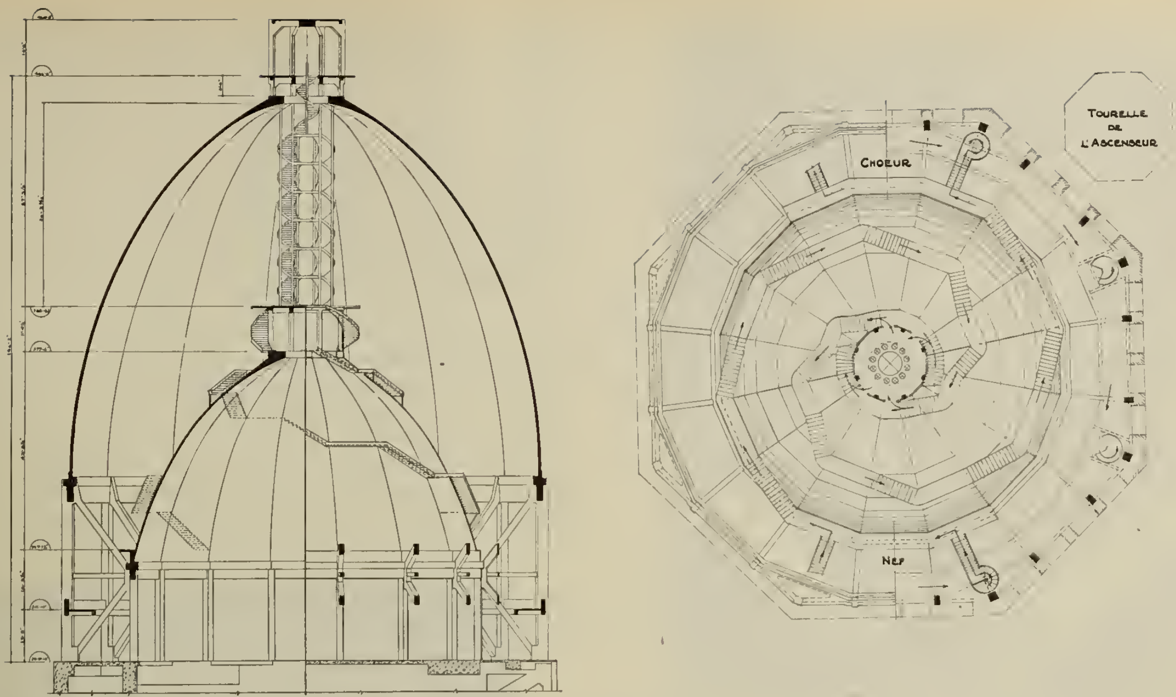

Fig. 3—General Section of the Domes also Showing Future Arrangement of Stairways Leading to the Observation Lantern

corners of the domes, as shown in Fig. 2, and these, in turn, rest on the eight main beams forming the sides of two concentric squares shown in Figs. 2 and 9. These beams span the choir, the transepts, and the nave of the church in pairs. In all cases their span is 69 ft. and their width 3 ft 6 in. At the centres of their spans the outer beams are 24 ft. deep and the inner beams 12 ft. deep. The positions of these beams, the auxiliary beams, and the main supporting columns are shown in Figs. 2, 8, 9.

Temperature Stresses and Details

The dome shells each rest in a groove in the supporting beams, as shown in the section, Fig. 5, and in detail in Fig. 4. The lip shown on the inside of the dome engages a keyway cast in the beam, thereby transmitting any uplift from the overturning effect of the wind to the supporting structure. The domes were poured on asphalt cushions, placed in the bottom of the grooves, on which they are free to slide. The annular space in the grooves, left on the outside of the domes, was later filled with plastic asphalt to allow for expansion, while at the same time sealing the grooves against the entrance of water. As the domes were to be built in cold weather and could, in any event, be expected to expand slightly when the centering was struck, it was not considered necessary to provide for any contraction. The shells of the domes, themselves, contain temperature reinforcing steel, in both directions, close to their inner and outer surfaces.

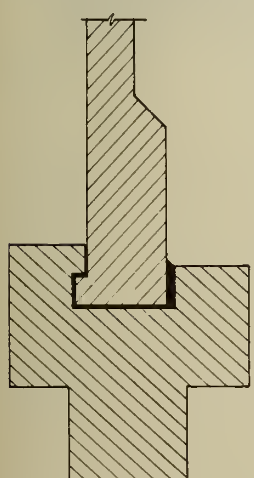

Fig. 4—Section Showing the Detail of the Expansion Joint between the Dome Shells and the Supporting Beams

To pour the concrete successfully without an outside form, it was necessary to limit the maximum bar spacing to 4 in. Near the outer face of the shell, horizontal hoops were placed at 4 in. centres, the bar sizes being made large enough to take both the ring stresses and the bending stresses occurring in the centre of each face. Temperature steel, at right angles to these bars, was also placed at 4 in. centres, creating a network of reinforcing steel. Another net of small bars was built near the inner face of the shell to distribute the temperature stresses and the inward bending stresses experienced at the angles of the dome.

As it was impracticable to place the hoop steel in continuous lengths, or weld short bars together in place, continuity was provided by hooking the ends of the bars and lapping them a sufficient distance to transfer the stress through the concrete. As an additional precaution, splices were made by bolted clamps sufficient to transfer the stresses by friction on the bars. Samples of these clamps were previously made up and tested to determine their behaviour under load.

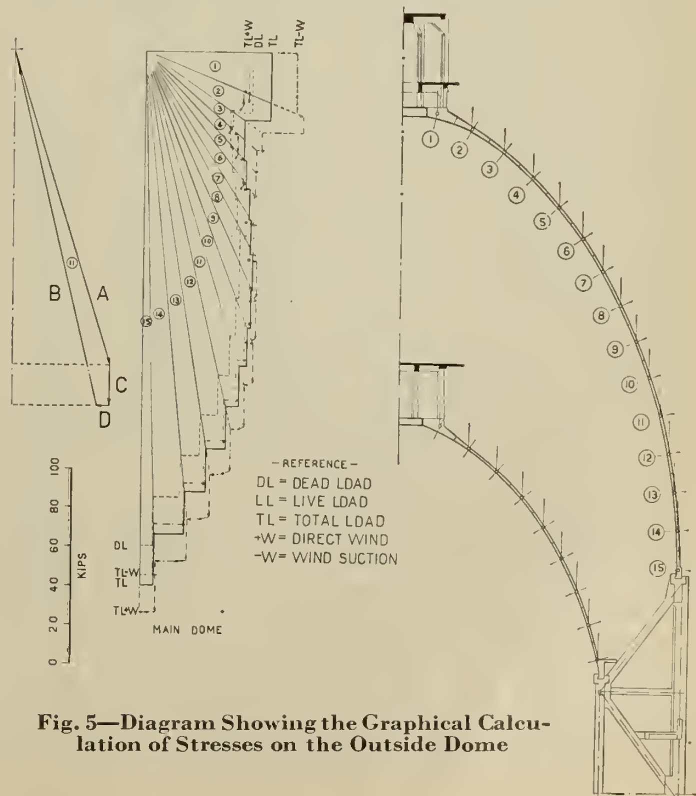

Fig. 5—Diagram Showing the Graphical Calculation of Stresses on the Outside Dome

closed up as the concreting progressed and the hoses were moved higher and higher up the dome. The contractors for this work, Messrs. Gunite and Waterproofing Limited, installed four compressors driven by diesel engines, and one by electricity, in a room on the main floor of the building. Any four of these could deliver 1150 cu. ft. of air per min. at 60 lb. per sq. in. to a primary receiver placed on the main floor. The fifth compressor was a spare. From the primary receiver, air was delivered to a second receiver placed 200 ft. higher, where it was maintained at 45 lb. pressure with an output of 908 cu. ft. per min. Air was delivered to the receivers through 4 in. pipes. As it was necessary to supply water to the nozzles at 65 lb. per sq. in., and concrete was to be poured as high as the roof of the lantern, two electric centrifugal pumps in series, at different levels, were used to boost the pressure. The water was heated at the guns by steam heaters to 120 deg. F.

Aggregates were first heated over wood fires in steel cylinders and then stored over steam coils at

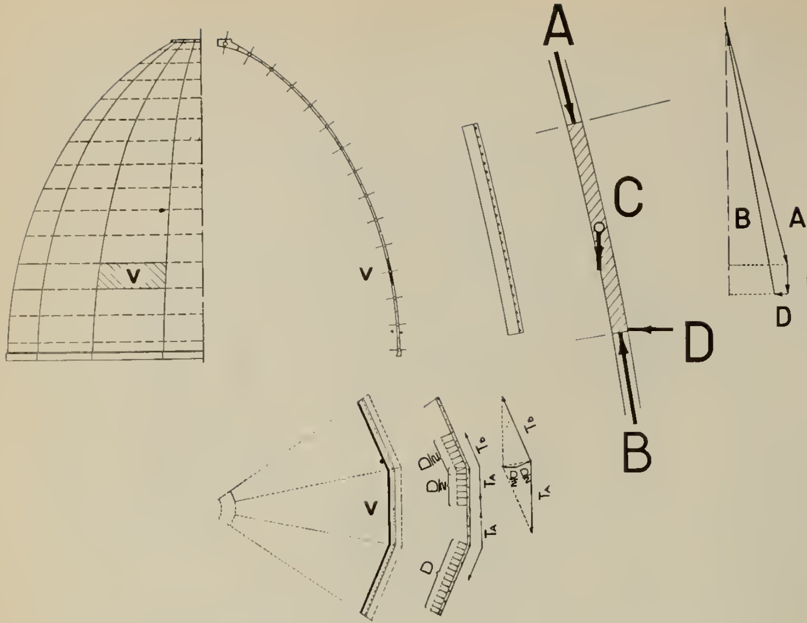

Fig. 6—Diagram Showing Graphical Calculation of Stresses on One Voussoir

Construction

The construction of the framework supporting the domes presented no special difficulty. For the main dome, which was poured the first, a tower was erected from the floor of the Basilica to carry the forms for the crown ring. From the top of this tower, 32 arched wooden trusses were built, resting at their outer ends on the drum structure, one at each corner and one at the centre of each face of the dome. These trusses were laid out full size and fabricated on tables placed in the lower parking space adjacent to Queen Mary Road. They were then dismantled and reassembled in place. When the trusses were all in place and checked, wooden beams were set between them, on which rafters were placed cut to fit the curve of the dome. On these rafters, cellboard planks 2½ in. thick were placed, secured by specially made wire fasteners. This cellboard, designed to remain in place as the permanent insulation of the dome, was also used as the form sheathing. The tower and formwork were erected in the remarkably small time of 6½ days, erection beginning on the 18th and finishing on the 23rd of October, 1937.

Before the forms were completely erected, placing of reinforcing steel was started. Notched angle spacers were used at the corners of the dome, and elsewhere the steel was supported on precast concrete blocks or steel chairs. When wired together, the steel formed an immense web in which every bar was accurately placed and rigidly held. Reinforcing bars ranged in size from ¼ in. in dia. to ¾ in. in dia., the ¾ in. in dia. bars being only used near the springing of the dome. Temperature steel amounted to about 0.35 per cent of the cross section area.

Concrete was poured by the gunite process, involving the use of guns set close to the work that require a supply of compressed air and water, as well as the aggregates and cement. For the aggregates and cement, bins were constructed at a point about 220 ft. above the main floor and about 15 ft. above the platform on which the guns were placed. As this platform was built inside the dome, it was necessary to take the concreting hoses out through holes left temporarily in the formwork, and successively

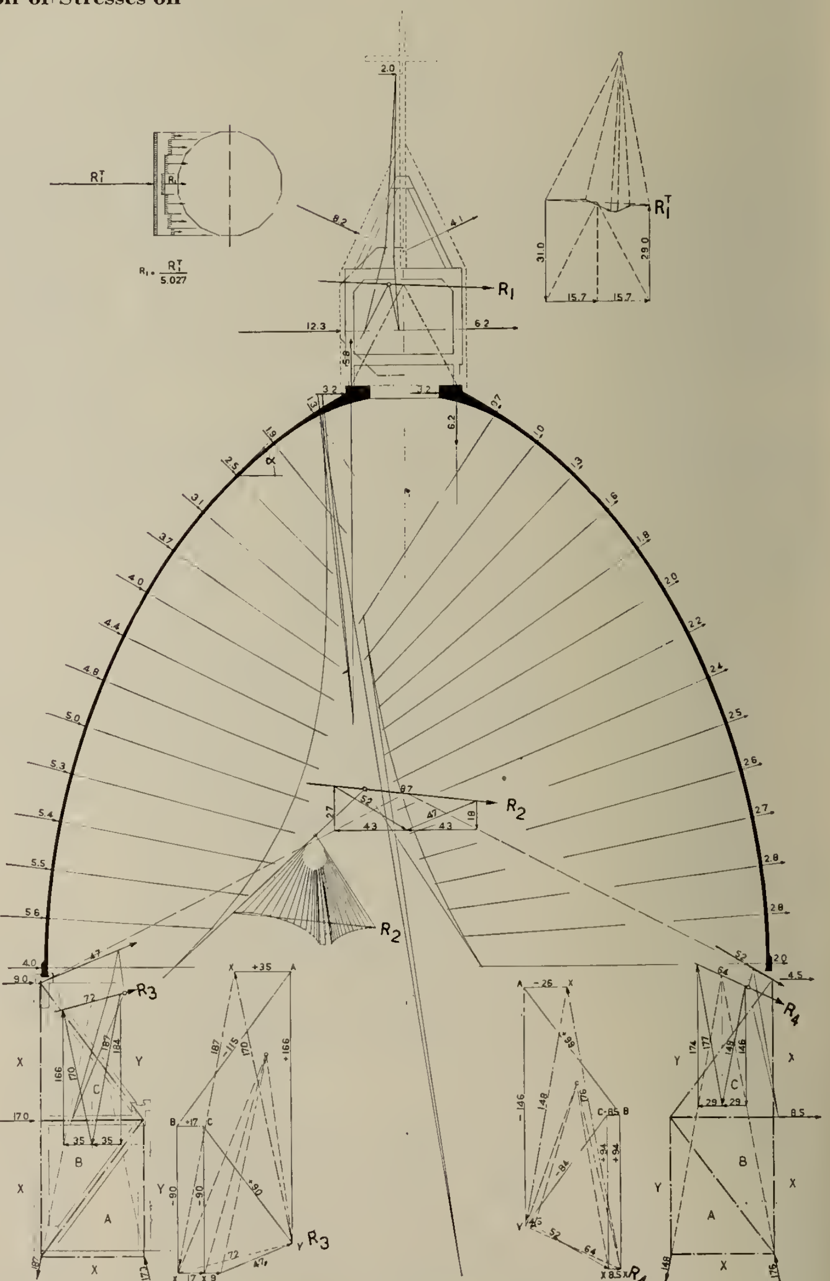

Fig. 7—Diagram Showing the Graphical Calculation of the Wind Loads for One Pair of Opposite Faces

the foot of the hoist on the main floor of the Basilica. The aggregates were taken as required from these stock piles and mixed before being raised to the bins above, for later feeding to the guns. With the water and aggregates so heated, it was possible to obtain concrete at the nozzles varying from 50 deg. to 72 deg. F. with a mean temperature of 64 deg. F. Steam for heating the aggregates and water, and for curing the concrete, was supplied at 80 lb. per sq. in. from boilers of 60 hp. total capacity, with one 10 hp. and one 25 hp. boiler as a standby. Owing to the great length of the riser from these boilers it was covered with 4-ply Aircell insulation.

Three cement guns were kept in constant operation, and a fourth was maintained as a spare. For the benefit of any not familiar with the process, it may be stated that these guns mix the cement and aggregates and deliver them through rubber hoses to the nozzles where, together with the water, they are discharged at a velocity of about 135 ft. per sec. A certain amount of the concrete rebounds from the forms and reinforcing, and must be continuously

Fig. 8—Inside View of the Nave from the First Gallery Showing the Lower Facings of the Domes

removed from the work. Pouring of concrete on the dome started at 2 o'clock in the afternoon of November 6th, and continued day and night till the 15th at 9 o'clock at night, making the dome a monolithic shell. Pouring of the lantern and its roof was completed a week later, including the time taken to erect forms and place reinforcing steel.

As construction was to be carried out at a time of the year when sudden drops of temperature might be expected, it was decided to use Canada Cement high early strength cement, the use of which made possible savings that more than offset its added cost over standard Portland cement. The guaranteed strength of the concrete was 3500 lb. per sq. in. at 28 days, but tests of the concrete as poured showed an average strength of 4225 lb. per sq. in. The concrete was cured by steam jets under tarpaulins placed about 6 in. away from its surface. The space under the

Fig. 9—Upper View from the Nave Floor Showing the Small Dome and Its Supports

tarpaulins was maintained at close to 100 deg. F. for about two days, after which the tarpaulins and steam jets were moved up to the freshly poured portions.

Pouring of the inner dome was carried out in a similar manner early in the spring of 1938, the central tower being cut down and the bins and guns lowered to a point within it, after which all scaffolding and equipment was removed from the job.

The total quantities of material used in the domes were as follows:

For the main dome, 696 cu. yd. of concrete and 58 tons of steel.
For the inner dome, 250 cu. yd. of concrete and 14 tons of steel.
For the lantern on the main dome, 24 cu. yd. of concrete.
For the superstructure on the inner dome, 23 cu. yd. of concrete.

The cost of gunite per cu. yd. for the inner dome, which was poured with standard cement, was $18.75, and the additional cost of using the high early strength cement in the main dome was $2.15 per cu. yd. Reinforcing steel cost about $80.00 a ton, on account of the small sizes of bars used, and placing steel cost about $15.00 a ton.

At the time construction of the main dome was undertaken, it was intended to place the permanent roofing on it immediately, but, owing to lack of funds, this was not done. As a result, the main dome was left for nearly a year without protection. Later, a thin waterproof coating was applied to the outside surface. It is to be hoped that it will soon be possible to put the permanent roofing in place, and construct the proposed stairways to the lantern.

Acknowledgment

The author wishes to acknowledge his indebtedness to D. S. Laidlaw, A.M.E.I.C., of Toronto for his kind assistance in editing the paper for purposes of printing in *The Engineering Journal*.

MAINTENANCE AS AFFECTING THE ELECTRICAL FIRE LOSS RECORD

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Paper presented before the Saguenay Branch of The Engineering Institute of Canada at Arvida, Que., June 16th, 1939

SUMMARY—In manufacturing plants there has been an increase in the proportion of fire losses due to electrical causes, although the greater use of electric energy has removed many hazards formerly existing. Statistics are given regarding this change. Inadequate maintenance of electrical equipment, particularly in the case of motors, is found to result in a large increase in the number of fires.

The proportion of the number of fire losses of electrical origin to the number of fire losses from all causes has been steadily creeping up for many years until for the United States and Canada it now ranks as the third in importance, while for the properties insured by some companies it is first.

There is a very good reason for at least some of the increase over the years, for the amount of electrical equipment in use started from small beginnings in the latter part of the last century and increased up to 1930 with accelerated rapidity, until at the present time there are but few properties that do not have electrical equipment of some kind. Many of them have very extensive installations and individual pieces of apparatus of very large size. In manufacturing properties electricity is now a necessity and almost all processes depend upon it to a greater or less extent. In fact many processes have been developed to a high degree of perfection because such energy is available and others would be impossible without it.

As electricity, however used, is a potential source of fire hazard it is natural that along with the increase in amount of electrical equipment installed there should be a larger number of fires reported which can be attributed to electrical causes. Almost all defects which occur in an electrical circuit (the word circuit includes the parts through all utilization and control apparatus, etc.) have a tendency to generate heat. Even the opening of a circuit is attended with a spark or arc. Under controlled conditions the amount of heat generated may be very small or limited and cause no appreciable damage, while under abnormal conditions an enormous amount may be involved and develop extremely high temperatures. In the latter case the apparatus where breakdown occurs may not only have its metal parts fused but the arcing may damage adjacent equipment, and, if combustibles are present fire may follow. A fire once started may be small or it may spread, depending upon conditions, and involve considerable property.

While the electrical fire losses have increased there is no question but that other causes of fire have correspondingly decreased. The broad use of electrical energy has resulted in the abandonment or modification of some of the former common practices, for instance, the extensive use of shafting, belting, lighting by lamps of the open flame type, etc. There is no doubt that the net result has been very favourable, all things considered. The increase in losses occasioned by electricity itself is more than compensated for by the very many benefits obtained by the use of this form of energy which previously were not possible.

To give some idea of the present relative values of electrical installations in manufacturing properties, and by so doing permit some understanding of the extent to which electrical equipment is used in different types of plants, a number of reports, covering valuations of several modern properties, were examined.

The appraisal figures disclosed that a certain fully electrified large newsprint mill had 20.6 per cent of its insured value tied up in its electrical equipment. An up-to-date cotton mill had 4.1 per cent; a foundry 0.9 per cent; a hosiery mill 3.7 per cent; a lace curtain mill 4.1 per cent; an average machine shop 2.8 per cent; a rubber mill 7.6 per cent; a large manufacturer of electrical apparatus 12.0 per cent, and a laundry 6.4 per cent. With the electrical equipment assuming so much importance and the nature of the energy being what it is, it is to be expected that electricity will be the cause of many fires, even under the best of conditions, but on the other hand as electrical fires are largely preventable, the number should be held down to a reasonable percentage of all fire losses.

Here are a few figures which may be of interest as indicating the extent to which fires of electrical origin have built up the total fire loss experienced in Canada and the United States. None of these figures include losses to electrical equipments caused by breakdowns at times of lightning storms even though in many cases the breakdowns could have been avoided if reasonable precautions had been taken.

The National Fire Protection Association "Quarterlies" show that for the years 1936 and 1937 the number of fires of electrical origin in Canada and the States was approximately 11.2 per cent of the number of fires from all causes, while the loss due to these fires was 10.9 per cent of the total fire loss. It has already been pointed out that this type of loss ranks third for both countries, as a whole, and is only exceeded by the losses caused by defective chimneys and by smoking.

The similar records of the Associated Factory Mutual Companies cover a longer period and indicate that for the years 1920 to 1930 inclusive, or for the years just preceding those in which electrical equipment felt the effects of the depression, the number of electrical losses was 16.5 per cent of the number of all fire losses, while the amount of the electrical loss was 17.6 per cent of the total fire loss. The larger percentage of number of electrical losses in the properties referred to is undoubtedly due to the greater relative amount and capacity of electrical equipment in such properties to that in properties in general.

For the years 1931 to 1938 inclusive, or those since the effects of the depression were felt, 19.8 per cent of the total number of fires reported to the Factory Mutuals were of electrical origin and the direct loss occasioned by them was 19.2 per cent. It will be noted that a pronounced increase, namely, 12.4 per cent, in the proportion of the number of electrical fires, has occurred since 1930.

It is in the number of fires that we are particularly interested in this discussion and not the amount of loss. The amount of loss occasioned by a fire is more or less accidental although of course it is the real burden to be shouldered. Any fire, no matter how small it may be at the start, may spread from its point of origin, if conditions are favourable for its spread, and cause large loss. The greater the number of fires the greater the chance that at least some of them may do just that, also the greater the number of fires the larger the aggregate loss will be.

Those who are acquainted with conditions before and since the start of the depression can undoubtedly supply the answer to the question "why the increase." The answer is that since the start of the depression electrical equipments in general have not been maintained in as good condition as they were before. The figure 12.4 per cent does not call as forcible attention to the effects of the poorer quality of maintenance as the actual facts warrant, for during the few years preceding the depression electrical equipments in general were being worked to a degree that before had only occurred during the war, also new equipments were installed at a high rate. Since the depression started most electrical equipment has been only used at partial capacity and for at least part of the time some has not been used at all. We all know that the harder and longer equipment is worked the greater the number of fires that will occur, so that if the equipments had received the same relative care during the "let down" of the depression as before, the number of electrical fires and the resulting losses should naturally have fallen off to a marked extent. Therefore, instead of 12.4 per cent increase in number of fires we should have expected a decrease of more than that percentage.

The managements of manufacturing properties were forced to let up on maintenance to a great extent owing to financial reasons, but many of them went too far and gave their electrical equipments less than the safe minimum of attention and some gave none at all. Many of them undoubtedly thought that when and as production increased they would see to it that their equipments received correspondingly more care, but many did not even keep step with production. In many instances load was put on the equipments before they were in condition to take it, with the result that an unnecessary number of breakdowns and fires have occurred.

An evil effect of the depression has been that many of the manufacturing property managements have become accustomed to the low level of maintenance and have adopted it as a standard. Therefore, unless they come to realize the consequences, a greater proportion of electrical fires are bound to occur in the future. There should be a proper balance between the cost of maintenance and the various savings and advantages to be obtained by relative freedom from accidents.

It should not be overlooked that only that part of the loss actually caused by fire is borne by the fire insurance companies. The owners of the plants themselves almost always have to bear some part of the total loss, which is usually a combination of different types of loss. Under certain conditions it may be the larger part. Most electrical equipment is not specifically insured against that part of the damage caused directly by the electrical current. The fire insurance companies do not cover it. The owners must then assume this loss. Also when electrical equipment is put out of service, due to its having been more or less damaged, loss of plant production takes place, and this is a direct loss to the plant unless, fortunately for it, coverage has been obtained against such loss of production. More or less inconvenience, embarrassment, mental anxiety and extra work may be experienced by the managements. In some cases profitable orders may be cancelled by customers if they are not able to obtain the apparatus desired or material ordered at specified times.

The Canadian Electrical Code used in Canada and the National Electrical Code used in the States as specifications for obtaining equipments that are reasonably safe from a fire hazard standpoint, cover only installation requirements. They deal with neither methods of operation nor with the care and attention equipment should receive.

The work of the laboratories who examine and test electrical apparatus, devices, fittings, materials, etc., from the standpoint of possible fire hazard has more of an influence on preventing fires due to lack of proper maintenance than do the electrical codes referred to, for the laboratories aim at getting substantial construction and reliable materials. The more substantial and rugged the construction and the higher the grade of materials used the longer can equipment be expected to go before breakdown occurs. But even the best of construction and materials cannot resist indefinitely the effects of even partial neglect, particularly under severe operating conditions.

The codes are very good as far as they go, and equipments installed to conform to them and having apparatus, devices, fittings, etc., approved by the recognized laboratories, at least start as near right as can be expected, but that is not the whole story, for after they have been inspected for approval when new, the electrical inspection authorities generally make no reinspections and, therefore, the codes have no further influence and fall short of covering the entire field of fire prevention as it relates to electrical installations. Except for some assistance given by fire prevention engineers who make general inspections of properties the electrical equipments are largely left to the owners to take care of them properly or not, just as their inclinations lead. Some managements and electricians, due to lack of appreciation of the need of proper maintenance, have more or less neglected them and as there are an extremely large number of places in an electrical equipment where potential hazards exist, it is not to be wondered at that fires frequently happen.

Experience of a number of years with electrical equipment over a good part of the country, and studies of many reports covering the initial causes of fires lead one to believe that not less than one-third, and possibly as many as one-half of the so-called electrical fires are due to the equipments not having received reasonable care. This is a conservative estimate.

With such a great proportion of the electrical fires due to lack of proper care, there obviously is a large field which can be worked to advantage. By giving this subject the attention it warrants not only can direct loss be avoided to a large extent but safety from a personal standpoint can be improved at the same time.

The records indicate that one of the chief, if not the greatest cause of fires in electrical equipments in properties they insure is due to breakdown of motors. In many cases fires have been limited to the insulation on the windings but where combustibles have been in the vicinity the fires have spread and caused considerable loss in numerous instances.

As motor fires are such a large proportion of all electrical fires and as the condition of motors can usually be easily observed, their condition can be taken as an indication of the care given to electrical equipment in general in any particular plant.

If, with due regard to the nature of the manufactured product, the motors are dirty, breakdowns may be expected sooner or later. If oil is mixed with the dirt, conditions are worse and it is likely that not enough attention is being given to proper lubrication. By proper lubrication in such cases is meant the use of too much oil. Too little oil causes worn bearings and uneven air gaps. Air gaps are probably not being checked. Sparking may be taking place at brushes from one or more of several causes resulting in excessively worn slip rings or commutators.

If motors are in poor condition it can be taken for granted that the electrical equipment in general is not receiving the attention it should and starters, switches, circuit breakers, and other similar equipment, are liable to be out of adjustment, or contacts are too deeply burned. If these conditions exist it is also likely that poor workmanship will be in evidence when changes or extensions are made in the equipment. The results which may be expected from the fire and personal safety standpoints are obvious.

When electrical equipment is allowed to get into questionable condition it is difficult to get it back into good shape again. Time is needed and considerable expense must be incurred. Even then some of it cannot be put back into as good condition as reasonably good maintenance methods would have left it. Some of the damage done will be permanent. Old equipment will suffer more than new and the depreciation rate will be high.

As examples of excellent and poor maintenance methods, and the results, let us examine the actual experience of two plants in New England both of which manufacture electrical apparatus. In each case about 2,500 motors of nearly the same average size are involved. The conditions under which the motors operate do not differ much. At one plant only about four motors burn out yearly, while at the other plant more than 500 have burned out in one year and the average is not far from 300. At the first place a few men have no other duty than to blow out the motors. In addition every motor is taken down and given a thorough cleaning at least every six months, air gaps are checked and lubrication receives careful attention. Temperatures are watched while the motors are in operation. At the second plant the motors receive little attention except for oiling. They are not blown out or cleaned. They are operated until they fail. Fortunately the damage done by fire has been small but probably this has been due to good luck as much as anything. The first plant spends considerable for maintenance and little for repairs, the second less for maintenance and much for repairs or replacements. There is much more chance of a fire getting away and causing large loss in the second than in the first plant. Also the hours that production has been interrupted at times of burn-outs are obviously more in one case than in the other.

The amount of care that electrical equipments should have will depend greatly on conditions. The processes carried on in some plants may be very severe on electrical apparatus and, therefore, careful maintenance will be needed, while in others only a little care may be sufficient. If the plants are clean and dry and motor service requirements light, a blowing out of the motors may be needed only at intervals of several weeks and a thorough cleaning may be necessary at much longer intervals. Air gaps, however, should be checked occasionally and the proper amount of oil kept in the bearings. If too much oil is used the windings are likely to be covered with it, necessitating more frequent cleaning and varnishing of the insulation. Under such conditions motor starters, circuit breakers, etc., also, will be subjected to light service so that contacts need to be smoothed, replaced or adjusted only at long intervals and mechanical wear and tear will be little.

At other plants, however, electrical equipment may receive hard service due to a number of causes, in which cases maintenance of a more rigid nature may be needed if it is expected to help the equipment in service without burn-outs, fires, or interruptions.

Periodic inspections by qualified electricians are needed to insure that equipments are receiving proper care and as a result of these inspections the desirable intervals between inspections and the amount of care and maintenance required will be readily determined.

In cotton, hosiery, and mills of similar nature, conditions are very favourable. The principal thing to contend with is cotton fly. This light lint is deposited on all stationary surfaces except those in a vertical plane. If the surfaces are not smooth the lint is likely to adhere to them, especially if oily conditions are present, so that in addition to blowing wiping is needed at intervals. The lint is easily ignited by a spark or arc and fire will travel over it very fast.

Machine shops use much oil. Unless precautions are taken wood floors are liable to be oil soaked, and oily waste may be left around. An oily film on which dirt collects is likely to cover electrical equipment so that chance of electrical breakdown increases and an arc is likely to ignite the oily dirt.

Those of you who are familiar with paper mills know that the equipment in some parts of the plants receives hard service and that the effects of water or moisture on and in electrical apparatus must be contended with.

Carbon and graphite plants are bothered by dust being deposited on insulation and filling rough places on surfaces. This dust is more or less a conductor of electricity. Graphite is particularly bad as it cannot be blown or wiped off and may be the cause of current leakage and finally a breakdown.

Power-house installations almost always receive good care because those in charge understand the penalties of breakdowns which may result in loss of service to customers. The large quantities of oil present combined with the enormous energy available at points of short circuit is the principal fire hazard in such properties. It is extremely important that the insulating properties of the oil be kept at a high value.

Some plant managements are fully alive to the importance of having their electrical equipments carefully maintained, while unfortunately others are not, as seen in the two cases previously cited. Some may realize the importance but have been held back as they thought temporarily by financial conditions during the last few years. Those who have followed the practice of not properly maintaining their equipment must pay a penalty in several ways and those who indemnify them for loss caused by fire also suffer.

Inspectors whose duty it is to prevent fires and particularly those who devote all their attention to electrical equipments, and who visit many plants, can give effective aid by having their inspections cover maintenance conditions in addition to the construction and installation features which ordinarily receive practically all of their attention.

The managements of manufacturing plants by having good inspection and maintenance service can largely prevent breakdowns and loss by taking the initiative in giving their valuable and necessary equipment good care. The well-kept plant has few fires.

THE INVENTOR OF THE CINEMATOGRAPH

The Engineer, June 23, 1939

The application for the first provisional patent for cinematography was lodged on June 21st, 1889, by Mr. William Friese-Greene, and to commemorate the fiftieth anniversary of the occasion a memorial plaque was unveiled at a Bristol cinema on Wednesday, June 21st. The inventor was born in Bristol in 1855, and a further memorial is to be erected there by the Friese-Greene Memorial Fund Committee. An affidavit sworn before a New York court in 1910 gives Friese-Greene's own complete and detailed account of the experiments which led to his invention of cinematography. In 1885 he built a camera with a handle, which when turned, operated a circular shutter to permit the exposure of separate sections of sensitized glass plate. The camera was next adapted to take photographs on strips of sensitized paper, about 50 ft. long. The strips of paper passed through a guide, across the light aperture, between a feed and a take-up roller. Risk of breaking the paper restricted the speed of taking pictures to a rate of seven or eight a second. In co-operation with Mr. Alfred Parker, Friese-Greene produced transparent celluloid film and used it in an improved camera in 1889 to take moving pictures at a rate of ten a second. He did not regard his camera as satisfactory until he completed the fifth one in May, 1890, with which he was able to take as many as fifty pictures a second. In this camera the size of the exposure was reduced to approximately one square inch. After his patent had been filed, Friese-Greene approached Edison with a view to operating a moving picture in combination with Edison's phonograph, and there thus came from him the original suggestion for the modern "talking film."

THE MILITARY ENGINEER AND CANADIAN DEFENCE

An Address delivered before the Military Engineers' Association, Ottawa, April 8th, 1929

MAJOR-GENERAL A. G. L. McNAUGHTON, C.B., C.M.G., D.S.O., M.Sc., LL.D., M.E.I.C.

NOTE—This article appeared in The Engineering Journal of August, 1929. It is being reprinted because it is just as appropriate to-day as when it was written. The interval of ten years has served to prove the wisdom of the plans and proposals which were recommended, but which it was hoped and perhaps believed would never be put to the test.

In the present state of world political development, an organization for defence is a necessary part of the equipment of a nation, because it is a matter of common knowledge that powerful forces are in existence in the world which are not susceptible to safe control by any organization either national or international in which we can properly have confidence and, indeed, in many instances the direction of these forces is in the hands of persons and groups who are not only hostile to the British Empire but antagonistic to every basis on which our civilization rests.

It is generally held in Canada that our defence land force should take the form of a Non-Permanent Militia, and this follows naturally from the favourable position in which we find ourselves—on the East and West wide oceans across which no expeditionary force of dangerous strength could be transported to our shores without preliminary arrangements of such magnitude that they could not be kept secret; on the South a great friendly nation with which we have been at peace for a hundred years; our membership in the British Commonwealth of Nations, the League of Nations and the generally increasing respect for International law and arbitration; all these factors combine to assure us at least of a warning of major dangers and of some time in which to mobilize our forces for local defence, and as far as offence is concerned, it must be obvious to any observer of the course of Canadian national life that we are highly unlikely to be precipitated into any wars of that nature—we have no reason to look outside our boundaries for our food supply; our natural resources are so vast and diversified that we will, for many generations, have ample to do to develop them without coveting any other nation's possessions, and for the few things that we lack we have large surpluses of exchangeable goods.

The other type of war in which it is conceivable we might be engaged in certain eventualities is in support of our associated nations in the British Commonwealth, or of the League of Nations if that were decided upon. The problems which arise in this connection are relatively simple of solution provided our organization for self defence is on a satisfactory basis, and in consequence we are not faced with the task of maintaining in peace any Expeditionary Force.

The principle underlying a militia defence organization is that of a nucleus force around which the defence resources of the nation can be crystallized in emergency. Theoretically its size, relative to the manpower of the nation and the completeness of its organization, equipment and training, depend inversely on the time which may be considered to be safely available for mobilization. If the force kept up in peace is too large or the time taken up in training is too great, the economic development of the country will be unnecessarily restricted, an important consideration in these days when high economic development is a most important element in military strength. If the force is too small we are under-insured in the face of the risks considered.

The whole question of the right forces to maintain, like many engineering problems, is a question of proper balance between conflicting factors—quantity and quality of materials available; the time in which to use them; the risks to be run—the factors of safety to be used. It is our business as soldiers to know all there is to know about the quantity and quality of our materials of construction—animate as well as inanimate—about the facilities existing and required for training or manufacture; we must appreciate what we can do in a given time starting from a given level of organization; we must be prepared to estimate and advise on the risks to be run, but the big decision, as in all engineering work, is the factor of safety, and that decision must rest with the Chief Engineer of National Defence—the Government. Given this decision (which is not always easy to obtain) the soldier's task becomes if not easy, at least straightforward. Each Department and Corps of the fighting forces and the great services that must exist behind them, have their own factors to be evaluated; plans for each have to be made, assembled and correlated; compromises have to be made. Time does not permit of travelling far along this complicated road, but something should be said about these matters as they concern the Corps of Engineers, more especially as regards the question of personnel.

The engineers have been an important branch of military organization ever since war developed out of the phase of single handed conflict, but it remained for the late European War to demonstrate how intimately dependent on the engineer any large military operation had become, and a consideration of the subsequent trend of development shows that the engineers are becoming increasingly important and that their tasks in the next war, whenever that unfortunate eventuality arises, will be extremely complicated and dependent for their execution on the ability to apply an intimate knowledge of a wide range of technical subjects. It is understood that we now recognize with separate college degrees, about thirty varieties of engineers. In a war organization it is quite impracticable to have all these represented. Equally is it impossible for any individual to be a specialist in many branches.

Wherever the execution of the particular work in question requires a large and approximately fixed proportion of engineers in relation to the other troops, our custom, based on the historic precedent set by Marlborough in 1716 when he separated the Artillery from the Engineers, is to create a new corps. As an example for this in the late war, we had the creation of the Corps of Signals, the Railway Troops and the Forestry Corps. Aviation, begun in the Engineers, not only became a separate corps but a separate service. All these separate corps have their own special problems which they must develop to meet, sometimes taking over in the process other specialist subjects from the Engineers, as has now happened in the case of artillery survey and sound ranging.

The creation of these new corps leaves the engineers with basic duties such as bridge building, surveys, road construction, field works, etc., which all engineer officers must be qualified to carry out, and also with the certain liability that if anything new is wanted it will be up to them to meet the need, at least to begin with.

The accepted way to handle the special tasks which develop is to leave them under the engineers, to collect into temporary units or formations any engineer officers who happen to have a special knowledge of the subject in question, and to supplement them from such specialists as are available from civil life or from other arms of the service. Usually the Command and Staffs of these temporary units are found by the engineers and on them devolves the duty of making the best possible use of the somewhat uncertain facilities which they can improvise.

From this it is seen that the army engineer must not only be capable of performing the principal basic tasks which have been mentioned but must also have such a broad knowledge of engineering and science in general as to be able to grasp the possibilities and requirements of any special development which may come about, and be able to carry it out with or without assistance.

It is quite in the normal order of things for these new tasks to be, for the time being, the absolute limiting factor on military operations—for example, gas warfare in 1915—and hence the high qualifications required by engineer officers are not open to question.

In considering this question after the war the Haldane Committee came to the interesting conclusion that it was essential that all engineer officers in the Regular British Army must, for the future, be University graduates. This decision has been put in force and their young engineer officers now go to Cambridge for two years as part of their initial training.

We are following this lead, and through the improved scheme of education and training it is hoped not only to provide our young officers with a fairly broad basis of engineering knowledge, but to put them into touch with their contemporaries in civil practice. It is then up to them to keep up this touch throughout their careers and in this connection these officers should support The Engineering Institute of Canada and the similar organizations of engineers in Great Britain. To help in this and to ensure that our permanent officers, whose principal duty is to be instructors to the Non-permanent Active Militia, obtain a certain amount of practical experience in the larger phases of engineering work, proposals have been made for the seconding of suitably qualified Royal Canadian Engineers officers to other Government Departments.

The provision of engineers for a Canadian Force on mobilization is more a question of organization than of training, as, fortunately for us, practically every line of Military Engineering finds its counterpart in the civil life of a new country such as ours which is in process of rapid material development, and from careful surveys it is apparent that, subject to one condition, there are enough professionally qualified personnel to meet the needs of any force which it is conceivable Canada might require to raise. The condition is that we do not assign qualified engineer personnel, as we did in the last war, to work which can perhaps be equally well done by others, but that we reserve them for the work which they alone are qualified to do. This side of our organization is receiving attention, and for the future the professional qualifications of all officers of the Non-permanent Active Militia are being carefully listed and indexed, to the end that if and when a War Organization is required they may be put into their proper places without hysteria or confusion.

Even if we had a complete Engineer War Organization in peace we could not afford to provide the elaborate and extensive equipment required, nor to train it. Fortunately, as already noted, the professional side of the training is already being done as practical work which is better than any exercise we could arrange. It is now necessary to provide for the adaptation of civil knowledge, and experience to military needs, and this is not difficult because we have a highly intelligent and educated body of men with which to deal and also because Army and Civil engineering requirements do not differ greatly. In fact with each new Army development they tend to differ less and we would be guilty of serious inefficiency in Staff work if we resisted this natural process. Thus, since we base our whole defence on adaptation, obviously we must keep our ideas on tactics and employment as near as possible to those which already exist in the civil life of the community.

To any one who was not familiar with our special circumstances and who compared our peace time engineer organization with the formidable list of engineer units which we had in the late war and which we may require again, it might appear that our situation was far from satisfactory, but the person who reached this conclusion would have left out of account the real elements of our strength—the wide diversity and high standard of the Engineering Profession in Canada; the number of able engineers who are learning the adaptation of civil to military practice, both in the engineer units and in those of the other Arms; and the strength of the Canadian Officer's Training Corps at our great Engineering Colleges which are giving useful fundamental military knowledge to several hundreds of young engineers each year at the same time as they are obtaining their general education.

Not the least important of these factors is the high standard of qualification which is being demanded from officers joining the Corps of Engineers, as it is on these gentlemen that the first impact of expansion would come, and it is they who will then increase in rank and responsibility very rapidly. We must be sure that they will be able to command the confidence, respect and support of the many eminent engineers who will come under their orders on Mobilization. The support of this Association is asked in developing and maintaining this high standard among those who elect to serve in peace.

In the time available it has not been possible to touch on more than a small fraction of this great subject. Nothing has been said about the provision of non-commissioned officers and artificers—about how we are going to organize our skilled and unskilled labour, and so on. And indeed it must be admitted that many of these matters are as yet in the controversial stage. What we are striving to work out is a plan.

In an address given by Lord Haldane a few months before he died, in which he was outlining his ideas on the organization of the defence of the Commonwealth of Nations which constitutes the British Empire, he stressed the importance of this same point, and he showed by repeated instances taken from his own wide experience as a War Minister, that the one thing which could not be extemporized was a plan that was any good, but if you had a good plan quietly prepared and your officers had thought about it and understood it, it was usually possible to extemporize the material resources to carry it out.

The most important thing for us in Canada is to base our defence organization on the resources naturally available in the country, either in men or material, so that our problem will be adaptation rather than creation. In this work it must be said, and with emphasis, that quality is far more important than quantity.

Abstracts of Current Literature

Contributed articles based on current periodicals, papers and events

TIME AND ITS EFFECT IN RELATION TO STRUCTURES

By F. S. Snow in The Structural Engineer, London, June, 1939, Vol. 17, pp. 286-310

TIME STUDIES IN HEAVY CONSTRUCTION

By F. C. Wardwell in Civil Engineering, New York, May, 1939, Vol. 9, pp. 281-284

Reviewed by R. F. Legget, A.M.E.I.C.

The difference between the speed of civil engineering construction in Great Britain and in North America is so marked as to be repeatedly a matter of surprise to those who are familiar with practice in the two regions. Canadian engineers may sometimes look askance at the seemingly foolish speed with which some American jobs are done and yet may wonder how it is that American contractors can undertake important works in Great Britain without appearing to have much effect on the apparently leisurely speed of the typical British civil engineering contract. These two papers throw some light on this interesting contrast and for this reason attention is directed to them jointly although they are dissimilar in nature and in value. The first is a discursive collection of notes on the time element in construction (despite the strange title, suggestive of a treatise on the preservation of old buildings); the paper takes up eight pages only, the remaining 17 pages containing photographs and diagrams of miscellaneous construction jobs. The second paper is a concise summary of some of the results of time and motion studies as applied to heavy construction operations of the Tennessee Valley Authority, following a discussion of the place and function of the cost engineer on construction.

At the outset of his paper, Mr. Snow states that he does not entirely disagree with the point of view that "the more speedily a job is erected, the more money it costs and the less satisfaction it gives, because owing to the speed with which the structure is erected, the work is scamped, which results in greater maintenance cost." He adds that all structural work has an economic time limit for erection which will enable the client to have a well constructed job and the contractor to make a reasonable profit. The matter is then discussed under these heads:

(a) The supply of sufficient information well in advance of the progress of the job, the author suggesting that "no other set of circumstances causes greater delay, with commensurate increase in cost, than the items listed under the heading of Lack of Information";

(b) Design, the author here stresses the need for standardization;

(c) Job organization, the author stating that "before the commencement of any important contract (he) usually prepares a time schedule", a copy of the usual North American type of progress schedule being reproduced as "a much more elaborate time schedule (used in England and) regularly sent to the parent company in America to keep them in contact with the works in progress";

(d) Plant layout, in which some general notes are presented;

(e) Site supervision—"in general, the author is of the opinion that half a million pounds worth of work is as much as can be properly supervised by one man on the site over a period of a year";

(f) Organization of Labour into a team, the author presenting some general notes together with some interesting data on labour output when overtime is being worked, the conclusion reached being that "overtime in excess of two hours per day is uneconomic, both from the point of view of time and cost". The paper comes to an end with a comment on the relation of the construction methods described and the "short term policy of erecting splinter-proof shelters and digging out trenches" as part of the A.R.P. work in Great Britain.

"The cost engineer's chief function on the job," says Mr. Wardwell in his paper, "should be to assist in reducing the cost of the work. He should analyze the reason for delays, the cost of such delays, and suggest methods of improvement; he should prepare comparative estimates of various proposed methods of performing work and should have the opportunity to present his analyses to the job management before the method to be used is decided upon. Among the methods that a cost engineer can use in determining and controlling construction costs, and one which has been almost entirely overlooked, is the use of time studies." Mention is made of the pioneer work of Taylor, and particularly of Gilbreth on building operations, and an account is then given of the application of these methods to the construction work of the T.V.A. This started in a very small way in 1934 at the Norris Dam, in the form of a comparative study of drill bit performance. "So valuable were the results that shortly thereafter a regular time study group, consisting of three engineers, was organized to make similar investigations of other construction operations." This group made studies of form handling, steel handling, etc., at the Norris Dam and was then transferred to the Wheeler Dam to make studies of panel form erection, line drilling, welding operations, and other work features. In March, 1936, it was transferred to the Pickwick Landing Dam, and later to the Chickamauga Dam where it was still engaged when the paper was written. During a period of 33 months, 30 extensive studies were made and many shorter ones. Mention is made, in the paper, of the following typical studies: (1) Erection of panel forms; (2) Operation of carrying scrapers; (3) Crushing plant operation; (4) Conveyor and mixing plant operation; (5) Miscellaneous hauling equipment; (6) Placing of rolled earth fill; (7) Rock excavation, and (8) Miscellaneous rock drilling operations. Cost savings are noted. It is emphasized that the engineers engaged on these studies should have tact and speak the language of construction men. The author concludes by noting that so far as has been determined, the increased production obtained as the result of the studies described has not resulted in any ill feeling among the men or toward either the time study group or the management.

THE GROWING USE OF EXHAUST STEAM

Abstracted by the International Power Review, June, 1939

The need for low pressure steam in many industries appears to be increasing, and several manufacturers have developed special power plant for this purpose.

Originally, pass-out steam was only used from turbines, but it has long been realized that the reciprocating engine is more economical on back pressure working than any size of steam turbine.

An interesting example is the Parker pass-out engine, which has been specially designed for power purposes in industries where exhaust steam is utilized. For this purpose a special control arrangement has been evolved to ensure the most economical working under all conditions.

This gear ensures that until the maximum pass-out quantity for which the engine is designed is reached, no more steam is allowed to pass the L.P. cylinder than is necessary to keep it warm; the maximum quantity of pass-out steam is automatically limited to the designed amount, but at every load and quantity a perfectly steady pressure is maintained in the pass-out receiver; higher loads are dealt with by an over-riding action admitting additional steam to the L.P. cylinder, and when no steam is passed out the engine works as a purely normal compound or triple expansion type.

ELECTRIC CARBONIZATION OF COAL

By H. Stevens in The Engineer, July 14th, 1939

Abstracted by A. A. Swinnerton, A.M.E.I.C.

The use of electricity to carbonize coal was probably first suggested in 1901 by a Dr. Otto Schmidt in Switzerland. The idea reappeared several times thereafter, but hitherto no contribution of value was ever made.

The electric carbonizing process uses electricity to make coke, gas and oil from any bituminous coal or lignite. It differs from other processes not only because the coal is heated electrically but also because the coal is internally heated. This is possible because bituminous coal, which is a poor conductor of electricity, becomes a relatively good conductor when heated and during its transformation into coke.

An experimental plant using this process has apparently been erected, (location not given) the main feature being a cylindrical retort constructed of fire brick encased in a welded steel shell. This retort is suspended vertically in a steel cradle and is provided with top and bottom steel covers, lined with firebrick, through the centres of which pass short graphite electrodes. The top cover is electrically insulated and the bottom cover and the steel work are grounded.

When operating, the bottom cover is placed in position, and then the vertical starting fuse (a conductor pipe filled with coke) contacting the top and bottom electrodes is centred in the retort, which is then completely filled with coal. This charge may amount to as much as 30 tons, depending on the nature and condition of the coal. The top cover is placed in position and the current turned on. Electricity flows through the starting fuse heating it and the surrounding coal driving moisture, gas and oil outward. The layer of coal surrounding the fuse becomes coke and makes a definite path for the current. As carbonization proceeds, oil and gas are driven from the coking material and the zone of heat generated travels radially outwards until the whole charge has been coked. The gas and oily vapours leave the retort through suitable outlets to the connecting mains, while practically all the oil evolved is drained from the bottom cover. When carbonization is completed the top and bottom covers are removed and the hot coke falls by gravity into the conveyor, where it is quenched and loaded into railway cars.

Thus it will be seen that the electric carbonization process makes for a highly advantageous utilization of heat. The thermal efficiency is stated to be better than 95 per cent.

It is claimed that the electric carbonization process is superior to the by-product oven, in that construction is simpler, the retorts can be started up or closed down as required, less ground space is needed, no coke pusher or leveller is required, and maintenance and capital costs are lower.

The coke made by this process is stated to have been tried out in various types of house heating furnaces with success and favourable comments owing to its uniform burning characteristics, and the greatest field of usefulness of this process will be in making an inexpensive solid smokeless fuel for heating houses. The gas made by this process differs from the gas from the by-product ovens in its higher hydrogen content (61.5 per cent as against 46.5 per cent) and lower nitrogen content (0.8 per cent as against 8.1 per cent). The yield of tar and oil by the electric process varied from 12 to 27 gal. per ton as against 9 gal. per ton from by-product ovens.

The flexibility of operation is stated to be one of the main features of this process as the rate of heating may be varied over fairly wide limits.

Current is supplied to the 30-ton retort through a single phase 60 cycle 850 kw. transformer. By means of this and secondary switching it is possible to get a very flexible rate of heating. The flexibility of this process makes it possible to efficiently use available off peak power and the whole economics of the process would appear to depend on the quantity and cost of off peak power.

THE CHANNEL TUNNEL

The Engineer, June 23, 1939

So long as the proposal to construct a tunnel under the Channel was regarded as of value in facilitating traffic and trade between the two countries it received undivided support in France, and now that the economic character of the undertaking is overshadowed by the strategical, the tunnel has become one of the most thoroughly discussed problems of national security. In a changed world that has moved the strategical frontier of Great Britain to beyond her coast line, it is felt that it would be unwise to neglect any opportunity to ensure the safe transport of material and men in times of emergency. The Foreign Affairs Commission in the Chamber of Deputies is examining a proposition presented by Monsieur Marcel Boucher, deputy of the Vosges, inviting the Government to undertake the construction of a tunnel in collaboration with the British Government. The proposition is accompanied by documentation with plans for the tunnel.The cost of the work is estimated at between 4,000 and 5,000 million francs. Further action is now being taken by the French Channel Tunnel Committee which has just held a meeting under the chairmanship of Monsieur Raoul Dautry. This action aims at co-ordinating effort and collecting all possible data of a technical, financial, commercial, and military character, and communicating to the British military authorities all information regarding the tunnel from a strategical standpoint. In order to cover the ground as completely as possible the Committee has decided to constitute regional committees, particularly in Nancy and other centres directly interested in carrying out the tunnel scheme. This interest has extended beyond the French frontier to Switzerland, Belgium, and Luxembourg, where the Committee has found it desirable to set up local organizations to complete a documentation that will have a wider international character and give more importance to the tunnel as a commercial and strategical undertaking. A similar organization is being created in England. All this is, of course, independent of the Channel Tunnel Company, of which the president is Baron Emile d'Erlanger, and the object of the new organization is not to favour any particular project, but to supply the fullest possible data in order to convince the British and French peoples that the tunnel is a vital necessity for the two countries.

HIGH PRESSURE STEAM-ELECTRIC LOCOMOTIVE

By W. D. Bearce in The International Engineer, Vol. 75, No. 2

Abstracted by the International Power Review, June, 1939

A 5,000 hp. steam-electric passenger locomotive has been designed by the General Electric Company in conjunction with experts of the Union Pacific Railroad, nearly two years having been spent in the designing and building.

The locomotive is intended for the Chicago and Pacific Coast service, pulling a 12-car train and negotiating 2.2 per cent grades without help. The climatic conditions are severe, the temperatures encountered ranging at different seasons from 40 deg. F. to 115 deg. F. above, while some of the mountain passes rise to altitudes above 8,000 feet. While the locomotive as a whole unit is decidedly a new departure, the various components have been thoroughly tried out for use on ships. The tubular boilers are designed for forced instead of natural circulation, the steam first passing through a separator where the excess water is removed, then the superheaters before entering the turbines.

The exhaust steam goes to the condensers and then returns to the hot well.

The electric equipment is materially the same as that used in trains already in use.

The advantages of the steam-electric system are manifold; the thermal efficiency from fuel to driving wheels is more than double that of the ordinary steam locomotive, high rates of acceleration and braking, the electric braking, moreover, saving brake shoes and tires for the entire train, a 500-700 mile performance without stops, elimination of corrosion due to the use of distilled water in a closed circulation system and the absence of unbalanced reciprocating parts.

The locomotive consists of five identical units of the 2-C-C-2 type mounted into a single-ended streamlined cab. Each unit consists of two three-axle driving trucks and two two-axle guiding trucks, these being made of steel castings. A flexible metal tube provides the ventilating air to the motors. Smooth running is secured by employing damping devices between the cab and the truck system. The cab-frame is of tubular design, the sheeting being made of aluminum, except for the streamlined nose, which is welded steel.

Each cab contains two 2,500 hp. geared turbo-generator sets, a high-pressure steam boiler, a turbine driven auxiliary set with automatic control and the air-cooled condenser system. The steam is raised at 2,500 lb. per sq. in. and 920 deg. F.

The total weight of the locomotive complete with fuel and water supply is 530,000 lb. weight on driving wheels 342,000 lb. The fuel oil capacity is 3,000 gal. the water capacity being 4,000 gallons. The total length is 90 ft. 10 in. overall, width 10 ft. 8¾ in., maximum height 15 ft. The diameter of the driving wheels is 44 in., that of the bogie wheels 35 in. Maximum operating speed: 125 miles per hour. In order to obtain the required operating flexibility the rate of firing is adapted automatically to the load demand. The water-tube boilers, designed and built by the Babcock, Wilcox Works and the Bailey Meter Company, raise 45,000 lb. steam per hour and are fed with bunker "C" fuel oil. The boilers are shock and vibration proof. The economiser is an integral part of the boiler system.

For starting the locomotive when cold, a small vertical tube boiler is employed, raising 100 lb. steam per hour, using propane gas for fuel. The steam is used for the heating of the bunker oil and for atomizing it at the burners. Where ready steam is available at the round houses, the auxiliary boiler is not necessary.

The main turbo-generator set consists of high and low pressure turbines, and the two-armature direct current generator driven through a gear-reduction 10 to 1. The generator is self-ventilated. In cold weather the warm air is utilized for the heating of the cab.

The main generator drives a 220 volt a.c. generator which furnishes power to the auxiliaries, and its shaft carries also the variable-voltage exciter which supplies the exciting current. The main turbine steam is bled to drive the auxiliary set, which supplies and regulates the bunker oil and combustion air supply to the furnaces and also supplies and regulates the feed water. This set comprises a starting motor, an auxiliary turbine, combustion-air fan, boiler feed and fuel oil pumps. The rotary type lubricating pump is independently driven by an electric motor. The variable speed condenser fan turbine is also independently driven, its maximum speed being 12,000 revs. per minute.

The condenser is mounted on each side of the rear end of the locomotive cab and is of the tubular finned type, the condensate being drained by gravity into the sump under the cab, the ventilation being by propeller fans. For the production of the low pressure steam required for train heating, fuel oil heating, etc., steam is being extracted from the main turbine supply and fed to an evaporator, consisting of a coil immersed in water, the water being supplied to the coil by electrically driven pumps.

The compressed air, at about 130 lb. pressure, is supplied by an extra steam-turbine driven 150 cu. ft. compressor.

The locomotive is essentially an electrical one, carrying its own power plant. The train speed is regulated by varying the generator voltage, thus avoiding rheostatic losses. The speed, i.e., acceleration, is controlled by varying the exciting current by means of the master controller, the control current being supplied by a 125 v. motor-generator set with a battery floating on the line. The motors are controlled in the three usual combinations, series, series-parallel and parallel.

The auxiliary power is supplied by an a.c. generator which feeds the traction motor blowers, lighting and headlight circuits and a motor-generator set supplying d.c. of 125 and 64 v. This latter voltage is supplied for the ordinary train lighting circuit.

The power plant is entirely automatic, the pressure and temperature gauges being located on a control board in the separate apparatus cab. In the event of any protective device entering into operation, a gong sounds a warning to the engineer.

The locomotive is now undergoing commercial tests before commencing its service on the Union Pacific Railroad.

SIXTY YEARS AGO IN 'THE ENGINEER'

The Engineer, June 23, 1939

Two small items in our issue of June 20th, 1879, serve to illustrate the progress which the world has made during the past sixty years. In a note we recorded that a novel addition had been made to some of the through trains on the Canadian railways in the shape of a "dining car", where dinner or supper, consisting of at least as great a variety as could be obtained at any station could be had for 75 cents *en route*, thus obviating the scramble at intermediate stations. It may perhaps be added that relics of the pre-dining car age still exist in this country. At Swindon, for example, the large refreshment rooms recall the fact that Parliament required all through trains to halt at that station in order that passengers might obtain food. The second item is a paragraph referring to the establishment of "telephone exchanges" in America. These exchanges, we said, were a useful and practical outgrowth of the introduction of the telephone. It did not seem to be generally understood, we remarked, that the system consisted of the establishment of a central office, from which wires ran out into the offices, warehouses, mills, and residences of the subscribers. When one subscriber desired to talk with another the central office was notified of the fact, his wire was connected with that of his neighbour and communication was established. By this arrangement, we added, every subscriber was put in direct intercommunication with any other. . . . Other items in the same issue illustrate the reverse side of the picture, namely, the existence sixty years ago of developments which we are sometimes apt to consider modern. We recorded, for instance, that British railway engineers were at last modifying their antipathy to the use of iron on their roads. Iron sleepers and fastenings, we said, had now arrived at something like a practical form. The North-Eastern Company was trying Mr. C. Wood's system and the London and North-Western Company was about to make a somewhat exhaustive trial of rolled channel iron cross sleepers. In another paragraph we mentioned that Cowper's writing telegraph was working most successfully on the London and South-Western Railway between Waterloo and Woking, a distance of 26½ miles. It wrote off the messages in ink one after the other in a perfectly legible manner, and by the insertion of known resistances in the two line wires it had been shown that it would be capable of operating with every satisfaction over distances of 62½ miles and even 99½ miles. The writing telegraph presented facilities and advantages which, in our view, would make its adoption rapid and extensive.

Editorial Comment...

WAR

The dread event which we have feared so long, and against which we have hoped and prayed so earnestly, is at last upon us. No man can tell where it will lead us or what it will demand of us as individuals or as civilization. No one could wish for such a development and yet no one will deny the necessity of it in view of the circumstances. The justice of right over might must still be fought for even though the price at times may seem unnecessarily exhorbitant.

Doubtless, the activities of the Institute will be affected but it is likely they will be changed in character rather than in volume. Such an organization, established so firmly in twenty-five cities of Canada, should be able to make a real contribution to the national contribution. Time will disclose the nature of this effort, but in the meantime the support of the Institute has been offered to the Government by the President and Council, and indications have been given that it will be accepted.

FROM PEACE TO WAR

For the past month the officers of Government departments and professional institutes have been receiving a stream of letters from Canadians of all classes offering their services and asking how they can best serve their country. This splendid response to the stirring event of the third of September is no surprise to anyone who knows the character of the Canadian people and their hatred of totalitarian methods. The enquirers are anxious to find as rapidly as possible the places in the new scheme of things in which they can make the most useful contribution. They feel their efforts must have a single aim—the effective prosecution of the war in which all of us are now engaged.

A change from peace to war-time activities cannot be an instantaneous one, for it affects the daily life of everyone and in fact calls for a general economic mobilization. In peace time Canada's armed forces are only large enough to serve as a nucleus for growth and as a source of trained instructors. It is obvious that to expand such a body ten or twenty-fold, to equip and train the larger force, to organize the industrial activities which will supply its needs in arms, munitions, equipment, food, and transportation, is a task which needs weeks or even months of steady effort before results are obtained. Under present day conditions requirements in *matériel* are many times greater than in 1918, a proportionately larger number of men are required to meet these requirements, and effective plans for economic mobilization cannot be made until the armed forces know what men and *matériel* they will need in war.

It is perhaps natural that men who have offered to serve should feel some impatience if they are not at once informed as to their proper spheres of duty. The circumstances just outlined, however, give some idea of the many plans and decisions which must be made before people can be fitted into their appropriate places. This applies particularly to the many professional or technically trained men—like members of the Institute—who filled in and returned the questionnaires sent out in December last. Through the combined efforts of The Engineering Institute of Canada, the Canadian Institute of Mining and Metallurgy, and the Canadian Institute of Chemistry, over 16,000 questionnaires have been distributed, which will be used as the basis of a national register of professionally trained engineers and scientists. These records are being classified and cross-indexed, which is in itself a large undertaking, and it is expected that as soon as the industrial and governmental needs for men of this type can be specified with some precision, the register will be available as a source of information from which selections can be made. It is impossible to say exactly what disposition will be made finally of the technical resources that are contained in this file, but on all sides, from those in authority, assurances have been received that they will be used to maximum advantage. In the meantime it is asked that patience be shown until the preliminary work is completed, and comprehensive plans developed to the point that the most effective distribution of technical manpower can be made.

Completed questionnaires are still coming in, and will probably continue to do so. This is as it should be, for a register of this kind is not a static thing, it must grow and be maintained as long as the need for it exists. Members who have not completed the form are still urged to do so. Additional copies may be obtained from Headquarters if the first one has been misplaced, or if extra ones are required for the use of others.

EMERGENCY ARRANGEMENTS

A notice, bearing the above heading, has been received from the Institution of Mechanical Engineers, whose Headquarters are in London, England, advising members that in the event of war the Institution building would be closed and the work would be transferred to the country. A letter of slightly later date accompanies the notice, and without comment is headed ominously "The Meadows, Betchworth, Surrey."

At the time of writing there have been no air-raids in England, but it is evident that such an exodus as has already taken place is attended by much inconvenience and distress. Add to this the excitement and horror of actual attack, and we get a faint conception of the conditions which our fellow-engineers and their families are facing. Multiply this by thousands of groups and millions of individuals and we have a mass effort that is almost impossible to comprehend.

We read of these evacuations and see them in pictures, but actual experiences that come close to us are not frequent. We send to our sister societies in England our best wishes, our sympathy and our assurance that Canadian engineers are equally concerned in the affairs of Empire, and will be glad to serve to the utmost of their abilities and their opportunities.

PRESIDENTAL ACTIVITIES

The visit of the President to the branches is always an event of importance. Doubtless, this year there will be added interest because of world conditions and the desire of members to know what they can do to help. Such visits will enable the President to gain a first hand knowledge of the ideas and wishes of members with regard to Institute policy for the war years, and enable him to give direction to Council when such matters are being considered.

The regional meeting of Council at Calgary is an important event. It is expected that all councillors from the branches of the four Western Provinces will be there, as well as branch chairmen and past councillors and that full discussions can be given to matters which are of prime concern to the western members. The Calgary branch has planned a full programme for Dean McKiel.

The President's plans include responsibilities other than those of specific Institute concern. He has undertaken to speak on several occasions to service clubs, universities, and college graduate societies, thereby carrying the message of engineering activity, accomplishment and responsibility into non-technical groups of citizens in many parts of the country. The duties of the presidency are wide and varied, and no one but a president can fully appreciate the magnitude of the office.

BROADCASTS

As was announced in the March Journal, arrangements have been made with the Canadian Broadcasting Corporation for a series of trans-Canada broadcasts, sponsored by The Engineering Institute. The original plans of the committee have had to be changed somewhat, due to the outbreak of war, but the Chairman, Fraser S. Keith, announces that the first two broadcasts will be on Friday, October 27th, and November 3rd, at 7.45 p.m. E.S.T. Others will follow and details will be announced as they are determined.

The purpose of these broadcasts is to tell the general public in an interesting and non-technical manner, something of what the engineer has done for the advancement of civilization. It is hoped that members will listen in, and also, spread the news among their friends. The C.B.C. has been very considerate in allotting this time to the Institute, and members can show their appreciation by their attention and their comments.

READING ROOM HOURS

Owing to the fact that almost no members used the Headquarters' reading room after six p.m., the House Committee recommended to Council that the building be closed at that hour, except for nights when a meeting was taking place in the auditorium.

On Thursday nights, when the Montreal Branch is meeting, the reading room will remain open from nine a.m. until the conclusion of the meeting. On all other nights it will close at six o'clock, but any member who desires access to it after that hour can make arrangements by calling LAncaster 7772.

THE STUDENT'S DUTY IN WAR-TIME

Recently, Major-General McNaughton, President of the National Research Council, sent a letter to the presidents of twenty Canadian Universities and Colleges, in which he dealt with the questions of student participation in war activities. He was kind enough to give permission to the Journal to reprint the letter in full. Members of the Institute will find its advice pointed, interesting and helpful. It is encouraging to know that such farsightedness is being exhibited, and that a real endeavour is being made to conserve manpower. The letter follows:

Dear Sir: Ottawa, 16 September, 1939.

At the meeting of the National Research Council held in Ottawa on 15 September, 1939, careful consideration was given to the advice which the National Research Council should offer to the many university authorities who have inquired as to the views of the Council in the matter of the nature of the training which should be offered to undergraduate and post-graduate students during the course of the present emergency.

It is the view of the Council that, owing to the possibility of the present war extending over a very long period and the need that there will be for large numbers of well trained men in all branches of pure and applied science, including medicine, dentistry and agriculture, students now pursuing successfully university courses in these fields will serve their country in a most valuable way by continuing their university training until graduation, and that specially able students should be encouraged to continue their studies in post-graduate courses in all branches of science, especially along the lines required to meet national requirements as they develop.

The National Research Council has been informed by the military authorities as to the principles which have been established to govern the training to be given in the several contingents of the Canadian Officers Training Corps. The Council considers that it is eminently to be desired that all students who are qualified for entry to the Canadian Officers Training Corps should take full advantage of this opportunity, particularly as at the present time it is not possible to differentiate between those who will go into scientific work in industry in relation to the national war effort and those who will be commissioned in the Armed Forces.

The Council, at the instance of the military authorities, wishes to point out that under the conditions of modern war, both in the military forces and in essential civil industries, there will be a very large and increasing need for a steady supply of fully trained men in all branches of science. It is their hope that the universities of Canada will continue to meet this need.

The Council is closely in touch with the requirements of the Armed Forces and of Industry for men of special scientific training and it is the intention that as particular needs develop these will be brought to the attention of the Universities possessing appropriate facilities in the hope that they may find it possible to provide the special instruction required. Meanwhile, and until these particular requirements can be indicated, it is considered that changes in the ordinary curricula should be restricted to a minimum.

Yours faithfully,

A. G. L. McNaughton, *President.*

MARITIME PROFESSIONAL MEETING

A Maritime Professional Meeting of The Engineering Institute of Canada was held at Pictou Lodge, Pictou, N.S., on August 31st and September 1st, with an attendance of nearly one hundred including guests. News of the invasion of Poland by Germany was received during the morning of September 1st and the programme was terminated prematurely at noon.

During the morning of August 31st, a professional session was held with R. L. Dunsmore, M.E.I.C., Vice-President of the Institute in the chair. Addresses of welcome were made by the Honourable J. H. MacQuarrie, representing the Province of Nova Scotia, and Mr. Frank MacNeil, representing Pictou County.

Three papers were presented during the morning session, illustrated by slides and moving pictures. The first, entitled "The Canadian Broadcasting Corporation Network and The Royal Visit Broadcast" was delivered by J. A. Ouimet, A.M.E.I.C. The second paper, by J. Carlisle, B.Sc. dealt with the Canadian Broadcasting Corporation's New 50 kw. Station in the Maritimes. The last paper of the morning entitled "The Newfoundland Air Base of the Transatlantic Route" was presented by Donald Ross, A.M.E.I.C.

During luncheon C. S. G. Rogers, M.E.I.C., acted as chairman and Dean H. W. McKiel, M.E.I.C., President of the Institute, gave an interesting address dealing with the Institute and the Young Engineer. Upon request a special session was added to the agenda in the afternoon to provide discussion on this subject. This session adopted a resolution urging all branches to appoint special representatives to co-operate with the local members of the Committee on the Welfare and Training of the Young Engineer.

Part of the afternoon was given over to motoring, golf and tennis with competitions arranged for both ladies and gentlemen. The ladies were also entertained at afternoon tea at Mr. D. R. Sutherland's cottage, located near the Lodge.

At dinner Geoffrey Stead, M.E.I.C., presided. Sir Wylie Grier was the guest speaker for the occasion and delivered a very interesting and witty address on "Adventures in Portrait Painting." The remainder of the evening was given over to dancing.

A second professional session was held during the morning of September 1st, with W. S. Wilson, A.M.E.I.C. in the chair. Two papers were presented during this period. The first, entitled "Experiences in Steel Mill Design," was given by Mr. A. G. McKee, president of the McKee Engineering Company, and the second by J. W. Roland, A.M.E.I.C., who spoke on the Lions' Gate Bridge Substructure. Notwithstanding the fact that very unfortunate news came from Europe during the morning these papers were well attended and enjoyed keen interest. It was felt, however, that in view of the circumstances, the remainder of the programme should be cancelled. The following telegram was sent to the Honourable W. L. Mackenzie King: "Members of The Engineering Institute of Canada assembled in session at

Pictou, N.S., this morning unanimously adopted resolution expressing their confidence in the governments of the British Commonwealth and pledging the complete support of the members of the Institute to the Government of Canada in the emergency which has just arisen, signed: H. W. McKiel, President, Louis Trudel, Assistant Secretary.

The members of the Committee who were responsible for this very successful function are as follows:

Chairman	R. L. Dunsmore, M.E.I.C.
Vice-Chairman	I. P. McNab, M.E.I.C.
Publicity & Attendance	K. L. Dawson, M.E.I.C.
Entertainment	C. A. Fowler, M.E.I.C.
	Harvey Doane, M.E.I.C.
	B. H. Zwicker, A.M.E.I.C.
Transportation	Charles Scrymgeour, A.M.E.I.C.
Finances	L. C. Young, A.M.E.I.C.
Chairman of Papers Committee	C. S. G. Rogers, M.E.I.C.

The winners of the various sports events are as follows:—

Ladies Golf

Low Gross	Mrs. P. A. Lovett
Low Net	Mrs. E. L. Ganter
High Gross	Mrs. J. R. Kaye.

Section 1

Men's Golf

Low Gross	J. H. Reid, A.M.E.I.C.
Low Net	H. W. L. Doane, M.E.I.C.
High Gross	James Harnett, A.M.E.I.C.

Section 2

Low Gross	J. H. Fraser, A.M.E.I.C.
Low Net	H. King, A.M.E.I.C.
High Gross	J. R. Kaye, A.M.E.I.C.

Ladies Tennis

Winner	Mrs. L. C. Young
Runner-up	Mrs. Louis Trudel

This report of the Maritime Professional Meeting was prepared by the Halifax Branch News Editor, A. G. Mahon, A..ME.I.C.

LIST OF NOMINEES FOR OFFICERS

The report of the Nominating Committee was presented to and accepted by Council at the meeting held on August 30th, 1939. 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 1940 as Proposed by the Nominating Committee

President	T. H. Hogg, M.E.I.C.	Toronto
Vice-Presidents:		
*Zone "B" (Prov. of Ont.)	K. M. Cameron, M.E.I.C.	Ottawa
	J. Clark Keith, A.M.E.I.C.	Windsor
	W. R. Manock, A.M.E.I.C.	Fort Erie North
	E. P. Muntz, M.E.I.C.	Hamilton
*Zone "C" (Prov. of Que.)	McNeely DuBose, M.E.I.C.	Arvida, Que.
*Zone "D" (Maritime Provinces)	W. S. Wilson, A.M.E.I.C.	Sydney, N.S.
Councillors:		
†Cape Breton Branch	I. W. Buckley, A.M.E.I.C.	Sydney, N.S.
†Moncton Branch	G. E. Smith, A.M.E.I.C.	Moncton
†Quebec Branch	A. Larivière, M.E.I.C.	Quebec
‡Montreal Branch	J. G. Hall, M.E.I.C.	Montreal
	C. K. McLeod, A.M.E.I.C.	Montreal
	H. J. Vennes, A.M.E.I.C.	Montreal
†Ottawa Branch	J. H. Parkin, M.E.I.C.	Ottawa
†Peterborough Branch	A. B. Gates, A.M.E.I.C.	Peterborough
†Toronto Branch	C. E. Sisson, M.E.I.C.	Toronto
†Hamilton Branch	W. L. McFaul, M.E.I.C.	Hamilton
†Niagara Peninsula Br.	W. R. Manock, A.M.E.I.C.	Fort Erie North
	G. H. Wood, A.M.E.I.C.	Niagara Falls
†Sault Ste. Marie Branch	J. L. Lang, M.E.I.C.	Sault Ste. Marie
†Winnipeg Branch	A. J. Taunton, M.E.I.C.	Winnipeg
†Lethbridge Branch	J. M. Campbell, A.M.E.I.C.	Lethbridge
†Calgary Branch	G. P. F. Boese, A.M.E.I.C.	Calgary
†Victoria Branch	A. L. Carruthers, M.E.I.C.	Victoria

*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.

MEETING OF COUNCIL

A meeting of the Council was held at Pictou Lodge, Pictou, Nova Scotia, on Wednesday, August 30th, 1939, at 2.30 p.m.

There were present: President H. W. McKiel, in the chair; Vice-President R. L. Dunsmore; Councillors S. Hogg, I. P. MacNab and A. P. Theuerkauf; Past-Vice-President F. A. Bowman; Past-Councillors Y. C. Barrington, V. C. Blackett, W. P. Copp, H. J. Crudge, F. W. W. Doane, J. R. Morrison, C. S. G. Rogers, G. Stead, H. Thorne and C. H. Wright; A. D. Nickerson, chairman, and J. R. Kaye, past-chairman of the Halifax Branch; S. W. Gray, President of the Association of Professional Engineers of Nova Scotia, Mr. Kelley, general manager and vice-president of the Dominion Steel and Coal Company, and Louis Trudel, assistant to the General Secretary. Telegrams expressing regret at their inability to be present were read from Vice-Presidents E. V. Buchanan and Fred Newell, Past-Vice-President S. C. Mifflen, and Past-Councillors H. S. Johnston and A. G. Tapley. The President extended a cordial welcome to all councillors and guests.

The President read a report from Mr. H. F. Bennett's Committee on the Training and Welfare of the Young Engineer regarding the awarding of Student memberships in the Institute as prizes for papers presented in competition to the various branches of the Institute. He reported that he had received a letter from a member of the Institute resident in the Maritime provinces urging that provision be made at this Maritime meeting for a full discussion of the work of this committee. After some discussion, it was resolved that the report be held over for discussion at a general session to be held during the professional meeting.

The membership of the Publication Committee, as appointed by the committee named at the last meeting of Council, was noted and endorsed by Council as follows:

A. Duperron, M.E.I.C., Chairman
C. K. McLeod, A.M.E.I.C., Vice-Chairman
J. B. Challies, M.E.I.C
R. H. Findlay, M.E.I.C.
O. O. Lefebvre, M.E.I.C.
F. P. Shearwood, M.E.I.C.
J. E. St. Laurent, M.E.I.C
T. C. Thompson, A.M.E.I.C.
H. J. Vennes, A.M.E.I.C.

The report of the Institute's Nominating Committee was presented by the President, and it was unanimously resolved that the list of nominees for officers for the year 1940, as submitted by the committee, be accepted and approved. A unanimous vote of thanks and appreciation was extended to Mr. A. L. Bishop, chairman of the Nominating Committee, for the excellent work which he and his committee had done in developing the list of nominees.

The President referred to the British-American Engineering Congress which had been planned for New York, but which had been cancelled because of European conditions. He pointed out that a tremendous amount of work had been done by the American committees, particularly so, from the Institute's point of view, by the American Society of Civil Engineers, and thought Council would be well justified in passing a resolution expressing its appreciation of the work which had been done. The resolution, which was approved of unanimously, was as follows:

"The Council of The Engineering Institute of Canada wishes to record its regret of the necessity of cancelling the British-American Engineering Congress, and to express its appreciation of the work which has been done by the American Society of Civil Engineers to make that meeting both pleasant and profitable for the visiting engineers. It is evident from the programme that the meeting would have been one of the outstanding events in the history of the profession, and would have added much to the knowledge of engineering and the development of international goodwill.

"The Institute joins with the other societies in the hope that the future will permit of an early opportunity for such plans to be carried through to completion."

The President reported that he had received suggestions from the Hamilton Branch for changes to the by-laws. After some discussion, it was decided to leave the subject to the next meeting of Council when a fuller discussion could be given to it.

In accordance with the terms of the agreement with the Association of Professional Engineers of Saskatchewan, and on the recommendation of the Saskatchewan Branch of the Institute, Council classified a number of members who had recently joined the Association. Five were classified as Associate Members, and two Juniors and two Students were added to the list.

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

ELECTIONS	
Members	2
Associate Members	9
Juniors	2
Affiliate	1
Students Admitted	4
TRANSFERS	
Associate Member to Member	2
Junior to Associate Member	5

In presenting the financial statement to the end of July, the President commented on the fact that the revenue, up to the present, had exceeded expenses substantially. He expressed the thought that the finances of the Institute were in a healthy condition, and that the thanks of the Institute were due in no small measure to Mr. Newell and his Finance Committee for the excellent showing.

On his own behalf, and on behalf of the other guests, Colonel Doane expressed his gratitude for the courtesy extended by the President and Council in giving them the privilege of attending this meeting and of taking part in the discussions. Past members of Council appreciated the indication that they had not been cut off entirely from the business of the Institute.

The President thanked Colonel Doane for his expression of appreciation. The Council was delighted to have senior members of the Institute present at Council meetings. He wished that it were possible for a greater number of past and future councillors to attend Council meetings. He believed that regional Council meetings served an excellent purpose in bringing members resident in the various districts into contact with the workings of Council.

The Council rose at five-thirty p.m.

ELECTIONS AND TRANSFERS

At the meeting of Council held on August 30th, 1939, the following elections and transfers were effected:

Members

Belnap, LeMonte Judson, B.Sc. D.Eng., (Univ. of Nebraska), president, Consolidated Paper Corporation, Limited, Montreal, Que.

Small, Walter Henry, B.S., (Michigan State College), chief engr., Barnett-McQueen Co., Fort William, Ont.

Associate Members

Archer, Ronald Gordon, asst. engr., sewer section, Dept. of Works, City of Toronto, Ont.

Fleischmann, Albert Charles, C.E., (Univ. of Cluny, France), industrial engr., 3814 Kent Ave., Montreal, Que.

Fraikin, Leon Arthur, C.E., (Univ. of Ghent), Vice-Pres. and Gen. Mgr., Franki Compressed Pile Co. of Can. Ltd., Montreal.

Godfrey, John Alexander, supervisor of apprentices, C.N.R., Moncton, N.B.

Lawrence, Frederick S., B.Sc., (McGill Univ.), engr., M.L.H. & P., Montreal, Que.

McMullen, Elmer Russell, B.Sc., (N.S. Tech. Coll.), div. acct., Consolidated Paper Corporation, Limited, Shawinigan Falls.

Meadows, Walter Ronald, B.Sc., (Elec.), (Univ. of Sask.), engr., T. C. Gorman Construction Co. Ltd., Town of Mount Royal, Que.

Reid, Alexander MacLaren, dist. engr., Alberta Dept. Public Works, St. Paul, Alberta.

Williams, Roberts Kitchener, (Univ. of Tor.), engr., Geo. S. May Limited, Toronto, Ont.

Juniors

Fuller, Harold Alexander, B.Sc., (Univ. of Man.), engr., Highway Paving Co. Ltd., Val David, Que.

Taylor, William Ebin, B.Sc., (Queen's Univ.), asst. to elect'l. supt., Intl. Petroleum Co., Negritos, Peru, S.A.

Affiliate

McKay, Walter Neil Thompson, B.A., (Univ. of Tor.), sec. treas., Assoc. of Professional Engineers of Ont., Toronto, Ont.

Transferred from the class of Associate Member to that of Member

Angell, Henry Gerald, asst. engr., Admiralty, Cosham, England.

Runciman, Arthur Salkeld, E.E., (Univ. of Toronto), supt. transmission lines, Shawinigan Water & Power Co., Montreal.

Transferred from the class of Junior to that of Associate Member

Chambers, Ronald John, B.Sc., (Queen's Univ.), mech. engr., Anglo-Canadian Pulp & Paper Co. Ltd., Quebec, Que.

Rogers, Joseph Victor, B.A.Sc., (Univ. of B.C.), asst. engr., Privateer Mines Ltd., Zeballos, B.C.

Ross, Donald, B.S., (Civil), (Univ. of N.B.), engr., Newfoundland Airport, Newfoundland.

Schultz, Charles Davies, B.A.S., (Univ. of B.C.), forest engr., Assoc. Timber Exporters Ltd., Marine Bldg., Vancouver, B.C.

St. Jacques, Gustave F., B.A.Sc., C.E., (Ecole Polytechnique), engr. Prov. Transportation and Communication Board, Quebec, Que.

Students Admitted

Baker, George Chisholm, (R.M.C.), Kingston, Ont.

Singer, Gerald, B.Eng., (McGill Univ.), 1560 Van Horne Ave., Montreal, Que.

Wall, James Gilbert, B.Sc., (Univ. of N.B.), P.O. Box 370, St. Stephen, N.B.

Webb, Earle L. R., (McGill Univ.), 835 Pratt Ave., Outremont, Que.

APPOINTMENTS TO NATIONAL SERVICE

Major-Gen. A. G. L. McNaughton, C.B., C.M.G., D.S.O., M.E.I.C., president of the National Research Council of Canada, who has been appointed Officer Commanding the First Division, Canadian Active Service Force

Major W. G. Swan, D.S.O., M.E.I.C., consulting engineer, Vancouver, B.C., has received the appointment of Director of Construction of the War Supply Board

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

R. A. C. Henry, M.E.I.C., vice-president of the Montreal Light Heat and Power, has been elected recently to the board of directors of this firm. From 1904-1908 he was associated with the Canadian Pacific Railway, rising from rodman to assistant engineer, western lines. He served the Government in the Department of the Interior (Water-power) from 1908-1909 and was superintendent of various construction works in the succeeding two years. He joined the Department of Railways and Canals in May, 1912, filling successively the posts of inspecting engineer, assistant engineer, general assistant engineer, engineer-in-charge Grand Trunk Arbitration, and special engineer. He was director, Bureau of Economics, Canadian National Railways from 1923 to 1929; deputy minister, Federal Department of Railways and Canals from 1929-30, resigning to accept the post of general manager, Beauharnois Power Corporation Limited, and in February, 1939, was appointed to his present position.

Lt.-Col. G. M. Carrie, M.E.I.C., has been appointed president of the Canadian Refractories Ltd. He graduated from the University of Toronto in 1913 and was overseas during the last war with the Royal Regiment of Artillery after which he saw much active service in the far east as assistant advisor to the Minister of Communications and Works for Iraq. In 1922 he returned to take over the active management of Scottish-Canadian Magnesite Company Limited and after the amalgamation of this company with the North American Magnesite Producers Limited in 1933 proceeded to organize Canadian Refractories Limited and became general manager.

J. C. MacDonald, M.E.I.C., has been appointed recently to the Public Utilities Commission of British Columbia. Since 1926 he has been comptroller of water rights for the province of British Columbia. He graduated from Dalhousie University with the degrees of Bachelor of Arts and Bachelor of Science and after four years engineering work in eastern Canada he moved to British Columbia, where as a member of the firm of Cleveland and Cameron of Vancouver, he was engaged on various works principally in connection with the design and installation of municipal water systems. Mr. MacDonald served with distinction overseas with the Canadian Engineers, having risen from lieutenant to major during service. From 1919 to 1926 he was in charge of the reorganization and reconstruction of irrigation systems in the interior of the province of British Columbia for the provincial Department of Lands.

A. O. Wolff, M.E.I.C., assistant district engineer of the Canadian Pacific Railway in Toronto, is now acting district engineer in Saint John, N.B.

F. J. Heuperman, A.M.E.I.C., has been appointed Secretary-treasurer of the Calgary Branch to complete the term of B. W. Snyder, A.M.E.I.C., who resigned recently to enlist in the Canadian active service force.

J. P. Young, A.M.E.I.C., who has been superintendent of construction for the Department of Public Works of the Province of Ontario, is now in charge of the maintenance of all the government buildings north of Toronto. Upon graduation from Queen's University in 1922 he entered Herbert Morris Crane Company. After remaining with this firm for two years he was made field superintendent of construction for the Detroit Gas Company. In 1933 he was employed by the Department of National Defence on construction of the Signal Corps Barracks near Kingston. In 1938 he entered the Department of Public Works as assistant superintendent and was very soon promoted to the position of superintendent.

M. Balls, A.M.E.I.C., of the Shawinigan Water and Power Company attended the Seventh Triennial Assembly of the Union of Geodesy and Geophysics in Washington, D.C.

S. F. Hubbard, S.E.I.C., has accepted a position with the Mallinockrodt Chemical Works Ltd., Montreal. Mr. Hubbard graduated from McGill University in 1938 with the degree of B.Eng. in chemical engineering.

C. D. Pengelley, S.E.I.C., is now junior engineer with the Curtiss Wright Corporation, St. Louis Airplane Division, Robertson, Mo. Mr. Pengelley obtained the degree of B.Eng. in mechanical engineering from McGill University in 1937 and the degree of S.M. from the Massachusetts Institute of Technology in 1939.

J. N. McCarey, Jr.E.I.C., is now employed with the Stephens Adamson Mfg. Co. of Canada Ltd., Belleville, Ont. Since graduating from Queen's University in 1935 he has been with the Canadian International Paper Company, Temiskaming, Quebec, and the Wabi Iron Works, Ltd., New Liskeard, Ont.

E. L. Miller, S.E.I.C., is now on the engineering staff of the city of Westmount. Mr. Miller graduated from McGill University in 1936 with the degree of B.Sc. in civil engineering.

Obituaries

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

John Dow, M.E.I.C., died at Calgary on August 16th. He was born at Whitetown, Aberdeenshire, Scotland, on May 6th, 1879. His entire professional career was connected with the telephone. In 1904, he entered the engineering department of the National Telephone Company, Scotland, and served apprenticeship in all branches of telephone engineering. In 1909 he became associated with the Automatic Electric Company, Chicago, U.S.A., and on the completion of a special nine months' course open to graduates of universities or technical institutes, he was attached to their engineering department. In 1912, he entered the service of the Alberta Government Telephones and became engaged in the installation and maintenance of automatic and manual switchboards, various power equipment and testing apparatus. He later became plant chief at Lethbridge and in 1929 he was transferred to the same position in Calgary. At the time of his sudden death, he was branch manager in Calgary.

Mr. Dow joined the Institute as a Member in 1922. He filled many offices in both the Lethbridge and Calgary branches during his period of membership.

Lt.-Col. James Lester Willis Gill, M.E.I.C., died in hospital at Toronto on August 26th, 1939.

This member of the Institute had a truly remarkable career. Born in 1871 on a farm at Little York, a few miles east of Charlottetown, P.E.I., he attended the country school and, for a few months, Prince of Wales College, Charlottetown. At the age of sixteen he went to Boston, Mass., where he was successively, livery stable helper, street car conductor, carpenter, painter, and general handy man.

In 1892 he arrived at Montreal and asked to be admitted to McGill University to study engineering. He had no matriculation certificate but through persistence and intense study he was able in three months to secure enrollment as a regular undergraduate, and in 1896 obtained his degree as Bachelor of Applied Science, with honours, and the British Association Gold Medal. He was also awarded the three year scholarship "Colonial and Indian Exposition of 1851" and spent thereunder two years of research work at McGill University laboratories, in physics and electricity and one year of research at Harvard. In recognition of his research work he was awarded the degree of Master of Science by McGill.

During part of the year 1900, Mr. Gill was in the Testing Department of the Westinghouse Electric and Manufacturing Company. From 1900 to 1919 he was professor of electrical engineering at Queen's University, with four years time out in military service overseas. Returning to his university in 1919, he was in 1920 appointed Director of Technical Education for the Dominion of Canada and after a year was made professor of mechanical engineering at the University of British Columbia, and in 1922 left that chair to take the appointment of Director of Technical Schools, Department of Education, Hamilton, Ont., which position he held with success and distinction until the time of his death.

Since his return from England after the Great War, Col. Gill contended that the youth of Canada who have inclination towards studies in mechanics and engineering should be trained in technical schools and industrial establishments, instead of going to the universities. His plea was that for many years, hundreds of young Canadians have been passing through the engineering schools, these young men beginning with great ambitions, or with visions of earning great salaries as designers, constructors, scientists, but that the great majority of them are a disappointment not only to themselves but to the country. His contention was that it is tremendously more important to establish really effective technical training schools all over Canada than to endeavour to foster the production of engineering school graduates. He frequently pointed out that while Canada has a distressing surplus of engineering school graduates it has a distressing dearth of Canadian-born youths being trained in technical schools or as apprentices in factories and mills.

Notwithstanding his close application as an engineering student teacher and scientist he found time to serve the Empire and rose from Lieutenant in 1915 to Lt.-Colonel in 1919. He was assistant director of the "Khaki University" under Col. Tory in England, 1918-19.

Col. Gill joined the Canadian Society of Civil Engineers as an Associate Member in 1901, becoming a Member in 1919.

Andrew Fullerton Macallum, M.E.I.C., died in Toronto on August 26th after a long illness. He was born in Toronto on August 9th, 1870. He was graduated from the University of Toronto with the degree of B.A.SC. in 1896. Following service with the Canadian Pacific Railway and the Canadian National Railways, he went into private practice and specialized in municipal engineering. For six years, he was city engineer for Hamilton and during sixteen years he was commissioner of works for Ottawa. In 1932, he opened an office in Ottawa as a consulting engineer in municipal and general engineering. He was a specialist in arbitration, valuations and appraisals.

Mr. Macallum joined the Canadian Society of Civil Engineers in 1907 as an Associate Member and a year later he was transferred to Member.

VISITORS TO HEADQUARTERS

Past-President Geo. A. Walkem, M.E.I.C., managing director, Vancouver Machinery Depot Ltd., Vancouver, B.C., on August 6th.

E. V. Gilbert, A.M.E.I.C., Department of Public Works, Ottawa, Ont., on August 7th.

Jean Doucet, S.E.I.C., superintendent Plessisville Foundry, Plessisville, Que., on August 15th.

R. T. W. Allen, S.E.I.C., draughtsman with the Dominion Government, Kelowna, B.C., on August 16th.

Rene Dupuy, Sr.E.I.C., assistant to the maintenance engineer, Quebec North Shore Paper Company, Baie Comeau, Que., on August 16th.

O. N. Mann, Jr.E.I.C., assistant to the manager and plant superintendent, Eagle Pencil Company, Drummondville, Que., on August 17th.

J. W. McBride, S.E.I.C., Graduate House, Massachusetts Institute of Technology, Cambridge, Mass., on August 17th.

Paul E. Buss, A.M.E.I.C., president of Spun Rock Wools Ltd., Thorold, Ont., on August 18th.

Horace L. Seymour, M.E.I.C., consulting engineer, Ottawa, Ont., on August 21st.

W. P. Nesbitt, Jr.E.I.C., Hawkesbury, Ont., on August 21st.

J. W. Porter, M.E.I.C., assistant principal engineer, Western Region, Canadian National Railway, Winnipeg, Man., on August 29th.

S. T. Farnsworth, engineer-in-chief, Metropolitan Water Sewerage and Drainage Board, Sydney, N.S.W., Australia, on September 8th.

E. P. Muntz, M.E.I.C., president of E. P. Muntz Ltd., Hamilton, Ont., on September 9th.

D. G. MacKenzie, A.M.E.I.C., vice-president and general manager, Rogers-Majestic Corp. Ltd., Toronto, Ont., on September 13th.

John Morency, Jr.E.I.C., inspector, Quebec Bureau of Mines, Quebec., on September 13th.

E. R. Brannen, S.E.I.C., assistant chief fiber inspector, Canadian Johns-Manville Co., Asbestos, Que., on September 14th.

C. H. Piercy, of the Public Works Department of the Soudan, on September 15th.

H. W. Furlong, A.M.E.I.C., of Stone and Webster Engineering Corp., structural engineers, Boston, Mass., on Sept. 18th.

N. C. Cowie, Jr.E.I.C., engineer, Great Lakes Power Co. Ltd., Sault Ste. Marie, Ont., former secretary-treasurer of the Sault Ste. Marie Branch, on September 25th.

O. L. Flanagan, A.M.E.I.C., of Toronto, Ont., on September 26th.

Vice-President H. O. Keay, Three Rivers, Past-President G. J. Desbarats, Ottawa, Col. L. F. Grant, Kingston, A. Larivière, Quebec, W. R. Manock, Fort Erie North, and E. Viens, Ottawa, attended the Council meeting at Headquarters on September 30th.

COMING MEETING

Canadian Institute on Sewage and Sanitation—Sixth Annual Convention, October 19th and 20th, at the Royal Connaught Hotel, Hamilton, Ont. Secretary-treasurer, Dr. A. E. Berry, Ontario Department of Health, Parliament Buildings, Toronto.

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 Civil Engineers:
List of Members, July, 1939.

North-East Coast Institution of Engineers and Shipbuilders:
Transactions, Vol. 55.

REPORTS, ETC.

Bell Telephone System, Technical Publications: Crossbar Dial Telephone Switching System; The Impact Testing of Plastics; Adherence of Organic Coatings to Metals; A New Apparatus for Microsublimation; Some Contemporary Advances in Physics 32 Particles of Cosmic Rays; A Terrain Clearance Indicator; Electrostatic Electron-optics; A Twelve-channel Carrier Telephone System for Open-wire Lines; Equivalent Modulator Circuits; Transcontinental Telephone Lines; Recent Developments in the Measurement of Telegraph Transmission. (Monographs B-1119 to 1129.)

The Electrochemical Society: Electrolytic Preparation of Sodium Arsenate; The Cadmium-nickel Storage Battery; Porosity of Electrodeposited Silver on Steel; Anodes for the Electrowinning of Manganese; The Electrodeposition of Lead from Solutions of Lead Sulfamate with Addition Agents; The Formation of Hydrogen Peroxide During Corrosion Reactions; The Nature of the Cathode in the Rusting of Iron; Rate of Solution of Zinc and Aluminum while Cathodic; The Classification of Anodic and Cathodic Inhibitors; The Electrometric Estimation of the Tarnish Products on Silver and Copper Alloys; The Detection of Small Traces of Copper Using the Antimony Electrode; Electrotitrations; Observations on the Behaviour of Steel Corroding Under Cathodic Control in Soils; Electrochemical Studies of the Corrosion of Steel and Magnesium in Partly Inhibited Solutions; A New Cathodic Process for the Production of H_2O_2; An Electrochemical Study of the Corrosion of Painted Iron; Tarnish Studies; A New Theory of Overvoltage; Internal Electrolysis as a Method of Analysis; (Preprint 76-3 to 76-12, 76-20 to 76-27).

Queen's University:
Calendar, 1939-40.

U.S. Department of Commerce:
List of publications available, June, 1939.

TECHNICAL BOOKS

Applied Economics for Engineers:
By Bernard Lester. New York, John Wiley and Sons, 1939. 464 pp., illus., 9¼ by 6 in., cloth, $4.00.

This book provides an introduction to the practical aspects of economics, based upon conditions and problems which are encountered in engineering practice.

Physik:
By Dr. Paul Wessel. Munich, Reinhardt, 1938. 514 pp., illus., 8¼ x 5 in., cloth, 4.90 rm.

Geology and Engineering:
By R. F. Legget, with a foreword by P. G. H. Boswell. New York and London, McGraw-Hill Book Co., 1939. 650 pp., illus., diagrs., maps, charts, tables, 9 x 6 in., cloth, $4.50.

This treatise is the work of an engineer trained in geology and is the most comprehensive on its subject in the English language. The applications of geology in tunneling and excavating, in building transportation routes and constructing foundations and reservoirs are discussed. Chapters are devoted to landslides, water, materials and soil mechanics. Practical illustrations of the solution of geological problems occur throughout the book, and there is a useful bibliography. The book will interest civil engineers generally.

U.S. Works Progress Administration Bibliography of Aeronautics: Pt. 30 Aerial Photography; Pt. 38 Skin Friction and Boundary Flow; Pt. 39 Stress Analysis; Pt. 41, Comfort in Aircraft; Pt. 45 Wind tunnels and laboratories. New York, 1939. 10¾ by 8½ in., paper.

VAPOR CHARTS and Special Tables for Turbine Calculations
By F. O. Ellenwood and C. O. Mackey. New York, John Wiley & Sons, 1939. 43 pp., charts, tables, 11 x 8 in., cloth, $2.50.

These vapor charts replace the "Steam Charts" published by Mr. Ellenwood in 1914. The book form of chart is retained, but the steam tables have been greatly extended and improved. Charts that show the thermodynamic properties of water, ammonia, dichlorodifluoromethane (freon-12) and mixtures of air and water vapor have been added.

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 CURRENTS
By C. E. Magnusson. 5 ed. New York and London, McGraw-Hill Book Co., 1939. 719 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $5.00.

This textbook is intended to present "in systematic order and logical sequence the basic principles of alternating currents and their application to electric-power engineering." This edition has been revised to represent current conditions in this field and has been considerably enlarged, but without change in the order and form of presentation.

ATOMS IN ACTION, the World of Creative Physics
By G. R. Harrison. New York, William Morrow & Co., 1939. 370 pp., illus., diagrs., 9 x 6 in., cloth, $3.50.

This is an unusually able and authoritative presentation of what modern physicists think and do, and of the more important applications of their work in daily life. The book is eminently readable and interesting, as well as accurate, and is endorsed by eminent physicists.

CHEMICAL SPECTROSCOPY
By W. R. Brode. New York, John Wiley & Sons, 1939. 494 pp., illus., diagrs., charts, tables, 9 x 6 in., c oth, $6.00.

This book is intended to supply spectroscopic information to chemical workers and also to serve as a textbook for a course in chemical spectroscopy. The principles of spectroscopy are explained, and the apparatus and methods used in chemical analysis described. There is a bibliography and an extensive collection of tables of spectroscopic lines.

THE DISEASES OF ELECTRICAL MACHINERY
By G. W. Stubbings. New York, Chemical Publishing Co., 1939. 219 pp., diagrs., 8 x 5 in., cloth, $3.00.

This small manual is intended for power-plant engineers and electricians. The defects that arise in the operation of electrical machinery are discussed, their underlying causes explained and practical directions given for their location and rectification.

ELECTRICITY TO-DAY (The Pageant of Progress)
By T. B. Vinycomb. New York and London, Oxford University Press, 1939. 192 pp., illus., diagrs., charts, 9 x 6 in., cloth, $1.75.

The object of this work is to supply non-technical readers with an account of the way in which electricity is produced and distributed, and of its uses in daily life. Heating, lighting and methods of communication are described in terms of current practice.

ENGINEERING PHYSICAL METALLURGY
By R. H. Heyer. New York, D. Van Nostrand Co., 1939. 549 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.50.

The aim of this book is to provide a simple treatment of the subject, intended for those making their first acquaintance with engineering metals and alloys. A wide range of materials is discussed, including pure metals and alloys, processes of hot and cold reduction, heat treatment, welding machining, etc. Each chapter has a bibliography.

FRÄSEN
Ed. by Wanderer-Werke Aktiengesellschaft, Siegmar-Schonau bei Chemnitz, 1939. Berlin, Julius Springer. 89 pp., illus., tables, diagrs., 12 x 9 ins., cloth, $6.60 rm.

Milling machines form the subject of this memorial publication of a large German machine works. The first four chapters cover milling theory, rules for proper milling work, and feed and speed calculations. Chapters 5 and 6 contain descriptions of actual jobs, and of machines and supplementary equipment manufactured by the company.

THE GASOLINE AUTOMOBILE (Engineering Education Series)
By B. G. Elliott and E. L. Consoliver. 5 ed. New York and London, McGraw-Hill Book Co., 1939. 754 pp., illus., diagrs., charts, tables, 10 x 6 in., cloth, $4.00.

This well-known text aims to present the fundamental principles and ideas upon which motor vehicles are designed, constructed and operated. In the new edition attention is given to the automotive-type diesel engine and the low-compression spark-ignition oil engine. The material on tractors and automatic transmissions has been enlarged and the book brought up to date throughout.

Great Britain, Dept. of Scientific and Industrial Research

METHODS FOR THE DETECTION OF TOXIC GASES IN INDUSTRY
Leaflet No. 3, Sulphur Dioxide. 1938. 6 pp., 2s. 6d.; Leaflet No. 4, Benzene Vapour. 1939. 9 pp., 3d.; Leaflet No. 5, Nitrous Fumes. 1939. 9 pp., 3d. London, His Majesty's Stationery Office, diagrs., tables, 10 x 6 in., paper. (Obtainable from British Library of Information, 50 Rockefeller Plaza, New York, Leaflet 3, 75c.; Leaflet 4, 10c.; Leaflet 5, 10c.).

These leaflets contain approved methods for testing the freedom from various gases of enclosed places which workmen are about to enter. The directions are full and simple, and have proved satisfactory under practical conditions.

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.

Last month, we issued a questionnaire for the purpose of bringing the employment records up to date, in view of the increased demand for engineers which may result when industry is organized on a war-time basis. The questionnaire has been addressed to all those who have at one time or another registered for employment with the Bureau and have not advised us that they have since found a satisfactory position.

The need for such a questionnaire is amply demonstrated by the fact that nearly twenty-five per cent of the returns to date have come from men who are satisfied with their present positions but whose names were still retained on our list because they had failed to advise us of their employment.

If our Employment Service is to work efficiently for both industry and the engineer, it is essential that those who register keep us informed, particularly when they have found a satisfactory position. Otherwise, our records become out of date, which makes our work more complicated and may give to the employer an unfavourable impression of our service.

This Employment Bureau is operated as a service without charge. Please do your share! Keep your record up to date! Make a point of advising us of any change of address or occupation! You may need the service again in the future.

SITUATIONS VACANT

YOUNG GRADUATE engineer with some experience in ceramics or related industry to work in plant. Send applications with full particulars and photograph to Box No. 1948-V.

GRADUATE ENGINEER with sales and management ability, good personality, for a firm in Montreal district. Send applications with full particulars and photograph to Box No. 1949-V.

YOUNG GRADUATE MECHANICAL ENGINEER. Previous experience not necessary but preferably one with a slight amount in machine design, lay-outs, estimating, draughting, shop practice and general maintenance in a good sized industrial plant. French language would be helpful. Must have initiative, ability to accept responsibility and work harmoniously with large organization. Applications should include experience, age and fullest details. Box No. 1954-V.

JUNIOR CHEMIST for a pulp and paper manufacturer. A graduate in chemical engineering is preferred. Experience in pulp and paper is desirable but not necessary. Apply to Box No. 1961-V.

GRADUATE ENGINEER, experienced in steel pipe manufacture with some knowledge of industrial management. Knowledge of French an asset. Position is permanent and well remunerated for the right man. Apply giving full particulars to Box No. 1962-V.

CIVIL SERVICE OF CANADA VACANCY

Comp. No. 29388—An Assistant Director of Operation, Male, for the Operating Branch, Board of Transport Commissioners, Ottawa, at an initial salary of $4,140 per annum which may be increased upon recommendation for meritorious service and increased usefulness at the rate of $180 per annum until a maximum of $4,680 has been reached. *Duties:* Under the direction of the Director of Operation to assist in administering the Operating Department with particular reference to mechanical questions and the supervision of the staff engaged in the inspection of railway equipment and the investigation of accidents; to report upon general questions of operation, train rules, signals, train services, car supply and fire preventive appliances and regulations; to act for the Director of Operation in his absence; and to perform other related work as required. *Qualifications:* Either graduation from a university of recognized standing and eight years of practical experience on a North American railway, including five years' practical shop work and locomotive, coach and car design experience, and three years in an administrative capacity, or high school graduation and ten years' practical experience on a North American railway, including a five year term of apprenticeship in engine or railway shops, supplemented by practical shop experience and thorough training in design and construction of locomotives, boilers and railway rolling stock, with at least three years in an administrative capacity; expert knowledge of locomotive design and construction, including boilers and appurtenances; a general knowledge of air brakes, safety appliances on all types of railway equipment, crossing signals, operating safety devices and methods of fire prevention; demonstrated administrative ability; tact and good judgment.

Application forms properly filled in must be filed with the Civil Service Commission, Ottawa, not later than October 16th. Forms may be obtained from local Post Office.

Please quote competition number when filling out application form.

Candidates must be British subjects, and must have resided in Canada at least five years.

SITUATIONS WANTED

MECHANICAL DRAUGHTSMAN, 12 years experience in mechanical and structural draughting and general mechanical design, including recently perfected new type Diesel head. Married. Age 37. B.Sc. in mechanical engineering. Employed steadily but desirous of good opportunity in Diesel or general mechanical field. Apply to Box No. 1081-W.

CHEMICAL ENGINEER, McGill '34. Pulp and paper mill experience, production control, meter maintenance, and tests. Apply to Box No. 1222-W.

REFINERY ENGINEER, B.Sc. (E.E.), Man. '37. Experienced in supervising operations and maintenance of small refinery. 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.

TRAINING AS SALES ENGINEER desired by civil engineer, B.E., Jr.E.I.C. Single. Age 27. Has taken extensive additional study in education, particularly in psychology and personality. Experience consists of surveying, detailing, designing, and principal of a high school. Desires permanent position. Available on short notice. Apply to Box No. 1843-W.

CIVIL ENGINEER, A.M.E.I.C. Married. Ten years experience on railway location and construction. Twenty years on hydro-electric power and mill construction in executive capacity in charge of preliminary investigation, engineering, estimating, costs and purchasing. At present unengaged owing to the firm associated with discontinuing operations. Available at once. Apply to Box No. 1896-W.

MECHANICAL ENGINEER, B.E. (Sask. '38), S.E.I.C. Age 25. Single. Year's experience with large steel plant, general piping, fuel oil lines and storage tanks, surveying, draughting, furnace construction and operation, adjustment of automatic control equipment, testing. Considerable electrical knowledge. At present employed but available on short notice. Desires specialized position but will consider others. Apply to Box No. 1907-W.

ELECTRICAL ENGINEER, B.Eng. (McGill '37). Age 24. Eighteen months experience in test department of big English electrical manufacturing firm. Returning to Canada in June. Would prefer design, sales, or practical work. Apply to Box No. 1911-W.

CIVIL ENGINEER, A.M.E.I.C., R.P.E. Age 48. Married. Fifteen years city engineer, fourteen years experience on design, construction, maintenance, road location, railways, underground, also experience in hardware, plumbing, heating, air conditioning. Desires steady position. Available on short notice. Apply to Box No. 1923-W.

ELECTRICAL ENGINEER, B.A.Sc. (Toronto '35). Age 27. Jr.E.I.C. Graduate of business college. Technical experience in aeronautics, comfort air cooling, refrigeration and communication equipment. Office experience, including shorthand, typewriting and correspondence compilation. Apply to Nox No. 1926-W.

CIVIL ENGINEER, B.Sc. in C.E. '39, S.E.I.C. Age 20. Three summers experience in land survey. Will undertake any work of an engineering nature. Location immaterial. Further details on request. Apply to Box No. 1943.-W

CIVIL ENGINEER, B.Sc., S.E.I.C. Age 31. Canadian. Interested in sale and production work. Speaks Polish, Slovak, Ukrainian. Apply to Box No. 1955-W.

ELECTRICAL ENGINEER, B.A.Sc. (Toronto '35), Jr.E.I.C. Married. Age 26. Experience—21 months with small company on factory service, and installation work of farm and commercial refrigeration equipment. Thirteen months on maintenance of construction tools and instruments, erection and service work on electric furnaces, office work on apparatus orders. Sixteen months of testing of various electrical equipment, and four months to date on transformer engineering, all with a large Canadian electrical manufacturer. Available on short notice. Technical work preferred. Apply to Box No. 1958-W.

ELECTRICAL ENGINEER, B.E. (N.S.T.C. '35). Age 25. Single. Three summers as paving inspector. One year selling, servicing and installing theatre sound equipment. Willing to go anywhere on short notice. Apply to Box No. 1959-W.

ELECTRICAL ENGINEER, B.Sc. (E.E.) Man. '37. Age 26. Two years experience with large manufacturing firm one year in factory work testing and inspecting, transformers, industrial control gear, fractional motors and large A.C. and D.C. rotating machinery. Three months in engineering dept. of wire and cable factory. Nine months in training course covering factory organization and production methods. References. Location immaterial. Available on short notice. Apply to Box No. 1961-W.

LARGE SCALE PRODUCTION EXPERIENCE in an airplane factory or other plant, with a view to learning the business and a permanent position, desired by young man, single, age 25, S.E.I.C., having a B.Sc. degree with distinction in engineering and advanced training in economics and business. Past work includes highway design, draughting, four years as advertising solicitor, and at present engaged in design and related work in the steel industry. Available on two weeks notice. Apply to Box No. 1962-W.

ELECTRICAL ENGINEER, B.Sc., E.E. '37, age 23, single, Canadian. Experience includes one year in large electrical factory, testing large and small motors, generators and transformers; also one year and a half on sales engineering work. Interested in permanent position with a good future. Would consider any location. References available on short notice. Apply to Box No. 1981-W.

PRELIMINARY NOTICE

of Application for Admission and for Transfer

September 26th, 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 November, 1939.

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

ASHTON—ERNEST, of 169 Lansdowne St., Kamloops, B.C. Born at Liverpool, England, Jan. 1st, 1899; Educ.: I.C.S. course in Railroad Engrg., not completed. Night school course in maths.; from 1919 to date with the C.N.R. as follows (except 1933-35, when camp foreman, Dept. of National Defence); 1919-25, rodman, and topographer; 1925-6, instr'man.; 1926-27, dftsman.; 1927-28, res. engr.; 1928, asst. engr., 1928-30, res. engr.; 1931, instr'man.; 1932, rodman; April, 1935, to date, cost clerk, welding gang., Western Region, Winnipeg, Man.

References: J. L. Charles, A. J. Gayfer, C. Ewart, W. Burns, T. C. Main.

FLOOD—ALBERT J., of Toronto, Ont. Born at Toronto, Ont., Oct. 8th, 1893; Educ.: Univ. of Toronto, Special Mining, 1922-1924; Member, C.I.M.M.; 1921-23, general supt., Kirkland Mines Ltd.; 1923-25, field engineer, Stobie Forlong & Company; 1926-27, general supt., Laval Quebec Mines Ltd.; 1928, Harvie Mining Co. Ltd., Vice-Pres. and Gen. Mgr., 1929-1939, General Consultant (Mining); Sanshaw Mines Limited, Treasurer, 1937, President, 1938-9; Quebec Eureka Gold Mines Ltd., Managing Director, 1938-39; at present, 2nd Army Troops Co., R.C.E.

References: T. H. Hogg, J. R. Montague, J. J. Traill, J. Mackintosh, J. W. Falkner.

MacMILLAN—JOHN SHERMAN, of Dolbeau, Que. Born at Ottawa, Ont., Oct. 26th, 1910; Educ.: B.Sc., Queen's Univ., 1933; 1929-30 (summers), Hollinger Gold Mines; 1933-34, rodman, Dept. of Highways of Ont.; 1935-37, dftsman., under hydraulic engr., Montreal Light, Heat & Power Cons.; 1937 to date, dftsman., Lake St. John Power & Paper Co. Ltd., Dolbeau, Que.

References: H. P. Moller, E. Cowan, S. H. Wilson, F. L. Lawton, C. Miller.

MARCOTTE—CHARLES, of 3647 University St., Montreal, Que. Born at Grand Mere, Que., Apr. 6th, 1913; Educ.: I.C.S. Civil Engrg. and Mech. Dfting.; 1935-39, junior engr., engrg. dept., Shawinigan Chemicals; at present, junior engr., Shawinigan Engineering Company, Montreal.

References: R. E. Heartz, A. S. Poe, A. L. Patterson, M. Eaton, H. K. Wyman.

McISAAC—WILFRED JOSEPH, of 93 Douglas Ave., Saint John, N.B. Born at Bayfield, P.E.I., May 25th, 1910; Educ.: Engrg. Cert., St. Francis Xavier University, 1932; Nov., 1934, instr'man. for contractor in charge of Armouries floor job, at Charlottetown; 1934 (two mos.), grade foreman, and 1935-36, grade supt., Modern Paving Co., Charlottetown; 1936 (two mos.), asst. to city engr. i/c of paving streets, Charlottetown; 1937 (May-Nov.), i/c of paving with Standard Paving Co., Charlottetown; at present, industrial power sales engr., International Harvester Co. of Canada Ltd., Saint John, N.B.

References: W. H. Blake, E. B. Martin, E. L. Miles, H. W. Read, M. W. Black.

PATTERSON—DONALD SKILLMAN, of 503 2nd Ave. South, Kenora, Ont. Born at Birtle, Man., Nov. 26th, 1905; Educ.: B.Sc. (C.E.), Univ. of Man., 1927; Summers: 1923, C.P.R. constrn.; 1924-25-26, Provisional Pilot Officer, R.C.A.F.; 1927, instr'man., power house constrn., Manitoba Power Co.; 1927-28, instructor, dept. of civil engrg., Univ. of Man.; 1928-30, asst. bridge engr., Good Roads Board, Prov. of Man.; 1930-32, engr., Cowin & Co. Ltd., Winnipeg, Man.; 1934-35, sub-foreman and foreman on relief projects; 1935-37, instr'man., Dept. of Northern Development of Ont.; 1937 to date, instr'man., Dept. of Highways of Ontario.

References: E. A. Kelly, M. H. McEwen, H. B. Henderson, J. N. Finlayson.

FOR TRANSFER FROM THE CLASS OF JUNIOR

BUNTING—WILLIAM LLOYD, of Edmonton, Alta. Born at Swan River, Man., April 12th, 1906; Educ.: B.Sc., Univ. of Man., 1928; Summers, 1923-27, sampler, rodman and instr'man., Dom. Govt. Surveys; 1928-29, res. engr., Man. Good Roads Board; 1930, instr'man., Winnipeg City Hydro; 1931, concrete inspr., city of Winnipeg; 1931 (May-Oct.), inspr., Man. Good Roads Board; 1932, operator, North British Mining & Milling Co.; 1932-34, operator, Hudson Bay Mining & Smelting Co.; 1934-36, municipal engr., Flin Flon, Man.; 1936-38, res. engr., reclam. branch, Manitoba Govt.; Feb., 1939, to date, field engr., Ducks Unlimited (Canada), Edmonton, Alta. (St 1927, Jr. 1934.)

References: A. J. Taunton, T. C. Main, G. H. Herriot, V. H. Campbell.

FISHER—FREDERICK S., of 5 Ingleside Ave., Westmount, Que. Born at Edmonton, Alta., Nov. 19th, 1901; Educ.: B.Sc. (E.E.), Univ. of Alta., 1924; 1919 (summer), electric meter dept., City of Edmonton; 1920-22 (summers), telephone mtce. work, Alta. Govt. Telephones; 1924-28, and 1930-32, telephone engr., Northern Electric Company; 1928-30, C.N. Telegraphs, Toronto; 1932-37, technical development dept., Northern Electric Co. Ltd., Montreal; 1937 to date, gen. equipment engr., C.P.R. Communications Dept., Montreal, Que. (Jr. 1926.)

References: D. N. Macleod, H. J. MacLeod, E. S. Kelsey, J. S. Cameron, N. E. D. Sheppard, J. D. Baker, A. W. Y. DesBrisay.

ROBERTSON—IAN ANSLEY, of 274 Erskine Ave., Toronto, Ont. Born at Stirling, Ont., May 24th, 1906; Educ.: Home study and corres. course in mech. engrg., R.P.E. of Ont.; 1927-28, dftsman., Grinnell Co. of Canada; 1928-29, Lincoln Meter Co. Ltd.; 1929-31 and 1934-35 (intermittent), dftsman., also plant constrn., Can. National Telegraphs; 1929-32, intermittent work with Water Equipment Ltd.; 1932, dftsman. and designer, International Cooler Corpn.; 1932-34, mech. designer, designing and contracting on heating work; 1935-36, mech. engr., Canadian Air Conditioning Co.; 1936 to date, mech. designer, Railway & Power Engrg. Corpn., Toronto, Ont. (Jr. 1936.)

References: A. S. Cook, W. B. Redman, H. N. Gzowski, J. A. C. Bowen, J. H. Fox. R. N. Austin, V. S. Thompson.

THORN—RICHARD, of 1216 Crescent St., Montreal, Que. Born at Norwich, England, Dec. 3rd, 1905; Educ.: Gresham College, Norfolk, England; Graduate Member, Inst. of Mech. Engrs. (Passed Inst. M.E. Exams. for Assoc. Member in 1930); 1925-29, pupil with Marshall Sons & Co. Ltd., Lincs., England, gen. mech. engrg.; 1929, mech. dftsman., Canadian Vickers Ltd., Montreal; 1929-31, mech. dfting., heating and ventilating, Messrs. Ryan & Combe, Montreal; 1931, sales engr., Lewis Brown Ltd.; 1932, 5th engr., marine work, Canadian National Steamships; 1932-33, sales mgr., Heating Equipment Co., Halifax, N.S.; 1933-34, sales engr., F. S. Coombes & Co., Halifax; 1934-36, asst. meter engr., Imperial Oil Ltd., Dartmouth, N.S.; 1937, meter engr., McColl Frontenac Oil Co. Ltd.; 1937-38, air conditioning dftsman., Canadian Industries Ltd.; 1938-39, air conditioning engrg., McDougall & Friedman, Montreal; st present, designing air conditioning systems for Walter J. Armstrong, M.E.I.C., consltg. engr., Montreal. (St. 1930, Jr. 1936.)

References: F. J. Friedman, G. K. McDougall, W. J. Armstrong, F. S. B. Heward, J. F. Plow, L. S. Cossitt.

FOR TRANSFER FROM THE CLASS OF STUDENT

DAVIS—EDGAR HAWKINS, of Edmonton, Alta. Born at Gladstone, Man., Dec. 3rd, 1916; Educ.: B.Sc. (Civil), Univ. of Alta., 1938; 1937 (summer), instr'man., Dom. Govt. Survey; 1936 (summer), gen. surveying; at present, assessor, industries and utilities, for Prov. Govt., also temporary struct'l. design work. (St., 1938.)

References: R. S. L. Wilson, J. T. Watson, H. R. Webb, P. M. Sauder, R. Livingstone.

FROMSON—SAM, of Red Lake, Ont. Born at Winnipeg, Man., June 17th, 1916; Educ.: B.Eng. (Mech.), McGill Univ., 1938; 1935-36 (summers), crushing plant operation, 1937 (summer), gen. plant mtce. and shop work, 1938 to date, mechanic and dftsman., Howey Gold Mines Ltd., Red Lake, Ont. (St., 1937.)

References: C. M. McKergow, A. R. Roberts, N. M. Hall, G. H. Herriot, J. G. Hall.

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MODERN HIGHWAYS

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Engineers are far from being in accord as to the meaning of the term "modern highway" and would, no doubt, resent the implication that highways they are building, regardless of their alignment, width, grade or surface, are not modern. Actually, any highway is modern where the resultant development meets modern requirements; that is, it is suitable to its geographical locality, satisfying all demands made upon it. In the final analysis, it must be a highway which fulfills the desires of the travelling public and provides for free and flexible movement of the varying types of transportation it must carry.

Canada is engaged in service road development and will continue to be occupied with this type for many years; roads that permit of convenient movement from point to point without congestion. For many years, provinces throughout the Dominion were forced through lack of funds to confine themselves to drainage, grading and structures, adding such surface materials as could be obtained at a sufficiently reasonable cost to permit of application. The thought behind all the work, however, has been modern highways; that the day would come when surfaces of sufficient width and weight would be laid that would meet all requirements. In many instances throughout the Dominion, pavements have been laid that are modern in every respect and each year finds many miles added to this type of road. The Canada Year Book showed 7,725.5 miles of paved highway in 1928; at the end of 1936 the mileage was 9,832. Roads such as are being constructed in Canada of this type are superior in alignment and grade to those of any other country; they have the advantage that they are really new. They have been developed within the age of the motor car and at no time have been under the influence of the horse and carriage period.

England, France, Germany, Belgium and Italy are advocates of modern highway development but these countries already have thousands of miles of market or local roads dating back to earliest history. These roads are not particularly straight, they are narrow and hilly, but have served and will continue to serve their purpose. However, the cobblestone, the high crowned macadam and the other types of the ancient road-builders are not pleasing to the present-day motorist and so the highway engineer is asked to meet the demand for modern highways.

Fig. 1—The Queen Elizabeth Way between Toronto and Fort Erie, Ontario. Note widened traffic way to permit of traffic leaving the highway

Geography and population play their part in present day highway construction. Germany is possibly the most definite example of the result of these two forces. Almost surrounded by countries with dense populations, the Germans justify modern development under three headings: tourist traffic, industrial advantages and convenience of movement over long distances.

In the first instance they believe that express highways (autobahnen) will permit motor traffic from all surrounding countries to reach central Germany with dispatch, comfort and safety.

Secondly, they contend that unrestricted movement of goods makes for lowered prices and permits of keener competition particularly from an export point of view.

Thirdly, defensively or offensively, Germany's "autobahn" highways are well known. Paralleling boundary lines like the rim of a wheel with its spokes ending at the Berlin hub, this great system of highways in the process of completion has great military possibilities and would play an important part in any international situation. The only retarding factor at this time is their lack of continuity, the major mileage being as yet unconnected. Approximately 2,000 miles have been completed.

Fig. 2—Highway No. 11, between Pont Bélair and St. Jérôme, Que., showing well marked traffic lanes making for increased safety

Germany has treated its express highway development as it might a railway system except that towns, villages and cities are by-passed. Its relation to the local system of highways is in the nature of the subway to the ground system in street railways; the connections are as limited as possible, having public service in mind.

The autobahn or divided motorway as built in Germany provides for four lanes of traffic, separated by grass boulevards, and is expected to give the maximum of safety. The pavement is generally cement concrete varying in width from 20 to 24 feet, flanked on either side by bituminous penetrated stone blocks or penetrated crushed stone three to four feet in width. All traffic lanes are distinctly marked. The grassed area separating directional traffic varies from 14 to 16 feet; it is unbroken throughout its length, prohibiting traffic travelling in one direction from interfering with that flowing in another direction. Intersecting roads, local or otherwise, pass over or under, dependent upon the topography of the country. The directness of the autobahn highway, with its avoidance of community centres, means new right-of-way and the severance of much farm land. The State makes the practice of exchanging ownership as far as possible, thereby avoiding property damage. Where transferring land in this way cannot be made effective, provision is made to allow the owners to cross by use of over or under passes as with local roads. Often a number of owners are required to use the same structure reaching their property by private lane or service road, dependent upon convenience.

This great express highway system, built and controlled by the State in co-operation with the railways, will provide a means of transportation unequalled in any other country.

Modern highways in England and France are being developed in keeping with the requirements of the countries. England has under way a programme calling for the completion of 4,500 miles of express motorways of the divided type. A problem of major importance in the design of

Fig. 3—Entrance to the George Washington Bridge, State of New Jersey

modern highways in England is the bicycle. Cyclists to the number of over 12,000,000 create a situation demanding special treatment. While in Germany regulation excludes the cyclist from the divided highway, this is not possible in England. And so the express highway of that country provides for bicycles as well as motor cars; in fact, goes one step further, building paths for the pedestrian. The cross-section is made up approximately as follows: two motor lanes 20 to 30 ft. in width separated by a grassed area 5 to 20 ft. wide, a narrow strip of grass separating motor and cyclist traffic, and a further section separating the cyclist from the pedestrian. The cyclists' pathway varies in width from 9 to 11 ft. and is generally constructed of the same material as the motorway except that it is lighter in weight. The pedestrian walk, on the other hand, may be constructed of slag, cinder, stone, bituminous or any material suitable and convenient to the locality. The width may vary from 4 to 9 ft.

In a country such as England where congestion of population plays such a tremendous part, specifications as to widths of right-of-way, standards of grades and alignment allow for considerable latitude. Again here, however, safety is the governing factor. Their immediate concern is the by-pass road. As the name implies, this involves the building of roads around communities where the present accommodation along the main thoroughfare makes the rapid movement of through traffic impossible. England found that directly by-pass roads were completed the tendency was to build along the new highway, creating, in a short time, a situation similar to the condition which had just been remedied. Legislation was accordingly introduced, known as the Restriction of Ribbon Development Act, which provided for State control of building construction and entrances or exits along new highways.

To deal with the same difficulty, Ontario has recently passed an amendment to the Highway Improvement Act, covering divided highways, which provides as follows:

Section 79A—(1) The Lieutenant-Governor in Council, upon the recommendation of the Minister, may designate any portion of the King's Highway as a divided highway and all the provisions of this Act relating to the King's Highway as well as the provisions of this section shall apply to every divided highway.

(2) The Lieutenant-Governor in Council may make regulations relating to divided highways:
  (a) Prohibiting or regulating the opening into divided highways of private roads and entrances to premises adjoining divided highways;
  (b) Prohibiting or regulating the use of divided highways by any type or class of vehicles;
  (c) Prohibiting or regulating the erection of buildings or other structures upon or adjacent to highways intersecting or running into divided highways for a distance of six hundred feet from the divided highways;
  (d) Prohibiting or regulating the erection of power lines or other pole lines upon or within one-quarter of a mile of any divided highway and the provisions of any regulations made under the authority of this clause shall apply notwithstanding any provision of any other general Act or any special Act heretofore passed by this Legislature; and
  (e) Generally for the better carrying out of the provisions of this Act relating to divided highways.

(3) Every person who violates any of the provisions of the regulations made under the authority of this section shall be liable to a penalty of not less than $1 and not more than $100 recoverable under The Summary Convictions Act, and the continuance of the condition constituting such violation for each week after a conviction therefor shall be deemed to be a further violation.

(4) Subject to the approval of the Board, the Department may close any county, township or other road which intersects or runs into a divided highway.

(5) The Board may direct that notice of any application for approval of the closing of a road under this section shall be given at such times, in such manner and to such persons as the Board may determine and upon the hearing of such application the Board may make such order as it deems proper refusing its approval or granting approval upon such terms and conditions as it deems proper.

Fig. 4—Highway in the Borough of Derby, England. Note the division to provide for cyclists and pedestrian pathways

(6) Any order of the Board approving of the closing of a road may contain provisions:
  (a) Determining the point or points at which such roads shall be closed;

(b) Providing for the compensation of persons injuriously affected by the closing of the road:
  (i) By the payment of damages by the Department to any of such persons;
  (ii) By the providing of another road for the use of any of such persons;
  (iii) By the vesting of any portion of the road allowance of the road so closed in any of such persons notwithstanding the provisions of any other Act; and
  (iv) In such other manner as it may deem proper;

(c) Providing for the payment of the costs of any person appearing on such application and fixing the amount of such costs; and

(d) Providing for the doing of such other acts as in the circumstances it deems proper.

(7) Upon the approval of the Board being so obtained, but subject to the provisions of the order of the Board made on the application for such approval, the Department may do all such acts as may be necessary to close the road in respect of which the application is made.

(8) Any person who claims to be injuriously affected by the closing of the road may, by leave of the Court of Appeal, appeal to that Court from any order of the Board approving the closing of such road, and the Department may, upon like leave, appeal from any order of the Board made on an application under this section.

(9) The leave may be granted on such terms as to the giving of security for costs and otherwise as the Court may deem just.

(10) The practice and procedure as to the appeal and incidental thereto shall be the same, mutatis mutandis, as upon an appeal from a county court and the decision of the Court of Appeal shall be final.

(11) Section 103 of The Ontario Municipal Board Act shall not apply to any appeal under this section.

(12) In this section "Board" shall mean Ontario Municipal Board.

(13) The name "King's Highway" shall be any highway so designated by the Province of Ontario and which is constructed and maintained one hundred per cent by the province. King's Highway and State Highway have exactly the same meaning.

Under Section 79a, subsection (2), clause (c), provision is made that no building shall be erected within six hundred feet of the divided highway at the intersection of any road running into the highway. Regulation prepared by the Province of Ontario requires that on straight-away sections on divided highways no structure shall be placed within a distance of one hundred and fifty feet of the right-of-way. Where buildings are already in position at the time the highway is being constructed they may be allowed to remain in their original position under a lease arrangement, but improvements or re-building can only be undertaken through permission from the province.

Ontario legislation is typical of the type of restriction that must be put into effect in any country if highways are to be permitted to assume their proper place. National in importance, politics or selfish influence should play no part in highway administration. The business of modern highway development is too serious an undertaking to allow for any interference. In the Province of Ontario, and in fact throughout the Dominion of Canada, an examination of the highway situation to date would indicate considerable lack of planning and an enormous expenditure that might have been saved with early study and a vision to grasp the future. True, the motor car has passed our wildest dreams; methods of transportation have become revolutionized, public opinion has changed and many other reasons might be given to excuse our short-sightedness, but the fact remains that great mileages of roads already in use will be destroyed or abandoned in planning for present and future needs.

A study of the modern highway, whether in Europe or America, indicates a similarity of purpose; safety in construction, directness, a demand for permanent surfaces, smoothness in quality of these riding surfaces and unhampered movement. In densely populated countries to attain these results much money must be expended. Topography also plays an important part; mountainous countries such as Italy and France force enormous additional expenditures for grading alone. Fortunately this last factor, which, after all, is the only permanent thing about highway building, means no further outlay if properly done in the beginning. Our method in Canada has been to try for the best possible alignment and grade, then construct to this, allowing the fills to settle under traffic for such time as may be considered necessary to properly consolidate the subgrade. In many instances we have laid light types of cheap surfaces thereby eliminating dust nuisance and encouraging traffic until more permanent surfaces can be constructed. The United States more often follows the practice of consolidating the grade as the material is moved. The fill is placed in layers. Various types of tamping equipment, frequently similar to that used in Europe, is specified, the whole consolidated ready for paving directly grade is reached.

Pavements of every conceivable kind have their advocates. Generally, they may be classified as bituminous, either pre-mixed or road mixed, and cement concrete, while granite block, brick and many patented types have been used successfully. Under certain conditions the two first named meet the general demand to give satisfaction. The finished

Fig. 5—Reichsautobahn, Munich-Salzburg, Germany. Limited highways not necessarily built at the same elevation

surface should be as near skid-proof as possible in wet or dry weather; its life must be of sufficient length to justify its cost. Geography plays a large part in the selection of these surfaces. Canada, for instance, has been obliged to build pavements of considerably greater weight, keeping density of motor traffic in mind, than southern United States carrying an equal motor car tonnage. When light types of surface have been developed in Canada legislation has been enacted controlling the type and weight of vehicle that is permissible during the winter and spring season.

Generally, engineers in all countries will be forced into the development of express highway systems. Increasing registration of motor cars and trucks will force this condition whether we wish it or not. The building of these systems will take many years; mistakes can be avoided only by the most careful analysis of all items that enter into the future of our countries. The motor car has become the most important factor in our systems of transportation. There seems no possibility of its being supplanted; in short, its usefulness would appear to be almost unlimited.

RADIO AIDS TO AERIAL NAVIGATION

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Paper presented before the Peterborough Branch of The Engineering Institute of Canada, March 9th, 1939

Introduction

This paper is composed of a condensation of abstracts of a number of scientific papers pertaining to the subject. Nothing is original except the arrangement. The present work is justified only in that it provides a concise but general treatment of this branch of radio science for which there has been some need.

The consistently successful navigation of an aircraft under conditions of limited visibility requires, in addition to the usual blind flying instruments, the provision of:

(a) Means to enable the pilot to guide his aircraft to the vicinity of its destination.

(b) Means to enable the pilot to locate the landing field and to land his aircraft, having reached the vicinity of his destination.

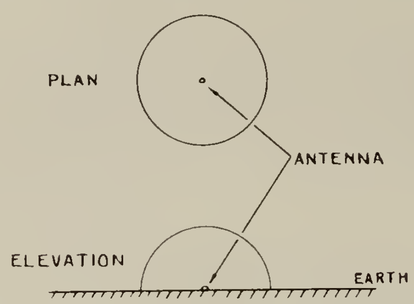


Fig. 1—Space pattern of non-directional antenna

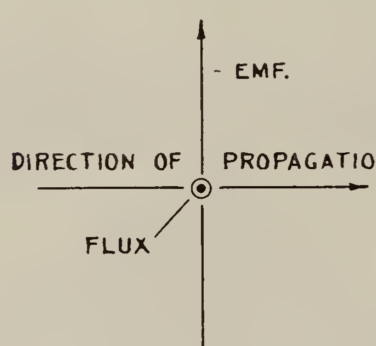


Fig. 2—Radio-wave components

The means of enabling a pilot to reach the vicinity of his destination safely consist essentially of indications of his direction of flight (or course) and of his clearance (vertical separation of the aircraft and the ground). The use of any form of compass and flight by "dead reckoning" is not sufficiently accurate to be dependable, mostly because of the variable cross-winds which are usually encountered. Consequently, use is made of various radio devices to indicate the course or position of the ship. The aneroid altimeter provides a suitable indication of the clearance for most purposes, except blind landing. However, its indication will likely be supplemented with that of a recently developed, terrain-clearance meter, having greater accuracy.

The means of enabling a pilot to successfully and consistently execute blind landings are more complicated. Only in recent years has a reliable method been proposed to satisfy this requirement.

The following pages are devoted to a description of the development and operation of those radio devices which have been or are being used to facilitate aerial navigation. As the loop-antenna forms the basis of most of the devices employed, it is perhaps advantageous to discuss the properties of antennae in general and the characteristics of the loop-antenna in particular before approaching the subject proper.

Antenna Characteristics

An antenna may be defined as a device whose main purpose is to transform high frequency electrical energy into electromagnetic wave energy or vice versa.

Antennae vary in their relative properties. Some are superior to others as regards the efficiency of the transformation. The basis for the comparison of antennae in this respect is termed the effective height.

Signal voltage	=	Field intensity	x	Effective height.
μv	=	$\mu v/m$	x	m
(microvolts)	=	(microvolts/meters)	x	(meters)

Thus, the greater the effective height, the greater the signal received, the field intensity of the incoming signal remaining constant.

All antennae exhibit some directional properties. Some antennae are almost non-directional while others are highly directional. The directional effect of an antenna is described by means of its space pattern, which is formed by plotting the field intensities at points equidistant from the antenna on polar co-ordinates, having the antenna as a centre. In general the space pattern will consist of a three-dimensional surface but it is usually sufficient because of symmetry to use the horizontal and vertical cross-sections of the space pattern to describe the antenna's properties. Thus, the space pattern of an antenna having uniform radiation (non-directional) would be a hemispherical surface and its horizontal and vertical cross-sections, as shown in Fig. 1, would describe it completely:

An electromagnetic wave (radio wave) is composed of two components, a moving electric field and a moving magnetic field, as indicated in Fig. 2. The direction of propagation of the radio wave, the direction of the electric lines of force, and the direction of the magnetic lines of force are mutually perpendicular. Normally the energy of the radio wave is divided equally between the electric and magnetic fields but near transmitting antennae the electric field is more intense than the magnetic field.

All radio waves are polarized, that is, the electric and magnetic fields are in definite planes. By convention, a radio wave is said to be vertically polarized when the lines of the electric field are vertical and those of the magnetic

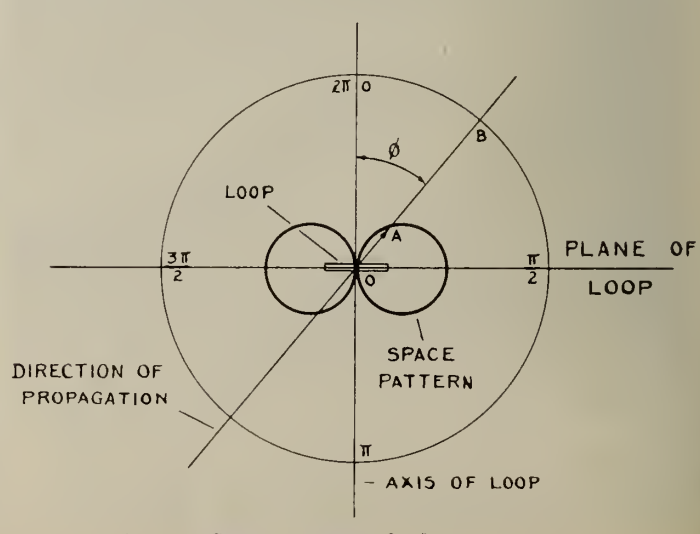
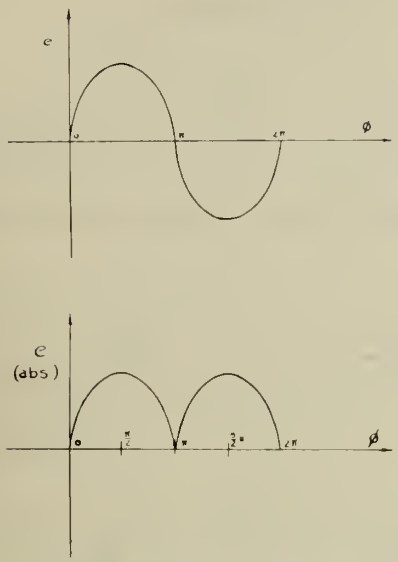


Fig. 3—Space pattern of a loop-antenna

field are horizontal. Similarly, a horizontally polarized wave has horizontal electric lines of force and a vertical magnetic field. Usually a radio wave contains components in both planes of polarization. The vertical members of an antenna radiate and receive vertically polarized waves only. Likewise, the horizontal members radiate and receive horizontally polarized waves only.

In most cases the energy radiated by an antenna follows two paths. Part of the energy follows the earth in what is



Figs. 4a and 4b—Sinusoidal variation of intensity of received signal of a loop-antenna

termed a "ground wave." The remainder angles into the sky as a "sky wave." The sky wave is reflected and refracted back to the earth by the ionosphere, an ionized layer or layers of the stratosphere. The sky wave may have any plane of polarization. The horizontally polarized component of the ground wave is rapidly absorbed by the conductivity of the earth so that the ground wave is vertically polarized. It is the ground wave and not the sky wave, as might be presumed, that is used to assist aerial navigation. The sky wave is only encountered near the antenna or at relatively great distances from it (after reflection back to earth). Consequently, the sky wave need only be considered in these two cases, where its presence is the cause of considerable difficulties.

Most antenna functions are reciprocal, that is, what is true for the transformation from electrical to radio energy (radiation) is likewise true for the transformation from radio into electrical energy (reception). For instance, the space pattern is identical for either radiation or reception.

Signalling by radio is accomplished in two ways. The radio energy may be interrupted by keying to form code characters or it may be modulated with an audio-frequency. In the former case the energy radiated is of one frequency while in the latter case the radiations from the antenna consist of a single-frequency carrier wave and two side bands of frequency.

Loop-antenna Characteristics

The general theoretical characteristics of the loop-antenna, whose dimensions are small compared to the wavelength, are outlined briefly below.

Effective height (maximum).

$$h = 2\pi na/\lambda$$

where $\pi = 3.1416$
n = number of turns
a = area of the loop
λ = wavelength.

Hence, the larger the loop and the more turns, the greater will be the effective height. Also as the wavelength decreases, that is, as the frequency increases, the effective height increases. Compared to other types of antennae, the loop-antenna has a relatively low effective height or in other words it is a relatively inefficient radiator or receiver.

The horizontal cross-section of the space pattern of a loop-antenna for a vertically polarized ground wave is as shown in Fig. 3.

This space pattern is termed the "figure of eight" or "two-tangent-circle" diagram. For radiation of energy from the loop-antenna, the field intensity at any point on the circumference of a circle, having the loop as a centre, is represented by the length of the radius vector of the space pattern in the direction of that point. Thus, the intensity at B would be proportional to OA. Similarly, for the reverse transformation, the signal received in the loop-antenna from radiations originating at any point on the circumference of a circle, having the loop as a centre, is proportional to the radius vector of the space pattern in that direction. For instance, the signal received from B would be represented by OA.

It is evident, therefore, that the intensity of the received signal (or of the radiated field) of a loop-antenna varies sinusoidally with the angle between the axis of the loop and the direction of propagation of the radio wave.

$$e = E.\ \sin\phi$$

where e = intensity at an angle
E = maximum intensity ϕ
ϕ = angle between the axis of the loop and the direction of propagation of the radio wave.

Plotting this on Cartesian co-ordinates the curve, in Fig. 4a, is obtained.

As only the absolute amplitude of the intensity is measurable, the negative alternation is meaningless and the diagram is as shown in Fig. 4b.

However, the sense of the intensity does vary abruptly as ϕ varies through π radians, that is, as the axis of the loop crosses the direction of propagation of the wave and it has been suggested that advantage might be taken of this fact to give a method of bearing determination of greater accuracy than any now in use.

Obviously, the intensity is a maximum when the direction of propagation of the wave is in the plane of the loop and the intensity is a minimum when the axis of the loop coincides with the direction of propagation. Much use is made of these relations to obtain the direction of propagation of the wave and, hence, the bearing of its origin.

Due to the symmetry of the space pattern of the loop-antenna, the sense of the intensity is unobtainable, so that it is impossible by the use of the loop-antenna alone to

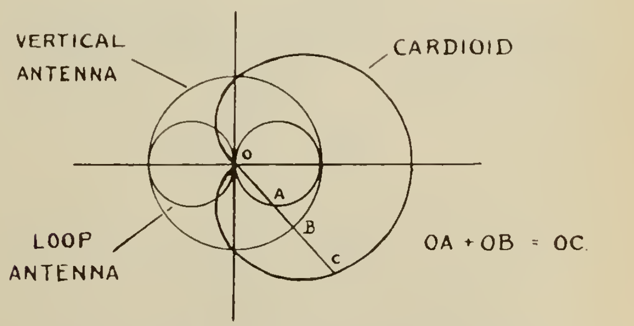


Fig. 5—Effect of adding vertical antenna

determine the sense of the propagation of the radio wave along its direction of propagation. This condition is usually expressed by saying that a loop-antenna has a 180 deg. ambiguity of sense. In most cases the determination of the direction is sufficient, but, where the sense is desirable, the ambiguity is overcome by the addition of a vertical antenna. When the signals or fields of the two antennae (loop and vertical) are superimposed, having due regard for the proper phase relations and amplitudes, a cardioid-shaped space pattern results. (See Fig. 5.) This has but one maximum and one minimum and, hence, the direction and sense of propagation of the wave may be obtained.

The characteristics outlined above are theoretical. The actual characteristics are distorted by the antenna effect (the loop acting as an ordinary antenna because of unbalance to ground) and by conductors (such as aircraft engines, metal wings, fuselages, etc.) in the vicinity of the loop. By grounding the centre of the loop, the antenna effect is reduced to a minimum, and by careful construction the loop may be made to have characteristics closely approaching the theoretical ones. However, it is necessary in many cases to calibrate the loop in order to obtain bearings from it of reasonable accuracy.

Because of its peculiar directive characteristics, the loop-antenna is admirably applicable to direction finding. Unfortunately, the restrictions as to the permissible size of the loop, imposed by the limited space available, the allowable air resistance, and the unwieldiness of a large loop as regards rotation, tend towards small effective heights and relatively inefficient operation. The number of turns depends to a large extent upon the wavelength.

Having treated the major properties of the loop-antenna, it is desirable to trace the development of the methods employing it as a means of obtaining radio bearings before dealing with radio range beacons.

Direction and Position Finding

Direction finding by radio, as applied to aerial navigation, lends itself readily to two main classifications. In one case the determinations are made in the aircraft by the pilot or radio operator through the use of equipment installed in the aircraft for that purpose. In the other method the ground stations make the observations and the bearings or positions are communicated by radio to the aircraft. The former method has the advantage in that the pilot may take a bearing at will but it requires the installation of much equipment on the aircraft. The latter method uses a minimum of equipment on the aircraft but the pilot in times of congestion is required to wait for a bearing.

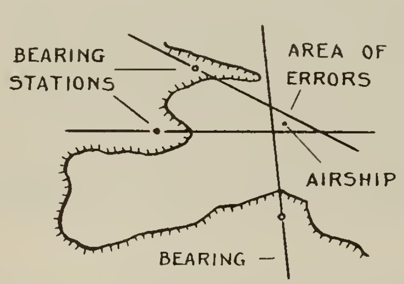


Fig. 6—Triangulation method of position finding

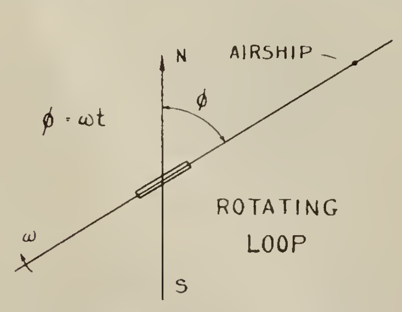


Fig. 7—Rotating loop-antenna beacon

The first system used the directional properties of a loop-antenna to determine two or more bearings. The intersection of the bearings located the aircraft, which method is known as triangulation. Where more than two bearings are available, their intersection does not define a point but rather an area, shown in Fig. 6 and known as the area of errors because it results from errors in the measurements of the bearings. The position is then taken as the centroid of the area, which for three bearings is the intersection of the medians of the triangle of errors.

Next came transmission of directional signals from the ground, using a rotating loop-antenna. This obviated much of the complicated equipment on the aircraft, leaving only

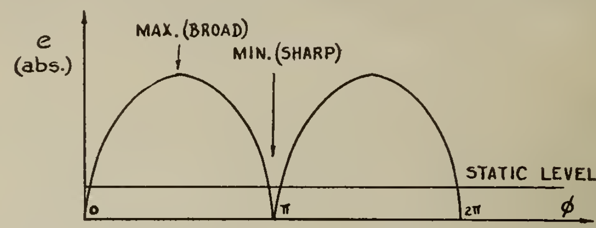


Fig. 8—Directional observation of beacon stations

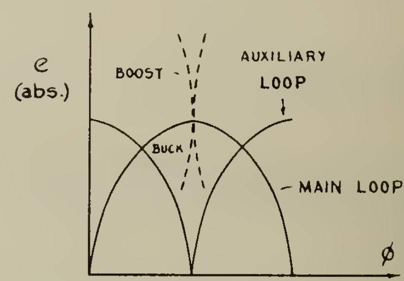


Fig. 9—Robinson method of directional observation

a receiver and transmitter. Each revolution a directional transmission was made to identify the reference direction (usually north and south). Thus, the time elapsed between the directional transmission and the maximum or minimum signal received was a measure of the angle ϕ between the reference directions NS and the bearing as uniform rotation ω of the loop was provided. (See Fig. 7.) This was the principle of the old Telefunken compass in which rotation in steps of 10 deg. was provided by switching of antennae.

Early use was made of a stationary loop-antenna, whose maximum or minimum signal axis was aligned with the desired course of flight. This was the first use of a radio beam to mark an airway.

By mounting a fixed loop on the aircraft, whose minimum signal zone corresponded to the longitudinal axis of the airship, a "homing" device was conceived. When flying directly towards the airport, no signal was received. Any angularity between the aircraft and its course resulted in angularity between the loop-antenna and the direction of propagation of the radio waves, and reception of a signal, indicating an error in the course being flown.

Directional observation of beacon stations by the loop-antenna methods described used either a maximum signal determination, which was difficult due to broadness (lack of sharpness) or a minimum signal method, which was sharp but liable to be submerged by static and engine noises when most needed. (See Fig. 8.) Also, this method of navigation, while it kept the airship pointed at the beacon, permitted drift with cross-winds so that flight was seldom straight.

The next improvement was due to Robinson. Two loops, connected in series, were mounted at right angles. By suitable switching, the signal from one loop could be reversed in polarity so as to buck or boost the signal in the other loop. When the signal in the first loop was a minimum, the difference between the two output signals (bucking or boosting) was a minimum. This method possessed the sharpness of the minimum signal method while it lacked its disadvantage of weak signal reception. It is shown in Fig. 9.

A further improvement was the reception of equisignals from two crossed loops. When the plane of the bisector of the angle between the two loops was in line with the incoming radio wave, the signals from the two loops were equal. (See Fig. 10.)

The equisignal method is more accurate than the Robinson method in that it is easier to match two signals in intensity than it is to determine a minimum signal. Both the Robinson and the equisignal methods have a 90 deg. ambiguity, which can be overcome by taking an additional bearing with a single loop. As will be shown later, the reciprocal of the equisignal method is the equisignal beacon of the radio range.

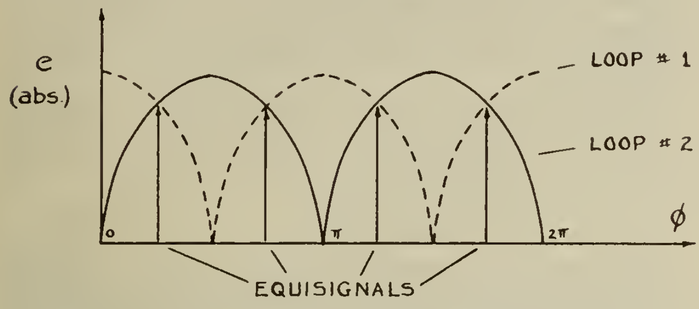


Fig. 10—Equisignal method of directional observation

Then, Bellini and Tosi patented a method of exciting (or receiving with) crossed loop-antennae, using a coupling device known as a goniometer. The device, shown in Fig. 11, incorporated two secondary coils at right angles, one connected to each loop. The primary consisted of a single coil rotor, which enabled variation of the coupling between primary and secondaries. By this means the coupling could be varied from a maximum between one secondary and the primary (corresponding to a minimum coupling between the other secondary and the primary) to a maximum between the other secondary and the primary. Hence, rotation of the primary of the goniometer produced rotation of the fields of the stationary, crossed loop-antennae, which was, in effect, equivalent to rotating a single loop-antenna.

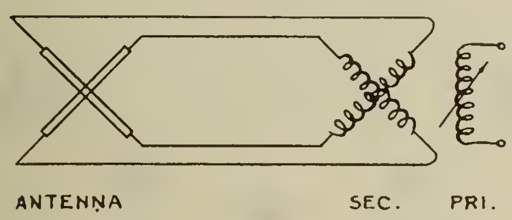


Fig. 11—Bellini-Tosi goniometer method

The addition of a second primary at right angles to the first one, results in the equivalent of the rotation of the fields of two crossed loop-antennae.

Hence, by the use of the goniometer the antennae may be fixed rigidly and permanently, rotation being accomplished, in effect, by the goniometer. This permits the use of large loops where they are feasible, and overcomes the problem of ice "freezing" rotating loops. The goniometer forms an essential part of the modern rotating equisignal beacon and it is also used in most stationary types.

The Radio-range System

The term "radio-range" was formed for convenience in describing the crossed-loop-antenna equisignal radio beacon. This beacon is the reciprocal arrangement of the equisignal method used for direction finding. It is superior to the single loop type in that it is sharp, enables the pilot to counteract drifting, and, if for any reason he gets off his course, he is automatically and continuously informed of the sense of his deviation.

If two, identical, loop-antennae are mounted at right angles and equally excited, their fields will interfere to produce equisignal lines as is evident from their superimposed space patterns. (See Fig. 12.)

The points of intersection, A, B, C and D, of the space patterns are points for which the radius vector (representing the field or signal strength) of one loop is equal to the radius vector of the second loop. Hence, along the directions of the equal vectors, OA, OB, OC and OD, equal field intensities will be present from the crossed loop-antennae so that an antenna located along these directions would receive equal signals from each loop. For this reason, these directions or lines are termed equisignal lines. For identical loops at right angles and equally excited, the equisignal lines coincide with the bisectors of the angles between the loops. The equisignal lines are aligned with the airways by methods to be described later. Then, a pilot is enabled to follow an airway by guiding his aircraft along an equisignal line.

Errors in the determination of the equisignal lines, especially in the matching of the equisignals, result in equisignal zones being obtained, rather than equisignal lines. This is indicated in Fig. 13. The more accurately the equisignals can be matched, the narrower become the equisignal zones.

The first few improvements over the rudimentary radio range were methods of matching the equisignals more easily or more accurately and, thus, of narrowing the equisignal zones.

At first, alternate excitation of the loops was employed, using two transmitters, one exciting each loop. This entailed the comparison of alternate signals which was difficult and inaccurate.

Interlocked Signals

A proposal to modulate the carrier of one loop with one character and the carrier of the other loop with another character in order to facilitate the comparison of the signal strengths was adopted. This method provided the pilot "off course" with an indication of the sense of his error. The idea was extended to the interlocking of the signals, the letter A (• -) being sent over one antenna and N (- •) over the other antenna. In the equisignal zone the letters blended to form one long dash, T (——), as shown in Fig. 14, and anywhere off the equisignal zone an irregular note was obtained. This method narrowed the equisignal zone to a few degrees. It also provided alternate excitation of the antennae from one transmitter, thus eliminating one transmitter and providing a more uniform load upon the remaining one.

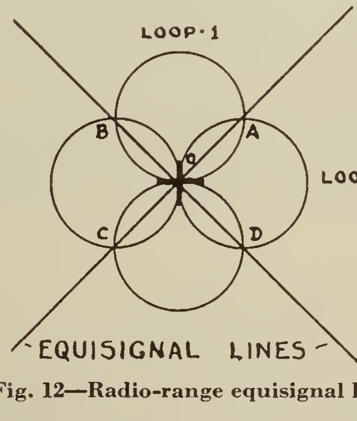


Fig. 12—Radio-range equisignal beacon

The keying must of necessity be done with interlocked cams in order to produce proper interlocking of the characters and their blending into the equisignal.

Double Modulation

In a similar manner, by modulating the carrier of one loop with one low audio-frequency and the carrier of the other loop with another low audio-frequency, and using a tuned-reed device rather than head telephones to provide the necessary indication, a visual method of determining the equisignal is provided. This arrangement is generally referred to as the double modulation type of radio range. One reed of the indicating device is tuned to the first low audio-frequency and the other reed is tuned to the other low audio-frequency. The reeds are excited electromagnetically from the signal output of the receiver, each reed responding only to its particular resonant frequency. On the equisignal zone the reeds will have equal excitation and, hence, equal amplitudes of vibration. They are mounted side by side with their ends exposed to the pilot to facilitate his comparison of their amplitudes of vibration. The result is shown diagrammatically in Fig. 15.

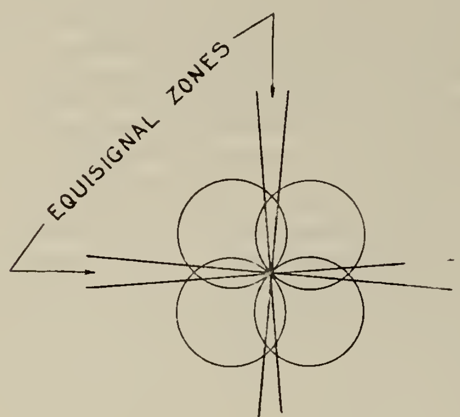


Fig. 13—Equisignal zones of beacon

A modification of the usual vibrating reed indicator was made in order to obtain a course indicator of the pointer type. The vibrations of one reed at one modulation frequency are used to generate, by means of a moving armature, an alternating current in an added coil of the instrument. This alternating current is rectified and applied to one of two moving coils of a zero-centre, pointer-type meter. The other moving coil is excited from the other reed vibrator, operating at the other modulation frequency. When the aircraft is "on course," the vibration amplitudes are equal, the alternating currents produced are equal and, hence, the torques produced by the moving coils are equal. So, as the torques oppose, the resultant torque is zero and the meter is at its centre position, corresponding to an "on course" indication.

The advantage of this modification is in its ability to combine with other instruments, notably the altitude meter used in blind landing, and the turn meter. It is also suited for use as a control for the automatic steering of the aircraft. For this use, the direct-current voltages produced are applied in opposition across the same device and, if they are unequal, their difference produces a current through the device which operates to bring the aircraft back on its course.

AURAL VS. VISUAL SYSTEMS

Comparing the relative advantages of the aural and visual methods, it is evident that:

1. The aural method requires the use of the ears, thus interfering with radio-telephone communication. The visual system relieves the ears of the beacon signals, permitting the simultaneous operation of beacon and communication services. The visual system, on the other hand, requires the addition of another meter to the large number already necessary.

2. The aural method is difficult because of the high noise level of the engines and propellers. There is no similar interference to the visual method indication.

3. The ear is relatively insensitive to differences in sound intensity (the minimum difference detectable being approximately one decibel) so that, where an aural system is used for the matching of signals, there is a tendency to inaccuracy. No similar condition reduces the accuracy of the visual system.

4. The aural system depends upon the ear to differentiate between the beacon signals and the static and external noises. The visual method uses the highly resonant properties of the tuned reed to select the beacon signal from the interference. Hence, the visual method is easier to operate (no strain on the ears) and because of the insusceptibility of the tuned reeds to static, it is more dependable under adverse atmospheric conditions. Visual (reed) indications are obtainable under conditions which submerge aural signals.

5. Using the aural system, the pilot must listen continuously to a monotonous signal or switch the receiver on and off. With the visual system, the beacon indicator is out of the way but available at a glance.

SIMULTANEOUS OPERATION

The increasing use of radio-beacon and radio-telephone services on commercial airways precipitated a need for their simultaneous operation. Formerly, it had been necessary to either retune the receiver to the telephone station or to interrupt the beacon service in order to establish communication with the aircraft, either of which operations resulted in a cessation of the beacon service. The solution was

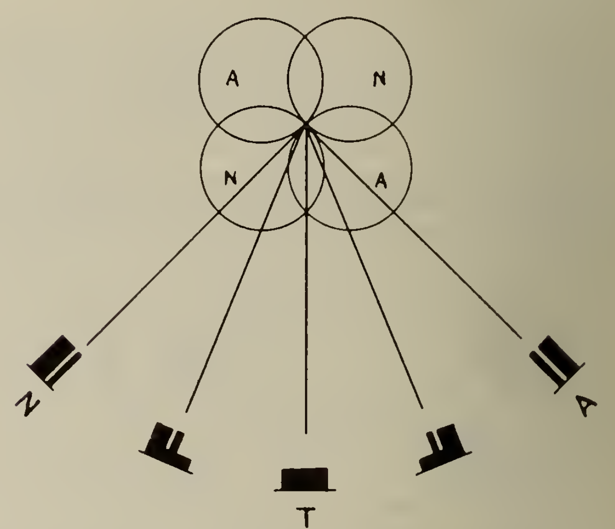


Fig. 14—Interlocked signals giving aural indication of course error

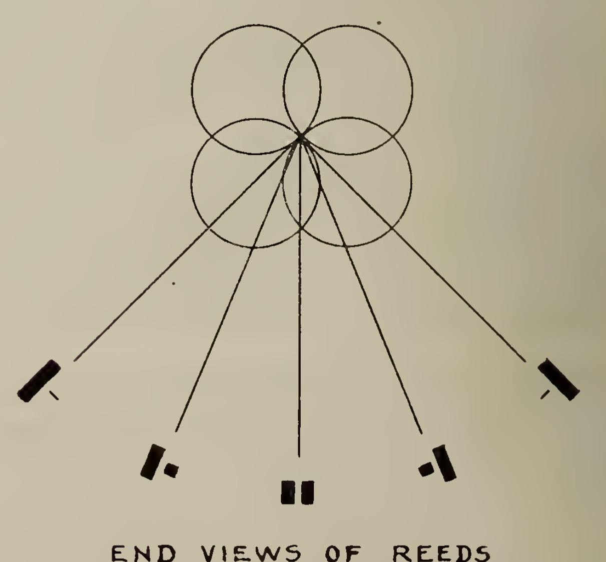


Fig. 15—Vibrating reed method giving visual indication of course error

obviously in their simultaneous operation and, hence, a suitable system was designed to meet the requirements.

One method tested was the double modulation of the beacon carrier waves with both reed and voice frequencies. Superfluous cross modulation and poor efficiency because of the loop-antenna were the main objections.

The recommended method is to suppress the carrier frequency, supplied to the crossed coils, and provide separate excitation, modulated by voice, to an open antenna system, symmetrically disposed to the loops. This eliminates all cross modulation and also provides a simple and effective means of controlling the modulation ratio of voice to reed.

The only change necessary in the receiver to conform to this type of operation is the addition of a filter circuit to eliminate reed-frequency hum in the ear-phones and flutter of the reeds due to the low voice frequencies.

COURSE SHIFTING

The variation of the angularity of the courses, set up by a set of crossed coils, so as to make the equisignal zones conform to the air routes is accomplished in various ways.

The use of the interlocked-signal radio range involves alternate excitation of the antenna-loops so that four variable courses are always obtainable. The use of the double-modulation type of radio range involves the continuous excitation of both antenna coils. Two distinct cases arise. If the loop currents are in phase or in phase-opposition, two fixed courses, 180 deg. apart, are obtained because the fields of the currents in phase-opposition neutralize each other on the other equisignal zones. If the currents in the loops are in quadrature, four variable courses occur.

The variable courses, occurring in either the interlocked signal or double modulation types of radio range, may be shifted in three ways.

As the activation of the receiving device depends upon the percentage of modulation, a reduction of the percentage of modulation will result in a shifting of the beacon course. This is known as the amplitude reduction method. See Fig. 16.

Again, the addition of a vertical antenna and the superimposition of its field upon those of the two antenna coils will, if the current that it carries is in phase with that of one of the loops, augment the field of that loop on one side and oppose it on the other side, thus distorting the resultant field and altering the course relationships, as shown in Fig. 17. This is the same means that is used to overcome the 180 deg. ambiguity of sense of the loop-antenna.

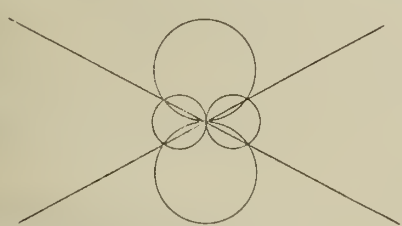


Fig. 16—Shifting of beacon course by amplitude reduction

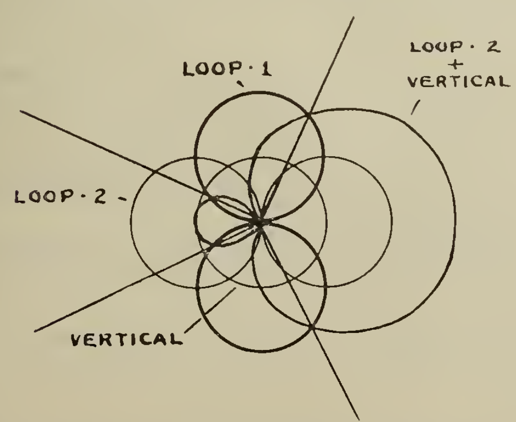


Fig. 17—Shifting of beacon course by addition of vertical antenna

Finally, without changing the field space pattern but by shunting one of the reed vibrators (or other device) its sensitivity is reduced and, hence, the course or path, where the response by the two reeds is the same, will be altered towards the side of the shunted vibrator.

TWELVE COURSE BEACON

The converging of many routes upon one airport required further advances in the application of radio beacons. Figure 18 shows the beacon developed to meet these needs, which yielded twelve courses, all capable of being shifted to alignment with the air routes. Previously four courses were all that were obtainable from a single beacon.

The carrier is fed to three separate modulator-amplifiers, each modulating at a different frequency. Their outputs excite a goniometer primary of three coils, spaced 120 deg. apart, which in turn excite the two loop-antennae through a two coil secondary so that a side-band space pattern, giving twelve equisignal zones, results.

To prevent mutual inductance and cross modulation of the primaries, they are excited in turn by a phase-splitting input circuit. The modulation frequencies are selected so as not to be in harmonic relation, otherwise erroneous indications will be obtained from harmonic response of the reeds.

Orientation of the courses is most easily effected by variation of the primary coil relations but it may also be accomplished by modulation-amplitude-reduction or by a vertical-antenna-addition.

LOCALIZING EFFECT

It is desirable that the pilot should have some indication when he reaches and crosses over the radio-range station.

From the horizontal and vertical cross sections of the space pattern for vertically polarized waves of the crossed-loop-antennae, constituting the radiating device of the radio-range station, it is evident that on the vertical line through the intersection of the loops no field intensity exists. Actually, due to the insensitivity of the system to weak signals, there is a space, resembling an inverted pyramid, over which no signal will be detected. This space is somewhat erroneously termed the "cone of silence." It is actually an inverted, square-based pyramid, having sides concave-outward with spherical curvature, as indicated in Fig. 19. By the use of a vertical antenna (susceptible to vertically polarized waves only) this "cone of silence" will cause a momentary cessation of the signals from the beacon as the airship passes overhead. This is known as the localizing effect.

The cone of silence is a zone in which the horizontally polarized component (if any) of the radiations from the antenna is a maximum. Hence, it is important that the antenna used be insusceptible to horizontally polarized waves, if the cone of silence is to be detected.

NIGHT EFFECTS

Soon after the inception of the radio-range beacon, it was realized that peculiar errors were being experienced in the form of apparent course changes, especially at night and at relatively great distances from the beacon station. This phenomenon was termed the night effect or aeroplane effect. Similar errors had been experienced earlier with direction finding equipment.

Experiments confirmed the theory that the night errors were due to the horizontally polarized component of the sky wave. The variation of the ionosphere was such that the reflected sky wave and, hence, the errors, were only encountered at night.

The use of a receiving antenna (such as the vertical pole or flat T) which was not influenced by that component of the sky wave provided a solution. However, due to a slight twist of the sky wave, during reflection and refraction, even these antennae were affected more or less so that the system was not perfect.

At this time, Adcock proposed a method for the suppression of the horizontally polarized component of the sky wave at its source—the crossed-loop-antenna. As this component was attributable solely to the horizontal portions of the loop-antenna, their removal eliminated the objectionable component. The method suggested by Adcock was the use of a directive antenna-array (which bears his name), consisting of four vertical antennae, one at each of the corners of a square. These antennae take the places of the vertical members of the loops. As shown in Fig. 20, they are excited by a balanced or shielded feeder so that no horizontally polarized radiation can occur.

Arrangements are made so that currents in diagonally opposite antennae are in phase-opposition and those of adjacent antennae are in quadrature, in which case the Adcock antenna has similar properties to the crossed-loop-antenna with regard to vertically polarized waves.

Many modifications of the Adcock antenna have been proposed, all of which deal with the electrical configuration of the feeder system. Almost all types include ground connections in the feeder circuit so that electrical balance and the suppression of radiation of horizontally polarized waves from the feeders depends upon balanced ground resistances. In mountainous regions, where ground resistances are high and tend to be irregular, the loop-antenna is usually employed. Elsewhere, the Adcock antenna has found preference.

MARKER BEACONS

Marker beacons are used to give an indication of progress along an airway or for assistance in blind-landing manoeuvres. They are of much benefit in mountainous territory. Cross bearings can be obtained, where two legs of different range-beacons intersect, but this seldom occurs where an indication is necessary.

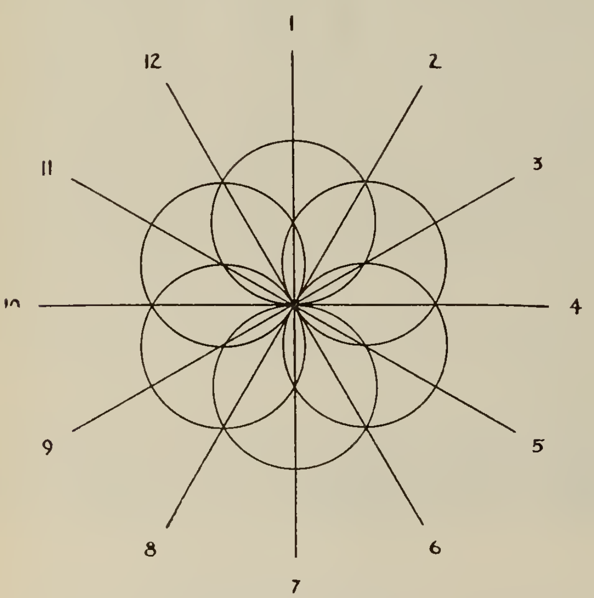


Fig. 18—Course beacon

A marker beacon may be formed of a loop-antenna, with the loop in a horizontal position giving a space of zero signals overhead, or it may consist of a directive array of antennae and reflectors, designed so as to radiate a beam intersecting the airway in the required manner. The horizontal loop type gives a momentary cessation of the signal as the aircraft crosses over the beacon station. The signal from the directed beam is rectified and passed through a saturable-core reactor, which it saturates. The indicator circuit is supplied with alternating current and passes through another winding of the reactor. When the reactor saturates, the alternating current impedance diminishes sufficiently to allow enough current to flow to actuate the indicator.

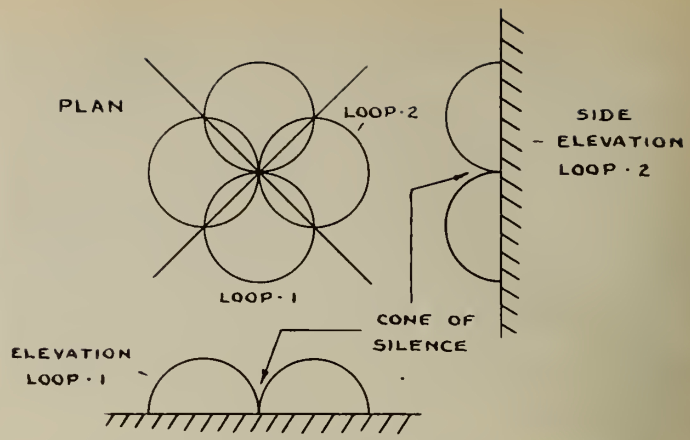


Fig. 19—Cone of silence over radio-range station

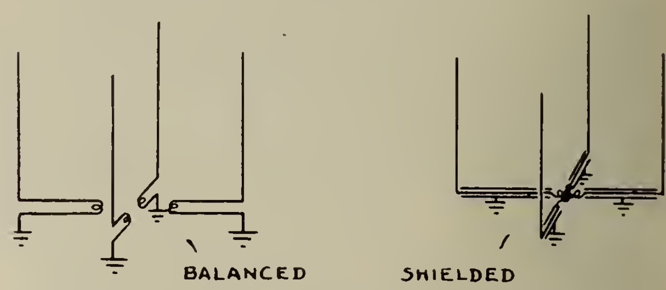


Fig. 20—Arrangements of Adcock antennae to avoid night-effect

Installation Requirements

Some of the most desirable properties of an aircraft radio installation are listed below.

1. Of major importance, the receiver and power supply must be of minimum weight and bulk.
2. Installation should be possible almost anywhere in the aircraft and, consequently, a remote unicontrol tuning system should be used.
3. Due to the rapid motion of the aircraft with respect to the beacon station, an efficient automatic volume control is essential.
4. Interference from the engine ignition system must be reduced to a minimum by shielding all parts of it.
5. Due to continuous vibration, rugged construction is required throughout and all microphonic tendencies of the tubes must be eliminated.
6. The output of the receiver must be ample for the operation of the course indicators of the beacon system.
7. To prevent shocks to the operator, the electrical isolation of the plate battery is desirable.
8. The audio output frequency characteristic must be fairly uniform over the range used (40 to 3,000 cycles per sec.) for satisfactory operation.
9. High sensitivity is required, due to restricted aerial space and the compulsory use of antennae of low effective heights.
10. High selectivity is required to permit the close spacing of channels (frequency bands allotted to the stations).
11. The installation should be made as insusceptible to precipitation static as is possible.

A few of the requirements listed merit further treatment.

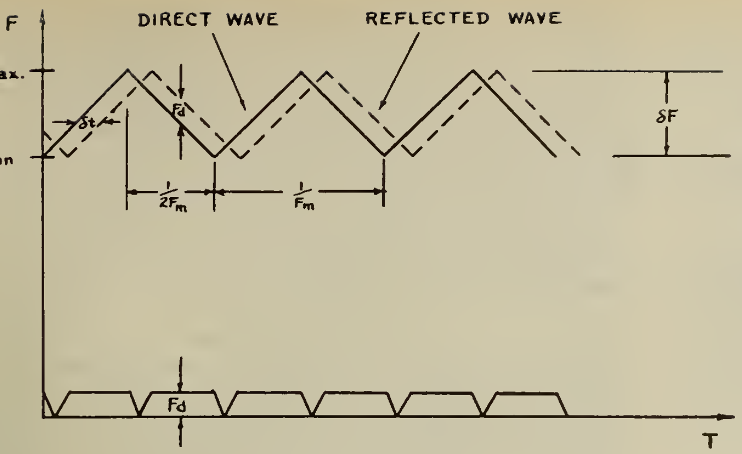


Fig. 21—Terrain-clearance meter

AUTOMATIC VOLUME CONTROL

The great and rapid variation of the distance between an aircraft and its beacon station, and the resultant variation of field strength at the aircraft receiver produced an acute need for an efficient automatic volume control suitable for such a purpose.

The greatest variation in field strength occurs at and close to the beacon transmitter and it is also at this point that the pilot finds himself busily engaged with other urgent matters as he prepares to land. Hence, the elimination of the manual control of the receiver gain was undertaken to ease the task confronting the pilot.

The control operates from the receiver output, a portion of which is rectified and applied as an increment to the grid bias of the radio-frequency stages of the receiver, resulting in fairly constant output for variations of 5,000 to 1, which is about that encountered in practice.

The grid bias, used for automatic volume control, varies with the signal strength which varies with the distance from the transmitter, and hence the bias can be used to operate a rough distance gauge.

The automatic volume control is easily applied to existing receivers and it can be connected through a filter to prevent operation by signals other than those from the beacon, thus permitting simultaneous radio-telephone operation.

IGNITION SHIELDING

The compulsory use of high sensitivity receivers to counterbalance the use of relatively inefficient antennae, required to overcome night errors, made the problem of ignition shielding one of prime importance.

Shielding of the ignition system so as to eliminate radio interference was comparatively simple but to do so in such a manner as not to affect the ignition system adversely proved to be much more difficult.

Requirements of the design were such as to provide the utmost reliability of the engine, to shield the system from water, oil and gasoline and to protect it mechanically from insulation and electrical failure.

Braided copper sleeves were tried first on all wires along with metal covers for the distributor, the spark plugs, switches, etc. This arrangement was frail, prone to short circuits, not waterproof, permitted oil to reach the rubber insulation and destroy it, increased the load on the magneto by greatly increasing the capacity of the system to ground, allowed the leads to whip in the slip stream, caused spark plugs to overheat, and was otherwise unsatisfactory.

To overcome these faults, an aluminum ignition manifold was used, providing for rigidity and strength. The wires were grouped in one conduit wherever possible to reduce the capacity of the shielding. Integral shielding on the spark plugs and magneto with flexible aluminum sleeves, resulted in reliable electrical continuity and insulation protection. Using this system, no ignition interference could be detected with full load gain of the receiver, nor was any impairment to the engine performance noticeable.

PRECIPITATION STATIC

This is a type of interference peculiar to aircraft. It occurs when an aircraft flies through dust, snow, rain, sleet, etc.

Heretofore, precipitation static was thought to result from electrically charged particles hitting the antenna and thereby exciting it. On the contrary, experiments have shown that the body of the aeroplane becomes highly charged, and the charge leaking off the sharp trailing edges of the wings and empennage produces the interference.

One simple cure provided is to trail wires of sufficient length from the airship so that, when the discharge or leakage does occur, it is too far removed from the antenna to influence it. A series resistor is necessary to damp out oscillations and prevent the radio energy from feeding back along the wire to the airship.

Another method makes use of the fact that the electric field in the vicinity of the antenna is stronger than the magnetic field so that by shielding the antenna electrically the majority of the precipitation static is removed but only half of the desired signal is lost. Hence, the signal to noise ratio is increased.

Either method is only partially successful. No completely satisfactory means to eliminate precipitation static is as yet available.

ALTIMETERS

Until recently, the aneroid barometric altimeter was the only satisfactory device available for the indication of the vertical position of an aircraft. Its major disadvantage is in that it refers to the sea level as a datum so that the pilot must know his whereabouts and subtract the elevation of the terrain below in order to obtain his clearance.

Attempts to develop a satisfactory sonic altimeter, similar in principle to the depth meter employed by watercraft, have been unsuccessful mostly because the attenuated sound of the echo is submerged by the noise of the engines and propellers. As approximately two seconds are required for the reflection of a sound echo in air for every thousand feet of altitude, during which time the aircraft would travel forward several hundred feet, it is evident that the sound echo is too slow to provide a suitable indication, even if the echo could be detected.

Endeavours to produce a radio altimeter of the echo type have recently culminated in success. Unlike the slow sound echo, the radio wave returns so fast as to make the measurement of the echo time very difficult. Lately, however, a frequency-modulated, ultra-high-frequency system has been described that measures the echo time through the beat frequency difference between the direct and reflected waves.

Frequency modulation of the ultra-high-frequency oscillator is accomplished by rotating the tuning capacitor with a small electric motor. The output is amplified and fed through a co-axial transmission line to a half-wavelength, dipole antenna, located a quarter wavelength below the wing, from which the energy is radiated downward. A similar dipole is used for reception, located so as to provide minimum coupling between the two antennae, and maximum emission and response to the reflected signal. Due to the difference in the lengths of the paths travelled by the direct and reflected waves, and to the continual variation of the transmitter frequency, there will be a difference of frequency between the direct and reflected waves, which depends directly upon the height of the aircraft above the ground. The direct and reflected waves are received and demodulated to obtain the beat frequency difference, which is measured by a suitable instrument, the indications of which represent the clearance of the aircraft above the ground.

The operation of the terrain-clearance meter is shown diagrammatically in Fig. 21.

H = aircraft height or clearance.

c = velocity of propagation of radio waves.

$\delta t = 2H/c$ = time difference between the direct and reflected waves.

F_m = modulation frequency.

δF = frequency swing of transmitter.

Then, $2.\delta F.\ F_m$ = rate of change of transmitter frequency.

If F_d = beat frequency difference in the receiver

$= 2H/c \times 2.\delta F.F_m = 4.\delta F.F_m.H/c.$

If the rate of change of the transmitter frequency, $2.\delta F.F_m$ is maintained constant, then the beat frequency F_d will depend directly upon the clearance, as c is a constant.

In the figure F_d has been exaggerated in magnitude for the sake of clarity. It is actually only a few cycles in several hundred millions.

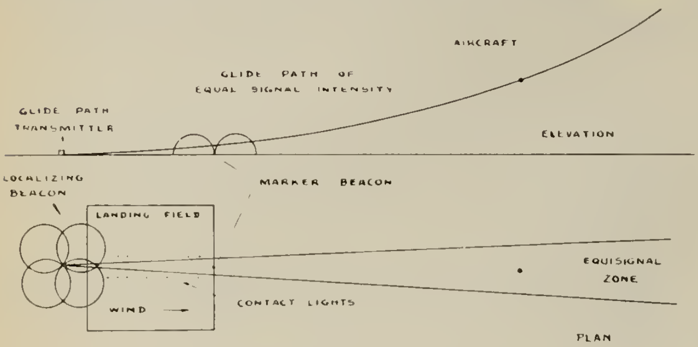


Fig. 22—System of blind landing

Letting F_s be the number of cycles of the frequency F_d, occurring in one sweep of the oscillator frequency, that is, in time $\frac{1}{2}F._m$, then,

$F_s = F_d/2.F_m = 2.\delta F.H/c$

$F_d = 2.F_s.F_m$

Because F_d drops to zero with each sweep of the oscillator frequency, the frequency meter will indicate a frequency $2.F_m$, even though F_s may be less than unity, that is, only a fraction of a cycle. Hence, the minimum detectable clearance occurs when $F_s = 1$ and obviously, if H is to be small, δF must be large as c is constant. For a minimum clearance of twenty feet, the oscillator frequency must swing through 25 megacycles.

For high antenna efficiency the percentage frequency modulation must be small. Hence, an average frequency of several hundred megacycles per second is necessary. Fortunately, such a frequency entails the use of small antennae, having little drag, weight and space.

The radiation from the dipole antenna is nearly hemispherical so that banking has little effect upon the indication and some advance indication of obstacles is provided.

Blind Landing

In addition to the usual radio-range beacon service and other blind-flying aids, such as the compass, artificial horizon, etc., some means of continuously indicating to the pilot his three-dimensional position in space relative to the field as he approaches and prepares to land is required in order to execute blind landings successfully.

The position of the aircraft with respect to the field entails the knowledge of its lateral position with respect to the runway upon which it is to land, its distance from the field (approach) and its elevation (clearance).

The problem of lateral position is identical with that of course position on air routes, so that the use of a small equisignal beacon of low power, whose course coincides with the wind direction, enables the pilot to locate the runway direction and follow the beam up wind right onto the field. Fortunately, this method entails no additional apparatus on the aircraft as the same receiver suffices for both beacons. The localizing beacon must be readjusted frequently for wind direction so that its transmitter is usually mounted upon a vehicle, or else several fixed transmitters are used, each set for a different direction.

The distance from the field or approach is more difficult to obtain but, fortunately, the use of a landing beam, to be discussed later, obviates the need for continuous indication of this dimension. Two indications are provided, however. The automatic volume control, made necessary for satisfactory beacon operation by the rapid rate of change of field strength near the beacon transmitter, produces a direct-current voltage inversely proportional to the separation of the transmitter and receiver, which may be used to operate a rough distance gauge. The other and more important indication is that of a boundary marker, giving the pilot a last minute warning that he is over the field and about to land. The marker beacon works through a loop-antenna, whose minimum field zone coincides with the boundary, and operates a tuned reed, whose vibrations cease momentarily as the boundary is crossed. A filter must be provided in the receiver so that the marker beacon will not operate the automatic volume control, otherwise the marker beacon cannot be detected. The present tendency is to provide a second marker beacon in the centre of the field to warn the pilot that he is about to overshoot the field.

Indication of the altitude is given by the ingenious use of an inclined ultra-high-frequency beam. Corresponding to this, a high-frequency receiver is required, the output of which is filtered, rectified and applied to a microammeter. Equal field intensities will then produce equal meter indications, so with the aid of this meter the pilot can follow a course of equal field intensity of the beam below its central axis. The beam is designed so that the path of equal field intensity and the path followed normally are congruent and it is aimed and adjusted so that the constant field intensity path is well clear of all flying hazards. These arrangements are indicated in Fig. 22.

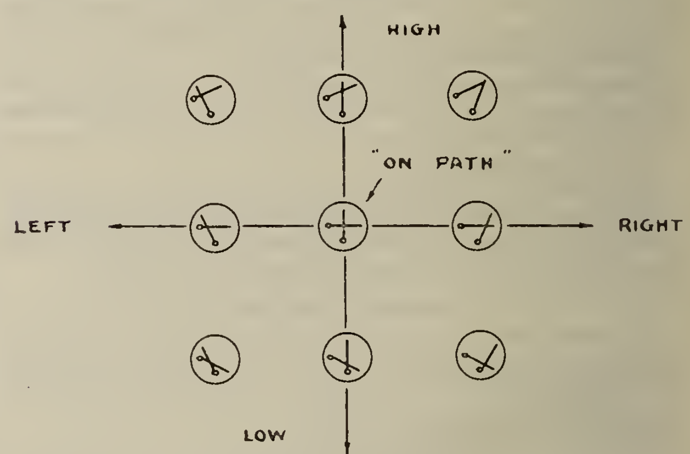


Fig. 23—Path-meter indications

By use of the localizing beacon and landing beam in conjunction with each other, the pilot is enabled to follow a definite path in space, terminating near the centre of the field. As he crosses the boundary of the field, the marker signal warns him that he is over the field and about to land. Except in rare cases, he will then be able to see the field. When zero visibility prevails, the use of contact lights has been suggested to assist the pilot in landing. These lights are spaced along the edges of the runway at frequent intervals.

The joint use of localizing beacons and landing beams has made desirable the combination of their indicators into one combined unit, known as a path meter, showing both lateral and vertical position of the glide path. (See Fig. 23.) This necessitated the design of a pointer-type meter for the radio range. The combination eliminated one more of the group of meters that a pilot is required to watch, and thus made for more efficient operation.

The advantages of this system include:

The use of a predetermined path, free from obstacles, for approaching the field.

There are only slight changes necessary in the aircraft receiving equipment.

No adjustments by the operator are necessary as all variations are automatically compensated. Thus the pilot is left free to concentrate upon controlling his aircraft.

The descent of the landing path is such that the speed of the aircraft is slightly higher than that normally used for landing, thus a higher factor of safety is employed.

The curvature of the landing path decreases as it approaches the field, corresponding to an actual landing.

The landing beam may be contacted over a wide range of altitudes.

Present Status

The development of radio aids to aerial navigation has now progressed to the stage where the consistently successful navigation of an aircraft under conditions of limited visibility is quite possible. However, still further development is necessary before the system can be said to be absolutely reliable.

Blind landing is not yet entirely dependable, despite the rapid advances that have been made. The difficulty at present is with the final landing manoeuvre. Landing is the most difficult operation to perform because of the great accuracy required, and it is the most dangerous manoeuvre to execute because of the close proximity to the ground. The blind landing aids outlined heretofore are not sufficient to enable the pilot to make good landings so that some suitable indication for this purpose is required. At present, the tendency is towards the use of contact lights, spaced along the edges of the runway. These lights become visible to the pilot, despite poor visibility, in sufficient time for him to "flatten-out" and land his aircraft.

The radio range beacon is finding a suitable application to the marking of airways of relatively great distances, such as are encountered in North America and Australia. However, in Europe, where airways are many and relatively short, the rotating beacon or loop direction finders are superior because of their greater flexibility.

Ordinary radio ranges are long wave but for transoceanic routes short waves are employed.

The aural system of range beacon reception is still favoured but further congestion will probably result in greater use of the visual system.

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THE INSPECTION OF OIL REFINERY EQUIPMENT

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Paper presented before the Border Cities Branch of The Engineering Institute of Canada, May 20th, 1939

SUMMARY—The author discusses the procedure in inspecting equipment worked at high pressures and temperatures to ensure safe working stress and detect weakening or embrittlement. Methods of protection against corrosion and erosion are described, and notes given on fire protection.

In the oil refining industry today, the equipment carries pressures and temperatures which are much higher than those encountered in every day steam plant operations. These severe conditions necessitate rigid inspection by qualified engineers who are familiar with the peculiar conditions of the industry and whose duty it is to maintain the equipment in a safe and economical condition to comply with Government codes and good engineering practice.

Safety records in the petroleum refining industry disclose, over the last decade, a marked decline in the rate of accidents and fatalities. This is a fact of great importance, as fewer accidents mean a reduction in loss of equipment and production through forced shut-downs as well as loss of employment because of disablement.

Safety in operation begins with safety in design and in Canada all pressure vessels are designed to the requirements of the Canadian Inter-Provincial Code. This code, however, does not cover vessels in high temperature and high pressure service, nor large welded pressure vessels; these are constructed in accordance with the American Society of Mechanical Engineers Code, which is acceptable to the provincial governments.

It is general practice in the oil refining industry to add a liberal allowance to the required code thicknesses of pressure equipment to provide for corrosion or erosion in service.

Some of the many metals and alloys now available to the designer have great advantages to recommend them, such as greater strength at elevated temperatures, but their particular disadvantages must not be lost sight of before selection. When corrosion problems arise, valuable data can often be obtained by installing samples of various metals in the equipment, in this way finding out which one is most suitable for the conditions of the particular process in question.

Design Factors

For pressure service at temperatures below 700 deg., a thickness of vessel is required which will give a factor of safety of four. This safety factor is based on the ultimate tensile strength of the metal and the inspection department maintains such vessels at the required factor of safety. Should metal loss occur which would reduce the safety factor below four, the vessel is either condemned for this particular service or a recommendation is made to reduce the safety valve setting.

In pressure service above 700 deg., it is necessary to base the design and thickness of the material on a factor other than a quarter of the ultimate strength. Steel possesses the property of slowly stretching when subjected to pressure at high temperature, this property being termed "creep." Creep becomes of increasing importance as the temperature of the stressed metal rises above 700 deg. because of the progressively lower stresses necessary to produce a given amount of creep as the temperature increases. The problem of vessel design, therefore, for elevated temperatures, requires the determination of a safe allowable stress. The stresses required to produce creep are far below the short time ultimate strength of the cold metal, being of the order of one-fifth at 800 deg., and becoming a lower proportion as the temperature rises. All authorities are not agreed on actual creep stresses at different temperature ranges, but safe values have been laid down which are used in vessel design and maintenance, and are based on research and practical experience.

Some of the stainless steel alloys have a high creep value at elevated temperatures, but their high initial cost and embrittlement properties at low temperatures are against their use, except in extreme cases. They are used extensively in some American refineries where the crudes being processed are high in sulphur and possess corrosive properties.

After the properly designed equipment has been approved and tested by the Government Inspection Department, its further inspection and maintenance in operation comes under the refinery engineering inspection service.

Protection Against Corrosion

Where there is a possibility of metal thickness being lost in the processing operations through erosion, electrolysis or corrosion, it is good practice to protect the metal surfaces against such loss. There are several methods adopted to give protection, and, while none of them gives

Fig. 1—Section of heavy walled tube which has been overheated, bulged and split

complete protection, they very considerably reduce the rate of loss. From past experience in refining operation, the parts of equipment where such protection has been beneficial are generally known and protective linings are installed when new units are built. The most common and successful lining used in our Canadian refineries is made up of a two-inch layer of cement laid over expanded reinforcing metal. This metal is held to clips welded to the vessel surface at nine-inch intervals. For successful laying and bonding of cement linings, it is very necessary to have clean, sand-blasted, metallic surfaces and operators experienced in this work. Such operators know the proper consistency of cement to deposit through the special air gun. Care has to be exercised that too much water does not pass through the gun nozzle which might wash away cement already deposited and also cause slumping. The mix used is 1:1 and a uniform temperature should be maintained above freezing point for best results. Curing of linings for 48 hours with low pressure exhaust steam has proved to be beneficial. Another advantage that cement linings have in high temperature vessels is that they act as a heat-insulator between the high temperature vapour or liquid and the metal of the vessel. Metal temperatures may thus be reduced 50 deg. to 100 deg., thereby allowing a higher permissible stress in the metal than if no lining was installed.

Another method of protecting interior metal surfaces in pressure process equipment consists of welding light alloy plates over the surface to be protected. This method is not used in our Canadian refineries, but has been tried in the United States. Considerable trouble is experienced with metallic liners cracking and bulging due to the difference in expansion between the liner and the vessel metal at high temperatures. This can only be overcome by plug welding at very close pitch, which requires ¾ in. diameter plug welds pitched at 2 in. The laying of metallic liners over irregular surfaces, like rivet heads and inside butt straps, and in drums where there is a lot of internal equipment such as in fractionating towers, involves considerable labour and expense. A method adopted by an American plant to weld metallic linings inside a reaction chamber makes use of square plates welded to the drum and having circular corrugations. The corrugations were intended to take care of expansion differences. Metallic liners generally collapse badly after cracking, as coke builds up behind them and bulges them from the vessel they are put in to protect. Tees and fittings can be protected successfully against wear by installing thin stainless steel tubing in the runs and rolling and welding in place.

Another method of protecting metal surfaces is by metallizing. This involves sandblasting and roughening the surface to be protected and then spraying a coating of protecting metal over it.

Cracking Units and Tubes

Proceeding to the consideration of some of the equipment and conditions met with in a modern cracking unit where the temperature and pressure conditions are generally the highest in the refinery, the oil is pumped at a pressure of 1,300 lb. per sq. in. and a temperature of 600 deg. F. to a tubular furnace for further heating. This furnace may be made up of a brick setting 25 ft. by 80 ft. and having over a hundred tubes 5 in. outside diameter and with a wall thickness of ⅞ inch.

Tubes are rolled into headers, each header taking the outlet end of one tube and the inlet end of the next tube in circuit. As the oil flows from the lower temperature end of the furnace to the outlet end, its temperature is raised to 900 or 950 deg. at a pressure of 1,000 lb. per sq. inch. Tube metal temperatures recorded from various tubes in the furnace range from 1,050 deg. ot 1,150 deg. at the outer skin and have a calculated temperature drop of 35 to 40 deg. at the inside fibres. While considering these temperatures and the 1,000 lb. pressure, it may be mentioned that steel shows a red heat visible in sunlight at 1,070 deg. F., so the severe conditions under which these furnace tubes function can be appreciated.

For inspection purposes, all tubes are gauged internally at five places and their diameters recorded. Similar readings are taken every few months so that the rate of wear and the life of the tubes can be determined. Limits of thicknesses for different zones are set and tubes are renewed at these limits which are based on safe creep stress.

The tubes are secured into the headers by rolling and inspection of this part of tube is necessary to ensure that the heavy wall has been flowed into the header serrations. Insufficient rolling and flaring may cause the tube to pull out of the header in operation, with disastrous results. As there is considerable turbulence set up in return headers due to change of direction of oil flow, appreciable wear in header boxes occurs, and they must be carefully gauged and protected with cement if their shape is suitable.

Headers also require careful inspection for casting shrinkage cracks which may progress to dangerous limits under repeated heating and cooling in service.

Inspection of tubes on the firing side is necessary to reveal bulging through overheating. In service a considerable amount of coke is deposited on the oil side of tubes, which raises the metal temperature, so that great care is necessary by the operators to prevent bulging and splitting.

Tube metal temperature recorders show the temperatures of outsides of tubes; when a limit of 1,200 deg. is reached, the unit is taken out of service for cleaning and inspection. Experience generally indicates where overheating of tubes has occurred. An outside calliper reading showing an increase of diameter of 2.5 per cent or greater, or considerable checking of the tube metal, generally warrants tube renewal. Bulging and failure of tubes occurs when metal temperatures are such as to cause a high rate of creep under the imposed stresses. Figure 1 shows a section of heavy-walled tube which has been overheated bulged and split.

Inspection of setting brickwork, arch and tube supporting walls is also made at the time of outside tube inspection. These settings have suitable permanent connections for releasing steam to setting in the event of fire from tube failure. This can be controlled by valves at a safe distance from the setting.

The average rupture in a tube from overheating may be four or five inches in length with a maximum opening of one-half in. to three-quarter inch. One of the disadvantages of the 18 per cent chromium eight per cent nickel alloy tubes is that, in failing, they generally open right up for a considerable distance, causing a setting fire of grave proportions and very often burning other adjacent tubes. It is also necessary to sandblast and examine them for cracks twice a year. The four-sixths per cent chrome molybdenum alloy tubes have characteristics of failure similar to the carbon steel which are not generally too serious. Settings are fitted with explosion doors to release any undue pressure in the setting without damaging walls.

Soaking Drums

After being heated in the tubular furnace the oil passes through a transfer line and fittings to a reaction chamber known as a soaking drum. This vessel may be five ft. in dia. by 35 ft. long and requires a wall thickness of 6¼ in. to withstand the pressure of 1,000 lb. and temperature of over 900 deg.

At manufacture, each of these drums was shaped out of a billet weighing 480,000 lb. and after shaping, cropping and machining, the finished weight was about 250,000 lb. They are of forged seamless construction with conical heads at each end and with flanged manheads.

They are generally protected with cement linings which, as already mentioned, have a good insulating value. Permissible safety valve settings, however, are generally governed by the temperature of the oil in the vessel as the metal temperature is assumed to be the same as the oil temperature, and a safe creep stress at this temperature is used in computing allowable pressure.

The method of determining any metal loss in these heavy walled vessels consists in drilling shallow holes and keeping records of their depths. Any wear or metal loss shows a reduction in depth of these test holes as they are plugged between inspections to protect the bottoms. The original shop thicknesses of the drums were taken at two ft. intervals on two axes, so a complete knowledge of any reduced wall thickness at different locations can be readily determined. Definite thicknesses can also be checked by stretching a piano wire vertically through the centre of the drum and a parallel wire on the outside at a known distance apart. At any distance down from the top flange, the sum of the distances between the wire and drum metal, subtracted from the distance the wires are apart, will give the thickness at the point under consideration.

Inspection consists of checking and recording test holes and examining the lining for wear and having repairs made to it if necessary. Condition of nozzle attachments to drum is noted and periodically the protective lining is removed and the metal surface is sandblasted and examined to ensure it is in good condition. The safety valve is set at 1,100 lb. per sq. in. to permit an operating pressure of 1,000 lb. and the strength of the vessel is computed on the safety valve setting.

Pressure Drums

The remaining pressure vessels in cracking units are in lower pressure service, viz., about 125 lb. per sq. inch. They are mostly of rivetted construction and vary in size from three to ten feet in diameter and six to forty feet in length. Careful internal inspection is carried out and any unusual conditions noted and remedied. Rivetted seams and plating are examined for any signs of wear or distress and the points of vapour impingement tested for loss of metal. Test holes drilled at strategic locations and plugged with screwed removable plugs are measured and recorded at each inspection period and a check kept of the safety valve setting in conjunction with the metal thickness and the required factor of safety. A knowledge of the correct layout of any internal equipment in the pressure vessels is necessary so that any displacement may be noted by the inspector and rectified.

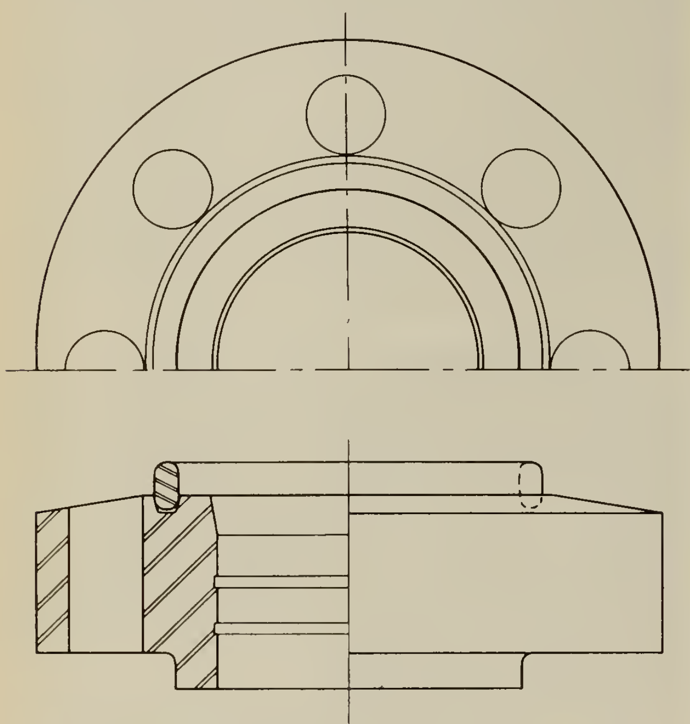

Fig. 2—Ring joint for high temperature and high pressure line flanges

Safety Valves

One of the principal means of defence against overstressing of refinery equipment, and one which is given great care and inspection, is the safety valve. All safety valves are removed for testing and overhaul at set intervals. Those in the higher pressure and temperature zones are given this maintenance more frequently. Discharge outlets from high pressure safety valves are led to stacks having inside water sprays. Lower pressure discharges are led to water sealed blow-down drums or boxes. It may be mentioned that safety valves in cracking equipment are set at pressures ranging up to 1,700 lb. per sq. inch.

Lines and Fittings

Lines, fittings and valves require careful inspection and maintenance. With high oil and vapour velocities and some corrosion, it is necessary to dismantle this equipment periodically to take calliper readings of inside diameters and to hammer-test expansion bends. At such bends it is sometimes advisable to drill test holes to determine the condition at the outside radius where impingement occurs. In large vapour lines this method of drill testing and plugging with removable plugs for a future check up at the same points is used, as these lines are often difficult to dismantle without erecting elaborate scaffolding, and the test hole method indicates when they are nearing their allowable limits, at which time a more thorough inspection by dismantling is necessary. It is important that screwed plugs be cut off flush with the inside pipe surface because coke will build up on a projection and such coke will prevent loss of metal at the point where gauging is made, thus misrepresenting the true thickness of the adjacent material.

A system adopted by some refineries for protecting piping consists of drilling a number of three-sixteenth in. diameter holes with a sharp pointed drill on the outside of pipe to a depth equal to the pre-determined limiting thickness of the pipe. About three or four such holes are drilled per foot spirally. When deterioration thins the pipe to the limit, a small leak develops at the point of the holes, which serves as a warning. This system must only be regarded as an additional safeguard and must not be considered as a substitute for rigid inspection. A high factor of safety is set when determining the limiting thicknesses of piping to take care of any expansion or other severe stresses during operation.

In the high pressure and temperature lines connecting the heating furnace and pressure drums, joints are made of flanges of the ring joint type, as shown in Fig. 2. The flanges are of heavy construction with a V groove inside the bolt holes, to take the steel gasket ring. This ring is elliptical in cross section and, when in position, the major axis lies parallel to the centre line of pipe. The flanges are pulled together lightly when cold and in this position have about one-eighth in. clearance between faces, due to depth of the rings. When the temperature is raised, the expansion of the joint ring forces the flanges against the securing stud bolts and they have proved to be a sound and tight joint under severe conditions. Considerable wear has been experienced at the faces of these flanges inside the rings, but this has been overcome by machining out to a depth of one-half in. and welding up with one-eighth stainless steel welding rod and afterwards machining. Considering the amount of coke in the vicinity when these flanges are dismantled and reassembled, and the high pressures and temperatures in the lines, they have been remarkably successful. High stresses are set up in the stud bolts and they must be made of a high tensile strength material. Rigid inspection of stud bolts in such service is necessary because continual dismantling and reassembling of lines for cleaning purposes causes considerable wear on threads, and bolt failure would be most undesirable. It is common practice to renew at set intervals, all small piping nipples adjoining pressure drums, such as gauge and steam connections, as experience shows that fatiguing of such small piping rigidly fastened at the drum can occur from vibrations transmitted through pump discharge lines, etc. Failure of such small connections can cause very serious destruction.

Heat Exchangers

Heat exchangers are largely used in all refinery plants for utilizing heat, which would otherwise be lost, to preheat the oil in processing. They consist of shells having tube bundles through which the oil is pumped and having vapour passing over the outside which is to be cooled. Some wear on the vapour sides of tubes and shells occurs and the inspection periods the tube bundles have to be withdrawn and callipered for wear. Test holes are drilled in the shells and a check is kept of any wear, and recommendations made regarding allowable pressures to be carried. Severe wear of tubes requires a knowledge of the particular causes of the wear and it is often good economy to change to a more resistant tube metal.

Insulation

All pressure vessels and piping in high temperature service are insulated for the two-fold purpose of preventing heat loss and for protection of the equipment in event of fire, and the maintenance of such insulation falls under the general supervision of the Inspection Department. The insulation of structural steel supports of pressure equipment is another important item to be watched, as their overheating during a fire might have disastrous consequences.

Pumps

During the inspection periods, pumps throughout the units are opened for overhaul and necessary repairs, and any unusual condition is noted and remedied. This overhaul includes the testing and repairing, when necessary, of pump relief valves.

Gauges

At these inspections it is also general practice to remove all pressure gauges for test and calibration. This work is supervised by the Inspector, as accurate gauges for recording pressures are very necessary in operation.

Low Pressure Equipment

The procedure outlined for the inspection of high pressure and temperature equipment applies in a lesser degree to the lower pressure process units throughout the refinery. It is found that other factors may enter into the inspection of this equipment which do not apply to the high pressure and temperature units. For instance, large cylindrical stills for treating crude oil at atmospheric pressure require only a very limited thickness of plate to satisfy the common engineering formula for the pressure and size of vessel, but limits must be set which will maintain the rigidity of the vessel while filled with crude for processing. The peculiar conditions of the process involved must be taken into consideration by the efficient inspector in determining what is safe practice for the particular piece of equipment being inspected.

Plate Blistering

At the inspection of steel vessels in low temperature service at plants handling low temperature gases and products, occasional blistering of plates has been observed in the vessels. On submitting samples of blistered plate for analysis, an interesting explanation was suggested by the metallurgical department of the refinery. It is that a light acid attack on the surface of the plate produces nascent hydrogen; the steel can absorb this hydrogen in the nascent state. When the atomic hydrogen reaches any discontinuities in the steel, such as slag inclusions, it changes to the molecular state and is then unable to pass through or be absorbed into the steel. When this happens, high pressures are built up in the discontinuities, rupturing of the plate occurs along the plane of weakness and blisters are formed. All carbon steel plate has some slag inclusion. Plate steel which is quite acceptable under any commercial specification may have enough small slag inclusions, sufficiently close together, to permit blistering to occur.

The absorption of atomic hydrogen into the steel causes embrittlement while the hydrogen is retained in the steel. This is purely a mechanical action. Under suitable conditions, the hydrogen will be released from the steel and the steel will then regain its original ductile properties. This release of atomic hydrogen from the steel usually takes place within a few hours after the metal is exposed to normal atmospheric conditions, and is accelerated by heating to any higher temperature.

Since the formation of blisters occurs while the absorbed hydrogen is in the steel, these blisters are quite liable to have cracks formed in them due to the embrittled condition of the metal. Also, while this type of damage is occurring, it is probable that all of the metal in the vessel, at or near the locations of such injury, contains absorbed hydrogen and has become embrittled. It is often necessary to remove and replace such defective plating.

In actual service it has been found that concrete liners similar to those installed for protection against corrosion have been effective in preventing the acid attack and penetration of the metal. In one refinery, some of the lower sections of drums were cemented for protection against metal loss. Immediately above the lining, blistering occurred, while the cemented areas remained free from this condition.

Storage Tanks

Storage tanks are given periodic inspection to ensure their being maintained in a safe condition. After being cleaned out and made gas free, all internal plating, rivetting and structural supports are examined and any necessary repairs made. If any doubt exists about the thickness of plating in tanks, this is drill tested and calculations made to determine the stresses from static head of liquid to be carried in storage. In such computations, a high factor of safety is carried so that the stresses in the material will be kept below a safe limit.

Fire Equipment

Another important part of an oil refinery plant, coming under the critical eye of the Inspection Department, is the fire protection equipment. A considerable sum is generally invested in fire fighting equipment in a refinery and unless it is in a condition to function quickly and efficiently when needed, the investment would be a poor one. The main protection given consists of a wet foam system piped to all process units and to all storage tanks in light products service. The wet foam solutions are kept in tanks next to suitable pumps and a central control manifold is provided, so that from this location the foam can be pumped to a particular area while blanking off all other sections of the plant. Lesser protection for smaller fires consists of 40-gallon fire extinguishers mounted on wheels, dry foam generators with the necessary powder mounted on a trailer which can be pulled to any location where water is available, steam connections to particular buildings or tanks which are considered a hazard and which have remote control valves, and various types of hand extinguishers, pails of sand and blankets.

Annually all of this equipment is tested by an inspector to determine how well it has been maintained, and if additions to the plant during the year have been given the protection necessary. A check is also made of the training of personnel in the handling of the fire protection apparatus and the whole equipment is discussed with the refinery supervision with a view to modernizing any obsolete types.

Conclusion

From the foregoing it will be realized how essential the inspection of refinery equipment becomes when the varying conditions throughout the plant are considered.

In conclusion, it may be stated that experience shows the necessity of looking after the small equipment in the large units. The keeping of careful records of conditions found and measurements taken, to be checked against similar records at subsequent inspections, involves considerable work but has proved to be a satisfactory method of knowing the actual metal conditions and generally enables necessary repairs to be anticipated, besides achieving the prime purpose of refinery inspection, viz., safety.

Abstracts of Current Literature

Contributed articles based on current periodicals, papers and events

A.R.P. IN GREAT BRITAIN

The power and speed of present-day fighting aircraft have completely changed the problems of defence in the British Isles. Under conditions now existing, not only the combatant forces and the industries upon which they depend, but also practically the whole civilian population, are liable to sustain casualties in air-raids of which only a few minutes warning can be given, and in which serious damage may be done to the utility services—such as transportation, sanitation, the supply of food, water and electricity—which are essential to life in a modern city.

The necessity of civilian defence against enemy action from the air was realized, and planning was commenced by the government, three years ago. The resulting Civil Defence organization, decentralized as far as possible, but co-ordinated under the Minister of Civil Defence, directs the activities of some two million men and women who have volunteered their services in various capacities. The purpose of this system of Air Raid Protection—commonly referred to as "A.R.P."—is the maintenance of the life of the country in face of every attempt of the enemy to disorganize it. For the public, A.R.P. in peace time was a voluntary system, developed by the government by pamphlet, broadcast and practical experiment; these educational measures did much to inform each member of the public as to the duty for which he or she is fitted. Emergency legislation has now called everyone to work, in accordance with the plans prepared.

Control of A.R.P. activities is organized regionally and locally. The administration staffs of the various regions work under twelve regional commissioners who represent the central government. There is a local emergency committee in each borough and town, assisting an A.R.P. Controller who is the local executive officer. These local authorities are responsible for preparing local A.R.P. schemes suited to local conditions but conforming to broad lines laid down by the central government. A control centre is established in every large town.

Contact between the public and the local A.R.P. organizations has been provided for by the appointment of Air Raid Wardens. These are volunteer members of the public, whose duty is to advise and help their fellow citizens in the sector to which each is allotted. The warden is responsible for reporting air raid damage and calling aid. He receives training in precautions against gas, high explosive and incendiary bombs, in fire service organization and elementary first aid. He is issued with a distinguishing armlet, a steel helmet, a respirator and other equipment. It is his business to know the people who live in his sector—who can help and who need help. He must be aware of any places of special danger—timber yards, petrol stores and the like. He must know what public shelters are available in his sector and where there are telephones which can be used in emergency. During a raid his first duty is to get reports to headquarters as to the points where rescue or fire parties are needed, whether water mains are broken and so on. Administration of the Air Raid Warden system is in the hands of Chief and Divisional Wardens. The local arrangements are not rigid, but each warden's sector is supposed to contain about 500 people.

The cost of the whole A.R.P. organization, central and local, is estimated at more than £70,000,000 for this year, about ten per cent of this falling upon local authorities.

Activities connected with A.R.P. may be classed under eight heads, as follows: (a) Protection, i.e., defence against aerial attack by bombs; (b) Evacuation, the removal of population from highly dangerous to less threatened areas; (c) Casualty services, providing for first aid and hospitalization; (d) Fire fighting, to control as far as is possible the fires resulting from incendiary bombs; (e) Anti-gas measures, including the provision of gas-masks and refuge rooms; (f) Lighting restrictions, particularly as regards railways, street lighting, factories, private houses and motor cars; (g) Public warnings of the imminence of an air raid, or the departure of the raiders, and (h) Food defence, dealing with the provision, distribution, and sale of food.

Protection

A heavy bomb may reach its target with a striking velocity of nearly 1,000 feet per second and may carry from 200 to 1,000 lb. of explosive. It will thus be understood that general protection against direct hits would be too expensive and would take too long to construct to be practical. Shelter against the "blast" or shock-wave in the air caused by the explosion, and against splinters from the bomb case, can be provided, however, to a reasonable extent. About 15 inches of concrete, 30 inches of earth, or 1½ inches of steel plate will protect against splinters from a 500 lb. bomb exploding fifty or more feet away.

The government's general policy as regards air-raid shelter is that in industrial areas and large cities in districts obviously exposed to risk, dispersal of population must be ensured as far as possible by the evacuation of children, mothers, and the aged and infirm, and by limiting the size of individual shelters to capacity for say 50 people; further, shelter at home is being provided by "garden steel shelters" (of which about 2,500,000 are being distributed) or, by "domestic surface shelters" consisting of concrete and/or brick huts, for which standard designs are available, or by reinforcing suitable basements and cellars in houses up to three storeys, or finally by "communal shelters" for people who have neither basements or gardens. So far these five shelter systems are being provided only for persons within the £250-a-year income limit, who are roughly estimated at 20 millions in number. Private persons above the £250 limit, are expected to provide their own shelters.

Public shelters are the responsibility of local authorities; extensive systems of this kind have been constructed in many places (e.g., the concrete covered trenches in Hyde Park). Provision of this kind for from ten to fifteen per cent of the day population is thought to be reasonable in business or residential districts.

The government is arranging for special types of heavily protected shelters for factories where steady maintenance of production is vital in war time. All employers who have more than fifty workers have to provide shelters and may receive financial assistance from the Treasury for this purpose.

The system of shelter provision which has been evolved after much thought and experiment is intended to give everyone the same degree of protection. It reduces the chance of a "knockout blow" and greatly lessens the psychological effect of air raids.

Evacuation

In 1938, before preparing the scheme for evacuation, an inquiry was made to discover how much accommodation existed in "reception areas"—i.e., districts unlikely to be attacked and affording opportunities for dispersal. It was found that on the basis of one person per room, space for about five million people was thus available. Of this number about one-fifth could be handled by private arrangement.

It was further found that the "evacuation areas"—containing congested cities and towns most likely to be attacked—had a population of about eleven millions and that provision could be made for transport and billeting of the children of school or pre-school age, expectant mothers, and adult blind and cripples from these areas, totalling some four million persons. Extensive movements along these lines have actually taken place.

These figures give some idea of the magnitude of the problem. The biggest evacuation areas are: London, 1,300,000, to be dispersed over an area southeast of a line between the Severn and the Wash; Manchester, 247,000, to move into Lancashire; Liverpool, 216,000, to move into Wales. Householders on whom unaccompanied school children are billeted receive payment covering board, lodging and care; for children accompanied by their mothers or other adults a smaller payment is made covering shelter only.

Certain districts, listed as neutral areas, are available to accommodate business firms desiring to move their offices from evacuation areas.

Casualty Services

Even when all that is possible has been done by evacuation and the provision of shelters, intensive air raids are still bound to cause many injuries. It has been suggested that 300,000 civilian casualties might occur in a week of heavy raiding.

To deal with these, much organization work has been done. Volunteer first-aid parties have been formed and equipped, some 8,000 first-aid posts provided and 20,000 ambulances (largely converted motor vans) are ready.

As many as possible of the 500,000 beds available in existing hospitals have been cleared by removal of the less serious cases to their homes or elsewhere and 200,000 new beds have been provided. Large hospitals in the big centres, casualty clearing hospitals for urgent treatment, and base hospitals for others are being equipped, and arrangements made for transporting patients to them. The medical profession is co-operating nobly; the existing register of nurses is being augmented to a total of some 200,000.

Fire Fighting

No ordinary fire-fighting force can possibly deal with the multitudes of simultaneous fires which may be caused by incendiary bombs during an air raid. The most formidable type of these bombs weighs about two lb. and is of metallic magnesium, having a thermite primer. The priming composition burns for about 45 seconds, the molten magnesium continues to burn for from 15 to 20 minutes and spatters over a considerable area.

A large bomber can carry over 1,000 of these bombs. If flying at 200 m.p.h. at 5,000 feet, 1,000 bombs could be released in three miles, and in a large city, with the average ratio of open to built-up areas, a fire would probably start about every 70 yards along its course. There are other types of heavier bombs which burn over a wide area. This picture needs no elaboration.

To supplement existing Fire Brigades, an Auxiliary Fire Service has been formed, with voluntary personnel and additional sub-stations based on schemes prepared by the various local authorities. Its equipment includes heavy duty motor-driven pumps, two types of trailer and the necessary hose, ladders, and other stores for the use of 250,000 auxiliary firemen. The initial expenditure is nearly £4,000,000. Householders are being asked to inform themselves as to necessary precautions and methods of dealing with fires, for which purpose excellent instruction pamphlets have been issued by the government.

Gas Attacks

Three years ago, gas was thought to be the most dangerous feature of aerial warfare against civilians, and at first the training of instructors for A.R.P. personnel laid great emphasis on anti-gas work. It is now thought that gas is likely to be used rather to delay rescue work and impede essential services after a big raid of high-explosive and incendiary bombs, than as a primary means of destruction.

The public has been informed as far as possible as to the various types of gas (blister, choking, nose and tear gases) and the precautions and treatment they call for.

The government is providing three types of gas masks (or "respirators," to give them the official title):

1. The "service respirator," for the armed forces, police, firemen and members of the A.R.P. services who may have to remain in high concentrations of gas for considerable periods.
2. The "civilian duty respirator," for normal duty. A less complete protection for first-aid posts, A.R.P. wardens, ambulance drivers, etc.
3. The "civilian respirator," a still simpler design for use when gas is present and no gas-protected room or shelter is available. This gives protection to adults and is carried by the general public. Special provision is made for babies, for whom some two million special protective helmets are ready for issue. Child protection is only one part of this extremely difficult problem.

Lighting

The co-operation of every citizen in "obscuration of light" is essential. London, Paris, and Berlin, and indeed all large centres in the warring countries are subject to drastic regulations, looking to the complete abolition of lights visible from the air. The official requirements in Britain include the use of opaque blinds or curtains to mask all windows, skylights and doors in private houses as well as in business premises and industrial buildings, the restriction of lighting in motor cars, buses, railway trains and stations, the extinguishing of street lighting and the lights along waterways.

A single light overlooked in the middle of a big town can betray the whole neighbourhood. This actually happened near Brighton on July 9th during a practice "blackout" when a light was found burning in a cigarette machine. The Lighting Order now in force prohibits the emission from the premises of all direct or reflected light of whatever colour. Under these conditions, movement in the streets naturally involves considerable risk, as is already proved by the rise in street fatalities at night during September. Experience has shown that the use of white paint on the kerbs, at road junctions and at corners is of some assistance. Traffic lights, where permitted, are screened by discs in which a small X shaped opening is made. Motor cars have a special metal hood or mask with small slits fitted to the right hand headlamp, while the headlamp nearest the kerb is removed.

Air Raid Warnings

Thousands of warning sirens have been installed in public buildings in urban areas—usually in police stations. These are to be aided by factory whistles, whose use for any other purpose would be barred. The signal for an impending raid is a "fluctuating or warbling signal of varying pitch," or a succession of blasts of about five seconds duration broken by silent periods of about three seconds. The duration of the "wail, blare or hoot" is two minutes. A continuous sounding of all available signals gives the "raiders passed" message. Much experimenting has been necessary to ensure satisfactory locations for the sirens, and apparently improvement is still possible. Air raid wardens and police supplement the sirens by sounding their whistles.

When the presence of gas is detected, air raid wardens and police sound hand rattles. The gas warning is cancelled by ringing of hand bells.

The whole system has been planned to give the quickest warning to threatened places while not disturbing more of the country than is absolutely necessary. It is desirable to avoid perpetual false alarms, as a probable cause of "war nerves."

The 116 warning districts have been laid out with the existing telephone exchange system as a basis. Each exchange has a list of priority numbers, which includes the telephone numbers of fire stations, docks, railways, power stations, munition factories, and other factories employing more than 500 people. When there is an alarm, these numbers are the first to be warned.

The whole system has already been tested on a national scale. It is understood that it is being modified in certain respects as a result of the experience thus gained.

Food Supply

Precautionary measures regarding food are not directly connected with air raids but should be mentioned here as a part of the general Civil Defence organization. Since 1936, governmental plans for food supply in war-time have been made to cover (a) increase in home production, (b) provision of shipping (and means for its protection) to bring in about £1,000,000 worth of food a day, and (c) the storage of suitable essential commodities—such as wheat, sugar and oil—to tide over some weeks or even months, if there should be a time of difficulty or dislocation.

Care has been taken to profit by the experience of the 1914-18 period, and to take steps to prevent soaring prices, hoarding, food queues, and exploitation of markets by greedy speculators. This work involves the organization of wholesalers under government control, the supervision of retail requirements and purchases under a system of local licenses, and the establishment of a general rationing system for certain articles as may be found necessary. In addition to food, conservation of fuel supplies is of importance, and transportation must be provided for. Over seven million fuel ration books have been printed. Rationing of petrol is in effect and rationing of some foods will go into force shortly.

Although no intensive air raids have yet occurred, there has been sufficient enemy activity to give a preliminary test to many of the arrangements described in the foregoing notes. In some cases, as might be expected, the plans require modification to obtain smoother working, in others they may prove to be unnecessarily elaborate. Stress is rightly laid on the need to educate the public and to accustom people to the new conditions of life. To this end the government has published an admirable series of pamphlets, each dealing with some particular phase of the situation. It is from these handbooks and from a summary issued by the Daily Telegraph that the information contained in this article has been taken. R.J.D.

AIRCRAFT OF 600 MILES AN HOUR

***Trade and Engineering*, September 1939**

Flying-boats for 200 or more passengers; 600 m.p.h. military aircraft; an economic speed limit for civil machines, and their unsuitability for use in war as fighters or bombers, were matters referred to by Mr. H. E. Wimperis, formerly President of the Royal Aeronautical Society, in his presidential address before the Engineering Section of the British Association at Dundee on August 31.

Mr. Wimperis spoke of changes in design since the original Wright machine of 1903, with the result that aeroplane performance had increased from the 31 m.p.h. of the Wrights to the 469 m.p.h. of to-day. Further progress in height and range must depend chiefly on improvements in the materials of construction or in the discovery of new ones.

Greater Engine Power

Speeds had increased because of the smoother shapes used in construction and greater engine power. Could speeds continue to rise indefinitely? We had gone almost as far as we could in using ship-shaped forms; if an increase in the laminar flow of the air over the surface of wings or body could be ensured, resistance would drop considerably. One heard of testing plants being adapted to deal with engines of no less than 3,000 horsepower apiece. But a definite speed limit was being approached, imposed by the laws of Nature.

It was unlikely that 600 miles an hour would be much, if at all, exceeded, for that figure was some 80 per cent of the speed of sound. When the speed of sound was approached the drag rose to a level far ahead of any prospective engine improvements. Although nothing in the physiology of man prevented even higher speeds being attained, there was soon imposed a physiological limit if high speed was combined with rapid manoeuvre. Only the future could reveal how the balance between the two would be struck.

Engines to-day ran safely at far higher speeds and were cooled with much less expense in air drag than used to be the case. In fact, at the highest speeds the drag offered some theoretical promise of being displaced by a small thrust.

Comfort and Cost

The flying-boats of to-day represented a great technical advance over their predecessors of ten, or even five, years ago, but they had not yet shown any marked advance in size. The Empire flying-boats weighed 20 tons each; the new Short Golden Hind class for the Atlantic weighed 35 tons; the Yankee Clipper had a total weight of nearly 40 tons; the Dornier Do-X, which long preceded them, ran to 50 tons laden.

Turning to what lay ahead in speed, size, and range, Mr. Wimperis thought there was little doubt that speeds between 500 and 600 m.p.h. would become usual for military craft. Not so, however, for the civil air services, where quiet, comfort, and cost were all-important; here there was good economic reason for speeds to settle down in the 200 to 300 range. In both classes we seemed, therefore, to be approaching some degree of finality. High flying, whether in the stratosphere or just below it, required the sealed cabin, and would be chiefly sought by those whose first care was speed and whose lesser concern was cost.

Size depended mainly on engine power. Even if we had tractor and pusher airscrews in tandem (and tractor screws might well become unpopular where the highest aerodynamic efficiency was sought), six such pairs might be the practicable limit. This would mean 12 engines which, at 3,000 h.p. apiece, made the total power 36,000 h.p. At 15 lb. carried per h.p. available this would give a total flying weight of some 250 tons. Such a craft would take 200 passengers or more; and that was the largest flying craft that could be said to be in sight. Difficult as it might be to foretell accurately the future of the large flying boat, there could be little doubt that we should soon see such craft.

Military and Civil

Mr. Wimperis said that the lack of success attending an effort made some years ago to reach an understanding about air armaments was due partly to the inherent difficulty of distinguishing between military and civil types of craft. He thought that the conversion of civil into military aircraft was not now as germane a question as it was then. The comfort and space needed for civil transport tended to produce a design of body not in the least resembling military requirements. The more the really large sizes of civil craft took the flying-boat form, so were they the less like military types. He was leaving aside reconnaissance duties and troop carrying.

Civil types would, by reason of their low speed, be incapable of acting as fighters, and would be speedily shot down if they tried to act as bombers.

It did seem, said Mr. Wimperis, as though mankind was beginning to see his way out of the terrible problems raised by the discovery of the art of flight. The laws of Nature imposed a speed barrier, which suggested some finality to the development of types. That speed limit was much above the economic limit of the civil machines, which could be easily defeated if they tried to play the corsair. At the same time the strength of A.A. defence from the ground and in the air was increasing in effectiveness at a rate that even the most optimistic had hardly dared to hope.

REORGANIZATION OF A EUROPEAN MACHINE SHOP

By Professor Dr.-Ing. G. Schlesinger in *Engineering*, September 22, 1939

Abstracted by R. H. Field, A.M.E.I.C.

The Dutch machine shop and dockyard forming the subject of this paper is more than 100 years old. In times of great activity 5,000 men are employed of whom 600 work in the machine shop. Faced with the question of raising the output of this shop with only a limited number of hands available, the owners entrusted the author with the necessary reorganization. It was begun in 1936 and the shop was running by the end of 1937.

The old-fashioned shop is modernized in two stages: (1) modernization of the existing machines if still useful or adaptable; (2) purchase of new high-speed machines as pace makers. Modernization can be accomplished by rebuilding in the owners works, but great care is necessary in deciding whether or not repair is worth while. An overhauled tool, which cannot be adapted to modern output rates is expensive, and reduces the morale of the operators. New machines, while more costly, raise output and enhance the satisfaction of the workers. At the start it is best to get along with rebuilt machines, adapted for high speed work, and concentrate on the improvement of high speed small tools, which are easily provided.

Concurrently suitable cutting tools must be supplied, and their uniformity ensured, to give workers confidence. Then the increased output must not endanger quality, and an adequate gauging system becomes necessary.

The reorganization began by purchasing gauges to control cylindrical parts and threads. In the drawing office a careful adaptation of limits to the needs of assembly was made, under the control of a "connecting man." He mastered both shop needs and design possibilities, and learned how to instruct designers so that the limits chosen would allow the manufacture of a good product at the lowest assembly cost. The rate-fixing department must fully exploit the machines, to obtain maximum output.

In the machine shop the chief engineer plans the general programme, time of delivery and material purchases, while the production engineer determines the quickest way of manufacturing, designs jigs, fixtures, tools, fixes cutting speeds, etc. Under his control is the tool-making department and a staff executing only repair work, as well as an inspector who examines new and rebuilt machines and sees that the prescribed feeds and speeds are maintained.

The manufacture of the cutting tools is well organized. In particular, tungsten carbide edged tools are carefully finished and given a smooth edge for long life. For 150 men on lathes, etc., not more than one or two men are needed to prepare the tools. A roughing tool should keep sharp for a day and a finishing tool for a week. The operator knows the duration of a tool and uses a red lamp signal to call the tool boy in good time so that the work is not interrupted for the exchange.

Tables were prepared giving the particulars and number of tools for different metals and machines. The central grinding shop ensures correct cutting angles and reduces the number of tools in use, while every machine has a table of speeds, feeds, etc., to guide the operator.

The rate-fixing office (seven men with one in charge) determines piece work rates with the aid of a cutting speed table, and has a difficult problem as in ship repairing scarcely two jobs are alike.

Twenty men are attached to the machine-tool reconditioning shop, where the extensive rebuilding operations are conducted. It has been found possible to increase the speed of 30 year old machines by three times, if well designed.

With the system adopted the depreciation and interest expenses were not increased, but there resulted higher quality quick delivery and lower prices with consequent increased employment.

WHERE TO USE ALLOY IRONS

By L. Sanderson in the Mechanical World, Vol. 104, p. 293

Abstracted by the International Power Review, June, 1939

One of the most important features of recent metallurgical progress is the development of the alloy cast iron.

The most interesting among these irons is the nickel alloy cast iron, which has a dense structure and a high degree of wear resistance, while machining presents no difficulties. After heat treatment, its tensile strength is 30 to 35 tons per square inch and the hardness 400 Brinell. The heat treatment comprises quenching in oil from 850 deg. C. succeeded by a tempering at 300 deg. to 500 deg. C.

Castings for heavy duty enable design to be simplified and economies to be effected as such parts will withstand higher stresses. In certain conditions this alloy iron has replaced steel castings and forgings.

Molybdenum cast iron has given good results in certain applications calling for high strength and wearing qualities, the molybdenum contents of this iron being 0.75 per cent. The tensile strength is about 22.8 tons per sq. in. This type of iron is used for heavy gears for rubber mill drives, where operating conditions are exceptionally severe.

The nickel-copper-chromium cast iron withstands corrosive attack by chemicals and the scaling effects of heat. Its quality and its cost being lower than that of brass or bronze has made this iron increasingly popular. This iron resists creep at high temperatures.

Nickel-molybdenum castings have a tensile strength of about 25 to 30 tons per sq. in. and may be used for large cast parts of machinery, where high static and dynamic stresses are set up.

Copper-chromium-molybdenum iron is mainly used for Diesel engine cylinder heads on account of its great resistance to oxidation under heat.

Another wear resisting iron is the white nickel alloy cast irons, having great hardness and strength. The average hardness of this iron is 500 Brinell.

Heat-resisting alloy irons are the high silicon-nickel austenitic cast iron and the non-nickel high silicon alloy iron, which is unmachinable, but which withstands the corrosive effect of acids, etc. Another high silicon alloy iron without nickel, resisting to heat, and finally the high chromium-nickel iron having the highest erosion, heat and scale resisting characteristics.

Vanadium cast irons are used principally in the United States, but complete data concerning their characteristics are not yet available.

In the wide range of applications of the above special alloy irons, judicious heat treatment, improving their machanical characteristics, is of prominent importance.

Editorial Comment...

REGULATIONS FOR DEFENCE

The sight of military uniforms, parades, motor cars displaying impressive official stickers and other outward and visible signs of Canada's participation in the war, are rapidly becoming a commonplace. Business has already been obliged to make readjustments in methods and arrangements because of governmental wartime measures and regulations. The Institute, too, has felt the effects. So far the experiences are limited to the Censorship Co-ordination Committee in respect to material submitted for publication in the Journal. The Committee's veto has already been exercised in the case of two papers which were submitted to it. It is quite possible that other adverse decisions will further reduce our supply of approved technical material. But the rulings have been considerately given after consultation with the departments concerned, and have been accompanied in each case by a statement of the reasons for the action taken. The Institute staff is endeavouring to co-operate fully in this matter; we can only ask authors and readers to make allowances if some papers of obvious merit fail to appear in forthcoming issues.

As yet many people are not familiar with the important phase of government war-time regulation which affects the daily life and property rights of almost every citizen—namely, the emergency measures which are being taken for "securing the public safety and the defence of Canada.

Everyone realizes that in the event of war the Government needs extraordinary powers as regards defence and the administration of the country's business. At such times many special restrictions have to be imposed on the community. It is desirable that the nature of these limitations of our freedom should be generally understood, in order that the public may acquiesce in their necessity and co-operate in their enforcement.

During the period 1914-1918 many emergency measures respecting the defence of Canada were taken by Orders-in-Council. The more important regulations issued in this way were consolidated in a "Defence of Canada Order, 1917" which was allowed to lapse at the close of the late war. The present Government took action in this matter early in 1938, when an interdepartmental Committee on Emergency Legislation was set up, to report upon the legislation which would be required in the event of grave emergency.

After a survey of the situation the committee noted that the War Measures Act of 1927 had conferred upon the executive ample powers to meet the exigencies of war in practically all administrative matters save finance—action in regard to which would require specific legislation—thus it was considered that the government could properly take action under that act. The committee, after a year's further study, during which the views of the departments concerned received careful consideration, recently submitted a draft set of proposed regulations to the Government, embodying the essential provisions of the former Defence of Canada Order, together with new regulations to meet the needs of the present day. These draft rulings have now been 'made and established' by Order in Council dated September 3rd, 1939. Accordingly they possess the force of law, and have been printed under the title 'Defence of Canada Regulations.'

As might be expected, this important document gives many evidences of the care with which its provisions have been studied, and the ability of the distinguished officers of the various departments who have been engaged in its preparation. Many of its paragraphs deal with difficult or contentious matters, notably in the case of the control of means of communication, the treatment of enemy aliens, and the maintenance of public safety and order. A number of the regulations vitally affect property rights and the carrying on of the ordinary avocations of life.

Very properly the regulations commence by directing persons charged with the duty of enforcement to observe the general principle of interfering as little as possible with the daily occupations and the enjoyment of property by our citizens.

After paragraphs defining the meaning of terms used—such as 'enemy alien,' 'essential services,' 'radio,' 'war offence'—the thorny subject of 'espionage and acts likely to assist the enemy' is dealt with. Access to certain areas or premises may be limited or prohibited. The making of signals is controlled, together with the use of any means of secret communication. Censorship of telegraph, radio. telephone and postal messages is established and no document or photograph containing information may be conveyed into or out of Canada otherwise than by post.

The Secretary of State is empowered to prevent or restrict the publication of documents, pictorial representations, and films, whose publication might be prejudicial to the efficient prosecution of the war. Under this regulation he can require that such material be submitted to a censorship authority for approval before publication.

General provisions for safeguarding information include the prohibition of the possession or communication of any information with respect to naval or military matters or munitions of war, communication or association with any person who is assisting the enemy and the photography or sketching of a 'protected place' or any object therein. The Minister of National Defence may prohibit the publication of information regarding any patent; he may authorize the use of any drawing, model, or plan regarding any invention notwithstanding any license or agreement to the contrary.

The voluntary entry into enemy territory of British subjects or persons enjoying His Majesty's protection is forbidden. In order to prevent any particular person from acting in a manner prejudicial to the public safety, the Minister of Justice may prohibit the possession or use by that person of any specified articles and may restrict his movements, his employment or business, or his activities in disseminating news or propagating opinions—in addition such person may be detained in such place and under such conditions as may be determined. Appeals from Orders under this Regulation will be considered by an advisory committee appointed for that purpose.

No one is permitted to assist a prisoner of war to escape—Regulations for the access to such prisoners, their employment and their maintenance may be made by the Secretary of State.

The proper treatment of enemy aliens presents a difficult problem. It is of first importance to guard against the hostile acts or espionage in which some of these aliens may attempt to engage, but the necessary regulations should be such as will not press unduly upon the considerable proportion of aliens who are prepared to pursue peacefully their ordinary avocations. Accordingly, all enemy aliens must register under provisions made by the Minister of Justice, nor will they be permitted to leave Canada without an official *exeat.* In many cases there is no further restriction. But every enemy alien in whose case there is reasonable ground to believe that he is engaging or attempting to engage in improper activities or attempting to leave the country with a view to assist the enemy, is subject to internment as a prisoner of war; in certain cases he may be paroled.

Sabotage of equipment or essential services, interference with means of communication, and the commission of any act likely to cause such interference or sabotage are forbidden.

Misleading action or statements respecting information or defence signals, and the possession of a false passport, are prohibited.

Recognizing the fact that under present day conditions, enemy attack, actual or apprehended, is a matter of concern to the whole civilian population, the Regulations give very wide powers to the Ministers of the appropriate departments as regards measures for the public safety. These Ministers may make orders regarding the evacuation of threatened areas, the restriction of assemblies, the control of lights and sounds, the possession of arms and explosives and the manufacture and transport of dangerous articles. Action may be taken regarding damage to premises and contamination by gas, and inhabitants of certain areas may be required to remain indoors. These regulations would appear to give the government ample power to provide, so far as possible, for the protection of the public under conditions of life which have actually proved so terrible in Europe, but which we devoutly hope will never be experienced on this side of the Atlantic.

An important section of the Regulations treats of the control of ships and aircraft. Questions will doubtless arise regarding such matters as the transfer of ships registered in Canada, and special measures for the safety of such ships. It may be necessary to regulate the trades in which they may engage and the cargoes and passengers which they may carry. The control of the movements of commercial and foreign aircraft is provided for.

Under the section concerning essential supplies, the Regulations authorize government requisition of property other than land, control of land transport and the licensing of explosive factories.

The concluding section contains general regulations which require everyone to answer to the best of his ability questions put to him by naval, military or air officers in the performance of their duties, forbid false statements, prohibit obstruction and give authority to enter and search premises and vehicles.

Legal proceedings and appropriate penalties are prescribed for contravention of the Regulations or any Order issued under them.

It is obvious that many of these comprehensive regulations cannot be enforced without inconvenience, or even monetary loss, to organizations and individuals whose operations are affected by them. We must however count these limitations of our freedom of action as part of Canada's contribution to the war.

Officers and boards charged with the administration of the Regulations will have before them a difficult and thankless task in the performance of which they are entitled to the support of every citizen. There will be criticisms, of course, particularly in connection with the censorship of communications and publications—a matter which affects nearly everybody. For example, the consors' work may involve delays in business messages and result in checking the volume of export business whose maintenance is essential to provide the sinews of war. Again, injudicious or unnecessarily drastic press censorship might deprive the public of news or information which would be effective in maintaining the national morale or in placing the real war situation before neutral or friendly nations. Even in such cases those of us upon whom responsibility does not fall, should hesitate before finding fault with decisions necessarily made under pressure of heavy work and with limited time for reflection.

The Government points out that the Regulations as now issued cannot be regarded as final. As the situation changes modifications will no doubt prove to be necessary. Results of the actual working of the rules will possibly indicate lines along which improvements can be made to facilitate their operation.

A NATIONAL ORGANIZATION FOR RESEARCH

The coordination and development of scientific and industrial research in Canada is the function of the National Research Council. In addition to the considerable staff of the Council's laboratories, a large number of technical organizations and industrial researchers are working under the auspices of the Council and its associate Committees. The aim of each of these committees is the coordination of research in some special field, thus using to the best advantage the facilities and personnel available. Of major importance to the welfare of the country in peace time, a well organized industrial research is an essential feature of preparedness in modern war.

Under war-time conditions, a large proportion of the Council's activities will be intensified. This will apply particularly to the many technical problems which will come up in connection with war supplies of all kinds, the storage and transport of food, and the utilization of our fuel resources. Obviously, the services of an organization, whose staff includes such a wide range of scientific personnel, will be invaluable. The Council staff may even be able to help in examining the multitude of war devices which will inevitably be offered to the government, some by sober minded inventors, and others (more numerous) by well-intentioned enthusiasts.

For the past four years, this National laboratory has had as its president a distinguished physicist, soldier, and engineer, who now relinquishes the post, having been selected to command the First Division, Canadian Active Service Force. The Government is to be congratulated on having chosen another eminent engineer to replace Major-General McNaughton.

Like his predecessor, Dean C. J. Mackenzie has had a varied academic, professional and war experience. His record at the University of Saskatchewan speaks for his ability as educator and administrator. As an engineer he is familiar with the problems which face the consultant, the designer and the contractor, in the planning and construction of public works. As a member of the Research Council he is already familiar with the Council's work and that of its associate committees.

With his personal experience of research he is well qualified to develop that important feature of the Council's work, the training of a corps of young scientific men, holders of its fellowships and scholarships, to carry on the technical research of Canada.

It is also gratifying to note that the presidency of the Council has been placed in the hands of a prominent member of The Engineering Institute, who has served as Vice-President and as a member of the Institute Council. He brings to his new position the cordial good wishes of all his fellow members of the Institute.

Dean C. J. Mackenzie, M.E.I.C.

DOMINION COUNCIL OF PROFESSIONAL ENGINEERS

A meeting of the Dominion Council of Professional Engineers was held in the office of the Corporation of Professional Engineers of Quebec on October 17th, 18th and 19th, 1939. Delegates from all the provinces of Canada were present.

H. Cimon, M.E.I.C., Vice-President of the Dominion Council, acted as chairman in the absence of C. C. Kirby, M.E.I.C., and C. L. Dufort, Registrar of the Quebec Corporation, acted as secretary.

A committee to consider the conditions under which foreign engineers should be permitted to practise in Canada was appointed with J. B. de Hart, M.E.I.C., of Alberta as chairman.

D. A. R. McCannell, M.E.I.C.

M. Barry Watson, M.E.I.C.

It was decided at this meeting that a permanent secretary should be appointed and that the office of the Dominion Council should be the office of the Association of Professional Engineers of Ontario, 350 Bay Street, Toronto. Major M. Barry Watson, M.E.I.C.,Registrar of the Association of Professional Engineers. of the Province of Ontario, was requested to assume the duties of secretary-treasurer of the Dominion Council of Professional Engineers.

The Council were entertained at the Faculty Club at 7.30 p.m. on Tuesday, October 17th, at a dinner given by the Corporation of Professional Engineers of Quebec.

The Council discussed such topics as central examining board, interchange of membership with sister associations, training of young engineers, National Construction Council, national defence and the profession, relationship between engineers and architects.

The following officers were elected for the ensuing year:

Honorary President, Mr. C. C. Kirby, of New Brunswick.

President, Mr. D. A. R. McCannel, M.E.I.C., of Saskatchewan.

Vice-President, Mr. Hector Cimon, of Quebec.

Secretary-Treasurer, M. Barry Watson.

Third member of the Executive Committee, E. P. Muntz, M.E.I.C., of Ontario.

It was decided to hold the next meeting of the Dominion Council in Winnipeg.

PRESIDENT'S WESTERN TRIP

Details of the President's visit to Western Branches will be found in branch news, but the following function deserves special mention:

At Vancouver a very pleasant event was added to the programme of the President's tour. The executive of the Association of Professional Engineers of British Columbia arranged a luncheon at the Vancouver Hotel in his honor, to which the executive committee of the Vancouver Branch of the Institute was also invited.

Mr. E. Redpath, Vice-President of the Association, competently occupied the chair, in the absence of President Chris Webb, who was in Montreal at the meeting of the Dominion Council, and extended to Dean McKiel the greetings from the Association and a welcome to British Columbia The President responded, expressing his own thanks, as well as those of the Institute, for the courtesy and hospitality that had been extended on this occasion. He expressed the hope that the future would afford many opportunities, both social and professional, for these two bodies to work together. Dean Finlayson also spoke, and added his welcome to that expressed by the Chairman. General Secretary Austin Wright was also introduced, and joined with President McKiel in thanking the Association for its hospitality and welcome.

Arrangements for the luncheon were in charge of John C. Oliver, Registrar of the Association.

NIAGARA DISTRICT TECHNICAL COUNCIL

For some years the Niagara Branch of the Institute has been having one or two joint meetings annually with the Niagara District Chemical and Industrial Association. The success of these meetings has suggested that such cooperation might be extended to include any other groups of engineers in the Niagara District that might be interested, and also widened in scope so as better to forward some of the fundamental objects of the co-operating groups.

After some discussion between members of the branch executive and members of the executives of the Niagara District Chemical and Industrial Association and the Niagara District Discussion Group of the American Institute of Electrical Engineers, a plan was outlined to form a Niagara District Technical Council, the member societies being the two bodies above named and the Niagara Peninsula Branch of the Institute. Under this plan each member society, of course, retained its own identity and function. The plan has been adopted on a trial basis for one year and the Niagara District Technical Council has now become operative.

The N.D.T.C. proposes to control society meetings and thus avoid confliction of dates, to consider the subjects of the meetings ensuring as wide a variety of topics as possible. It will compile a mailing list covering the technicians in the district for the use of all societies. The profession as a whole will be better served by the information as to meetings of general interest, and the possibility of bringing larger groups together in joint and public meetings will enable the Council to obtain speakers of outstanding merit.

The Executive Committee of the Council for the coming year consists of: W. H. Macartney, chairman; A. W. F. McQueen, M.E.I.C., vice-chairman; R. T. Sawle, S.E.I.C., secretary; C. G. Moon, A.M.E.I.C., treasurer; C. H. McL. Burns, M.E.I.C., G. Morrison, M.E.I.C., A. S. Robertson, J. W. Turner.

CORRESPONDENCE

The following letter has been sent to Headquarters by Frederick Palmer, A.M.E.I.C., Canadian Trade Commissioner at Melbourne, Australia, to whom it was addressed in the first instance:

F. PALMER, ESQ., B.SC,
90 QUEEN ST., MELBOURNE, C.1.

Dear Mr. Palmer,

You were good enough to lend me the June number of "The Engineering Journal" published by The Engineering Institute of Canada, containing an article on "Operating Experience with Steel Tower Transmission Lines," which I have perused with very much interest, and I also took the opportunity of placing it before the head of our Power Production Department.

This article is outstandingly valuable and informative, and the frank discussion of transmission line design and operation features is helpful to an appreciation of the general problems, particularly as the design of the transmission line under review closely resembles our own 132,000 volt work.

Our Chief Engineer is quite in accord with Mr. Lawton as to the need for the utmost care in erection and attention to the finer details. All this is so necessary if excessive maintenance costs and operating troubles are to be avoided.

Lightning hazards are, of course, much greater in the eastern part of North America than in Victoria, and we would consider ourselves unfortunate indeed if the circuit interruptions due to lightning were as heavy as those experienced by Mr. Lawton.

On the whole, the article leaves one with the feeling that we are fortunate in having much better conditions for transmission here in Victoria.

The publication is returned with many thanks.

Yours sincerely,

(SGD.) G. S. JOBBINS, *Chairman.*

STATE ELECTRICITY COMMISSION OF VICTORIA,
HEAD OFFICE: 22-32 WILLIAM ST., MELBOURNE,
22ND AUGUST, 1939.

MEETING OF COUNCIL

A meeting of the Council was held at Headquarters on Saturday, September 30th, 1939, at nine-thirty a.m.

There were present: Vice-President H. O. Keay in the chair; Past-Presidents J. B. Challies and G. J. Desbarats; Vice-President F. Newell; Councillors J. L. Busfield, R. H. Findlay, L. F. Grant, A. Larivière, W. R. Manock, H. Massue, B. R. Perry, H. J. Vennes, and E. Viens; Treasurer deGaspé Beaubien, Secretary Emeritus R. J. Durley, General Secretary L. Austin Wright, and Past-President J. M. R. Fairbairn by invitation.

Mr. Durley reported on his meetings with members of the Joint Committee on Engineering Co-operation Overseas during his recent visit to London, speaking appreciatively of the kind way in which he had been received, and the evident desire of all concerned to arrive at a solution which would be beneficial, not only to members of the British Institutions resident in Canada, but also to The Engineering Institute. He also gave a résumé of the events in London leading to the regrettable cancellation of the sailing of the British engineers to attend the British-American Engineering Congress in New York. Both the Institution of Civil Engineers and the Institution of Mechanical Engineers fully realized the keen disappointment this had caused to their friends in the United States and Canada, and appreciated greatly the many hospitable preparations which had been made for their entertainment both in the United States and Canada.

Interim reports were presented from Mr. Bennett regarding the work of his Committee on the Welfare and Training of the Young Engineer.

The Secretary presented a letter from the chairman of the Hamilton Branch transmitting formal proposals to amend the Institute By-laws Nos. 12, 13, 64 and 67, signed by over twenty corporate members of the Institute. The changes suggested had to do entirely with the addition of another vice-president in the province of Ontario, making two, as in the province of Quebec. It was decided to advise the Hamilton Branch that the Council is in sympathy with the purpose of the proposed amendments, but recommends that the place of residence of the two Ontario vice-presidents should not be confined to the limits of any one or more branches.

The reappointment of Mr. M. V. Sauer, M.E.I.C., as the Institute's representative on the Associate Electrical Committee of the National Research Council was unanimously approved, as was also the appointment of Mr. R. G. Gage, M.E.I.C., to represent the Institute on the C.E.S.A. Committee on Canadian Electrical Code.

Mr. Newell, chairman of the Finance Committee, reported that the finances of the Institute were in a very satisfactory condition. Revenues were still ahead of the budget, and expenditures were below the budgeted amounts. This was noted with appreciation.

The Secretary read a letter from the Toronto Branch asking whether, in view of present conditions, Council intended to proceed with the arrangements for the Annual Meeting in Toronto. After discussion it was decided that, subject to branch approval, the branch should be requested to proceed with arrangements for an Annual General and General Professional Meeting which could be cancelled later if conditions made it necessary.

Mr. Perry, chairman of the Library and House Committee, reported on various points regarding the maintenance and operation of the Headquarters building.

Past-President J. M. R. Fairbairn explained in detail the proposal of the National Construction Council for handling emergency construction which had been presented to the Hon. James L. Ralston on September 13th by a deputation from the National Construction Council. A copy of this proposal had been sent to each member of the Institute Council. In accordance with the request of the National Construction Council it was unanimously resolved that a letter be addressed to the Prime Minister endorsing this proposal, and urging that the matter be given serious and early consideration.

After discussion, it was further resolved that such action be taken as is necessary to arrange for the appointment of Institute representatives on the regional committees of the National Construction Council.

A letter was presented from Councillor Vance regarding Institute activities and policy for the period of the war. In his opinion emphasis should be placed on maintaining branches and branch activities. The Secretary was directed to advise Mr. Vance that it is Council's policy to carry on as he suggests.

In response to an invitation from the President and Trustees of Cornell University, it was unanimously resolved that Dr. W. L. Malcolm, M.E.I.C., be asked to represent The Engineering Institute of Canada at the One Hundredth Anniversary of the birth of Robert Henry Thurston, to be celebrated at Cornell University, with the co-operation of the American Society of Mechanical Engineers, on October 25th, 1939.

A letter was presented from Mr. Donald C. Beam, A.M.E.I.C., suggesting that the Council of the Institute endeavour to promote such action on the part of employing corporations as will maintain the status of employees who have been called upon to serve in war work, not only as to men enlisted in the armed forces, but also technical men and other specialists who serve by request in other than military capacities. After discussion it was decided that the Institute might not be justified in making a general appeal as suggested, but that specific cases would be dealt with when brought to the attention of Council.

The Secretary reported upon the voluntary registration of technically trained men on which the Institute, together with the Canadian Institute of Mining and Metallurgy and the Canadian Institute of Chemistry, is working for the Department of National Defence. The three Institutes had urged that the completion and operation of the file should be placed in the charge of representatives of the three Institutes, and advice from Ottawa was being awaited as to whether this arrangement would be possible.

Seven resignations were accepted, and the names of four members were removed from the list.

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

ELECTIONS

Associate Members	9
Juniors	6
Students admitted	6

TRANSFERS

Student to Associate Member	1
Student to Junior	2

The Council rose at one-forty p.m.

ELECTIONS AND TRANSFERS

At the meeting of Council held on September 30th, 1939, the following elections and transfers were effected:

Associate Members

Brant, Cecil Mornington, (Polytechnic Institute, London), radio supervisor, Newfoundland Airport, Newfoundland.

Giroux, Maurice, valuation engr., Montreal Light, Heat and Power Cons., Montreal, Que.

Jones, Evan Stennett, district engr., Dept. of Public Works of B.C., Cranbrook, B.C.

Moore, Joseph Harry, B sc. (Univ. of N.B.), S.M. (Civil), (Mass. Inst. Tech.), associate professor of civil engineering, University of New Brunswick, Fredericton, N.B.

Ryan, James Lambkin, B.Eng. (N.S. Tech. Coll.), engr. foreman, Halifax Airport, Dept. of Transport, Halifax, N.S.

Juniors

Boutilier, Andrew Pringle, B.Eng. (N.S. Tech. Coll.), lubrication engr., Dominion Steel and Coal Corporation, Sydney, N.S.

Fasken, James Elgin, B.sc. (Univ. of Man.), 614 Huron St., Toronto, Ont.

Marion, Paul Jean Emile, B.sc. (Elec.), (Clarkson College), res. engr., Mattawin Storage Dam, Quebec Streams Commission, Montreal, Que.

Noonan, Richard, B.sc. (Univ. of Man.), time study man, Canadian Vickers Limited, Montreal, Que.

Smith, Murray Sutherland, B.sc. (N.S. Tech. Coll.), engineer, R.C.M.P. Macdonald, H.M.C. Dockyard, Esquimalt, B.C.

Smith, Willard A., B.sc. (Univ. of Man.), asst. engr., Madsen Red Lake Gold Mines, Madsen, Ont.

Transferred from the class of Student to Associate Member

Gregoire, Armand E., B.A.Sc., C.E. (Ecole Polytechnique), National Electric Syndicate, Cadillac, Co. Abitibi, Que.

Transferred from the class of Student to that of Junior

Angel, John Bartlett, B.Eng. (McGill Univ.), managing director, United Nail and Foundry Co. Ltd., St. John's, Nfld.

Candlish, Fairlie, B.Eng. (McGill Univ.), engrg. ap'tice, Canadian Westinghouse Company Ltd., Hamilton, Ont.

Students Admitted

Bradley, Lorne Delmer, (Univ. of Wash.), 911 Josephine St., Nelson, B.C.

Dawson, Henry Charles, (Montreal Technical Institute), junior engr., Bepco Canada Limited, Montreal, Que.

Dunn, Russell Arthur, B.Eng. (McGill Univ.), junior engr., Canadian Liquid Air, Montreal, Que.

Garrett, Richard Hudson, B.Eng. (McGill Univ.), (Grad. R.M.C.), asst. to supervising engr., Hudson's Bay Company, MacKenzie River Transport, Waterways, Alta.

Osborne, John Somerset, sapper, R.C.E., Danville, Que.

Rankin, Orla Joffre French, telephone switchboard technician, Royal Canadian Signals, Halifax, N.S.

Obituaries

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

Charles Henry Dancer, M.E.I.C., died at his home in Winnipeg on September 25th, 1939. He was born in Manchester, England, on April 7th, 1850, and was educated at Old Trafford School and Owens College, now Manchester University. From 1868 to 1871, he was apprentice to John J. Mawson, civil engineer, of Manchester. In 1871 he became assistant engineer of the Manchester, Sheffield and Lincolnshire Railway, and was subsequently connected with different railways in England and North Ireland until 1880 when he came to Canada to be resident engineer on the St. Paul, Minneapolis and Manitoba Railway. Coming to Winnipeg in 1881, he spent several years in location work for the Canadian Pacific Railway. In 1885, he joined the staff of the old Manitoba and Northwestern Railway, with headquarters at Portage-la-Prairie, and was in charge of construction on the line from Minnedosa to Yorkton. He became chief engineer and deputy minister of Public Works in the Manitoba government in 1899, retiring from the latter post in 1916.

Mr. Dancer joined the Canadian Society of Civil Engineers in 1888 as a Member. In 1909, he was chairman of the Winnipeg Branch. He was made a Life Member of the Institute in 1920.

Bertram Stuart McKenzie, M.E.I.C., died at his home in Ottawa, on October 6th, 1939. He was born at Almonte, Ont., on July 3rd, 1876. He was a graduate of McGill University, having received the degree of B.A. in 1900 and B.Sc. in 1901. Prior to graduation he had been for a short period with the town engineer at Brookline, Mass., and later with Messrs. T. Pringle and Sons, Montreal, on hydro-electric development at Shawinigan Falls, Que. After graduation he went in the bridge department of the Canadian Pacific Railway, where he stayed until 1907, when he was appointed assistant chief engineer, Eastern Division, with the same company, engaged on railway and maintenance work. In 1909 he was on the staff of the Quebec Bridge Commission on the final design of that bridge. During 1910-12 he was with the Grand Trunk Railway at Winnipeg as assistant engineer of bridges. In 1912 he entered consulting practice in Winnipeg, specializing on hydro-electric power work, foundations, underpinning, cement testing, structural work, and industrial reports and investigations. In 1920 he discontinued his consulting practice and became construction engineer with the Dryden Paper Company at Dryden, Ont., engaged on the design and construction of the company's hydro-electric plant, houses and mill extensions. From 1921-23 he was with the Manitoba Power Company as field engineer on the Great Falls development on the Winnipeg River, and in 1923 he moved to Montreal and became consulting engineer with the Dominion Engineering and Inspection Company. In 1925 he was with the Ottawa-Montreal Power Company on investigations and property surveys.

Mr. McKenzie was appointed Secretary of the Canadian Engineering Standards Association at Ottawa in 1926, which position had been left vacant by the appointment of R. J. Durley, M.E.I.C., as general secretary of the Institute. In 1937, he became consultant for the Canadian Engineering Standards Association, a position which he occupied until his death.

Mr. McKenzie joined the Canadian Society of Civil Engineers as a Student in 1902 and he was transferred to Associate Member in 1911. He became a Member of the Institute in 1919. He was on the Council in 1920 and was the first chairman of the Institute's committee on the Deterioration of Concrete in Alkali Soils.

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

Major-General A. G. L. McNaughton, C.B., C.M.G., D.S.O., LL.D., M.E.I.C., who was appointed, early in October, to command the First Division, Canadian Active Service Force, is an officer of outstanding military qualifications and long experience as well as a distinguished engineer. Born in 1887, at Moosomin, Sask., he was educated at McGill University, receiving the degrees of B.Sc. in 1910 and of M.Sc. in 1912. After a few years on the teaching staff in the department of electrical engineering at the University he entered private engineering practice for a brief period in 1914.

At the outbreak of the first Great War, he organized the 4th Battery, Canadian Field Artillery, which formed part of the 2nd C.F.A. Brigade of the First Canadian Division. He was wounded at the second battle of Ypres in April, 1915, but returning to France, commanded the 21st Howitzer Battery of the Second Canadian Division. Promoted to lieutenant-colonel in March, 1916, he took over the 11th Brigade, C.F.A. of the 3rd Canadian Division and commanded it through the battles of the Somme and until February, 1917, when he was appointed counter-battery staff officer of the Canadian Corps. After recovering from wounds received at Soissons, General McNaughton continued to carry out his duties until October, 1918, when he became General Officer Commanding the Canadian Corps heavy artillery. He was mentioned three times in dispatches, was awarded the D.S.O. and was made a C.M.G. Upon his return to Canada in May, 1919, he served with the Department of National Defence in numerous positions until 1929, when he was appointed to the highest military office in Canada and served four years as Chief of the General Staff.

General McNaughton temporarily retired from the active list of the Canadian Militia to become president of the National Research Council on June 1st, 1935. As head of the Council, he was primarily responsible for building up an electrical engineering laboratory, especially for high voltage work, the subject in which he did post-graduate work at McGill University. He was also directly responsible for development of the aeronautics laboratory and the cathode ray direction finder. Three months ago, he accompanied a delegation of Canadian industrialists to Great Britain in connection with war supply contracts.

Professor C. J. Mackenzie, M.C., M.E.I.C., Dean of the Faculty of Engineering at the University of Saskatchewan, has been appointed acting president of the National Research Council. He succeeds Major-General A. G. L. McNaughton, who has taken command of the First Division, Canadian Active Service Force.

Under the Research Council Act, an acting president may be appointed by the Council to fill a vacancy in the office of president. The selection of a prominent engineer with a distinguished war record for this position is timely. It will do much to ensure that the work of the Council will help in the solution of the technical problems now before the country.

Dean Mackenzie has already taken over his new duties, after a brief period during which the two presidents carried on in unison in the president's office.

Major W. G. Swan, D.S.O., Croix de Guerre, M.E.I.C., has received the appointment of Director of Construction of the War Supply Board, Ottawa. He is a graduate of the University of Toronto, where he obtained the degrees of B.A.Sc. in 1906, and of C.E. in 1911. His early work was with the Canadian Northern Railway where he was consecutively bridge engineer, resident engineer, and division engineer.

His conspicuous service overseas during the first Great War included twenty-seven months of continuous service in France, during which he was awarded the D.S.O., and was mentioned twice in despatches for distinguished service at Ypres and was awarded the Croix de Guerre while serving with the Armée du Nord. He was Lieutenant of the 104th Battalion and later Captain and Adjutant, and during 1915 and 1916 he was Captain of the 131st Battalion C.E.F. and was subsequently Major of the 31st Battalion. During 1916 and 1917 he was Major of the 2nd Battalion of Canadian Railway Troops and later was appointed chief engineer and in charge of maintenance of light railways with the 2nd British Army in France. During the period 1917-1919 he supervised the building of over 400 miles of railways.

Upon his return to Canada in 1919 he went back for a short period to engineering work with the Canadian National Railways in British Columbia.

In 1920 he was appointed chief engineer of the Vancouver Harbour Commission, holding that position for five years, during which period he supervised the construction of works costing approximately fifteen million dollars. In 1925 he entered private practice, specializing on reports and appraisals of all kinds of construction. He has since been connected with many large engineering projects and his recent appointment is a tribute to his wide experience.

Lt.-Col. C. S. L. Hertzberg, M.C., V.D., M.E.I.C., of Toronto has received the appointment of Commander, 1st Divisional Engineers, First Division of the Canadian Active Service Force. He was graduated from the University of Toronto in 1905. During the first World War, he served overseas with the Royal Canadian Engineers. Colonel Hertzberg has acquired a very wide experience in the construction field with the Trussed Concrete Steel Company of Canada and the Bishop Construction Company. He has been a member of the firm of James, London and Hertzberg, consulting engineers and he is at the present time a partner of Harkness and Hertzberg, consulting engineers of Toronto.

Brig.-Gen. T. L. Tremblay, C.M.G., D.S.O., A.M.E.I.C., has been appointed inspector of militia and Canadian Active Service Force units other than those of the First Division, for Eastern Canada. General Tremblay, who was born at Chicoutimi, Que., in 1886, was graduated from the Royal Military College, Kingston, Ont., in June, 1907. He was engaged on railway construction until 1910, and in 1911 he entered private practice as an engineer in Quebec City. At the beginning of the war in 1914, he joined the Canadian Expeditionary Force with the 22nd Battalion. In January, 1916, at the age of thirty, he was appointed commanding officer of this unit. In 1917, he assumed command of the 5th Canadian Infantry Brigade, and in July, 1918 was made Brigadier-General. He served in Belgium, France and Germany, and was awarded the D.S.O., the Croix d'Officier de la Légion d'Honneur and was made a C.M.G. He was mentioned five times in dispatches.

After War, General Tremblay became connected with the Quebec Harbour Commission, first as commissioner and later as chief engineer and general manager. He is presently a member of the Alaska Highway Commission.

Prof. W. L. Malcolm, M.A., B.Sc., M.C.E., PH.D., M.E.I.C., Director of the School of Civil Engineering of Cornell University represented the Institute at the celebrations of the one hundredth anniversary of the birth of Robert Henry Thurston, held at Cornell in co-operation with the American Society of Mechanical Engineers on October 25th. Robert H. Thurston has been recognized as the leading mechanical engineer of his time and as the most influential educator in this field. He was one of the organizers and the first president of the American Society of Mechanical Engineers, serving for two terms.

Hon. C. D. Howe, HON.M.E.I.C., Minister of Transport in the Federal Cabinet, and **Commander C. P. Edwards,**

O.B.E., A.M.E.I.C., chief of air services in the Department of Transport, were in the delegation which officially represented Canada in the dedication ceremonies of Manhattan's vast municipal airport in New York on October 15th.

F. W. Taylor-Bailey, M.E.I.C., has been elected a vice-president of Fairchild Aircraft Limited. He is a graduate in civil engineering from the class of 1916 at McGill University. During the first World War, he was in charge of aerodrome construction for the Department of Fortifications and Works, War Office, and for the Air Ministry, in Great Britain. He later served in France with the 3rd Battalion of the Royal Canadian Engineers. In 1924 he was placed in charge of sales for the Dominion Bridge Company, Ltd. He is at present a vice-president and general manager of this company.

D. A. R. McCannell, M.E.I.C., has been elected president of the Dominion Council of Professional Engineers at the meeting held in Montreal recently. He is a graduate of Queen's University in civil engineering from the class of 1914. He has been with the city of Regina ever since graduation and has held the position of city engineer since 1917. He has been a Councilor of the Institute.

Major M. Barry Watson, A.M.E.I.C., has been appointed permanent Secretary of the Dominion Council of Professional Engineers. He is the Registrar of the Association of Professional Engineers of Ontario and is a member of the executive of the Toronto Branch of the Institute.

Dr. C. A. Robb, M.E.I.C., Head of the Department of Mechanical Engineering at the University of Alberta, Edmonton, has been selected by the War Supply Board to take charge of its Gauge Division.

Dr. Robb's work in Ottawa will be concerned with the supply and inspection of the multitude of precision gauges needed to inspect and ensure the accurate dimensions of the various war stores and munitions to be furnished under the Board.

Hugh A. Lumsden, M.E.I.C., of Hamilton, Ontario, announces that he has opened an office as consulting engineer. He will specialize in municipal engineering and highways.

Carl Stenbol, M.E.I.C., was promoted last June from the position of mechanical superintendent to that of chief engineer of the Algoma Steel Corporation at Sault Ste. Marie, Ont. Mr. Stenbol, who came to this country from Norway early in this century, has been with the Algoma Steel Corporation, Ltd., since 1917, when he was assistant to the managing director. He had been appointed to the position of mechanical superintendent later in the same year.

Robert F. Legget, A.M.E.I.C., assistant professor of civil engineering at the University of Toronto, is to be congratulated as the author of a comprehensive book, entitled "Geology and Engineering," recently published by McGraw-Hill Book Company, Inc., of New York and London.

A. D. M. Curry, M.E.I.C., has been promoted to the rank of Engineer Captain, R.C.N., on October 1st and reappointed to Naval Service Headquarters as Director of Naval Engineering, Naval Service, Department of National Defence, Ottawa, Ont.

H. A. Dixon, A.M.E.I.C., has received the appointment of chief engineer of operation for the system with the Canadian National Railways. He succeeds C. B. Brown, M.E.I.C., who is retiring on pension. Mr. Dixon is a graduate of the School of Practical Science at Toronto and he took his B.A. degree at the University of Toronto with honours in science in 1901. After serving as a land surveyor in Ontario and Mantoba, he joined the Canadian Northern Railway at Winnipeg as a draftsman in 1903 and shortly afterwards became resident engineer. After serving in a supervisory capacity over engineering activities at Maryfield, Sask., Red Pass Junction, Resplendent, B.C., and Vancouver, B.C., he advanced to the position of chief engineer of the western lines of the railway. Mr. Dixon's headquarters will be in Montreal when his appointment becomes effective on January 1st, 1940.

W. H. Moore, A.M.E.I.C., has recently joined the engineering staff of the Canadian Industries Limited in Montreal. A graduate in mechanical and electrical engineering from McGill University, he has been for the past nine years on the engineering staff of the Canadian Marconi Company in responsible charge of research, development and design work on radio transmitting equipment.

W. T. Dempsey, A.M.E.I.C., is now employed with the Colombia Petroleum Company on oil field development in Cucuta, Colombia, S.A. A graduate from the University of Saskatchewan in 1934, he has been since connected with many construction projects in municipal engineering and in the paper industry.

E. A. Russell, Jr.E.I.C., has recently left the Coca Cola Company in Toronto to join the maintenance staff of Canadian Industries Limited at Beloeil, Que. Since graduating in civil engineering from the University of Toronto in 1938, he has been demonstrator in the department of surveying at the University until early this year when he joined the engineering staff of the Coca Cola Company.

J. L. Fair, Jr.E.I.C., has accepted a position in the Patent Office of the Department of Public Works at Ottawa. Upon graduating in electrical engineering from the University of Toronto in 1935, he entered W. C. Wood Company, Ltd., of Toronto, on assembly and testing of electric farm equipment. From 1936 until his recent appointment, he took the students' test course of the Canadian General Electric Company, Ltd.

VISITORS TO HEADQUARTERS

M. I. Bubbis, S.E.I.C. of Regina, Sask., on September 26th.

C. H. McL. Burns, M.E.I.C., works manager of Welland Plants of the Canada Foundries and Forgings Ltd., Welland, Ont., on September 27th.

Major W. D. Adams, M.E.I.C., of Toronto, on October 5th.

Carl Stenbol, M.E.I.C., chief engineer of Algoma Steel Corporation Ltd., Sault Ste. Marie, Ont., on October 5th.

F. L. Lawton, M.E.I.C., chief engineer of the Saguenay Power Company Ltd., Arvida, Que., on October 19th.

Jos. J. White, M.E.I.C., Building Inspector for the City of Regina, Sask., Registrar of the Association of Professional Engineers of Saskatchewan and Secretary-Treasurer of the Saskatchewan Branch of the Institute, on October 19th.

Major M. Barry Watson, M.E.I.C., director of military studies, University of Toronto, Toronto, Ont., and Registrar of the Association of Professional Engineers of the Province of Ontario, on October 19th.

J. B. deHart, M.E.I.C., department of natural resources, Canadian Pacific Railway Co., Calgary, Alta., on October 19th.

C. R. Webb, M.E.I.C., district chief engineer, Dominion Water and Power Bureau, Department of Mines and Resources, Vancouver, B.C., on October 19th.

Roland A. Lemieux, S.E.I.C., assistant division engineer, Department of Roads, Quebec, P.Q., on October 23.

Past-President A. J. Grant, M.E.I.C., of St. Catharines, Ont., on October 23rd.

Capt. J. L. Allan, town engineer, Dartmouth, N.S., on October 23rd.

M. Harrigan, S.E.I.C., marine engineer for Western Union Cable Company, Halifax, N.S., on October 30th.

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 following is a synopsis of the paper presented to the Border Cities Branch at the monthly dinner meeting held in the Prince Edward Hotel on September 22, 1939.

Mr. G. R. Scott, gear consultant with the Michigan Tool Company of Detroit, spoke on **The Evolution of Worm Gearing**, culminating in the cone design.

There are three main classes of worm gears, first those with neither element throated, second those with one element throated and finally the cone type or those with both elements throated.

The history of gears dates to the time of Archimedes when the first type was used. About 1873 the second type was discovered but not until about 15 years ago was the cone type evolved.

When neither element is throated, the theoretical contact is a point, which in practice is a small spot. The load capacity of this gear is therefore very limited. The conventional type where one element is throated has contact between the spindle and wheel, by a theoretical line, or practically a small strip, enabling it to carry more load for a given size, than the right angled spiralled gear. By throating both elements as in the cone design, the theoretical contact is believed to be a line in two directions, or, area contact. Tests in the aircraft industry, of gears, with a design stress of 85 per cent of the yield point of the material, show that for all practical uses there is actual area contact. It is this principle which makes the cone design superior to all others and its applications more varied.

Due to small inaccuracies in manufacture the ultimate wearing surfaces are formed after the gear has been in service. Here the cone gear has the advantage of having both elements help each other, through wear, to develop the true area contact surfaces. The gear may be made of softer metals and its oil pumping action makes it the most easily lubricated.

Tests have shown this design to have efficiencies as high as 99.34 per cent. For ratios of 15½ to 1 and 50 to 1, efficiencies of 98.7 per cent and 88 per cent have been found. Due to its great flexibility in use, high efficiency at a large range of speeds, capacity for heavy loads and its resistance to shock loads, the cone design for gears is now finding universal use in modern industry.

Illustrations and diagrams of the various gears were shown to the branch, and these combined with Mr. Scott's scholarly presentation of the paper proved interesting and intelligible to the members.

A discussion followed.

CALGARY BRANCH

F. J. Heuperman, a.m.e.i.c. - *Secretary-Treasurer*

A general meeting of the Calgary Branch was held on Saturday, October 14, 1939, under the chairmanship of S. G. Coultis, m.e.i.c., with Dean H. W. McKiel, m.e.i.c., President of The Engineering Institute of Canada, and L. Austin Wright, a.m.e.i.c., General Secretary, present as guests. Other guests were P. M. Sauder, m.e.i.c., Lethbridge, Vice-President Zone A; H. S. Carpenter, m.e.i.c., Regina, Past-Vice-President Zone A; J. Robertson, m.e.i.c., Vancouver, Councillor; W. R. Mount, m.e.i.c., Edmonton, Councillor; Prof. I. M. Fraser, a.m.e.i.c., Saskatoon, Chairman Saskatchewan Branch; A. J. Branch, a.m.e.i.c., Lethbridge, Chairman Lethbridge Branch; and C. Garnett, m.e.i.c., Edmonton, Chairman Edmonton Branch. About twenty-six members of the Calgary Branch attended.

Dean McKiel addressed the meeting on **The Engineer in War and Peace** and in addition, both the President and the General Secretary discussed Institute matters of general interest.

During the day Mrs. McKiel and other visiting ladies were entertained at a noon luncheon at the Country Club and an afternoon tea at which the wives of members were given an opportunity to meet Mrs. McKiel was held at the home of Mrs. S. G. Coultis.

In the evening a mixed dinner was held to which were invited representatives of the Canadian Institute of Mining and Metallurgy and the Association of Professional Engineers of Alberta, also visiting past vice-presidents, councillors and chairmen of other branches and their ladies. The City of Calgary was represented by Acting Mayor Frank R. Freeze, in the absence of Mayor A. Davison, and Commissioner J. Tweddle.

A short period of community singing followed the dinner.

S. G. Coultis, m.e.i.c., Chairman of the Calgary Branch, presided and welcomed the members and visitors to the gathering.

On behalf of the City of Calgary, greetings were extended by Mr. Freeze.

Short speeches were made in turn by each of the visitors present.

P. M. Sauder, m.e.i.c., Vice-President Zone A, introduced President McKiel.

Dean McKiel, in a humorous address, outlined the importance of the engineer in civilization, tracing the influence of his work in every phase of the average man's daily life.

During the evening songs were rendered by Mrs. Cailes

Calgary members and their wives entertain President and Mrs. McKiel at the Renfrew Club, Saturday, October 14, 1939

and Mrs. Higginbotham, accompanied on the piano by Mrs. Boese.

Altogether it was a very pleasant evening greatly enjoyed by all.

EDMONTON BRANCH

F. A. Brownie, A.M.E.I.C. - *Secretary-Treasurer*
J. W. Porteous, Jr.E.I.C. - *Branch News Editor*

The first meeting of the Edmonton Branch, on October 12, for the 1939-40 season took the form of a formal dinner in honour of Dean H. W. McKiel, President of the Institute.

Speakers of the evening included Dr. W. A. R. Kerr, President of the University, Mr. M. J. Hilton, Vice-Chairman of the Northern Alberta Branch of the Canadian Institute of Mining and Metallurgy, H. R. Webb, M.E.I.C., Registrar of the Association of Professional Engineers of Alberta, and Lt.-Col. P. L. Debney, A.M.E.I.C., of the Royal Canadian Engineers.

The Chairman introduced Mr. Monkman, President of the Engineering Students' Society at the University, and Dean McKiel presented the Engineering Institute prize for 1939 to Mr. Schulte.

Mr. G. A. Gaherty, M.E.I.C., Chairman of the Institute Committee on Industrial Mobilization, said a few words explaining what could be done by all citizens and by engineers in particular to assist the country during wartime.

Prof. E. Stansfield, M.E.I.C., proposed the toast to the Profession. He referred to the fact that in spite of the remarkable technological advances in recent years engineers were perhaps open to criticism for lack of action along social and political lines.

Dean McKiel replied to the toast to the Profession. In reference to Prof. Stansfield's remarks he agreed that the engineer must take a greater part in public affairs of a political and economic nature and he believed that this change is now taking place. He referred to the position of the engineer in this war, and to the work now being taken up by way of a consideration of the problems of the young engineer.

The President then described the increasingly favourable light in which The Engineering Institute of Canada is held by the general public, by Canadian engineers and by similar organizations in other countries.

Several songs were rendered by Mr. E. F. McGarvey.

Branch Chairman, C. E. Garnett, M.E.I.C., presided and about forty were present.

LAKEHEAD BRANCH

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

The President, Dean H. W. McKiel, accompanied by Mrs. McKiel, arrived at Fort William Sept. 28th at 10.45 p.m., and were met at the station by members of the executive and their wives and escorted to the Royal Edward Hotel.

An informal luncheon was held at the Prince Arthur Hotel, Port Arthur, Friday, September 29th, at 12.30 p.m. J. M. Fleming, M.E.I.C., newly appointed chairman, opened the meeting. He expressed pleasure at the large attendance and welcomed to the Branch two new members—H. H. Tripp, A.M.E.I.C., and W. H. Small, M.E.I.C. Mr. Fleming introduced Prof. McKiel who addressed the meeting. He spoke of the work the Engineering Institute had undertaken in a voluntary registration of the Engineering Institute members for the Department of Defence. Dean McKiel commended the work being done by the committee on the Training and Welfare of the Young Engineer, of which H. F. Bennett, M.E.I.C., is Chairman, and urged the Institute members to support him in this work. The President dealt briefly with engineering education and problems facing the young engineer after graduation. He also expressed satisfaction that the finances of the Institute were in excellent condition. P. E. Doncaster, M.E.I.C., made a motion that the President urge the Council to distribute copies of the report by Huet Massue, M.E.I.C., on Engineering Institute membership. E. L. Goodall, A.M.E.I.C., seconded the motion. R. B. Chandler, M.E.I.C., moved a hearty vote of thanks to the speaker, seconded by S. E. Flook, M.E.I.C.

During the afternoon, members of the Lakehead Branch accompanied the President on a tour of the Canadian Car and Foundry Company's plant.

An informal dinner was held at the Royal Edward Hotel, at 6.30 p.m., with Mr. and Mrs. McKiel as guests of honor. J. M. Fleming, chairman of the Branch, presided. R. B. Chandler led in community singing with Stanley Smith at the piano. Miss Alice Shoales gave a vocal solo, Mrs. C. Hopkins Ould being her accompanist. Prof. McKiel was then introduced by P. E. Doncaster. Prof. McKiel expressed his appreciation of the honor of being elected President of the Institute. He was pleased, he said, to see so many present and complimented the Branch on arranging the meeting to include the ladies. Prof. McKiel chose as his subject the place of the engineer in modern civilization. He outlined the growth of engineering from its earliest beginnings. With the coming of electric power, industry and manufacturing developed enormously, he said. First there was the civil engineer, then the mechanical and now the electrical engineer. Prof. McKiel pictured the average day of a modern home, showing the dependence of civilized men and women on the developments of engineering and science. When engineering dedicated itself to the service of mankind it became a profession. Prof. McKiel said he had not known of one case where an engineer had been found dishonest in carrying out his professional duties. Stanley Smith gave an outline of the history of Mount Allison University, Sackville, N.B., of which University Professor McKiel is Dean of the Faculty of Science. A vote of thanks to Prof. McKiel was moved by E. J. Davies, A.M.E.I.C., and seconded by H. G. O'Leary, A.M.E.I.C.

LETHBRIDGE BRANCH

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

President H. W. McKiel, M.E.I.C., visited the Lethbridge Branch on October 16th accompanied by General Secretary L. A. Wright, A.M.E.I.C., G. A. Gaherty, M.E.I.C., of Montreal, and G. H. Thompson, A.M.E.I.C., of Calgary.

The Branch held a luncheon meeting jointly with the Lethbridge Rotary Club in honour of the visitors. Dean McKiel was introduced by Vice-President P. M. Sauder, M.E.I.C. The Dean paid tribute to Mr. Sauder's work for the Institute and also spoke of the similarity of the aims of Rotary and the Institute. The subject of his address was **The Work of the Engineer in Peace and War,** and he defined engineering as the use of the materials and forces of nature for the benefit of mankind. He traced the ancient origins of the profession, and how it developed from a military science to one which is the basis of modern industry and commerce. The trend of development has gone full cycle, for now we find modern warfare being very highly mechanized, bringing the engineer back very close to the original concept of the profession. The appointment of two engineers Generals A. G. L. McNaughton, M.E.I.C., and T. V. Anderson, A.M.E.I.C., to the highest offices in the new Canadian Active Service Force illustrates the place scientifically trained men have in modern warfare.

But the engineer also has a significant place in civil life in times of war, directing research and organizing production. The technical backing required by a modern mechanized instrument of war is tremendous. To keep one tank and one aeroplane at the front requires the services of a hundred men for production and maintenance. Much research will be necessary to investigate and adopt various substitutes for materials not readily available. In Canada, which is to be a great supply base, the technical men will be the deciding factors in working the scheme of production, and with this in view the Government is conserving and directing the supply of engineers so that their services will be available for the work to which they are trained.

The Dean also pointed out that after the war there will be a still greater need for engineers to work out the problems of readjustment that are sure to follow. He urged that engineers should consider more the social and economic results of their handiwork, that a balanced order may be maintained.

In closing, Dean McKiel gave an excellent résumé of the life of Sir Casimir Gzowski, as an illustration of the romance of engineering.

Following the luncheon meeting the visiting officers met with the corporate members of the Lethbridge Branch to discuss Institute affairs. The President outlined the work being done by the Committee on the Training and Welfare of the Young Engineer. He also spoke of the advantages of regional council meetings, and drew attention to the improved membership and financial standing of the Institute.

General Secretary Wright told of the progress of the recent registration of engineers for National Service, and of other matters dealing with his department.

Mr. Gaherty gave a talk on the work to be done by the Committee on Industrial Mobilization, indicating the scope of the problems industry must face and solve in the prosecution of the war.

The meeting closed after a general discussion of Institute affairs by various members.

LONDON BRANCH

D. S. Scrymgeour, A.M.E.I.C. - *Secretary-Treasurer*
John R. Rostron, A.M.E.I.C. - *Branch News Editor*

The opening meeting of the fall season, 1939, was held on the 18th October, in the Board Room of the Public Utilities Commission at the City Hall.

The speaker was S. R. Frost, A.M.E.I.C., sales director of the North American Cyanamid Company Limited, and his subject—**The Limestone and Lime Industry of the Thames River Valley,** illustrated by lantern slides.

H. F. Bennett, M.E.I.C., chairman of the branch, presided, and in the course of his remarks when opening the meeting, he referred to the activities necessitated by the war making it difficult for various members to carry out our Branch intentions. It is proposed to hold a meeting shortly on the "Training of the Young Engineer" and it is hoped that most of the young prospective engineers in the district will assemble at this meeting. In the meantime he submitted a statement of what had already been done by the committee dealing with this subject and of which he is chairman.

Councillor J. A. Vance, M.E.I.C., introduced the speaker. Mr. Frost opened by describing the location and extent of the quarries. These are situated in the Thames River Valley, between Ingersoll on the west, and Beachville on the east. There is an exposure of high calcium limestone about two miles in length, which belongs to an Early Devonian formation known as the Detroit River Series. The quarriable width is limited, owing to hills about 100 ft. high on either side of the valley, and the presence of the Canadian National Railway tracks on one side and the Canadian Pacific Railway on the other.

The underlying rock formations have a dip to the southwest of one to two feet per 100, and the over-burden at the upper end is approximately 10 ft. in depth, which increases gradually towards the southwest where there is about 25 ft. of overburden.

At the southwest end an overlying cap rock (Onondaga) is deposited so that there is only a distance of 300 to 400 yd. where the full thickness of 90 ft. of high calcium rock is available. This is reduced to about 75 ft. at the northeasterly end, as the valley has been subjected to severe glacial action.

Early operations were crude and were for the manufacture of lime only, which was exposed in the river bed. It was customary to make a diversion of the river in the summer and quarry the rock, but as the purity of the deposit became recognized, and as the demands for high calcium limestone and lime for chemical purposes developed with the growth of the chemical industry, large operations soon superseded those earlier crude efforts.

The removal of the overburden is one of the major items of cost; a good deal of it is used for high dykes for stream diversion, and now that a portion of the quarry has been developed to its full quarriable depth, the overburden is deposited again. Several hundred thousand cubic yards of earth have been so dealt with. Blasting operations are used for the removal of the rock. Large holes are drilled 20 ft. back of the face and 12 ft. apart. Each hole is loaded with about 250 lb. of dynamite, the lower deck 40 per cent strength and the upper 30 per cent. It is important to have simultaneous discharge and the use of a new material named Primacord has been found very successful. The Primacord has a flexible casing enclosing a small amount of explosive material, no caps or primers are required, as the Primacord acts itself as a detonator. The whole of the charges are exploded by means of a short length of ordinary fuse and a No. 6 cap.

After the face is shot down it is handled by steam shovels and motor transport, and brought to the foot of the incline where the cars are hoisted up to the crushers and screens. The minus ⅝th material is used in various ways. A large quantity is used for the manufacture of Portland Cement, and a further amount is ground down and used as stone dust for use in asphalt roads and as a filler for various industrial operations such as the making of paper and for agricultural purposes.

The larger sizes are loaded in open steel hopper cars and sent to Niagara for burning in the kilns. These kilns are eight in number and of the rotary type, 8 ft. in dia. and 125 ft. long. They have a slope of ½-inch to the foot and a speed of one r.p.m. The fuel consists of pulverized coal which is ignited and blown through the kilns, developing a temperature of 2200 to 2500 deg. F. Lime as produced is used, together with coke, as raw materials in the manufacture of calcium carbide in electric furnaces. The calcium carbide is then ground and heated in special ovens and treated with nitrogen, the resultant product being called "cyanamid." Calcium cyanamid is used as a product from which is obtained a whole series of nitrogen compounds such as ammonia, Aero Brand Cyanide, prussiates, etc.

It is used in the industrial production of many well-known commodities widely divergent in character. Amongst these are the making of glass, the refining of sugar, the purifying of water, the withdrawing of impurities from iron ore, and in the making of steel, and also the extraction of gold from the nugget. It is used in the making of paper and precipitated chalk and as a fertilizer for agriculture.

Consignments are sent to all parts of the world for use in various manufactures.

An interesting discussion followed, and many questions were asked of Mr. Frost and answered by him.

Mr. Bennett, in thanking Mr. Frost, drew attention to the articles in the October Journal directed to Students and Members as to their responsibilities in, and in connection with the war.

W. C. Miller, M.E.I.C., also voiced a vote of thanks to the speaker. Twenty-five members and visitors were present.

MONTREAL BRANCH

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

Plans for the Montreal Branch activities for the year have remained unchanged and usual programme of meetings is being planned. The first meeting of the fall session was held at Headquarters on October 5th at 8.15 with an attendance of 120 members. C. C. Lindsay, M.E.I.C., was in the chair and introduced the speaker of the evening, Howard M. Baker, who is in charge of traffic control for the City of Montreal. His paper **Why Be Careless?** described the local traffic situation, the problem of regulation enforcement and the plans for future control of Montreal traffic. Moving pictures were used to illustrate the subject. Following the meeting refreshments were served.

On October 12th Dr. J. J. Green spoke to the Branch on **Streamlining.** He discussed the phenomena arising from the motion of bodies through ideal or perfect fluids, and the different phenomena present in the case of real fluids. The principles underlying the technique of streamlining were developed, and lantern slides were used to illustrate the engineers' attempts to apply these principles to transport vehicles. Dr. Green graduated from London University in physics in 1928 and studied aeronautics and carried out research in aeronautics, at the Royal College of Science, London until 1930. Since that date, he has been on the staff of the National Research Laboratories at Ottawa in charge of wind tunnel research and testing.

Chairman W. F. Drysdale, M.E.I.C., presided at the meeting which was preceded by a courtesy dinner at the Windsor Hotel.

On October 19th the Branch heard G. R. Hale, A.M.E.I.C., on the subject of **The Network Analyzer in System Planning.** A graduate of Harvard University and the Massachusetts Institute of Technology Mr. Hale is now electrical engineer for the Shawinigan Water and Power Company. For a number of years he has been actively engaged in stability and load studies in connection with changes and additions to the generating and transmission system. He discussed actual operating and design problems which his company has solved by means of the A. C. network analyzer, a device which reproduces the operation of an electrical power system under 'load' and transient fault conditions. The analyzer enables engineers to substitute facts for opinions and thus gives the executive a basis for expenditures in future system growth.

The lecture was illustrated by slides of the 'load' studies made in connection with the introduction of the La Tuque power house into the Shawinigan Water and Power Company system and of transient stability studies made to determine the optimum generator characteristics for the La Tuque machines.

Prof. C. V. Christie, M.E.I.C., presided at the meeting.

The fall programme of the Junior Section of the Montreal Branch began on October 18th with a talk on the Institute by C. K. McLeod, A.M.E.I.C., chairman of the Montreal Branch. Mr. McLeod described briefly its organization and activities and its value to the profession, particularly to the student and young engineers.

Two motion pictures were shown through the courtesy of the Shell Oil Company "Prelude to Flight" and "Wings over the Atlantic." Refreshments were served at the close of the meeting.

NIAGARA PENINSULA BRANCH

Geo. E. Griffiths, A.M.E.I.C. - *Secretary-Treasurer*
J. G. Welsh, S.E.I.C. - - - *Branch News Editor*

It has become apparent that there should be greater cooperation among the technical associations of this country, both locally and nationally. This has been under discussion for some time in the Niagara District, and as a result a plan has evolved for the formation and trial for one year of a Niagara District Technical Council. The member societies are the Niagara Peninsula Branch of the E.I.C., American Institute of Electrical Engineers (Niagara District Discussion Group), and Niagara District Chemical and Industrial Association.

Each of the member societies retains its own identity, function, etc. The Council consists of the chairman and one representative from each group, and a secretary appointed from the whole by the Council. Its main purposes are:

1. Control of society meetings to avoid confliction of dates, thereby giving all societies a better chance of good attendance.
2. Consideration of the subjects of the meetings to ensure as wide a variety of topics as possible.
3. Comprehensive coverage of the technicians in the district, by having a general mailing list for all societies. (Notice of all meetings held by each of the member societies will be sent by the N.D.T.C. to the entire mailing list of the three member societies, in order that each person may attend the meetings of the other associations that particularly interest them.)
4. Service to the profession as a whole by giving better information as to meetings of general interest.
5. The possibility of bringing together larger groups in joint and public meetings, so that increased attendance will make it possible to obtain speakers of outstanding merit.

On October 12th, the Council held a joint meeting of its member societies in the Leonard Hotel, St. Catharines, Ont. Mr. W. H. Macartney, chairman of the Council, presided and spoke briefly of the purpose of the N.D.T.C., and introduced the member societies' representatives: A. W. F. McQueen, M.E.I.C., and C. H. McL. Burns, M.E.I.C., of the Niagara Peninsula Branch, E.I.C.; A. S. Robertson, Chairman, and George Morrison, M.E.I.C., of the A.I.E.E.; C. F. Bruce of the Niagara District Chemical and Industrial Association, and R. T. Sawle, S.E.I.C., Secretary.

W. R. Manock, A.M.E.I.C., introduced the speaker of the evening, Mr. H. C. Boardman, chief research engineer of the Chicago Bridge and Iron Co., and President of the American Welding Society, who gave an illustrated talk on **Large Welded Tanks of Cylindrical, Spherical and Spheroidal Shapes.**

Mr. Boardman first pointed out the necessity of a uniform welding code, and showed on the screen the code adopted by the American Welding Society, pointing out its particular reference to welded tanks. The speaker then enlarged upon storage tanks, dealing particularly with those for the storage of volatile liquids such as gasoline. The unevenness of the all-welded tanks of seven or eight years ago, was compared with the almost perfectly smooth tanks, void of "valleys" at the vertical seams made possible by the use of the coated welding rods, and improvement in welding technique and procedure. Mr. Boardman illustrated several unique developments in the gasoline storage tanks of his company, made possible by welding.

For vessels of high working pressure, the cylindrical or spherical forms are usually used, the spherical preferably since it utilizes the metal most economically.

Recent developments in elevated water tanks were next discussed. The speaker said that the swing is undoubtedly toward all welded construction. The standard cone roof is being replaced by the more attractive smooth roof ellipsoidal in shape, with the top capacity line well up in the roof.

A few slides showing the architect's idea of the tanks of the future brought the talk to a close.

C. G. Moon, A.M.E.I.C., moved a hearty vote of thanks to the speaker, and after some discussion the meeting was adjourned.

OTTAWA BRANCH

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

The fall season of the Ottawa Branch commenced with a noon luncheon at the Chateau Laurier on October 5 at which Maxime Cailloux, B.A.Sc., C.E., of Montreal was the guest speaker. Mr. Cailloux, who is a member of the firm of Associated Engineers Limited of Montreal, spoke on the design and construction of **The Concrete Domes of the St. Joseph Basilica, Montreal.***

The address, which was of a technical nature, was illustrated with lantern slides. J. H. Parkin, M.E.I.C., Chairman, presided at the luncheon and introduced the speaker.

SASKATCHEWAN BRANCH

J. J. White, M.E.I.C. - *Secretary-Treasurer*

Visit of the President to Saskatoon

The President and Mrs. McKiel were entertained at tea by Saskatoon members of the Executive Committee of the Saskatchewan Branch of the Institute, on Sunday, October 8th, at the home of Dean C. J. Mackenzie, M.E.I.C, and

*Paper published in The Engineering Journal, October, 1939.

Mrs. Mackenzie. Members of the Institute and of the Faculty of the College of Engineering of the University of Saskatchewan, with their wives, were present.

In spite of the Thanksgiving holiday, thirty-eight engineers attended a banquet on Monday evening in honour of the President. They had an opportunity to meet him and to hear him speak on the work of the Institute.

On Tuesday morning, Dean and Mrs. McKiel were the guests of the College of Engineering. The President addressed the third and fourth year engineering students, and presented the E.I.C. Student prize awarded to the outstanding student of the third year, to D. W. Henderson.

Both Dean and Mrs. McKiel were greatly interested in the Ceramics department of the University.

SAULT STE. MARIE BRANCH

O. A. Evans, Jr.E.I.C. - *Secretary-Treasurer*
N. C. Cowie, Jr.E.I.C. - *Branch News Editor*

The fourth general meeting for the year 1939 was held on September 22nd when 26 members and guests sat down to dinner at 6.45 in the Windsor Hotel. Following this the meeting was called to order at 8 p.m. when Chairman A. E. Pickering, M.E.I.C., proposed a toast to His Majesty, the King. The minutes of the previous meeting were read and adopted on motion of A. H. Russell, A.M.E.I.C., and C. W. Holman, A.M.E.I.C. J. L. Lang, M.E.I.C., and H. J. Leitch, A.M.E.I.C., moved that the bills be paid. Chairman A. E. Pickering then expressed the sympathy of the branch to Mr. J. B. Challies, past president of the Institute, for the loss of his wife. The Chairman also expressed the loss of the branch in the death of J. J. Kelleher, who although not a member had been a regular attendant and had taken part in frequent discussions. Chairman A. E. Pickering then introduced the speaker of the evening, Dean H. W. McKiel, President of The Engineering Institute of Canada. Dean McKiel began his address by bringing greetings from the Sydney Branch of the Institute, stating that the basic industry of each town was steel. He then remarked on the position of Sault Branch on the international border, citing the opportunity this branch had to develop an international membership and foster good will.

Dean McKiel spoke briefly on the position of the engineer in the present war and the mineral wealth of the two opposing factions, stating that the democracies had an overwhelming source of supplies. He recommended any person interested in the subject to read the book of C. K. Leith on "World Minerals and World Politics." He then began his main topic of the evening, **The Young Engineer and the Profession.**

He felt that we were not training the young engineer properly for the responsibilities of the future. He said that there were two major trends to-day; that of the research engineer and the service engineer. The engineer is becoming more and more of a public servant. He believed that the ethics of the profession were very high. He felt that the old divisions of engineers are passing out, many students graduate in one field and practise in another.

The highly trained man or research specialist should have a general training and obtain his specialization after graduation, while the service engineer, besides his general course, should have a course of training in history, economics and psychology. In other words, the schools of to-day should lessen specialization and broaden out.

In view of this fact the Engineering Institute had set up a committee under the chairmanship of Harry F. Bennett, M.E.I.C., of the London Branch. This committee was composed of 70 per cent practical men and 30 per cent academic. He requested those who have the questionnaire sent to them to give it due consideration. He cited the fact that the Carnegie Institute had investigated the field of engineering students and found that 30 per cent graduate in the required time; 40 per cent graduate and the remainder do not ever graduate, while the majority who graduate practise in other fields than that for which they specialized. He felt that the great percentage of failures was due to the fact that students do not realize that engineering is a mathematical science, and possibly the failure was due to this. The duty of the present committee was threefold: fact finding, analysis and interpretation. The duty of the general membership was to supply facts, assist in the interpretation and to criticize. In closing, Dean McKiel requested the branch to set aside a meeting for this purpose. President McKiel thanked the Chairman for calling the meeting and the response from the branch.

Mr. J. L. Lang, M.E.I.C., expressed the gratitude of the branch in a few well chosen words.

Mr. T. F. Rahilly, manager of the Algoma Steel Corporation Ltd., stated that the system now in force at this company was similar to that advocated by the Institute. They employ college students in the summer and give an apprenticeship course after graduation. They also have an apprenticeship course for non-students, teaching them bricklaying, machine shop practice and other trades.

VANCOUVER BRANCH

T. V. Berry, A.M.E.I.C. - *Secretary-Treasurer*

The Vancouver Branch were pleased to entertain Dean McKiel and Mrs. McKiel on their visit to Vancouver on October 19th. A number of the Branch members were on hand to meet the train when the President and his wife arrived.

The Branch were hosts to the President in the evening at dinner in the Hotel Georgia. Fifty-three members and friends were present. At the head table with Ernest Smith, A.M.E.I.C., the Branch Chairman, sat the President Dean McKiel; L. Austin Wright, the General Secretary; Past President S. A. Walkem, M.E.I.C. and E. A. Cleveland, M.E.I.C., J. Robertson, M.E.I.C., Councillor; and Dean Finlayson, M.E.I.C., of the Faculty of Applied Science.

Following dinner the President addressed the gathering on engineering affairs generally. He gave as his opinion that it is the engineer and the scientist who are in a large measure responsible for the economic instability that now exists and possibly for the war that now confronts us. This war is one in which the engineer will play an immense part both on the battle front and on the home front. It was a matter of great satisfaction that the Department of National Defence is recognizing this as has been evidenced by the appointment of engineers to key positions both in the organization of the active army and the gearing of the nations' industry to wartime production. After the war too, the immense problem of reconstruction would be a challenge to the engineer and would require all of his resourcefulness and ingenuity to solve the stupendous problems that will then arise.

A very pleasing feature of the dinner was the presentation of The Engineering Institute of Canada prize award for 1939 to Mr. J. D. Leslie, a fifth year student at the University of British Columbia.

The function ended with the showing of a colour travelogue by Mr. Walter Gilbert, B.C. Superintendent of the Canadian Airways Ltd., taken on a recent survey of the proposed British Columbia-Alaska highway route.

The wives of the Executive members entertained Mrs. McKiel to lunch at the Golf Club—British Pacific Properties, and later in the afternoon Mrs. McKiel met many wives and friends of the Branch members at a tea held in the Georgia Club. These functions were under the convenorship of Mrs. H. N. Macpherson.

The annual visit made by the President of the Institute for the time being, is always looked forward to by the Vancouver Branch members with a great deal of interest, and on this occasion the members had particular pleasure in entertaining Dean McKiel and his charming wife from the farthest east. We hope it will not be long before we shall again have the pleasure of entertaining them.

VICTORIA BRANCH

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

Since his election to the Presidency of the Institute last February the members of the Victoria Branch of The Engineering Institute of Canada have been looking forward with anticipation to the visit of Dean H. W. McKiel to this most westerly Branch. The annual visits of the President and the General Secretary to the western branches have done much to stimulate interest in the Institute, increase attendance at Branch meetings and to promote additional membership. This is undoubtedly due to the opportunity afforded during these annual visits to make personal contact with Headquarters and to discuss Institute affairs directly with those who are in charge.

As a consequence there was a large and very representative attendance of members at the dinner tendered by the Victoria Branch on October 23rd, in honour of President H. W. McKiel and the General Secretary, L. Austin Wright. The dinner was held in Spencer's Lounge Tea Room at 7.00 p.m., and was followed by a period devoted to the messages of the President and the General Secretary and to a general discussion of Institute affairs.

In his address to the Branch, President McKiel referred to the growing interest in the Engineering Institute throughout the entire Dominion and to the considerable increase in membership in recent years particularly from engineers who were well up in the profession. Increased interest and activity had resulted due to the present international situation and many more engineers in uniform were to be seen as was evidenced in the present gathering. He divided the subject into two sections, the engineer at war and the engineer in peace. It was his intention to leave the subject of the engineer at war to Mr. Wright to discuss. Under government direction the Institute had sent out through various bodies some 16,000 copies of a questionnaire intended for the use of engineers in connection with war service. A very large percentage of these had already been returned and were still coming in.

For his part he intended to deal with the engineer and the period of reconstruction after the war was over. This was largely a matter to concern the younger engineer for the responsibility was his to carry on, and the young engineer would have to take hold where the older engineer left off. There was evidence that the role of the engineer was changing. Previously he had thought only of the technical aspects of his job. He had thrust upon an unprepared world developments which it was not prepared to digest and with no thought or consideration of the consequences. Now the time had come to consider the broader viewpoint of the welfare of society and the engineer's effect on it. The engineer had obtained a reputation of honesty and integrity. His motto could well be "service before self." The time has come when he must co-operate with the economist and even the historian. "On the young engineer's shoulders will fall the responsibility of reconstruction. We have a very definite duty to society and I know that the Engineering Institute will measure up to it."

President McKiel stressed the broader meaning of the term engineer and stated that the old divisions such as civil, mechanical, electrical, etc., were passing. They were all engineers without division and it was hard to tell where the limits or boundaries lay. It was well known to university men that from 25 per cent in civil engineering to 54 per cent in chemical engineering university graduates do not practise in the field in which they graduate, illustrating the broad undivided nature of the engineering profession. The Institute was very anxious to co-operate with all engineering and other bodies and felt very strongly its duty to society.

The President spent a few minutes outlining the two by-laws soon to be placed before the corporate membership of the Institute explaining the meanings of the proposed changes.

The Chairman, J. N. Anderson, A.M.E.I.C., then called upon the General Secretary, Mr. L. Austin Wright, to address the meeting. Mr. Wright dealt at some length with the origin and purpose of the recent questionnaire distributed to engineers throughout the Dominion stating that some 16,000 had been sent out and that to date over 9,000 had been returned which was a very good percentage in view of the fact that the returns were purely voluntary. The questionnaire was a national register of technically trained men made with a view to assist industry in time of war. He was continually being asked the question, what next ? and his answer was not to be impatient, that it might take from nine months to a year to properly organize the industry to war needs, that the avoidance of mistakes was a prime consideration and the engineer would be called upon as the need arose.

Mr. Wright reviewed the financial position of the Institute which was in excellent condition with the membership lists growing and stated that many new members of importance had been recently added to the Institute membership.

Following the addresses a very lively discussion ensued prompted by a list of prepared questions by A. L. Carruthers, M.E.I.C., Councillor of the Branch, on Branch and Institute activities and affairs and many points not hitherto fully understood were capably answered by both President McKiel and Mr. Wright. This form of discussion proved very interesting and informative and was confined to topics and problems of particular interest to the Victoria Branch membership.

At the conclusion of the meeting a hearty vote of thanks was proposed to the President and the General Secretary by J. P. Forde, M.E.I.C., who stated that he was satisfied that the Institute was now a national body. He thanked the President and the General Secretary for the privilege of meeting them and for their interest in the Branch.

The entertainment committee consisting of the members of the Branch executive arranged for a number of drives in and around the City of Victoria and to points of interest such as the Dominion Astrophysical Observatory, Mr. Butcharts' Gardens and the Esquimalt Naval Base, while the ladies of the Executive Committee and past chairmen of the Branch under the convenorship of Mrs. A. L. Carruthers and Mrs. J. N. Anderson entertained Mrs. H. W. McKiel, who had accompanied her husband on his trip to the coast, to an afternoon tea at the Empress Hotel on October 23rd. In their arrangements the ladies also included several other teas and an informal bridge in honour of Mrs. McKiel. After a three day stay in Victoria, President and Mrs. McKiel left on the afternoon of October 25th on their return trip east by way of California and the southern States.

WINNIPEG BRANCH

J. Hoogstraten, A.M.E.I.C. - *Secretary-Treasurer*

The visit from Headquarters of President and Mrs. H. W. McKiel marked the opening of the season's programme of meetings and activities. At a luncheon held on October 3rd, President McKiel met with members of the Branch Executive Committee for a thorough review of current Institute problems.

Members of the Branch had the opportunity of meeting President McKiel at a general meeting held on October 3rd, to which members of the Manitoba Association of Professional Engineers were invited.

In his address, President McKiel pointed out that Canadian engineers stand ready to take their positions in national defence. He spoke of the wide registration of technical and professional men carried out by The Engineering Institute of Canada together with the Canadian Institute of Mining and Metallurgy and the Canadian Institute of Chemistry, and reported that these data were being put in form to be used by the Department of National Defence as it sees fit.

Speaking briefly on the proposed co-operation between the Branch and the Professional Engineers of Manitoba, President McKiel pointed out that co-operation is a purely local matter, and gave assurance that the Institute would be found to be sympathetic toward such a move.

In reporting on the work of the Committee of Training and Welfare of the Young Engineer, President McKiel said that there exists a growing tendency to a new division in engineering education, namely, the highly specialized research engineer and the practising engineer. In the study of this problem, the Committee is gathering information by questionnaires sent to Canadian engineers and educators, and it is hoped that recommendations may be reported in the near future.

On October 19th, at a joint meeting of the Branch and the Manitoba Association of Professional Engineers, W. J. Waines, Professor of Political Economy at the University of Manitoba, spoke on **Foreign Exchange Control.**

Under normal conditions, foreign exchange constitutes a free market, and governments are in general not particularly concerned with the operation of foreign exchange. During times of emergency, however, as in the case of a state of war, there exists a greater demand for materials which can be obtained only from foreign countries, and belligerent nations are forced to take steps to assure themselves of an adequate supply of foreign money.

In cases of extreme emergency, a government through the agency of a Foreign Exchange Control Board, commandeers all foreign securities available in the country, paying in return to the holders thereof, securities of the country and the government itself. Moreover, exports as well as imports are licensed in order to maintain a check on foreign securities held in the country. In this country, for instance,if such action by the Foreign Exchange Control Board is deemed necessary, Canadians will become holders of Canadian securities, and foreign securities will be sold abroad by the government.

The mobilization of the gold resources is not an important factor today since Great Britain mobilized its gold in 1914 which has not been relinquished since that time. Canada mobilized its gold resources in 1934, at the time the Bank of Canada was instituted. It is of interest to note that in Great Britain, a large part of the gold formerly held by the Bank of England has been turned over to the British Exchange Equalization Account to avoid the necessity of the publication of weekly accounts, a practice followed by the Bank of England. In order to obtain a greater purchasing power in Canada, it is expected that Great Britain will mobilize Canadian securities to be sold in Canada.

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.

Handbook of Chemistry:

Ed. by N. A. Lange. 3rd ed. Sandusky, Ohio, Handbook Publishers Inc., 1939. 1,850 pp., 5⅝ by 7¾, fabrikoid, $6.00.

U.S. Mineral Yearbook, 1939:

U.S. Department of the Interior Bureau of Mines. Washington, D.C., 1,437 pp., cloth, 6¼ by 9¼ in., $2.00.

PROCEEDINGS, TRANSACTIONS, ETC.

Canadian Electrical Association:

Proceedings forty-ninth annual Convention, 1939.

Royal Society of Canada:

Transactions, Biological Sciences, Vol. 33, Section 5, May, 1939. List of Officers and Members, 1939.

Society for the Promotion of Engineering Education:

Proceedings of forty-sixth annual meeting June, 1938.

REPORTS

Canada Bureau of Mines: Investigations in ore dressing and metallurgy, January to June, 1938, (No. 792). Grindability indices of typical Canadian and other coals and the relation of grindability to friability by R. E. Gilmore and R. J. Young; Fusion point of coal ash (F.P.A.), determinations by R. E. Gilmore and R. J. Young (Memorandum Series Nos. 70 and 71, May, 1939).

Canada Bureau of Mines, Division of Economics: Petroleum refineries in Canada.

Canada Geological Survey: Geology and mineral deposits of Bridge River mining camp, British Columbia, by C. E. Cairnes (Memoir 213).

Edison Electric Institute: A-C Network Operation, 1936-1937 (No. G1, August, 1939).

Electrochemical Society: The Cathodic behavior of zinc versus iron in hot tap water; Polarization and overvoltage with special attention given to transfer resistance; A Pulse amplifier for performing differential electrometric titrations; An Electroanalytical estimation of rhenium; Rectifier equipments in the electrochemical field; The Study of cathodic reactions in metallic corrosion; Measurements with the dropping mercury electrode (Preprints, 76-13 to 76-19).

Ohio State University Studies: Influence of graphite ladle additions on the mechanical properties of gray cast iron by A. H. Dierker, R. P. Schneider and H. H. Dawson; The Effect of calcium chloride admixture with Portland cement by J. R. Shank (Engineering Experiment Station Reports, July, 1939).

BOOKS WANTED

Anyone who wishes to sell the below noted books should communicate with Headquarters. Second-hand copies have been requested by members of the Institute.

Kent's Mechanical Engineer's Handbook

Design. Shop Practice.
John Wiley and Son Inc., New York.

International Conference of Soil Mechanics and Foundation Engineering

June 22 to 26, 1936, Proceedings, 3 vols.

U.S. Bureau of Mines: Coal-mine accidents in the United States, 1936; Metal-mine accidents in the United States, 1936 (Bulletins 420 and 422). The Iron and steel industries of Europe (Economic Paper 19).

University of Illinois: Tests of plaster-model slabs subjected to concentrated loads; First progress report of the joint investigation of continuous welded rail; Moments in simple span bridge slabs with stiffened edges; An Investigation of wrought steel railway car wheels (Bulletins Vol. 36, Nos. 84, 88, 97, 101).

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.

BIG BUSINESS and RADIO

By G. L. Archer. New York, American Historical Company, 1939. 503 pp., illus., diagrs., tables, 10 x 6, cloth, $4.00.

A companion volume to the author's "History of Radio to 1926," the present book overlaps the former as a result of the inclusion of a large amount of new material concerning the struggle in the early 1920's between the groups interested in the field. Continuing from there the story covers subsequent developments and disturbances in connection with talking pictures, television, facsimile, and the general expansion of radio broadcasting. Free use is made of direct quotation, and the part played by various personalities has received full consideration.

COMPANY PLANS for EMPLOYEE PROMOTIONS

By H. Baker. Princeton, N.J., Industrial Relations Section of Princeton University, 1939. 48 pp., charts, 10 x 7 in., paper, $.75.

This pamphlet presents a brief analysis of the promotion programs of representative industrial companies. General procedures in promotional programs, training for promotion, publicity on programs and opportunities and the effect of promotional plans are discussed.

ELECTRICAL ENGINEERING

By E. E. Kimberly. Scranton, Pa., International Textbook Co., 1939. 324 pp., illus., diagrs., charts, tables, 9 x 5 in., flexible, $2.75.

Written specifically for the use of engineering students not majoring in electrical engineering, this textbook presents a comprehensive survey of fundamental theories, practices and machinery. The type and arrangement of the information presented have been chosen to assist the engineer in the intelligent selection of equipment and in dealing with electrical problems.

ELECTRICITY and MAGNETISM

By J. B. Whitehead. New York and London, McGraw-Hill Book Co., 1939. 221 pp., diagrs., charts, tables, 8½ x 5½ in., cloth, $3.00.

Dr. Whitehead's text is a compact presentation of the physical and mathematical theories, intended for fourth-year undergraduate students of physics and electrical engineering. The text follows the approximate chronological order of the classical development of electrical and magnetic science, and aims to meet the needs of those who must acquire the essentials of the theory in a relatively short time.

HANDBOOK OF CHEMISTRY

Compiled and edited by N. A. Lange, assisted by G. M. Forker, with an Appendix of Mathematical Tables and Formulas, by R. S. Burington. 3 ed. rev. and enl. Sandusky, Ohio, Handbook Publishers, Inc., 1939. 1,543 pp., Appendix 249 pp., diagrs., charts, tables, 8 x 5. in., cloth, $6.00.

This useful book contains an unusually extensive collection of chemical and physical data used by chemists, engineers and physicists. The data have been taken from reliable sources and are presented in convenient form for ready reference. This edition has been extensively revised and materially extended.

HANDBOOK OF HYDRAULICS

By H. W. King. 3 ed. New York and London, McGraw-Hill Book Co., 1939. 617 pp.- diagrs., charts, tables, 7 x 4 in., lea., $4.00.

"The outstanding feature of this edition is," according to the preface, "the complete revision and extension of the two chapters on open channels, one dealing with uniform flow and the other with non-uniform flow, adding in all ninety-four pages to the text and tables." The book is intended to provide in compact form the tables and reference data commonly needed for the solution of hydraulic problems, and to serve as a textbook for advanced classes.

HEAT POWER

By E. B. Norris and E. Therkelsen. 2 ed. New York and London, McGraw-Hill Book Co., 1939. 432 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

The major topics of the internal-combustion engine, steam engines, steam turbines, and boiler furnaces are presented in a simple manner, including theory, analysis of heat-cycles and performance, accessories and auxiliaries. This revised edition includes a chapter on refrigeration. Many numerical examples and problems help the student in his practical application of the information. The work varies the usual arrangement by commencing with the internal-combustion engine.

HEATING AND AIR CONDITIONING

By J. R. Allen and J. H. Walker. 5 ed. New York and London, McGraw-Hill Book Co., 1939. 593 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.50.

The purpose of this textbook is to provide a comprehensive account of the theory underlying heating and air conditioning, together with practical information upon design, equipment, etc. The work is adapted for use in engineering schools or by individuals for home study. This edition has been revised throughout and considerably enlarged.

INDUSTRIAL ELECTRICITY, Pt. 1

By C. L. Dawes. 2 ed. New York and London, McGraw-Hill Book Co., 1939. 387 pp., illus., diagrs., charts, tables, 8 x 6 in., cloth, $2.20.

This textbook is designed for use in technical high schools and other schools not of collegiate grade where elementary electrical engineering is taught. The fundamentals of electrical engineering are presented and their industrial applications discussed. The new edition has been revised to bring these applications into accord with current practice.

INSTRUCTION MANUAL for SHEET-METAL WORKERS

By R. W. Selvidge and E. W. Christy. Peoria, Ill., Manual Arts Press, 1939. 167 pp., illus., diagrs., tables, 9 x 6 in., cloth, $1.75.

The fundamental operations in sheet-metal work are successively described, with definite directions for performing each operation. Questions are included to bring out the reasons underlying certain methods. A brief treatment of numerous topics of related trade information, standard data tables, and literature references are of additional help to the student or apprentice.

IONS, ELECTRONS and IONIZING RADIATIONS

By J. A. Crowther. 7 ed. New York, Longmans, Green & Co.; London, Edward Arnold & Co., 1939. 348 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

The recent developments in the field of atomic physics are presented in this textbook for students who have covered the elementary courses. The mathematical treatment has been simplified in order to facilitate a better general understanding of the principles involved. Ionic charges, photo-electricity, atomic structure, and the various kinds of rays and radiations are covered, and each chapter has a brief bibliography.

LUBRICANTS and LUBRICATION

By J. I. Clower. New York and London, McGraw-Hill Book Co., 1939. 464 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $5.00.

In this comprehensive textbook the author devotes the first ten chapters to the fundamentals of lubricants and lubrication in such a way as to enable the student to analyze the requirements of most equipment. The following six chapters apply the basic principles to various machines and make specific recommendations for the analysis of equipment.

A MANUAL OF FOUNDRY PRACTICE

By J. Laing and R. T. Rolfe. New York, Chemical Publishing Co., 1939. 312 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $7.25.

The basic principles of molding and core-making occupy the first few chapters of this manual. Following these a comprehensive treatment of advanced technique is presented, with particular attention to special design problems. Both cast iron and non-ferrous practice are considered, including some information as to their metallurgy, but steel founding has been omitted.

MATHEMATICS OF STATISTICS, Pts. 1 and 2

By J. F. Kenney. New York, D. Van Nostrand Co., 1939. Pt. 1, 248 pp.; Pt. 2, 202 pp.; diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

An elementary textbook which calls for no mathematics beyond the ordinary freshman course in college algebra, this work aims to provide an acquaintance with the fundamental principles and concepts which underlie the applications of statistics in various fields.

MOTOR-CARS TO-DAY (The Pageant of Progress)

By J. Harrison. New York and London, Oxford University Press, 1939. 207 pp., illus., diagrs., tables, 9 x 6 in., cloth, $1.75.

This book gives a clear, detailed description of the construction of the modern automobile, in language as devoid as possible of technical terms. An interesting account of the development of the automobile is prefixed to the description of current practice. The book will be welcome to owners and others who wish to understand the functions of the various parts of the car.

A MUSICAL SLIDE-RULE

By L. S. Lloyd. London and New York, Oxford University Press, 1938. 25 pp., diagrs., tables, 9 x 6 in., paper, 75c.

This booklet is intended as an introduction to the study of the musical scale employed by composers and skilled artists. The differences between the scale of the tuned keyboard instrument and that sung or played on a stringed instrument are described. The reasons for the discrepancies are explained and directions are given for determining these discrepancies by means of a simple slide-rule which accompanies the pamphlet.

NOTIONS D'ÉCLAIRAGISME

By A. Salomon. Paris, Dunod, 1939. 189 pp., illus., diagrs., charts, tables, 10 x 7 in., paper, 58 frs.; bound 78 frs.

The physical and physiological factors of importance in satisfactory lighting installations, the production of light, lighting equipment and the proper illumination of residences and public buildings are covered in this textbook. The book is intended to give architects, artists and decorators a knowledge of the possibilities of modern technique.

THE PARKING PROBLEM in CENTRAL BUSINESS DISTRICTS. Publication No. 64

By O. F. Nolting and P. Oppermann. Chicago, Ill., Public Administration Service, 1939. 28 pp., diagrs., charts, tables, 11 x 8 in., paper, $1.00.

The off-street parking facilities of several large American cities are described and discussed, and various steps are suggested toward solving the parking problem. Certain pertinent data are presented in the form of tables and graphs.

PATENTS AND THE PUBLIC INTEREST

By H. A. Toulmin. New York and London, Harper Bros., 1939. 205 pp., illus., charts, maps, diagrs., 9 x 6 in., cloth, $2.50.

In this volume, Mr. Tolmin surveys our patent system critically and suggests lines of improvement. He discusses the reasons for it, the relation between patents and such public problems as patent pools, unemployment and patent suppression, and analyzes various proposals for its reform. In the final section the author describes the results of various modern inventions.

PETROLEUM PRODUCTION ENGINEERING, Oil Field Exploitation

By L. C. Uren. 2 ed. New York and London, McGraw-Hill Book Co., 1939. 756 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $5.00.

This volume is a revised and much extended edition of the part of "Petroleum Production Engineering" that discusses oil-field exploitation. It affords a survey, in considerable detail, of the technology of oil production, covering the methods and equipment, and the physical principles that control the recovery of petroleum from its reservoir rocks. Each chapter has a selected list of references.

PHYSICAL AND DYNAMICAL METEOROLOGY

By D. Brunt. 2 ed. Cambridge, England, University Press; New York, Macmillan Co., 1939. 428 pp., diagrs., charts, maps, tables, 10 x 7 in., cloth, $6.75.

The aim of this book is to provide English-speaking students with a textbook suitable for postgraduate study, which will represent our present knowledge of theoretical meteorology as completely as possible. The new edition has been extended and in part rearranged.

PHYSICS

By E. Hausmann and E. P. Slack. 2 ed. New York, D. Van Nostrand Co., 1939. 756 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

The aim of this work is to present the essentials of physics to college students who major in science or engineering. It attempts to give a gradual, logical approach to the subject, and to develop and illustrate clearly the fundamental concepts. The new edition has been revised thoroughly, rearranged in the light of teaching experience and provided with many additional problems.

RECLAMATION 1902-1938, a Supplemental Bibliography. (Regional Check List No. 6, May, 1939)

Compiled by J. J. Gaul at the Bibliographical Center for Research, Rocky Mountain Region, the Denver Public Library, Denver, Colo., 1939. 98 pp., manifold copy, 11 x 9 in., cardboard, $1.00.

This bibliography includes references on land reclamation not included in the three bibliographies devoted to that subject which are usually consulted. There are about 1,500 references arranged by author, with indexes by states, projects and dams.

SCIENCE and MECHANIZATION in LAND WARFARE

By D. Portway. New York, Chemical Publishing Co., 1939. 158 pp., diagrs., charts, 9 x 6 in., fabrikoid, $2.50.

Intended for students in the Cambridge University Officers Training Corps, this book supplies, in non-technical language, the principles and some of the details underlying the scientific side of modern warfare. The several chapters are devoted to a description of fundamental scientific principles, the importance of railways in war, the various aspects of mechanization, weather problems, chemical warfare, the work of the army engineer and the signal corps, the artillery survey and some problems of personnel.

THE SENIORITY PRINCIPLE in UNION-MANAGEMENT RELATIONS

By F. H. Harbison. Princeton, N.J., Industrial Relations Section of Princeton University, 1939. 39 pp., 10 x 7 in., paper, $.75.

This study, based largely upon personal interviews with employers and labour leaders, is a digest of experience and opinion on selected aspects of the seniority problem as it applies to the relations of union and management in the mass-production industries. It summarizes the reasons for the demand for seniority rights in trade-union agreements, the degree to which seniority is modified by other factors and the manner in which these modified rights are applied.

SEVEN PLACE NATURAL TRIGONOMETRICAL FUNCTIONS

By H. C. Ives. New York, John Wiley & Sons, 1939. 222 pp., diagrs., charts, tables, 7 x 4 in., cloth, $2.50.

These tables have gone into a second printing, in which certain revisions have been made, particularly in the tables for the time of culmination and elongation of Polaris. The book provides a compact collection for field and office use by surveyors, especially with calculating machines.

STANDARD CHEMICAL AND TECHNICAL DICTIONARY

By H. Bennett. New York, Chemical Publishing Co., 1939. 638 pp., diagrs., 10 x 6 in., cloth, $10.00.

This dictionary is a useful addition to the chemist's library. Over 25,000 terms relating to chemistry and the allied sciences are listed, with concise definitions. Many trade names, abbreviations and symbols are included, as well as explanations of the nomenclature of organic compounds and radicals.

STEAM, AIR, AND GAS POWER

By W. H. Severns and H. E. Degler. 3 ed. New York, John Wiley & Sons, 1939. 511 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.00.

The purpose of this textbook is "to present illustrations, descriptions, and underlying theory of construction, application, and performance of modern heat power plants and their correlated equipment." Numerous changes, reflecting recent progress in this field, have been made in this edition.

STEAM and HOT WATER FITTING

By W. T. Walters. Chicago, American Technical Society, 1939. 184 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $2.00.

A concise manual for those engaged in designing and installing these heating systems.

THE SWITCHGEAR HANDBOOK. Vol. 1—Apparatus

Ed. by W. A. Coates and H. Pearce. New York and Chicagok Pitman Publishing Corp., 1939. 190 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.50.

This book is the joint product of a group of British engineers, each a specialist in the subject he discusses. It is intended as a general guide to switchgear, considered from the point of view of the user rather than the expert designer. After a discussion of the theory, the actual design of circuit breakers, fuses, switches, instrument transformers, voltage regulators and other apparatus are considered and a large amount of useful data presented.

TECHNICAL METHODS OF ORE ANALYSIS for Chemists and Colleges

By A. H. Low, A. J. Weinig and W. P. Schoder. 11 ed. New York, John Wiley & Sons, 1939. 325 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.75.

This manual for the analyst is a revision of the late Dr. Albert H. Low's well-known work. The revisers have retained as much as possible of the original material, but have adopted a uniform presentation, added new methods and introduced directions for "spot" tests.

TRAINS, TRACKS AND TRAVEL

By T. W. Van Metre. New York, Simmons-Boardman Publishing Corp., 1939. 341 pp., illus., diagrs., tables, 10 x 7 in., cloth, $3.50.

This profusely illustrated book, by the Professor of Transportation at Columbia University, gives a readable, accurate account of present-day railroading. The descriptions of equipment and operating methods are clear, simple and detailed. Although intended primarily for boys, the book will be useful to all amateurs of railroading. This edition has been revised and expanded, and entirely reset.

WINTER AIR CONDITIONING; FORCED WARM-AIR HEATING

Edited by S. Konzo. Columbus, Ohio, National Warm Air Heating and Air Conditioning Association, 1939. 532 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.00.

A large portion of this book is based upon the research work in forced-air heating that has been conducted in the Warm-Air Heating Research Residence at the University of Illinois since 1932. From this and supplementary data a comprehensive survey of the present status of the design, installation and operation of the forced-air heating plant is gained. Extensive calculations, both theoretical and actual, are included for all phases of the subject.

WOOD STRUCTURAL DESIGN DATA

2 ed., edited by National Lumber Manufacturers Association, 1337 Connecticut Ave., Washington, D.C., 1939. 296 pp., diagrs., charts, tables, 11 x 8 in., paper, loose-leaf, $1.00; with supplements, $1.25.

This handbook is intended to supply engineers and architects with accurate information on the physical, chemical and mechanical properties of wood and with the data required for its safe, economical use in construction. This edition has been revised and enlarged. The data given have been drawn from the publications of the Forest Products Laboratory and from standard authors on the mechanics of materials.

COMING MEETINGS

American Society of Mechanical Engineers—Sixtieth Annual Meeting, December 4th to 8th, at the Bellevue-Stratford Hotel, Philadelphia, Pa. This is the first time since 1890 that an annual meeting of the Society is being held outside of New York City. Secretary C. E. Davies announces the election of the new officers of the Society for 1940. President, Warren H. McBryde; Vice-Presidents, Kenneth H. Condit, Francis Hodgkinson, J. C. Hunsaker, K. M. Irwin; Managers, J. W. Eshelman, Linn Helander and G. T. Shoemaker. Inquiries as to this meeting should be sent to the Society, 29 West 39th Street, New York.

Eastern Photoelasticity Conference—Tenth Semi-Annual Meeting, December 9th, at Cambridge, Mass., under the auspices of the Department of Mechanical Engineering at the Massachusetts Institute of Technology. Chairman of the local Committee, W. M. Murray, Room 1—321, Massachusetts Institute of Technology, Cambridge Mass., U.S.A.

PRELIMINARY NOTICE

of Application for Admission and for Transfer

October 30th, 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 December, 1939.

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

AUGUSTINE—WILLIAM PERCIVAL, of 1955 Oneida Court, Windsor, Ont. Born at Port Colborne, Ont., June 15th, 1896; Educ.: B.A.Sc., Univ. of Toronto, 1921; 1921-22, inspr., Port Colborne Waterworks; 1922, detailer, Lacakwanna Bridge Co.; 1922-23, detailer, Bethlehem Steel Co.; 1923-29, working for Town of Port Colborne, incl. grade for sidewalks, mapping town for numbering, grade for street lights; 1923-29, mgr., Port Colborne planing mill; 1929 to date, instructor of mech'l. dfting., Windsor Walkerville Vocational School.

References: C. G. R. Armstrong, R. C. Leslie, E. M. Krebser, J. B. Candlish, T. H. Jenkins, C. R. Young, P. E. Adams.

CHARNLEY—JAMES, of Longueuil, Que. Born at Torver, Lancs., England, June 14th, 1896; Educ.: Barrow Technical School. City and Guilds of London Institute. 1913-20, bonded apprentice with Vickers Limited, Barrow-in-Furness, England. Complete training in shops and drawing office. 1914-17, in various shipyards on Clyde, dockyards, and on various battleships, specializing on torpedo and gun control circuits and installation; 1920-21, dftsman., Wayagamack Pulp & Paper Company, Three Rivers; 1922-23, dftsman. and field work, Canadian Comstock Co.; 1923-24, asst. supt., L. K. Comstock Company, New York City, on electrical extensions and alterations to factories; 1924-25, supt. of elect'l. installn. of Elevator No. 3, Montreal, for John S. Metcalf Co.; 1925, engr. with same company on elect'l. design and layout for extension of this elevator; 1925-26, engr. on elect'l. layout of substations, and from 1926 to date, i/c of elect'l. layout and design of indoor and outdoor substations and electric steam generators, incl. control, relay protection and metering circuits, auxiliary apparatus, heating, lighting and power underground distribution systems. Making up of specifications covering various types of elect'l. equipment, also cost estimates and analysis of costs for these substations—Shawinigan Engineering Co. Ltd., Montreal, Que.

References: J. A. McCrory, R. E. Heartz, A. B. Rogers, A. L. Patterson, C. R. Lindsey.

CIRCÉ—ARMAND, of Montreal, Que. Born at Sherrington, Que., Aug. 6th, 1893; Educ.: B.A.Sc., C.E., Ecole Polytechnique, Montreal, 1916; Imperial College of Science and Technology, London, England, 1924. Ecole des Ponts et Chaussées, Paris, 1925; R. P. E. of Que.; 1916-17, surveying, Dept. of Mines; 1917-18, dfting., Dominion Bridge Company; 1919-20, concrete design, J. M. Robertson Ltd.; 1918-19, chief dftsman., American Steel Co. of Cuba; 1920-21, concrete designer, Truscon Steel Co.; 1921-24, steel designer, Dominion Bridge Company; with the Ecole Polytechnique, Montreal, as follows: 1926-34, professor of strength of materials and hydraulics, 1934-39, professor of strength of materials, 1936-37, asst. to the Dean, 1937-38, Director, and 1938 to date, Dean.

References: A. Duperron, A. Frigon, H. Massue, J. A. Lalonde, S. A. Baulne, T. J. Lafrenière.

COTÉ—EUGÈNE, of 2045 Des Carrières St., Montreal, Que. Born at Drummondville, Que. April 1st, 1895; Educ.: 1910-13, Montreal Technical School; 1913-15, survey work in Labrador; 1915-17, dftsman., Peter Lyall & Son, on plant layout dies and fixtures for munition work; 1917-18, principal asst. equipping a shell plant at Montmagny. On completion of plant appointed in charge of production until the end of the war. 1918-20, dftsman., Canadian Allis-Chalmers, on pumps, turbines, steam engines, etc.; 1920-22, dfting. and designing for R. L. Kelsch, consltg. engr., on a hydraulic power plant at Magog, steam plants for the Provincial Paper Mills, the Canadian Cotton Mills, and for the town of Marysville, N.B.; 1922-24, detailer and checker, on hydraulic turbines, Dominion Engineering Works; 1924-26, i/c checking drawings and ordering material for Charles Walmsley & Co., on paper machines for Price Bros. and Powell River; 1926 to date, with the Shawinigan Engineering Co. Ltd., Montreal, as follows: Partially designing, detailing and ordering material for various power developments; principal asst. on design and layout of constrn. plant for the Mattawin River Storage Dam, the recently completed power development at Rapide Blanc, and the project now under constrn. at La Tuque, also on prelim. studies leading to location and layout of the latter development. At present on layout of central governor system, lubricating, cooling, filtering, etc., for the La Tuque power plant.

References: J. A. McCrory, R. E. Heartz, A. L. Patterson, C. R. Lindsey, W. W. Graham.

DOWLER—JOHN B., of 754 Chilver Road, Windsor, Ont. Born at Galt, Ont., June 20th, 1908; Educ.: B.A.Sc., Univ. of Toronto, 1931; with the Ford Motor Company of Canada as follows: 1931-34, tool crib supervisor and trouble man, gen. stores dept.; 1934-35, tool designer on jig and fixture work, machine shop dfting. office; 1935, asst. foreman, rear axle dept.; 1935-37, night shift foreman, valve dept.; 1937 to date, apprentice supervisor, apprentice school.

References: J. E. Porter, J. B. Candlish, G. W. Lusby, W. A. Dawson, C. G. Walton.

HALTRECHT—ARNOLD, of 740 Bloomfield Ave., Outremont, Que. Born at Berlin, Germany, Aug. 11th, 1902; Educ.: 1924-28, Technical College, Darmstadt. Diploma in Engrg., 1928; 1928, testing high voltage apparatus, Voigt & Haeffner, Frankfort; 1928-29, designing radio equipment, Kramolin & Co., Berlin; 1930-31, C.N.R., drawing, estimating, designing, calculating, in chief elec'l. engr's office; 1932 to date, proprietor, Electroradio Engineering Company, Montreal, Que. Designing and building testing equipment and public address systems.

References: R. G. Gage, H. J. Roast, W. H. Cook, B. E. Bayne, G. L. Dickson, T. H. Dickson.

HENRY—DOWARD ALEXANDER, of 138 Ellsworth Ave., Toronto, Ont. Born at Singhamton, Ont., May 31st, 1915; Educ.: B.A.Sc. (Mech.), Univ. of Toronto, 1938; 1935-38, summer machine shop work; 1938 to date, dftsman., Massey-Harris Co. Ltd., Toronto, Ont.

References: J. S. Campbell, J. J. Spence.

JONES—ERNEST HAROLD, of North Bay, Ont. Born at Edinburgh, Scotland, May 30th, 1902; Educ.: 1920-24, Heriot Watt College, Edinburgh. Certified mining surveyor, Edinburgh Old University, 1928. R.P.E. of Ontario, 1938; 1918-20 (summers) and 1920-26, articled to Edinburgh Collieries Co. Ltd., 1920-24, asst. in mining engineer's office, surface and underground surveys, instrument work, assting. in mining design, concrete and steel constrn. work, geol. surveys, etc. Continued with same company, and from May, 1928 to May, 1929, qualified and licensed engr. (C.M.S.), making surface and underground surveys and connecting tunnels, designing mining methods and general mining practice; 1929-30, asst. right-of-way engr., Bell Telephone Company of Canada; 1931-32, asst. engr., Township Engr's Office, East York, Ont.; 1932-33, private tutor for matric. students; 1933-34, misc. engrg. work; 1934 (Mar.-Aug.), supt., Canadian Slate Mines Ltd.; 1934 (Aug.-Dec.), engr., New Roy Gold Mines; 1934-35, engr., Payore Gold Mines Ltd.; 1935, dftsman., 1935-36, instr'man., and April 1936 to date, res. engr., Ontario Dept. of Highways, North Bay, Ont.

References: H. G. Rose, H. Robertson, R. E. Smythe, T. F. Francis, J. V. Ludgate.

RONSON—JAMES KENNETH, of 1195 Kildare Road, Windsor, Ont. Born at Walkerville, Ont., Nov. 11th, 1913; Educ.: B.A.Sc. (Mech.), Univ. of Toronto, 1938; 1934-37 (summers), tool repair, power house, plant layout office, and from May, 1938 to date, engrg, dept., Ford Motor Co. Ltd., Windsor, Ont.

References: J. E. Daubney, C. G. Walton, J. B. Candlish, J. E. Porter, R. W. Angus, V. W. MacIsaac.

STAIRS—JAMES ALFRED, of Montreal, Que. Born at Dartmouth, N.S., Dec. 21st, 1876; Educ.: Grad., R.M.C., 1897; 1897-98, rly. surveying and map work; 1899-1902, mech. dftsman. and constrn. work; 1902-03, asst. supt. rolling mills, Carnegie Steel Co.; 1903-04, constrn. engr., Lackawanna Steel Co.; 1904-09, asst. supt. and supt. of rolling mills, N.S. Steel & Coal Co., Trenton, N.S.; 1909-18, vice-

(CONTINUED ON PAGE 499)

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

YOUNG GRADUATE MECHANICAL ENGINEER. Previous experience not necessary but preferably one with a slight amount in machine design, lay-outs, estimating, draughting, shop practice and general maintenance in a good sized industrial plant. French language would be helpful. Must have initiative, ability to accept responsibility and work harmoniously with large organization. Applications should include experience, age and fullest details. Box No. 1954-V.

GRADUATE ENGINEER, experienced in steel pipe manufacture with some knowledge of industrial management. Knowledge of French an asset. Position is permanent and well remunerated for the right man. Apply giving full particulars to Box No. 1962-V.

SENIOR ENGINEER capable of taking charge of engineering department in a large pulp and paper mill in Ontario. Extensive experience in the pulp and paper field essential. Permanent. Write full particulars to Box No. 1968-V.

GRADUATE ENGINEER—preferably with a few years experience in civil or mechanical engineering and some secretarial and literary ability. State qualifications and salary expected. Must be willing to reside in Ottawa. Apply to Box No. 1976-V.

ELECTRICAL ENGINEER with single and polyphase metering experience capable of handling meter department and assuming responsibility. Single man with knowledge of Spanish preferred although not imperative. Location South America. Apply to Box No. 1979-V.

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.

MECHANICAL DRAUGHTSMAN, 12 years experience in mechanical and structural draughting and general mechanical design, including recently perfected new type Diesel head. Married. Age 37. B.Sc in mechanical engineering. Employed steadily but desirous of good opportunity in Diesel or general mechanical field. Apply to Box No. 1081-W.

CHEMICAL ENGINEER, McGill '34. Pulp and paper mill experience, production control, meter maintenance, and tests. Apply to Box No. 1222-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.

TECHNICALLY TRAINED EXECUTIVE, general experience covers organization and management in business and industrial fields; including sales, purchasing, productions, accounting and costing, also industrial surveys, reorganizations and amalgamations in the United States and Canada. B.Sc. degree in mechanical engineering. Married. Canadian. Apply to Box No. 1871-W.

MANUFACTURING EXECUTIVE, B.Sc. in mechanical engineering. Married. Canadian. Experienced in munitions manufacturing and other precision work. Apply to Box No. 1872-W.

CIVIL ENGINEER, A.M.E.I.C. Married. Ten years experience on railway location and construction. Twenty years on hydro-electric power and mill construction in executive capacity in charge of preliminary investigation, engineering, estimating, costs and purchasing. At present unengaged owing to the firm associated with discontinuing operations. Available at once. Apply to Box No. 1896-W.

CIVIL ENGINEER, B.Sc., S.E.I.C. Age 31. Canadian. Interested in sale and production work. Speaks Polish, Slovak, Ukrainian. Apply to Box No. 1955-W.

ELECTRICAL ENGINEER, B.E. (N.S.T.C. '35). Age 25. Single. Three summers as paving inspector. One year selling, servicing and installing theatre sound equipment. Willing to go anywhere on short notice. Apply to Box No. 1959-W.

ELECTRICAL ENGINEER, B.Sc. (E.E.) Man. '37. Age 26. Two years experience with large manufacturing firm one year in factory work testing and inspecting, transformers, industrial control gear, fractional motors and large A.C. and D.C. rotating machinery. Three months in engineering dept. of wire and cable factory. Nine months in training course covering factory organization and production methods. References. Location immaterial. Available on short notice. Apply to Box No. 1961-W

LARGE SCALE PRODUCTION EXPERIENCE in an airplane factory or other plant, with a view to learning the business and a permanent position, desired by young man, single, age 25, S.E.I.C., having a B.Sc. degree with distinction in engineering and advanced training in economics and business. Past work includes highway design, draughting, four years as advertising solicitor, and at present engaged in design and related work in the steel industry. Available on two weeks notice. Apply to Box No. 1962-W.

ELECTRICAL ENGINEER, B.Sc., E.E. '37, age 23, single, Canadian. Experience includes one year in large electrical factory, testing large and small motors, generators and transformers; also one year and a half on sales engineering work. Interested in permanent position with a good future. Would consider any location. References available on short notice. Apply to Box No. 1981-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.

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. 2019-W.

PRELIMINARY NOTICE (CONTINUED FROM PAGE 498)

president and gen. supt., Brown Machine Co., New Glasgow, N.S.; 1914-17, equipped and in full charge of shell plant for Imperial Munitions Board; 1917-18, gen. supt., Harroun Motor Corpn., Wayne, Mich.; 1919-20, plant engrg. work, Ford Motor Co., River Rouge, Mich.; 1922-24, design of air recuperators, Calorizing Co., Pittsburgh; 1924-27, supt., Merchant Bar Mills, Tata Iron & Steel Co., India; 1928-32, design of rolling mills, United Engineering & Foundry Co., Pittsburgh; 1937-39, design of rolling mills and mining mchy., Dominion Engineering Works Ltd., Montreal; at present, manufacturing metallic packing, "Plasco" Regd., 389 St. Paul St. W., Montreal, Que.

References: G. A. Gaherty, H. T. Doran, H. D. Chambers, H. A. Crombie, P. E. Poitras.

TRETHEWAY—GRAHAM D., of 1580 West 71st Ave., Vancouver, B.C. Born at Spokane, Wash., Sept. 11th, 1915; Educ.: B.A.Sc. (Chem.), Univ. of B.C., 1937; 1938 to date, test chemist, B.C. Pulp & Paper Company, at Woodfibre and Port Alice, B.C.

References: T. V. Berry, V. Dolmage, J. N. Finlayson, J. C. Oliver, A. Peebles.

WEAVER—RALPH CROWELL, of Dartmouth, N.S. Born at Boston, Mass., Dec. 25th, 1901; Educ.: B.S. (Mech.), Tufts College, 1925; 1925-27, dftsman., designer, and cost man on automatic packaging machy., Flather Mfg. Co., Nashua, N.H. Since Jan., 1927 with Plymouth Cordage Company, of North Plymouth, Mass. 1927-32, mech. engr. i/c of physical tests and research, at research laboratory. 1932 appointed asst. supt. of plant. May, 1938, assigned to Consumers Cordage Co., of Dartmouth, as res. engr. i/c of installing complete mfg. unit of machy., introducing new methods of manufacturing, all hiring and dismissals, personnel arrangements, plant engrg, etc. From May, 1938 to date, complete and final responsibility for above mentioned duties.

References: J. S. Misener, J. D. Fraser, A. D. Nickerson, A. G. Tibbits, J. H. Winfield.

WILSON—HAROLD OLIVER, of Montreal, Que. Born at Chapleau, Ont., Sept. 21st, 1915; Educ.: B.Sc. (Elec.), Queen's Univ., 1937; 1936 (summer), electrician's helper; 1937 to date, dfting., elect'l. layout, Shawinigan Engineering Company, Montreal, Que.

References: J. A. McCrory, R. E. Heartz, A. L. Patterson, W. W. Graham.

WOTHERSPOON—RICHARD BRADBURY, of Gananoque, Ont. Born at Port Hope, Ont., June 11th, 1914; Educ.: Grad. R.M.C., 1935. 1936-37, one year mech'l. sciences, Cambridge Univ.; 1935-37, training with Royal Engineers, Chatham, England; 1938 to date, plant engr., Steel Company of Canada, Gananoque, Ont.

References: H. M. Jaquays, G. G. M. Carr-Harris, H. H. Lawson, L. F. Grant, O. T. Macklem.

YONG—MARK, of 383 Princess St., Kingston, Ont. Born at Canton, China, Sept. 16th, 1905; Educ.: Credit for 2 years work, Fac. App. Science, Queen's Univ., 1931. B.S.E. (C.E.), Feb. 1936, M.S., Sept., 1936, Univ. of Mich.; 1929-30 (summers), McIntyre Cons. Gold Mines Ltd., and topog'l. survey, Dept. of Interior; 1936-37, Nanking municipal govt. engr., topog'l. survey of Nanking district, design and layout of lots, streets, etc., and design and constrn. of sewerage system; 1937-38, railroad engr. of Hunan-Kwangsi Railway, Hengyang, Hunan, China. Relocation of rly., design of station bldgs., yards and platforms. Design and constrn. of timber bridge, boring foundations.

References: L. T. Rutledge, L. M. Arkley, W. P. Wilgar, D. S. Ellis, J. E. Goodman, C. Miller, A. T. Cairncross.

FOR TRANSFER FROM THE CLASS OF JUNIOR

ADDISON—JOHN HILLOCK, of Barranca Bermeja, Colombia, South America. Born at Toronto, Ont., Feb. 25th, 1912; Educ.: B.A.Sc. (Civil), Univ. of Toronto, 1933; Summers—1928, asst. timekpr., Royal York Hotel; 1929, jr. engr., Dominion Bridge Co., Copper Cliff, Ont.; 1930, jr. engr., Bituminous Spraying Co., Toronto; 1933-35, surveyor, Mine Finders Ltd., Toronto; 1936, res. engr., for diamond drilling and surface exploration, Wilport Gold Mines Ltd., Beardmore, Ont.; 1936-37, underground engr. and surveyor, Preston East Dome Mines Ltd., So. Porcupine, Ont.; 1937-38, asst. mgr. and engr., surveying, design of structures, supervision of mining development, Martin-Bird Gold Mines Ltd., Lardner Lake, Ont.; 1938, res. engr., exploration and development, Agami Gold Mines Ltd., Oba, Ont.; Feb. 1939 to date, topog'l. engr., Tropical Oil Company, Barranca Bermeja, Colombia. (St. 1932, Jr. 1935).

References: D. C. Tennant, C. R. Young, C. H. Mitchell, A. C. Macnab, R. E. Smythe.

D'AOUST—JOSEPH GILBERT, of Powell River, B.C. Born at Vancouver, June 14th, 1905; Educ.: B.A.Sc. (Mech.), Univ. of B.C., 1927. R.P.E. of B.C.; 1928-30, mech. dftsman., B.C. Pulp & Paper Co.; 1930, dftsman., J. R. Grant, M.E.I.C., and inspr., Dominion Bridge Co.; 1931-33, inspr., City of Vancouver; 1934-37, mech. dftsman., and 1937 to date, junior engr., Powell River Company, Ltd., Powell River, B.C. (Jr. 1930).

References: N. Beaton, W. Jamieson, C. J. Jeffreys, D. A. Evans, J. C. Oliver, J. R. Grant, T. H. Fenner.

FOR TRANSFER FROM THE CLASS OF STUDENT

CRASTER—JAMES EDMUND, of Trail, B.C. Born at Vernon, B.C., Feb. 3rd, 1907; Educ.: B.A.Sc., Univ. of B.C., 1930; Summer 1928, machinist asst., Port Alice Paper Mill; 1930-31, asst. to mech. engr., Can. Gen. Elec. Co. Ltd.; 1934-35, machinist asst., Trail smelter, 1936-37, tracer, and 1937 to date, junior dftsman., Cons. Mining & Smelting Co. Ltd., Trail, B.C. (St. 1930).

References: H. A. Moore, G. H. Bancroft, A. C. Ridgers, S. C. Montgomery, A. S. Mansbridge.

KING—HECTOR IRONS, of Bathurst, N.B. Born at Perth, N.B., March 3rd, 1916; Educ.: B.Sc. (Civil), Univ. of N.B., 1937; 1935-36 (Fall mos.), student instructor, surveying, Univ. of N.B.; 1936-37 (summers), instr'man., Dept. of Highways of N.B.; Sept. 1937 to date, asst. purchasing agent, Bathurst Power & Paper Co. Ltd., Bathurst, N.B. (St. 1938).

References: R. L. Weldon, E. O. Turner, J. Stephens, G. Stead, A. F. Baird, W. J. Lawson, D. Ross.

McCABE—RUSSELL I., of 4904 Grosvenor Ave., Montreal, Que. Born at Cowansville, Que., Jan. 30th, 1908; Educ.: B.Sc. (Mech.), McGill Univ., 1930; 1924-27 (summers), gen. work, Canada Paper Co., Windsor Mills, Que.; 1928 (summer), body assembly line, Ford Motor Co. of Canada, Montreal; 1929 (summer), dfting. and gen. work, Shawinigan Water & Power Co., Shawinigan Falls; June, 1930 to date, telephone divn., Northern Electric Co. Ltd., Montreal, Que. For the past three years—chief of the studies dept., and controlling new and changed design apparatus and equipment from a manufacturing point of view and compiling shop load and stock mtce. studies, etc. (St. 1928).

References: H. H. Vroom, H. J. Vennes, J. S. Cameron, J. W. Fagan, C. A. Peachey.

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

CAR PULLERS, HOISTS AND WINCHES

Stephens-Adamson Mfg. Co. Ltd. of Belleville, Ont., have issued an 8-page catalogue No. 1339, containing revised up-to-the-minute information on all Stephens-Adamson car pullers, hoists and sheaves of standard design, as well as certain of their hand and motor-operated winches. The catalogue is illustrated with photographs and sectional drawings and contains specifications and other important data.

HYDRAULIC PRESSES

An 8-page illustrated pamphlet has been issued by Dominion Engineering Co. Ltd. featuring Dominion hydraulic presses. The pamphlet contains some 15 photographs of different presses designed for a variety of uses. Copies may be obtained by addressing the company at P.O. Box 220, Montreal, Que.

INDUCTION MOTORS

The English Electric Co. of Canada Ltd., of St. Catharines, Ont., have issued a 4-page bulletin No. 2000-A illustrating and describing their type "D" protected induction motors (Nema Standards). General specifications are contained in the bulletin and the outstanding features of this motor are clearly stated.

MAGNETIC ACROSS-THE-LINE STARTERS

A 4-page descriptive bulletin is being distributed by English Electric Co. of Canada Ltd. of St. Catharines, Ont., listing the various types of English Electric across-the-line starters and designating the bulletin number under which each type is described. The present bulletin also contains general specifications covering all types.

CAPACITOR MOTORS

The type KC-½ to 1 hp. capacitor motors of the Canadian General Electric Co. Ltd. of Toronto, is described and illustrated in a 4-page bulletin issued by the company. It contains a detailed description of the construction of these motors and their mounting arrangements for every requirement.

STEAM GENERATORS

A 4-page illustrated bulletin issued by the Canadian General Electric Co. Ltd. of Toronto, Ont., describes the G.E. electric steam generator. The bulletin contains a drawing outlining a typical steam generator.

TRANSMISSION EQUIPMENT

Dominion transmission equipment is comprehensively described in an 8-page pamphlet issued by Dominion Engineering Co. Ltd., P.O. Box 220, Montreal, Que. This pamphlet covers standard speed reducing and increasing gear units; gear motors; cone worm gear units; anti-friction bearings; gearflex couplings and gears and pinions.

PERMANENT MAGNET EQUIPMENTS

The advantages of permanent magnet equipments are set forth in a 4-page leaflet (No. PM 32) issued by Electromagnets Ltd. Birmingham, Eng., through Bepco Canada Ltd., Montreal and Toronto. The leaflet illustrates and describes chute type magnetic separators with flux control and without flux control; magnetic drums and pulleys and also bench or suspension type magnets and hand magnets with flux control.

IMPACT PULVERIZERS

Whiting Corporation of Harvey, Illinois, are distributing a forty-eight-page illustrated catalogue giving full information of Whiting's complete line of pulverizing equipment and are presently featuring, in a leaflet, the Whiting impact pulverizer.

C-O-B HI-TENSION NEWS

Canadian Ohio Brass Co. Ltd., Niagara Falls, Ont., issue a monthly news publication, varying from 4 to 8 or more pages, dealing with the important features of O-B equipment and outstanding examples of their use. These monthly bulletins entitled "C-O-B Hi-Tension News" contain a fund of useful and up-to-the-minute information.

OILLESS BEARINGS

A complete new catalogue describing Metaline Oilless Bronze Bearings has just been issued by the R. W. Rhoades Metaline Company, of Long Island City, N.Y. It presents the history of these bearings, the various types manufactured—standard and special—and shows the flexibility possible in meeting unusual requirements. The catalogue is generously illustrated.

DEVICE ELIMINATING MOTOR-GENERATOR SETS FOR TELEVISION RECEIVERS

A device which eliminates the need for motor-generator sets for television receivers operated in districts served with direct-current power has been announced by Canadian General Electric Co. Limited.

It is a new type of vibrator inverter for changing direct into alternating current. Television sets cannot be operated on direct current, and somewhat costly motor-generator sets have been a necessary accessory to provide alternating current in districts where it is not commercially available.

The new-type inverter can also be used to provide alternating current for fluorescent lighting on railway cars, neon sign installations on automotive vehicles, and police car short-wave radio sets.

NEWLY APPOINTED PRESIDENT OF DOMINION RUBBER

Paul C. Jones, who has been appointed President of Dominion Rubber Company Limited, following the retirement of W. A. Eden, who becomes vice-chairman of the Board of Directors, was formerly chairman of the Board of Terminal Warehouses, Limited, of Toronto, and affiliate companies.

Paul C. Jones, President
Dominion Rubber Company, Limited

SPRAYED LIMPET ASBESTOS

A 24-page "Report of Tests on the Fire Resistance of Sprayed Limpet Asbestos," issued by J. W. Roberts, Ltd. of Armley, Leeds, England, has been received from Atlas Asbestos Company, Ltd., Montreal. The report is the result of tests undertaken by the Department of Scientific and Industrial Research, Building Research Station at the Fire Testing Station of the Fire Officers' Committee.

MONEL IN THE BUILDING FIELD

An interesting booklet entitled "Rustless Strength in Vital Spots" is being distributed by the International Nickel Co. of Canada Ltd. Toronto, Ont., dealing with the use of Monel in equipment, materials and accessories used in modern building construction. The use of white metals with rustless or corrosion-resistant qualities for ornamental work is well known, as are also the applications of Monel in kitchen service equipment.

Lesser known are Monel hanger rods and tie-wires for ceilings, anchor wire for tile roofing, corrosion-resisting parts for pumps in buildings, valves and steam joint gaskets, anchor bolts and safety studs, flashing, gutters and miscellaneous builders' hardware. More specialized but also of interest to the building industries are applications in air conditioning, refrigeration and sprinkler equipment, temperature and pressure controls, boiler meters and regulating valves. Developments in this field are reviewed in this booklet.

CONE WORM GEAR UNITS

Dominion Engineering Co. Ltd., Montreal, have prepared a 32-page catalogue and data book illustrating and describing Dominion cone worm gear units. The development and design of these units and the mounting of the gear sets are described at length, as are also the features of the various types of unit. In addition, some 17 pages are devoted to useful engineering data relative to Dominion cone worm gear units.

ELECTRIC ASSAY FURNACE

A 2-page pamphlet has been issued by Canadian General Electric Co. Ltd. of Toronto, describing with specifications the features of the company's electric assay furnace.

ROOTERS, SCRAPERS AND TRACTORS

Two new pictorial folders filled with job pictures and engineering data featuring scraper and tractor efficiency are now available through R. G. LeTourneau, Inc., of Peoria, Ill., manufacturers of construction equipment.

The Rooter folder, based on actual job data, explains the application of the Rooter, and how hardpan, limestone, shale, gravel, and frozen ground, after being "Rooted," can now easily be handled by scrapers.

A second folder gives the advantages of a tractor crane and shows how the same power that digs ditches, builds highways, throws up dikes, does fine grading, can be made available to handle heavy, awkward loads up to 10 tons.

AIR CONDITIONING UNITS

The Carbondale Division of Worthington Pump and Machinery Corp., Harrison, N.J., have published a description of the Worthington-Carbondale combined unit air conditioner in a six-page folder which may be obtained on application to the Company.

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THE ENGINEERING JOURNAL

VOLUME 22 DECEMBER 1939 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."

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VOLUNTARY REGISTRATION BUREAU

The following announcement has been issued by the Under Secretary of State at Ottawa. It is printed here in order that all members will know of the final disposition of the records and for their general information.

It has been announced that H. M. Tory, Esq., D.Sc., LL.D., D.C.L., F.R.S.C., F.R.H.S., has been appointed to take charge of the technical section of the Voluntary Service Registration Bureau.

Some months ago The Engineering Institute of Canada, The Canadian Institute of Chemistry and The Canadian Institute of Mining and Metallurgy undertook a very thorough canvass, not only of the members of their respective associations, but of all technical people belonging to their professions throughout Canada. This canvass involved a great amount of careful work on the part of the three Institutes and it is recognized by the Government that the records compiled as a result of this survey will be of the greatest assistance in the prosecution of the war.

In order that the fullest possible use may be made of the material obtained from the work of the Institutes, the records are being turned over to the Voluntary Service Registration Bureau and will be supervised by Dr. Tory, as head of the new technical section. The records will be at the disposal of departments or agencies of government seeking, for emergency purposes, the assistance of qualified engineers and other technologists, and also of industrial firms engaged in the manufacture of war supplies who may be in need of technical assistance. The offers of service previously sent direct to the Bureau from professional engineers and other technologists will be combined with the records which are being turned over to the technical section of the Bureau.

The Government greatly appreciates the patriotic service of the three Institutes in conducting the canvass and anticipates that in the working of the technical section it will have the benefit of further co-operation from the Institutes.

It may be desirable to explain to the members of the Institutes and others who have replied to questionnaires that every effort is being made to bring the records to the notice of departments, agencies and firms, in order that the fullest possible use may be made of the information. It will, of course, be understood that the planning of the war effort and its development along industrial lines will, necessarily, take time and that, so far as possible, it is being carried out to avoid disruption of normal industrial activities. It is hoped, therefore, that the engineers and technologists will appreciate that, while there may not be an immediate call for their services, their qualifications are being carefully studied and, as the need arises, will be utilized.

In some instances, those who have received questionnaires have not yet completed them. In these cases, to avoid any possibility of confusion and duplications, it is suggested that the questionnaires when completed should be returned to the particular Institute or agency from which they were received. The Institute will then see that the information contained in the questionnaire is made available to the technical section of the Bureau.

Dr. Tory is President of the Royal Society of Canada, a former President of the National Research Council and has been closely associated with the professions for a number of years.

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CANADIAN NICKEL

ITS HISTORY, PRODUCTION AND USES

By K. H. J. CLARKE

Sales Engineer, The International Nickel Company of Canada, Limited

Paper presented before the Toronto Branch of The Engineering Institute of Canada, October 12, 1939.

Canada's importance in world affairs can be attributed to a few matters in which she is pre-eminent. Of these, the great nickel industry is one of the most outstanding.

Historical and General

There is deposited along the outer edge of the Sudbury basin, an elliptically shaped area 36 miles long and 17 miles wide, the most important of the world's present commercially available nickel deposits. This basin extends in a northeasterly direction, the city of Sudbury being almost opposite its centre point and removed approximately two miles from its most southerly outside edge. The most important mines are found clustered along the southern boundary, the only mine of note on the northern boundary being the International Nickel Company's Levack property. Four other important ore bodies are being worked at the present time. They are the Frood mine, the largest mine in Canada, the Creighton mine, worked as early as 1899, the Garson mine and the Falconbridge mine. The first three are operated by the International Nickel Company of Canada, Limited, making four properties in all from which they are at present drawing ore.

The first indication of the existence of this famous basin has been found as a mere note of passing interest in a surveyor's field book. It was in 1856 that a government surveyor while running base, meridian and range lines preparatory to a general survey and sub-division of land between Lake Nipissing and Sault Ste. Marie, noticed a compass deflection of as much as 14 deg. while in the vicinity of what is now the Creighton mine.

Until 1883, this observation went unheeded. Then in this year the Canadian Pacific Railway in its drive to the west came to a point about four miles northwest of what is now the city of Sudbury, where it was necessary to make a deep rock cut. The resultant loose rock was bronze-like in appearance and later analysis showed a high copper content. With a new railroad all ready to handle transportation, the stage was set for the birth of the Canadian nickel industry.

Although the nickel industry was launched at this time, it was copper and not nickel for which prospectors combed the district in the next four years. Practically all of the important ore bodies were discovered by 1887.

During the era subsequent to this discovery and as a gradual development toward what we now know as the International Nickel Company, two important individuals stand out. They are Samuel J. Ritchie and Col. Robt. M. Thompson. Mr. Ritchie at the time of the Sudbury discovery possessed large but unprofitable iron ore deposits in Hastings County, Ontario, in conjunction with which he had built a 100 mile railroad to carry the ore to a lake port. The ore proved unsaleable and he began to think of extending his Central Ontario Railway to draw from these new rich copper deposits. Thus in 1885 he optioned and purchased many prospects and formed the Canadian Copper Company to develop them. This was the earliest Canadian corporate beginning of what is now the International Nickel Company of Canada, Limited.

In 1878 Col. Thompson with an associate had built a plant at Bayonne, N.J., for the refining of ores from a small Quebec mining property that had shown promise of developing into a copper producer. He bought out his associate's interests and incorporated his new company as the Orford Copper Company. Ritchie approached Thompson in 1886, with the object of contracting with him for the refining of Sudbury ores at the Bayonne refinery. A contract was signed between the two companies and the first shipment was made.

It was at this point that the nickel, ignored up to this time, began to assert itself. The ore smelted to a pale white metal that the Orford Copper Company's customers would not take. Nickel was soon identified as the culprit. There was Ritchie with immense deposits containing enough nickel to satisfy world needs for many years and Thompson with a contract to refine the ore, but as yet they were without an economical method to separate the nickel from its now less important companion the copper.

World production of nickel during this year 1886 was about 1,000 tons, most of which came from New Caledonia deposits controlled by the Rothschilds. The uses of nickel were confined mainly to nickel silver, nickel plating and coinage. Thompson and Ritchie, although without a process for refining the mixture, set out to find a market.

The answer came in 1889. James Riley of Glasgow read before the British Iron and Steel Institute his classic paper on experiments with nickel steels. Following this, with Ritchie forcing the issue, the United States Government

Fig. 1—Truck and shovel operating at Frood mine where surface, or open pit, mining obtains average grade of ore by combining surface and underground ore

tested nickel alloy steel for armour plate and their results were so promising that they decided to adopt it as standard.

Thompson got the contract for supply without any satisfactory method of separation. He made the first delivery, filling the order with an oxide containing most of the nickel but with iron and copper also present. In the meantime during his experiments he had introduced nitre cake to the furnace and upon solidification of the resultant matte, he found to his surprise that the bottom part of the button shape into which it had been cast was practically pure nickel sulphide while the upper portion carried the copper. This became known as the Orford process and is fundamentally the process used to-day.

There were several factors working against the new industry. The demand was still not great. The European market was closely controlled by powerful foreign interests who had built up a trade prejudice in favour of New Caledonia nickel and in addition to this, the ore was still

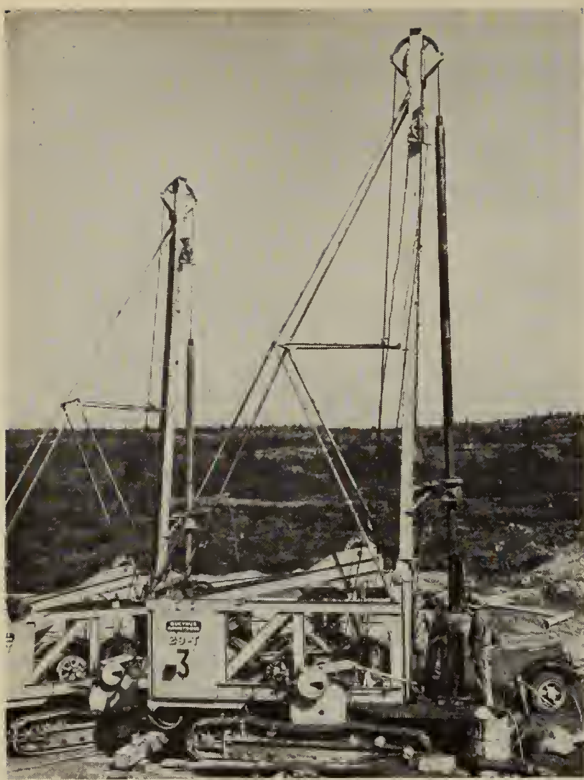

Fig. 2—Two of the drills used at Frood mine in surface mining by which average ore recovery is achieved when surface and underground ore are blended

costly to treat. A price war at this time made many small Sudbury producers fold up.

Thompson and Ritchie stuck to their guns in the face of stiff opposition and were able to obtain with much effort part of the British trade. As the contract between the Canadian Copper Company and the Orford Copper Company began to approach its completion, it became evident that good business demanded consolidation. In order to take advantage of the growing market and to produce at a satisfactorily low cost, larger plants had to be built and better equipment installed. This required capital and consolidation and in order to effect this the two companies merged in 1902 and the International Nickel Company was organized. The following decade was one of plant rehabilitation and market expansion. Many improvements were made in the metallurgy of the process and when the World War began, the company was prepared for the demands which were made on it.

At the end of the war the demand for nickel fell off to its 1900 level and prospects were far from bright. The management, however, instituted in 1919 a campaign of research and development to extend the use of nickel and nickel alloys in peacetime industries. Their success in this venture is a remarkable instance of industrial expansion. Production of Canadian nickel grew from a low of 6,500 tons in 1921 to 55,000 tons in 1929.

In 1916, the nickel refinery was being built at Port Colborne, Ontario, and, in order to consolidate the mining, smelting and refining operations which were now wholly confined to Canada, the International Nickel Company of Canada Limited, was formed.

In 1928, the interests of the International Nickel Company were merged with those of the Mond Nickel Company, Limited, which had started mining operations in the Sudbury district in 1900, and which refined at Clydach, Wales, by the nickel carbonyl process, an entirely different method, in which pure nickel is deposited in small pellets.

By this merger the International Nickel Company of Canada, Limited, became the parent company consolidating in a single Canadian corporation the various nickel interests, in the United Kingdom and the United States, with those of the Dominion. Mining, production and marketing were thus brought under our management.

This co-ordination of activities has resulted in rapid, yet stable development.

The present extent of the nickel industry can perhaps be best shown by a few 1938 statistics. During this year, world consumption of nickel reached an estimated 204,000,000 lb. of which the International Nickel Company produced approximately 164,000,000 or 82 per cent. World consumptions for the years 1908, 1918 and 1928 as a comparison were respectively: 32,000,000; 48,000,000 and 110,000,000 pounds.

From the four mines, Frood, Creighton, Levack and Garson, there was hoisted a total of 5,700,000 tons of ore and the underground developments of these mines including shafts, drifts, crosscuts, etc., amount to 136 miles.

The concentrator at Copper Cliff handled during 1938 approximately 4,500,000 tons of ore or a daily average of 12,300 tons.

Operations

The present relative importance of the Company's four mines can be gathered from the 1938 tonnage figures. During this year Frood yielded approximately 3,500,000 tons of ore, Creighton 1,000,000 tons, Levack 800,000 and Garson 360,000.

The Sudbury district ore bodies are not like the massive iron deposits of Michigan nor the vein and stringer type found in our northern gold mines but are lens-like in form,

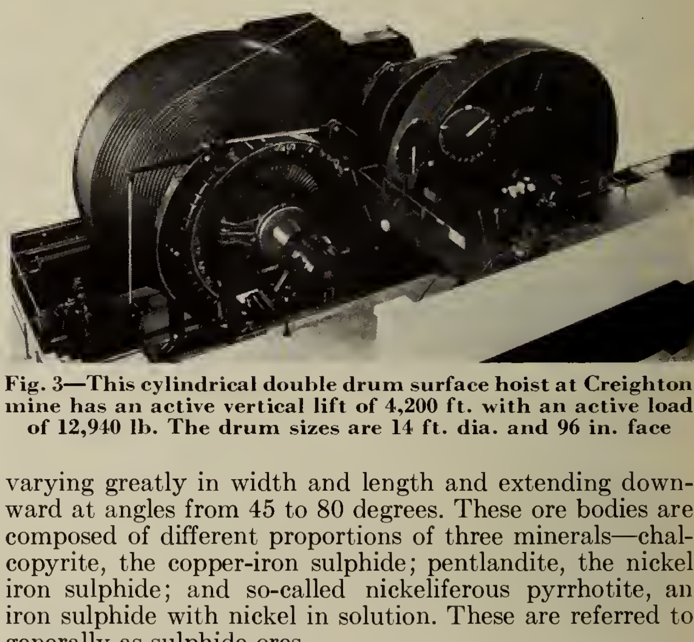

Fig. 3—This cylindrical double drum surface hoist at Creighton mine has an active vertical lift of 4,200 ft. with an active load of 12,940 lb. The drum sizes are 14 ft. dia. and 96 in. face

varying greatly in width and length and extending downward at angles from 45 to 80 degrees. These ore bodies are composed of different proportions of three minerals—chalcopyrite, the copper-iron sulphide; pentlandite, the nickel iron sulphide; and so-called nickeliferous pyrrhotite, an iron sulphide with nickel in solution. These are referred to generally as sulphide ores.

An example of the other major type of nickel occurrence is found in the New Caledonian deposits. These are referred to generally as silicate ores and are associated with and derived from the mineral serpentine. These ores are free from copper and contain almost 50 per cent of silica.

Silicate ore deposits occur in Egypt, Madagascar and Greece. Sulphides similar to Canadian deposits have been found in Tasmania, South Africa, Norway and Finland. Other references indicate that nickel deposits have been recorded in Brazil, Celebes, Greece, Germany, Italy and Russia. Most discoveries have been low grade and unworkable, except in case of national emergencies when cost is no object and outside sources of supply cut off.

Mining methods vary somewhat even between the International Nickel Company's own mines, safety and economics being the deciding factors. The Creighton ore body was at one time mined by the "shrinkage stoping" method. A stope is a section in underground operations in which ore is broken down in large quantities. In the shrinkage stoping method the stope is blasted down in stages and ore withdrawn in quantities sufficient only to allow working room. Rock increases in bulk 30 to 40 per cent when broken and obviously a certain amount must be withdrawn periodically. By this method when the stope is completed, the accumulated broken ore is withdrawn and the ore passes blocked. Waste rock is then usually fed into the completed stope to support the walls.

This method has been supplanted by the horizontal cut and fill method and the square set and fill method. These methods assure maximum extraction of the high grade ore and permit the lower grade in the upper levels to be fully supported so that it can be mined at a later date. This is now being done. At the Frood Mine the upper levels are being open pit worked in a similar manner to the huge porphyry copper deposits in Utah and the southwestern states. In the fill methods, the broken ore is removed as blasted and the working platforms raised every shift by waste fill. This is now considered to be the safest and most economical method of mining as the ore can be followed and dilution by waste material considerably lessened.

The ore as broken is much too large for handling at the surface. Immense jaw crushers at various levels underground break it so that the largest piece is no greater than 6 inches. It is then hoisted to the surface and is sent to the concentrator and smelter at Copper Cliff.

Copper Cliff, the site of the great concentrating and smelting works of the International Nickel Company is a town of slightly over 3,000 inhabitants with its own hospital, schools and recreation clubs.

When the ore reaches the concentrator it contains nickel, copper, sulphur, iron and waste matter or so-called gangue, in addition to small amounts of gold, silver and platinum group metals. Although the grade naturally varies considerably with the various mines and levels, ratios vary from one-third nickel and two-thirds copper to one-third copper and two-thirds nickel. One may be surprised at the fact that copper is so prominently mentioned, but it is nevertheless a true picture. In 1938 the International Nickel Company produced 290,000,000 lb. of copper from their Sudbury ores, and although a by-product, this is an important phase of the company's operations.

It is, of course, necessary to remove as much of the gangue as possible before smelting, and this is done by means of 'selective flotation.'

The incoming ore varying in size up to 6 in. is crushed in cone crushers to one inch size. Fine ore is screened from this product and successive roll crushings reduce the material in size until it is considered sufficiently fine for the wet grinding circuit.

As the efficiency of the flotation process depends on the extent to which the sulphide particles are separated from the waste material, fine grinding is necessary, which can be done most satisfactorily when the ore is mixed with a considerable amount of water. This is accomplished in rod mills which are operated in closed circuit with classifiers.

Some materials are more easily wetted than others and this principle is the one underlying the flotation process. Sulphide particles are not easily wetted whereas the gangue wets quite readily. When small additions of certain oils and organic compounds are added to the flotation cells, these tendencies are accentuated. By this means the first copper and nickel separation is made. In its simplest form the flotation process takes place in the following manner. Finely ground pulp is admitted to a flotation cell, various flotation agents are added, and air is admitted at the bottom forming stable bubbles to which the sulphides adhere. These bubbles rise to the surface, leaving the waste matter behind, and are skimmed as a froth and conducted away by means of launders.

The sulphide that most easily floats comes off first and it was found that a copper sulphide concentrate low in nickel could be produced.

Two concentrates are therefore made. The first is a low

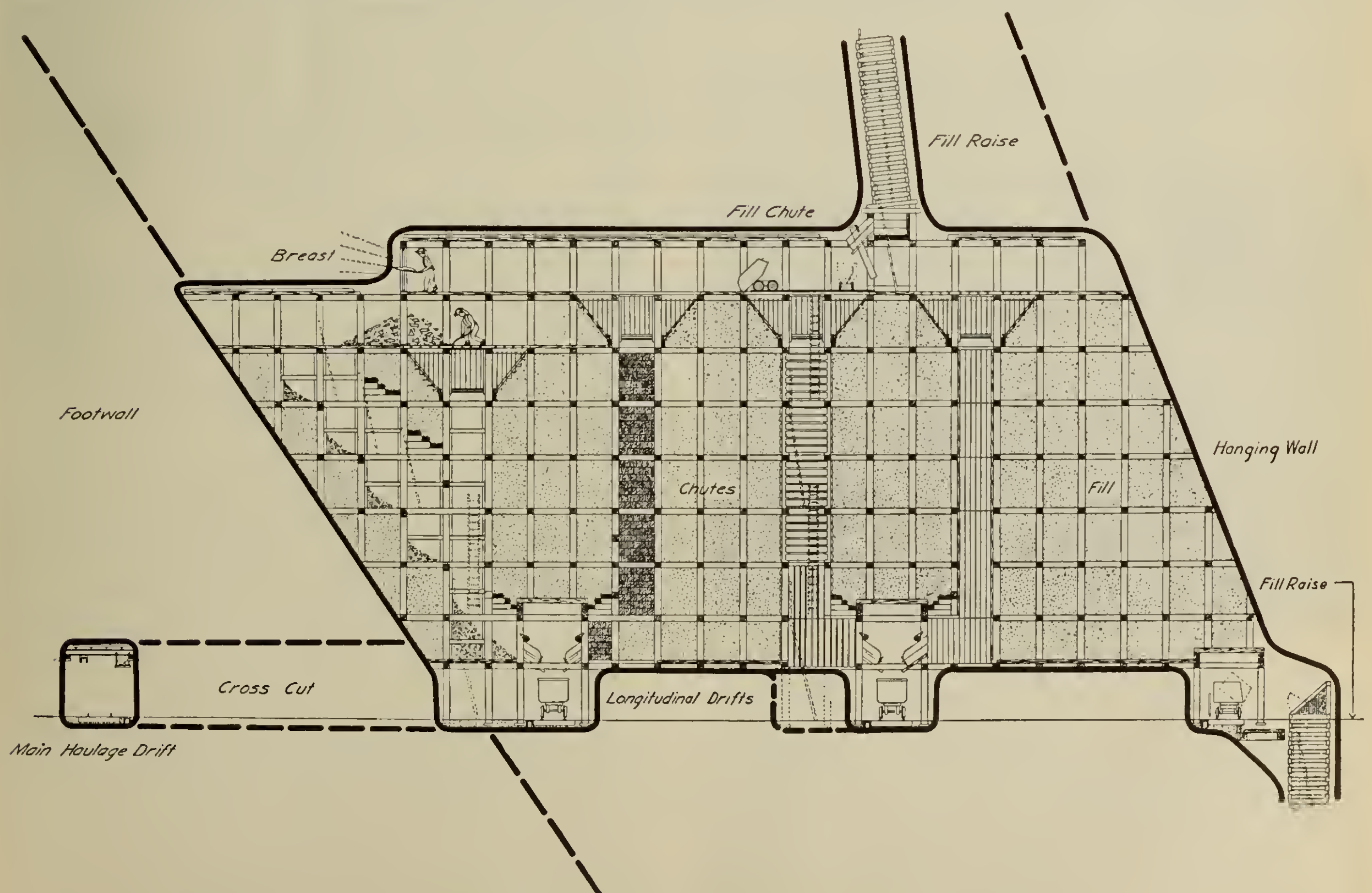

Fig. 4—Frood mine standard stope section

Fig. 5—A stream of molten nickel pouring into the huge waiting ladle as one of the furnaces is tapped in the refinery at Port Colborne

nickel copper sulphide, whereas the second is a mixture of nickel and copper sulphides, both with a considerable amount of iron present.

The *first concentrate* or copper sulphide follows normal copper smelting practice. This concentrate is first smelted in large refractory-lined reverberatory furnaces, each 110 ft. long and 24 ft. wide and fired with pulverized coal. A small amount of flux in the form of sand is added to slag off impurities, and matte containing mainly copper, iron and sulphur results. This matte is melted and blown in barrel shaped converters 13 ft. in dia. by 35 ft. long. Air is forced through the molten material combining with the sulphur which burns off as sulphur dioxide. By careful control and flux addition, the mass is left as practically pure copper known as blister copper. This product together with copper produced after separation from the nickel in the second concentrate is transported to the copper refining division about 1½ mi. from the smelter. An interesting innovation is the development of so-called hot metal cars for transportation of molten copper between these plants. These portable furnaces hold 70 tons, and with their charges of molten metal, are an interesting sight as they pass between the smelter and the refinery. Copper is electrolytically refined to extreme purity at the copper refining division, formerly the Ontario Refining Company, and is marketed in all the usual commercial shapes.

The *second concentrate* or nickel-copper-sulphide mixture is more difficult to treat. It is first roasted in huge vertical roasters in which the sulphur content is reduced from 28 to 16 per cent. It is then fed to reverberatory furnaces in a similar manner to the copper concentrate. Sand flux is added and during the smelting cycle a matte of nickel, copper, iron and sulphur is formed, having a copper plus nickel content of 20 per cent. This matte is converted in a manner similar to the copper matte with the exception that treatment is stopped after the iron has been oxidized and slagged off and the copper plus nickel content has been raised to 75 per cent. If it were blown until all the sulphur were removed it would solidify at the converter temperature.

This material is now known as bessemer matte and is subjected to the old Orford process. A representative analysis would be 48 per cent nickel, 2 per cent copper, 2 per cent iron and 23 per cent sulphur. This matte is smelted in blast furnaces with coke and sodium sulphate. This breaks down to sodium sulphide which has a marked dissolving power for copper sulphide. Nickel sulphide, however, is practically insoluble in it and thus after furnacing and settling, the nickel sulphide settles to the bottom and the copper and sodium sulphides rise to the top. This is the tops and bottoms process. The separation is not perfect so the first bottoms are again subjected to this treatment. The second bottoms, now fairly pure nickel sulphide, are shipped to the electrolytic nickel refinery at Port Colborne, Ontario.

The first tops or mixture of copper and sodium sulphides are charged to barrel type converters 10 ft. in dia. by 35 ft. long where the sodium sulphide is oxidized to sulphate. Copper sulphide with the small amount of entrained nickel is not soluble in this and settles out. The sulphate is poured off and used over again in the treatment of fresh matte. The copper sulphide with its small content of nickel is transferred to another converter where it is reblown. The residual nickel is slagged off and the sulphur blown to sulphur dioxide. The remaining blister copper is charged to hot metal cars and joins the blister copper from the first concentrate at the copper refinery.

A representative analysis of the second bottoms or almost pure nickel sulphide, as sent to Port Colborne would show 70 per cent nickel and 27 per cent sulphur. In this mixture would also be concentrated most of the platinum group metals. The gold and silver has a tendency to stay with the copper and is recovered for the most part at the Ontario Refining Company. During 1938, The International Nickel Company sold approximately 193,000 oz. of platinum metals including palladium, rhodium, iridium and ruthenium, 82,000 oz. of gold and 2,470,000 oz. of silver as well as 60,000 lb. of selenium and 3,000 lb. of tellurium.

At Port Colborne the sulphide is first crushed and then leached with hot water to remove any entrained sodium sulphide. A 10 per cent sulphuric acid leach follows this treatment to reduce the already low iron content. The leached sulphide is then washed with water.

For the production of high purity electrolytic nickel, this leached nickel sulphide is dried and then desulphurized on Dwight and Lloyd machines producing a rough nickel oxide known as "sinter." These machines are huge endless moving trays onto which the sulphide is fed and burned during its transit from front to discharge end where it falls off in cake form. Its sulphur content is reduced to 0.4 per cent by this treatment.

The sinter is then crushed and mixed with coal which acts as a reducing agent in its action on the nickel oxide sinter. The mixture is charged to oil fired reverberatory furnaces 25 ft. long by 10 ft. wide. From these furnaces the reduced nickel is cast molten into anode forms. These anodes weigh about 480 lb. and contain approximately 96 per cent nickel, 2 per cent copper, 0.75 per cent iron and 0.75 per cent sulphur. These anodes are then electrolytically refined by electro-deposition from a nickel sulphate solution. Cathode starting sheets are produced by plating thin sheets of nickel on aluminum or stainless steel blanks. Anodes and cathodes are then placed alternatively in mastic lined concrete tanks. Copper and iron would both plate out before nickel, so an ingenious diaphragm arrangement is used around the cathode by means of which a hydrostatic head is maintained. By this method the impure electrolyte in the area of the dissolving anode is circulated through a purification system and pure nickel sulphate electrolyte is fed into the cathode area. Pure nickel only is deposited from the purified electrolyte. When the cathode starting sheet, which weighed perhaps 10 lb. has been built up to about 135 lb. it is pulled from the tank and a new starting sheet put in its place. This cathode nickel, now 99.9 per cent pure, is the final product and is sheared into various convenient sizes for customer shipments. For special alloying purposes this cathode nickel is remelted, analysis arranged to suit the intended purpose, and shotted by means of a stream of water.

No discussion of the International Nickel Company's operations is complete without reference to monel.

The process of direct conversion of certain specially balanced nickel copper ores into this natural alloy of two-third nickel and one-third copper was developed about 1904 by Mr. Robert C. Stanley, the present president of the company.

Specially selected ores low in silica are roasted with limestone on Dwight and Lloyd sintering machines where the sulphur is reduced to about 10 per cent. The resultant sinter is smelted in blast furnaces to matte which is blown in converters to a white metal known as converter matte. This contains a total copper plus nickel content of about 80 per cent in the ratio of 2 to 1 nickel to copper, the balance being sulphur. It is then shipped to the International Nickel Company's conversion and rolling mill in Huntington, W.Va., where it is refined by means of electric furnaces and made into the required forms, such as sheet, tubes and rod.

Uses and Marketing

The scale of the production end of the business may be judged from the fact that during 1938 disbursements in Canada were over $63,000,000 of which about $19,000,000 was paid to employees.

Most references to the International Nickel Company stress production and certainly the producing units of the company have done an amazingly successful job. There is however another very important angle to be considered and that is the market. In the final analysis production is governed by sales and the engineering development and research in the market field that has been so actively carried on by the company since 1922 is also an outstanding achievement. An important part of the programme has been bringing to the attention of engineers the latest accurate detailed information and data on nickel-containing alloys. This is accomplished by personal contact and engineering bulletins and articles.

Two types of research are actively carried on by the company, namely, that associated with marketing, searching for new alloys and trying to improve those already in use, and works research, or that associated with the improvement and control of its own producing plants and products. Three main laboratories located at Bayonne, N.J.; Birmingham, England; and Copper Cliff, Ontario; come under the first category with the last mentioned also handling control work. Works laboratories are located at Acton, England; Clydach, Wales; Huntington, West Virginia; and Port Colborne, Ontario.

The uses of nickel and nickel alloys can be classed most conveniently in three groups: ferrous alloys, non-ferrous alloys and pure nickel. Of these three classes, the first is the most important. The last survey showed that of the various forms in which nickel entered world industry, 65 per cent was in steel, cast iron or high nickel-iron alloys.

Ferrous Alloys

Subdivision of this ferrous group in turn shows that the biggest tonnage outlet for nickel is strangely enough in steels of relatively low nickel content. These are the so-called constructional steels carrying from 0.5 to 7 per cent nickel. This refers particularly to the well known Society of Automotive Engineers series which has done so much for the standardization of alloy steels.

In order to explain the function of nickel in steel, it is necessary first to discuss briefly steel and it sheat treatment.

Steel is actually an alloy of iron and carbon with carbon present as the compound Fe_3C, a carbide known as cementite.

In a hypoeutectoid steel or one containing less than 0.9 per cent carbon, the microstructure in the as-rolled condition consists of pearlite or alternate crystals of iron and cementite with an excess of pure iron, or ferrite, as it is called. Upon heating the steel it passes through a temperature range known as the critical range during which phase changes take place. Above the critical range the cementite and the ferrite form a solid solution known as austenite, which on being cooled, breaks down into other forms, namely: martensite, troostite, sorbite, or its original form pearlite, depending on the rate of cooling. Martensite is slightly changed austenite and is the chief constituent of rapidly cooled steel. Troostite and sorbite are further stages in the transformation of austenite into pearlite.

Each of these microstructure forms has different properties and steel heat treatment in its simplest form consists of heating the steel, holding it at a temperature above the critical range, and quenching from that temperature in various media such as oil or water so that the rate of cooling is such that the desired resultant structure will be obtained. It is then tempered or drawn at a temperature lower than the critical temperature to modify this structure in accordance with the desired properties.

Nickel has a twofold function. Firstly, it strengthens, toughens and hardens the ferrite without loss of ductility, and secondly, it lowers the critical temperature and slows down the transformation rate of austenite into the other forms. This means that lower quenching temperatures and less drastic quenches are necessary.

The lowered quenching temperature necessary for heat treatment results in finer grain with improved elastic properties, impact resistance and toughness. It also reduces fuel costs and equipment wear. The less drastic quench results in a more stable structure with fewer internal stresses and less cracking and warping. Because of these several influencing factors, performance and properties are more easily reproduced in an alloy steel than in a plain carbon steel. The necessity of this, where quality is of paramount importance, as in the automotive industry, is apparent.

These low alloy nickel steels are used in practically all the principal industrial fields because of their dependability,

Fig. 6—Flotation cells in concentrator

high strength and toughness which can be enhanced to such an extent by heat treatment.

For special requirements there are also a variety of complex nickel-containing steels with different proportions of chromium, molybdenum, vanadium and other elements. They are used extensively in the automotive field for axles, transmission gears, connecting rods, steering knuckles and other parts. They are also widely used industrially for such parts as hydraulic press columns, cast and forged rolls,

Fig. 7—The converter aisle at Copper Cliff

shear blades, reduction gears, pump shafts and roller bearings. The low carbon 2 to 2½ per cent nickel steels are used for boiler plate and welded pressure vessel construction particularly for use at low temperatures.

In this low alloy steel group we also have nickel steel castings which are used because of high strength and ductility with resistance to shock, fatigue and wear, and are yet of moderate cost. They are used for locomotive frames, ore and rock crushers, high pressure valves, steel mill rolls and tractor and road machinery parts, to mention but a few.

The next group or corrosion resistant steels are represented most notably by so-called stainless steels, containing about 18 per cent chromium, and 8 per cent nickel. In addition to a high degree of corrosion resistance against many chemicals, these alloys possess excellent mechanical properties with high strength and fatigue resistance. With these high percentages of nickel and chromium, the lower critical temperature is dropped to such an extent that the structure remains austenitic at normal room temperature. Several so-called stainless steels for special purposes have a lower alloy content. These are not austenitic in structure and should not be confused with the higher alloyed grades of material.

Because so many industrial operations are carried on at extremely high temperatures, a demand for alloys to resist these conditions has led to the development of a series of nickel, chromium and iron alloys. They are chemically and mechanically stable at temperatures as high as 1,000 deg. F. resist oxidation, and retain their strength under operating conditions. Representative are alloys containing 28 per cent chromium with 12 per cent nickel; 38 per cent nickel with 18 per cent chromium and 65 per cent nickel with 15 per cent chromium. Such high-temperature alloys find extensive and varied uses in oil refinery construction, metallurgical processing equipment such as carburizing boxes, rabble arms and shoes, for shafts and discs in continuous annealing furnaces, in ceramic and glass furnace construction, and for high temperature chemical processes generally.

The last fifteen years have seen a revival in popularity and esteem of one of the oldest materials of construction, namely, cast iron. Remarkable progress has been made in the improvement of its properties and engineering performance. Nickel can be given credit for playing a very substantial part in this development. Grey cast iron may be regarded as a steel in which is mixed a quantity of weak graphite flakes. Generally speaking, the size, shape and distribution of these flakes determines its strength and the steel base determines its hardness. The first way in which a grey iron can be improved and strengthened is obviously by reducing the amount of weak graphite flakes. This can be accomplished by lowering the carbon and silicon content, and at this point nickel comes into the picture. If the silicon is lowered too far, the parts that cool rapidly, such as thin sections, fail to graphitize and hard unmachinable carbides form. If, however, the amount of reduced silicon is replaced by nickel in an amount sufficient to equalize its graphitizing powers the structure remains grey throughout, the graphite is finely divided and more evenly distributed, the grain size is smaller and the steel base or matrix is strengthened. It must be kept in mind, however, that strict foundry control and intelligent alloy additions must be made to attain maximum desired physical properties. The low nickel grey cast irons are used for automobile and truck cylinders, compressors, pumps, resistance grids, and glass moulds, to mention only a few of thousands of applications.

The International Nickel Company's research in the last decade has resulted in the development of several interesting cast iron alloys. Ni-hard and ni-resist are two outstanding examples. Ni-hard is a white cast iron containing 4½ per cent nickel and 1½ per cent chromium. This iron is martensitic in structure and has a chill cast hardness as high as 600-700 Brinell. Special treatments in the laboratory have produced hardnesses even in excess of 700. This iron possesses great resistance to wear and deformation and typical applications include rolls, crushers, grinders, pulverizers, car wheels and the like. A good example of co-operation between research, production and marketing in one organization was recently shown when this alloy developed by the Research Department was installed in the company's rod mills at Copper Cliff with the result that liners of this material proved to be a decided improvement resulting in economies for the grinding plant and a fine sales story for the sales department.

Ni-resist contains approximately 14 per cent nickel, 6 per cent copper and 2-4 per cent chromium and in structure is austenitic like the stainless steels, although considerably cheaper. Like those steels it possesses marked corrosion resistance. It has good thermal stability and is non-magnetic. It is especially useful for oil refinery equipment but is used extensively in the chemical, electrical, refrigeration, brewing, canning, paper, salt, soap and allied industries.

The last of the ferrous group are referred to generally as special iron-nickel alloys and include the invar type with 30-40 per cent nickel. These are useful for their low coefficient of expansion and invar itself with 36 per cent nickel does not undergo any appreciable dimensional change under ordinary temperature changes. It is said to vary less than one part in 500,000 after six months field use. It is used for dimension rods, auto-engine piston struts, surveyors' tapes and bi-metallic thermostats. Elinvar with 34 per cent nickel and 5 per cent chromium has an invariable elasticity and is used for watch springs and precision instruments.

The magnetic changes which take place in many of these nickel-iron alloys are interesting and useful. A group containing 15 to 25 per cent nickel are non-magnetic and are used chiefly in electrical machinery because of their good mechanical properties and freedom from ferro-magnetism. Another group containing from 45 per cent to 80 per cent nickel are magnetic and are finding new uses continuously. For example permalloy containing 78.5 per cent nickel has great magnetic permeability at low field strengths. Another example is a General Electric Company development called alnico, an aluminum-nickel-cobalt alloy of which a permanent magnet can be made capable of lifting 60 times its own weight. A recent article on the subject forecast the use of permanent magnet dynamic speakers on all radio sets in the near future, which would require an annual production of millions of these magnets.

Non-Ferrous Alloys

Another important field for the consumption of nickel and one in which 25 per cent of the world's production finds its way is the non-ferrous group or in other words, alloys containing nickel in combination with elements other than iron. Of these the most important are the copper alloys. Into this group falls monel, the International Nickel Company's "own baby" so to speak. They handle it from the ore to the finished product and market it through distributors, having exclusive territorial rights. Regular monel has high strength, hardness, remarkable corrosion resistant properties and as many uses as there are stars in the sky. Applications are found in the chemical, marine, petroleum, tanning, refrigeration, laundry, photographic, pulp and paper, paint and varnish, electrical and many other industries and vary all the way from kitchen sinks to huge valve stems. It is indeed a versatile metal. By the addition of small quantities of various elements to monel, it is possible for specific purposes to produce alloys of remarkable physical properties. "K" monel is a good example of this. By the addition of about 2.75 per cent aluminum to monel, a heat-treatable precipitation-hardening non-ferrous alloy is produced which had, when made into sluice gate valve stems six inches in diameter by 12 ft. 9 in. long for the Tygart River Dam project, the following physical properties:

Yield strength 109,500 lb. per sq. in.
Tensile strength 153,500 lb. per sq. in.
Elongation in 2 inches 24.7 per cent
Brinell hardness 297.

Another recently developed International Nickel Company alloy is one containing 80 per cent nickel, 14 per cent chromium and 6 per cent iron. This is called inconel and is particularly used for dairy and food-handling equipment as well as chemical equipment subjected to severe corrosion. It has also proved to be the best material available for aircraft exhaust manifolds and collector rings, which are subjected to extremely high temperatures and very corrosive exhaust gases.

Nickel and copper form solid solutions in all proportions and cupro-nickel alloys containing usually from 15 to 50 per cent nickel with the balance copper are becoming more widely used because of their corrosion resistance, colour, and mechanical properties. Principal uses are condenser tubes, corrosion resisting castings and sheets, and valves and valve trim.

The nickel silvers or alloys of nickel, copper and zinc containing anywhere from 10 to 30 per cent nickel are among the oldest established uses of nickel. Chinese paktong which was known to exist as early as 235 B.C., was an alloy of this general type. They find wide application as a base for silver-plated tablewear and filled jewellery, flat keys, plumbing fixtures, architectural trim, building and marine hardware and coinage.

There has been a tendency lately to replace tin by nickel in bronzes up to 50 per cent of its tin content. This reduces the cost and at the same time improves physical properties, most particularly pressure tightness.

The nickel-chromium alloys form a series containing up to 85 per cent nickel, the balance being chromium, and are used for a multitude of electrical resistance and heat resistant purposes. Heater and pyrometer wire, household electrical accessories, electric furnace heating elements, tubes and retorts in chemical industry, and glass and ceramic equipment are some of the applications. Chromel and nichrome are alloys of this type.

The demand for light alloys with good mechanical properties for aviation and automotive industries has led to the development of several important nickel bearing aluminum alloys. 'Y' alloy, an aluminum copper alloy with 2.3 per cent nickel has the strength of soft steel with good ductility and machinability. The Rolls-Royce hinduminum R.R. alloys also contain small percentages of nickel. These are used for pistons and cylinder heads and often crank cases for internal combustion engines.

Pure Nickel

As regards the uses of pure nickel itself, it may be noted that malleable nickel in wire, sheet and tube form is used extensively in the food and chemical fields. Some other uses are turbine blading, radio wires, screens, grids and plates, and a multitude of electrical uses, particularly in the advancing fields such as television. A recent development showing decided promise is a new age-hardening nickel which combines great strength and hardness with high resistance to corrosion. This 'Z' nickel, as it is called, although over 98 per cent pure nickel, is heat-treatable. Spring wire of this material has been produced with a tensile strength of 250,000 lb. per sq. in., an elongation of 10 per cent in two inches, with a modulus of elasticity in tension of 30,000,000. It certainly seems that the future holds some remarkable metallurgical developments in store. Related to malleable nickel is nickel-clad steel in which a pure nickel sheet of 10 to 20 per cent of the thickness of a base steel plate is welded to it, and rolled in such a manner that the bond is indestructible. This is finding a growing acceptance for storage tanks and chemical handling equipment where a nickel surface is essential and a solid heavy nickel plate would be too costly.

Nickel plating of brass and iron articles provides a steady demand for pure nickel anodes. Recent developments in so-called engineering deposits of relatively heavy coatings, for building up worn parts, should make this a more important outlet in the future.

Nickel is a catalyst for many chemical processes particularly the hydrogenation of edible oils. The use of nickel salts in the chemical, glass and ceramic fields continues to provide a small but steady market.

It may be of interest to note, in closing this brief market survey, that since the year 1881, when Switzerland first adopted nickel for coinage, a total of 33 governments have issued pure nickel coins in 87 denominations and 102 designs.

As mentioned earlier in this paper the International Nickel Company are currently spending $2,500,000 annually on research and market activities. As a result, the nickel market is being expanded, real engineering progress is being made, and new alloys are being developed. This is a real service to the engineering profession.

THE CIVIL ENGINEER IN CANADA

Activities for the Improvement of the Social and Economic Status of the Civil Engineering Profession in Canada

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Before confederation of the provinces of Canada, in 1867, so little was there of major engineering work and so few engineers were employed in the country that organized activities for the advancement of the profession had made but little headway. An illuminating commentary on the situation a century ago was the advice given to young Sandford (later Sir Sandford) Fleming, in 1845, by Casimir (later Sir Casimir) Gzowski, at that time engineer of roads and waterways for Upper Canada, who expressed the opinion that the great works were nearly all completed and that, as it was a very bad country for professional men, Fleming would do well to return to Scotland. Fortunately for Canada, the young man ignored the advice and later became not only the chief engineer of both the Intercolonial and the Canadian Pacific Railways but also one of the most outstanding figures in engineering that this continent has produced.

Although construction of the early roads and canals had afforded employment for numbers of civil engineers, it was not until the railway era was well advanced that the demand for their services assumed large proportions. Railway building, which was brought about by, and constituted a condition of Confederation markedly stimulated engineering activity. Indeed, it may be said that the most important event in Canada, so far as the early development of the engineering profession is concerned, was the linking together of the far-flung provinces of the Dominion by the Intercolonial and the Canadian Pacific Railways scarcely more than fifty years ago. It is therefore apparent that the history of organized engineering in Canada is contemporaneous with with the history of the Dominion as it is known today.

Engineering Organization in Canada

EARLY ORGANIZATIONS

Despite the fewness of their numbers, the early engineers of Canada were active in the effort to share in a common advance. In 1851, a small group of land surveyors, civil engineers and architects organized the Canadian (now the Royal Canadian) Institute, a body that has attained high prestige in promoting popular knowledge of the physical sciences and of the borderland lying between pure science and engineering.

Nine years later there was established under statutory authority "The Association of Provincial Land Surveyors and Institute of Civil Engineers of Canada." While there is no indication that this body made any deep imprint on professional life in Canada, its membership, like that of the Canadian Institute, was remarkably comprehensive, in that it included engineers, architects and land surveyors.

This early association was superseded in 1887 by the Canadian Society of Civil Engineers, the object of which was to promote the knowledge of civil engineering in the original comprehensive sense. Although its early activities were analogous to those of the Institution of Civil Engineers, they gradually came to be regarded as lying particularly in the field now considered as belonging strictly to the civil engineer. Moreover, the Society broke new ground in permitting the establishment of branches, the first of which was granted a charter in 1890. From time to time others have been added, so that there are now twenty-five, all enjoying important local autonomous powers.

THE ENGINEERING INSTITUTE

Due to the practice of confining the term "civil" to certain special applications of non-military engineering, which by the turn of the century had become established, and in the belief that a national organization comprehending all branches of engineering was needed in the country, the Canadian Society of Civil Engineers broadened its functions and sphere of action in 1918 and, at the same time, changed its name to The Engineering Institute of Canada. With the establishment of a full-time secretariat and the institution of *The Engineering Journal* as a monthly publication, the reconstituted organization was launched on an active and useful career.

SPECIALIZED ORGANIZATIONS

With the marked rise of specialization in engineering on this continent, a movement soon set in for the establishment in Canada of organizations or branches of organizations devoting themselves to restricted sectors of engineering knowledge, rather than to the whole front envisaged by The Engineering Institute of Canada. Chapters, sections, or branches, of several important American societies have been set up and are discharging a useful function. The Institution of Civil Engineers and the American Society of Civil Engineers have, however, no active organizations in Canada, although an appreciable number of Canadian engineers are members of these bodies. A Canadian advisory committee of the Institution of Civil Engineers exists and one member of the Council of the Institution represents Canada officially. Of particular value to civil engineers employed in the municipal field have been the Canadian Section of the American Waterworks Association and the Canadian Institute on Sewage and Sanitation.

PROFESSIONAL ASSOCIATIONS

As early as 1892, a vigorous discussion of the desirability of restrictive legislation and of the best means of improving the professional status of engineers set in, which, with varying intensity, has persisted in engineering circles up to the present.

In the early years of campaigning for professional legislation, the Canadian Society of Civil Engineers, recognizing that under the legal interpretation of the British North America Act, control of engineering practice was a provincial matter, sought to supplement its federal charter by charters in each of the provinces. Drafts of acts for provincial incorporation of the Society were prepared and the members in Manitoba succeeded in having civil engineering recognized as a profession in that province by the Manitoba Civil Engineers' Act of 1896. Quebec followed suit in 1898. While these Acts limited the practice of the profession to members of the Canadian Society of Civil Engineers, they were found to be difficult of operation and in both cases were superseded in 1920 by Acts administered respectively by the provincial Association and the Corporation of Professional Engineers.

In the last year of the war much activity developed in the branches of The Canadian Society of Civil Engineers, and its successor, The Engineering Institute of Canada, directed to the extension of legislation controlling the practice of engineering and recognizing the professional status of the engineer. A special committee of the Institute undertook the drafting of a model act to be used as a guide in the securing of provincial legislation and every assistance was offered to the provincial groups participating in the movement.

Despite the enthusiasm developed in certain branches of the Institute, particularly those in the west, much opposition to provincial legislation developed in the larger industrial centres. The idea of licensing engineers to practice was particularly repugnant to large companies employing many engineers who, applying the letter of the law strictly, need not belong to the professional associations.

Nevertheless, so strong was the appeal for restrictive legislation that by 1923 provincial acts had been obtained in all the provinces of Canada except Saskatchewan and Prince Edward Island. The Saskatchewan act was passed in 1930, but by reason of the small number of engineers in Prince Edward Island, no law has been deemed necessary for that province.

While the acts differ in detail, they are in general agreement that no one may publicly describe himself or hold himself out to be an engineer or practise engineering as defined by the law unless he belongs to the applicable provincial association of professional engineers.

Upon organization, or upon obtaining full restrictive powers, each of these associations had of necessity to admit to its membership many persons whose qualifications were more or less doubtful. No legislature would by direct enactment have deprived persons already engaged in the practice of engineering of their means of livelihood. In certain cases a too generous application of this provision has resulted in hostility to the law by some engineers and legislators, but time, of course, will ultimately solve this problem.

Concurrently with the movement for restrictive legislation, there has grown up the concept of Dominion licensing. Obvious advantages to the public, as well as to the engineer himself, would flow from this development. It is the hope of the Dominion Council of Professional Engineers, the advisory body set up by the provincial associations to promote reasonable uniformity of regulations and to strengthen the licensing movement, that there should be reciprocity in professional practice, as between provinces and the removal of interprovincial barriers against any Canadian engineer.

From the beginning, it has been the clear intention of The Engineering Institute of Canada that in supporting the licensing movement it was not abandoning to the provincial associations any of its proper functions as a voluntary organization. These are to promote engineering knowledge and the interchange of it amongst its members in a strictly professional manner, entirely divorced from legal and political considerations. The professional associations were sponsored by the Institute as the necessary legal means for bringing about economic improvement in the lot of the engineer and, at the same time, a recognition by the public of the importance and responsibility of his position. Up to the present there has been no voidance of this understanding either by the Institute or by the associations.

MOVEMENT TOWARDS CO-OPERATION

Due to the fact that the membership in the associations of professional engineers and in the voluntary engineering society is to a large extent the same, the movement to bring about some form of close co-operation has grown stronger in recent years. The most notable phase of this was the so-called "consolidation movement," based on the arduous labours of the Committee on Consolidation of the Engineering Institute during the years 1935-1937. The proposals then advanced, which provided for an eventual common membership of the provincial associations and the Institute, failed by a narrow margin to obtain the necessary majority vote of the members of the Institute. The movement has continued, however, and the present reaching out for a solution of the problem is strengthened by the mutual assurances of the Institute and the professional associations that they are prepared to co-operate to advance the prestige of the profession and its usefulness to the public. Ground for believing that something will come of this open-door attitude may be found in the signing of the first agreement for co-operation between the Institute and a provincial association. This agreement, between the Engineering Institute and the Association of Professional Engineers of Saskatchewan, was consummated in October 1938 and provides for a common membership in that province. As a result of it, resident members of the voluntary national body gained the privileges and assumed the responsibilities that go with the right to practise as professional engineers in the province of Saskatchewan. Reciprocally, the members of the association obtained the advantage of participating in all the social and technical activities of the Institue.

TECHNICAL SERVICE COUNCIL

A movement of importance to the engineers of Canada, and one altogether apart from the activities of the engineering societies, is that comprised in the work of the Technical Service Council, Inc. This body was founded in Ontario in 1928 by a group of citizens representing education, industry, and the professions, to provide a central clearing-house where employers might get in touch with men having specialized training and where these men might learn of openings in their own country. It undertakes to act not merely as an employment agency, but to convince industry of the value of utilizing men with scientific training. Although organized in Ontario, its activities are not limited to this province, much useful work having been done in moving technically-trained men from centres where the demand is small to those where it is important and pressing. Up to the present time, approximately 2,700 relatively permanent direct placements have been arranged and, in addition, many indirect and temporary placements.

PRESENT POSITION OF THE CIVIL ENGINEERING PROFESSION

TECHNICAL

The technical needs of the civil engineering profession in Canada are being met acceptably through the combined efforts of a number of organizations. In respect of matters of general interest the Engineering Institute serves its membership well, although internal problems have to some extent interfered with its normal work in recent years. An additional obstacle has been the lack of necessary funds, due to the relatively low scale of the membership fees. Because of the comprehensive nature of the organization, it is found impracticable to devote any large percentage of the meetings to highly technical papers or discussions. There are too few in each specialized branch of engineering to make this desirable. As a consequence, civil engineers in Canada have frequently found it to their advantage to join specialized organizations devoted to the fields of their major technical interests.

LEGAL

With existing Acts regulating professional engineering in eight of the nine provinces, it must be said that the legal position of the civil engineer in Canada is now fairly secure, at least in theory. No one may describe himself as an engineer, or hold himself out to the public as such, unless he is a registered member of the applicable provincial association or corporation of engineers. Due to more than forty years of operation in its various forms, the Corporation of Professional Engineers of Quebec may be said to represent the strongest legal entrenchment of the engineering profession in Canada. Perhaps most success in publicizing the importance and responsibility of the engineer's work has been achieved in British Columbia.

PROFESSIONAL

While substantial progress has been made in impressing upon the public the high character of the services performed by the engineer, there is still a very long way to go before the measure of public appreciation now readily accorded to the other professions will be granted to the engineer as a matter of course. Mr. Alan Macdougall, in a notable paper on professional status, presented to the Canadian Society of Civil Engineers in 1892, quoted with approbation a passage in the presidential address of L. E. Cooley to the Western Society of Engineers, in 1891, which asserted that

"The early engineer of this country was a species of scientific or skilled tramp with a precarious tenure of position measured by the work in progress. He furnished his employer with the skill of his trade without questioning public policy or the best solution."

For his own part, Mr. Macdougall observed that

"There is about as much wire-pulling and log-rolling amongst engineers as amongst the vendors of patent articles; corporations all know it and make full use of it; they either make engineers bid directly against each other, getting advice for nothing through the public press or set them to work directly or indirectly to cut down each others fees. As the profession stands to-day it is almost a trade."

Speaking some years later a member of the Society related that his parents had left him some money to study a profession and, on his choosing engineering, certain persons tried to prevent him from getting the money, representing that engineering was not a profession at all. He had to prove the validity of his choice in the courts at great expense and was impressed with the great surprise exhibited when the court decided in his favour.

Undoubtedly the activities of the Engineering Institute, and its predecessor, the Canadian Society of Civil Engineers, have done much towards remedying the situation complained of a generation ago. On more than one occasion the Society took strong ground where the interests of the engineer were at stake. Thus, it protested against the investigation of street railway affairs in Regina by a committee of the city council unsupported by technical assistance; it defended the city engineer of Calgary when unjustly criticized with regard to the construction of one of the city bridges, and was able to prove to the Board of Control and to the citizens generally that the engineer was unfairly treated; it reviewed numbers of cases of members charged with unprofessional conduct and administered censures where warranted. The Engineering Institute has protested vigorously against the attempts of certain municipalities to obtain engineering services by the device of calling for tenders on a price basis, in some cases involving the submission of competitive plans and specifications free of charge.

On the other hand, the development of a strong cooperative professional spirit has undoubtedly been retarded by the fact that many members of the Institute are employees of large corporations or of governments and work under conditions that frequently make it difficult to take firm ground in asserting the prerogatives commonly associated with a profession. This is evidenced in many ways. Employee-engineers are sometimes precluded from taking active part in strictly professional society activities and the comparative absence of discussion at some of the larger technical meetings of the Engineering Institute is, at least to some extent, related to the same cause. In times of economic stress particularly, it has been found difficult for those employed on a salary basis to do much in broadening and deepening the professional position.

Without doubt, uncertainty as to the respective fields of the Engineering Institute and the provincial associations has constituted a retarding influence on professional advancement. As official co-operation between these bodies develops, this uncertainty will be dispelled but it must be admitted that many professional matters have, in recent years, fallen between the two stools. On the one hand, the associations have kept as far as possible from invading what they regarded as the sphere of the Engineering Institute. On the other hand, in view of the apparent emphasis upon the economic aspects of engineering by the registration movement, the analogy of which to unionization cannot be denied, the Institute has probably left undone things which might have been given attention if the professional associations did not exist.

SOCIAL

Despite the occasional instance of an engineer serving in the role of cabinet minister, chairman or member of a utilities board, or member of a royal commission, engineers have played anything but a conspicuous part in the public life of this country. On the general ground that others are responsible for economic and social decisions, technically-trained men have remained sadly indifferent to the ultimate results of the technical developments following in the train of their labours.

On the whole, the licensing movement in Canada has not yet contributed to the social status or the public prominence of engineers. Whatever social and public position may have been achieved by them has been due rather to the strict observation of those standards of professional conduct that are set out in the codes of ethics of The Engineering Institute of Canada and the professional associations.

The Institute, and its predecessor, have on occasion taken an important stand in respect of matters of public interest and concern. Committees have served with effect in connection with conservation, testing laboratories, the fuel problem and the National Research Council. Important papers have been presented on the fuel supply, the St. Lawrence Waterway, the drought problem of the west and related matters. Influence has been brought to bear either by the Council of the Institute, by committees, or by the Institute's officers, with respect to the appointment of engineers to serve on royal commissions dealing with matters of technical importance, to serve on utility commissions, and to serve on the Board of Railway Commissioners for Canada. Representations of importance have been made with respect to the routing of an important highway, the enlargement of an aqueduct serving a large city, and the revision of building codes.

It must be said, however, that except for occasional activities of the kind mentioned, the engineering organizations of this country have concerned themselves very largely with internal affairs. Thus, discussions of the public business in the Engineering Institute are rare and no concerted effort is made to grapple with the social implications of the engineer's work.

ECONOMIC

So far, there has not been witnessed that improvement of the economic lot of the engineer in Canada that might have been expected to follow the increasing importance to the public of the services that he performs. There are various reasons for this. Many engineers employed on salary by large corporations, governments or municipalities are not regarded in such employment as occupying professional positions. Unceasing rivalry has undoubtedly subjected the young engineer to the unfortunate position of competing with his associates for employment on a price basis. While through the work of its Committee on Remuneration the Engineering Institute has set up a basis of fair compensation, conformity to it by employers is not general. So far, the professional engineering associations have not been able to bring about that general lifting of the level of compensation that is long overdue.

A highly delicate situation exists between the employer-engineer and the employee-engineer. While the former, in the effort to secure for his principal the cheapest services consistent with good work, is disposed in some measure to shop round, he cannot help feeling that as a member of a learned profession he should be endeavouring to raise the general level of compensation for all engineers. Unfortunately, many employer-engineers are themselves employed by corporations or governments and salary levels have been fixed by superior authority. Where the directive heads of large organizations employing engineers are not themselves engineers, the professional position of the employee is likely to receive scant consideration. It is not strange, therefore, that progress has been very slow.

The Canadian Society of Civil Engineers and The Engineering Institute of Canada have each in their time brought to bear influences for the general improvement of the economic status of the engineer in this country. Nearly thirty years ago a committee urged upon the federal government then in power the desirability of an upward revision of salaries paid to engineers in the government services. Following the setting up of the Civil Service Commission and the re-classification of positions, the lot of the engineer was undoubtedly improved. Civil servants engaged on technical work were thereby classed as engineers, with an improvement in compensation. Through the labours of the Committee on Classification and Remuneration of Engineers, and through its employment services, the Engineering Institute has contributed to the solution of the problem. In later years the Technical Service Council has offered helpful assistance in central Canada.

Although these activities have shown an awareness of the economic interests of the engineer, they have not appeared, in some quarters, to be adequate to meet the situation. As a result, the unionization of technically trained men has gained some headway in at least five centres in Canada.

Probable Future Trends

technical

The trend of activities for the furtherance of the social and economic status of civil engineers in Canada will inevitably be influenced to a remarkable degree by the geographical, governmental and industrial characteristics of the country. With a small population, distributed over a large area, it appears logical that there should be one national engineering body comprising all the branches of the profession. There are not enough in each of the specialized branches to warrant as yet the setting up of sections or divisions according to technological specialties. If the technical interests of the members of the profession in Canada are to be served adequately, there will continue to be a need for specialized organizations appealing to a relatively small number of persons, or the continuance of branches of non-Canadian organizations devoted to special fields. It may happen that in the course of time sections or divisions of the Engineering Institute devoted to special interests may be set up, as in the case of the divisions of the American Society of Civil Engineers. This is by no means imminent.

For many civil engineers in Canada who live away from the main centres of population, the *Engineering Journal* (the regular publication of the Engineering Institute) is the only material link between them and their professional fellows, this monthly production is therefore of singular importance. Despite much discussion, it is still far from perfect, and an inevitable trend will make for its improvement. Naturally, this is associated with Institute finances, the amelioration of which will provide a key to marked progress that is even now envisaged.

legal

Although control of the practice of engineering must be provincial, having regard to the provisions of the British North America Act, there is no valid objection to the requirements of the various provinces being identical, or approximately so. This being the case, it would be a simple matter for any province to admit for practice an engineer registered in any other province. In all probability the activities of the Dominion Council of Professional Engineers, together with those of the Engineering Institute, will in course of time result in what virtually amounts to Dominion licensing, although this is not immediately in prospect.

Very properly, the Engineering Institute should continue to encourage reciprocal licensing arrangements as between the provinces, and at the same time should endeavour to solve the problem of common membership. There seems now to be no formidable obstacle to the extension of the idea of unification of membership inaugurated in the province of Saskatchewan last year. It is the expressed hope of leaders of the Institute that such common membership may eventually, and in the not too distant future, be secured throughout Canada. When this is done, and the profession is at last united in a co-operative framework, the legislation which presently exists will be of more avail and substantial advance in professional well-being may confidently be anticipated.

It cannot have escaped those who have been active in furthering the licensing movement that no restriction of practice can be ultimately justified unless it redounds to the general good of the public. Whatever benefits come to the engineer must come as the natural concomitants of benefits enjoyed by the public. Manifestly, no proper legislation can rest solely on benefits to one class. As was tersely pointed out by *Engineering News-Record* on one occasion, there can be no case for legislation unless the applicants therefor can answer "yes" to the question: "Does the public interest require that the right to follow the vocation known as engineering be restricted and regulated by the state ?"

professional status

Much has been written concerning the mechanism by which the engineer may improve what has been termed his professional status. Sooner or later he will appreciate the fact that professional status, as such, cannot be aided by legislation. Legal restrictions may improve the economic lot of the engineer but, no more than unionization, can they enhance the position of the engineer in the mind of the public. As Colonel Willard Chevalier has pointedly said,

> "There is something bigger, more vital and more fundamental in a professional relationship than anything you could write into a statute . . . Enactment of a statute does not make a profession. It may create a false sense of security and may lead you to put too much faith in the letter of the statute, unless it has behind it the spirit and soul of a profession to breathe life into the letter of the law and to give it the force that it needs to make it effective."

No better appreciation of the fact that the professional status of an engineer cannot be commanded but must rest on honour and respect accorded him spontaneously by the public in the performance of his professional duties has been voiced than that contained in a letter from Lindsay Russell, at one time Surveyor-General of Canada, written in 1878. Said he:

> "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."

The simple truth is that the solution lies to a large extent in the attitude and bearing of the individual engineer himself. As has been strikingly put by Mr. J. B. Carswell, we should concern ourselves not with the "status," but rather with the "stature," of the engineer. Recognition will be accorded in ample or sparing measure in proportion to the impression gained by the public of the ability, integrity and fearlessness of the practitioner himself.

If the response to the desire of the engineer for recognition is to be cordial, he must create in the public mind a vivid appreciation of the high quality and dependability of his services. It should be recognized that his work is inevitably confidential in character and such that it cannot be checked by the employer. He is in a position of trust and if, as trustee, he fails to discharge his duty with fidelity his employer will suffer. Very frequently, the engineer performs in respect of complicated and expensive works, a quasi-judicial duty in that he adjudicates between the owner and the contractor, while at the same time being in the pay of the former. Despite the anomaly of his position, rarely indeed are there any complaints of unfairness. This fact, however, is not so widely appreciated as it should be; acquaintance with it is a matter that can be dealt with only by an organization in which the public has confidence. It is for this reason that many Canadian engineers are following with interest the progress of the Engineering Public Relations Committee, recently initiated in Great Britain.

Corporate action in relation to professional status is also of special value in connection with the delicate situations in which employee-engineers sometimes find themselves. Due to political or economic factors beyond their control, such engineers may be placed in positions that call for corporate professional action in support of the individuals concerned. As already noted, some instances of this nature have occurred in Canada, and it is fair to say that a necessary part of the future development of the profession in Canada will be an increase in this form of organized professional activity.

While participation in activities outside the profession may of itself increase public appreciation of the work of the engineer as a citizen, they are by no means a *sine qua non* of professional status. There are innumerable instances of men who occupy highly honoured positions in the learned professions and who represent the very best that the profession can give without taking any part whatever in public affairs. Complete devotion to the widest and best interests of professional practice frequently precludes ventures into other fields of activity. As has been well said by *Engineering*.

> "The status that attaches to the professions of arms, of law and of medicine was not acquired by making its attainments a deliberate goal, and can owe but little to the excursions of individuals from these professions into directive commercial or legislative offices, such as have long been whole-time occupations to those who have achieved any eminence therein."

To the end that the younger engineers may without undue delay acquire something of the professional spirit it may turn out that something akin to master-novice relationship should be set up by the engineering profession itself for the benefit and guidance of the young graduate engineer. As Professor J. K. Finch has pointed out, this would constitute a very necessary training analogous to that of a graduate school.

A mechanism calculated to usher the young engineer into the philosophy of the profession early in his career is that provided, for example, by the law administered by the Corporation of Professional Engineers of Quebec. In accordance with this, engineering students in college are regarded as engineers in training for the corporation and enter into full membership upon graduation. Apart altogether from the question of adequacy of experience for admission, it must be said that the importance and dignity of the profession are fully impressed upon them at a time when they are most susceptible to the idea. The extension of this training, possibly along the lines of the admirable plan for graduate engineers followed by the Institution of Civil Engineers, is something to which many Canadian engineers look forward hopefully.

An incidental difficulty that militates against a proper public appraisal of the position of the engineer is the current practice in English-speaking circles on this continent to employ the term "engineer" as applicable not only to the professional engineer but to those engaged in the operation, maintenance and repair of stationary or moving engines. There has been no general adoption of the suggestion that workers in the latter category should be characterized as "enginemen." As Canada is a bilingual country, it is of interest to note that French-speaking Canadians are spared this confusion. In Quebec, the home of most French-Canadians, the profession is legally represented by the Corporation of Professional Engineers, and application of the title "ingénieur" is specifically restricted by law to members of this corporation. The term "mécanicien" is employed in French to describe operators, locomotive drivers and others, who claim and use the title "engineer" in those parts of North America where the English language predominates and thereby add to the difficulties of the profession. It is regrettable that, in this connection at least, English-speaking Canadian engineers cannot follow the excellent practice of their professional fellows whose native tongue is that of France.

SOCIAL

If the engineering profession is to occupy an important position in national life it must take cognizance of the effect upon the general economy and manner of living of the scientific developments, credit or blame for which lies at the door of the engineer. It is not enough to be satisfied with the solution of the immediate technical problem without regard to the repercussions of its successful solution. There was much that needed saying in the historic letter written, in 1936, by President Roosevelt to the presidents of American engineering colleges, wherein he expressed the wish that the training of engineers might better prepare them to meet their social responsibility in finding means to lessen the impact of scientific advance upon society.

While there appears to have been a studied reluctance on the part of engineers to express opinions on public questions in this country, it does not appear possible for technical organizations of national scope to maintain for long their prestige and full usefulness without taking into account the most important of all problems—the general welfare of the people. The success of democracy will in large measure depend upon the ability and readiness of the most enlightened and intelligent citizens to come to the aid of the state in matters of doubt and confusion. To this class the engineer should attach himself with enthusiasm.

There is no need for the engineer to make a direct march to public office. If he achieves that measure of distinction which establishes him as an outstanding member of a learned profession, and shows the knowledge and appreciation of public questions that are properly associated with an educated man, the public will very soon realize his acceptability to represent them in difficult and important situations. Despite the shortcomings of democracy, a professional man of standing, accorded his place by common consent, has no need to force himself forward in public life.

ECONOMIC

While the action of the associations of professional engineers in restricting practice to those who are sufficiently qualified to become members of them has had some small effect on remuneration it has been by no means notable. Due to the lack of action on the part of engineering organizations, a growing uneasiness has set up amongst the younger members of the profession, more particularly in the sub-professional class. Many have been attracted by the lure of the increased earnings that may arise upon associating themselves with a union, but the hazards involved in so doing should be carefully appraised. The levelling effect and the barriers to promotion, except by virtue of seniority, in union organizations would undoubtedly prove a formidable handicap to progress. It is difficult to harmonize the traditional attitude of the unions with a profession. They are incompatible with the professional spirit, and while a junior still in the sub-professional class might conceivably derive some temporary advantage by associating himself with such organizations, he should be expected to drop the affiliation on admission to a professional society, provided the society shows definite interest in his economic welfare.

Conclusions

Consideration of the development of the engineering profession in Canada leads to the inevitable conclusion that the advancement of the engineer rests to a large extent with each individual of that profession. In accordance with the attitude taken by him in respect of the public and private responsibilities of his position will be rightly or wrongly regarded as belonging to a distinguished and learned profession—an instinctive classification created through confidence in the integrity of its members and a widespread belief in its general beneficence. While legislation and the observation of technicalities may in some measure assist in economic betterment, the solution of the problem as a whole turns largely on personal bearing and acceptability.

At the same time, and due very largely to the great number of Canadian engineers who are employees either of governments or large industrial corporations, engineering organizations are an essential complement to this sense of individual responsibility. In this respect civil engineers in Canada are relatively fortunate. In The Engineering Institute of Canada they possess a national voluntary engineering society embracing all branches of engineering with a great tradition and a record of over half a century of service. In the provincial professional associations they have well administered licensing bodies, all relatively young but all appreciative of their responsibilities to the public and the profession and all looking forward to a steady improvement of standards and regulations. And the movement which is gradually bringing the voluntary society and the professional associations into a co-operative working arrangement can be said even now to be in sight of the surmounting of the legal obstacle to a united profession in Canada, the profession being therefore on the threshold of an even more notable period of service than that to which its history now testifies.

Much that is to the advantage of the profession, and therefore to the public, may be achieved by whole-hearted co-operation of the engineering societies, national and international. The engineers of Canada are in a particularly fortunate position to further whatever international co-operation may be possible. Standing midway between the engineers of Great Britain and those of the United States, it may well be said that the engineers of this country constitute the keystone of the arch that makes for the solidarity of the whole structure of professional engineering in the English-speaking world.

ECONOMICS IN MODERN DEFENCE

Abridgment of a lecture* delivered at the School of Military Engineering, Chatham, Eng., on 9th February, 1939

D. J. F. MORTON, C.M.G., M.C.

The final decision in wars of the future in which modern industrial countries are concerned, will be determined by economic factors. Hungry people lose the will to win. These factors may be studied under two heads—economic mobilization and economic warfare. The latter, including for example organized blockade operations, really is an attack upon the enemy's economic mobilization. Military officers concerned with military planning must therefore co-operate with economic authorities in framing their military plans. Failure in this respect leads to strategic plans which are unsound and unpractical.

A country embarking on a modern war must have not only a naval, military and air staff, but also an economic war staff. Responsible authorities must count the economic cost of proposed operations—the cost of labour and materials—and see how best to meet it.

A German military writer, referring to the war of 1914, says:

"The idea that economics have nothing to do with war and that all the work in connection with mobilization preparations is entirely the province of a War Ministry was widely held (in Germany) right into the war itself, despite all attempts of those who really understood the problem to persuade the soldiers otherwise. That is why we lost the war."

Modern war between nations of high economic development involves national effort, and the use of the greatest armed forces which their countries can sustain. If England is to defend herself against totalitarian aggression she will require such a complete national effort, even though the men in uniform will constitute only a small fraction of the total population. A very much greater number of people will be needed in industry, agriculture, transportation, passive anti-aircraft defence, and other essential services, than was the case in the war of 1914.

Further, the armed forces themselves will require a greater proportion of men immediately behind the line than they did even in 1918. To illustrate this General Debeney estimates that a tank which is served by two men in action needs 46 men in uniform behind the line to look after it, while one aeroplane needs 60 men for its ground staff.

These approximate figures do not take into account the number of men or women required to manufacture the tank and the aeroplane, the munitions the latter will expend, the food, equipment and clothing necessary for the hundred odd military men concerned; nor do they allow for the men who will have to transport all these stores to the point at which they are to be used.

This great increase in the demand for men in uniform and out of it behind the lines to keep one fighting man in action is due chiefly to the increase in quantity and complication of the armament and other stores required in modern defensive and offensive operations of war. It applies equally to the Army, to the Navy and the Air Force, to Active Anti-Aircraft Defence and also to such purely passive defence measures as are at present comprised in the general term "A.R.P." all of which need not only men, but also war stores.

Supply of War Stores

Apart from actual armament, figures of a high order of magnitude apply to war stores of all kinds, food, blankets, boots, clothing, ships, naval stores, air stores, gas masks, decontamination equipment, fire fighting equipment and so on, many of which will be required for the civil population nowadays as well as for the armed forces.

Of course, the creation of large modern air forces accounts to no small extent for this expansion in requirements, but it does not account for it all. Requirements of *matériel* of all kinds in 1939 are, *pro rata*, much greater than they were even at the climax of the Great War.

Until recent years, officers of the armed forces never considered the question of how their war requirements in *matériel* were to be provided, nor, for that matter, did anyone else. Now that the problem has been recognized in all its magnitude, it is still not primarily the duty of armed forces staffs to work out detailed plans for industry. It is the duty of industry and of that part of the State organization which exists to deal with economic questions, that is,

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the economic war staff, if the State concerned has such an organization.

There is no exception to this rule. Even if warships are designed and constructed in government dockyards, the naval staff is still dependent on economic factors. The Navy has no coal mines or steel mills and does not build its ships from raw materials but from components. About ten times the number of men employed in a naval dockyard in assembling a capital ship are employed in industry in manufacturing the components and semi-manufactures from which she is assembled. Moreover, that great part of the national economy, employed on the work in question, cannot at the same time be used for other work, and the economic war staff must make adjustments accordingly.

It is the duty of the armed forces staffs to estimate and declare what they will require in war in the shape of men and finished war stores of all kinds. They must make this estimate, not only to cover the initial stages of war but also to meet the wastage and expenditure of several months of war. They, and they alone, must decide, not only upon the quantities of war stores that they will require but also the types and, what is more, they must make these decisions many months before war breaks out.

Finally, having informed the economic war staff of their requirements, they must try to make no major changes in their estimates, and especially in design. If, however, this is absolutely necessary, they must take the responsibility of doing so and must realize that, unless sufficient time elapses between the decision of their change of mind and the outbreak of war to enable the necessary adjustments to be made, the armed forces may get no delivery at all of the war store in question.

Were I compelled to confine my lecture to establishing one single point, I would choose this one, namely, that effective plans for economic mobilization cannot be drawn up until the armed forces have made up their minds what men and *matériel* they will need in war.

Now, although it is the responsibility of the armed forces staffs to decide the nature and quantity of their requirements in war stores, they must consult industry in the process.

An expert civilian designer on the staff of the Admiralty, War Office or Air Ministry can design, say, a fuze, a tank or an aeroplane which will perform all the antics the military staff require. A government arsenal, or other skilled armament works, employing hundreds of men of the highest skill and training in armament manufacture, equipped with every sort of special purpose machine tool and taking its own time, may manage to turn out a perfect prototype of the specialist's design. Industry as a whole, however, may be unable to manufacture the article at all.

Simplification of Requirements

If you want quantity in war, you must be prepared to sacrifice to some extent, not necessarily quality, but complications and unessential trimmings. Endless arguments are possible regarding the point at which the sacrifice of complications in favour of quantity production is justified. But, if these arguments are allowed to be endless, you will get neither quality nor quantity. You will get nothing at all. The reason for this is that it is not your State armament works, or even your privately-owned armament factories, upon whom you must rely to deliver the immense quantities of armaments which you will require in war, but the greater part of the whole corporate industry of the country.

No State, still less privately-owned industry, can afford to maintain in peace the immense range of special plant and machinery required in war to produce these astronomical quantities of armament stores. Nor can they afford to keep idle on their pay-roll the huge numbers of skilled workers needed to operate this plant.

At the same time, the manufacture of armaments demands a very high degree of skill, out of reach of the ordinary engineering works without due instruction and practice. The only solution of this problem is found in the relatively new science of "Economic or Industrial Mobilization."

It is not only as necessary to plan industrial mobilization in peace as it is to plan for the mobilization of the armed forces, it is far more necessary. The armed forces cannot exist in war unless kept supplied with war stores. Moreover, industrial mobilization affects the life and activities of the whole nation. It is thus a far more complicated matter than military mobilization.

Industrial mobilization plans must be co-ordinated with plans for military mobilization and vice versa, not only because the object of the former is to be able to supply and to go on supplying the armed forces with the war stores they require in order to wage war, but because it deals, first of all, with the distribution of man-power and labour as between the armed forces and other essential, national, war-time activities.

Supply of Man Power

When you subtract from the total population of a country that proportion which is too young or too old to undertake any war work, the invalids, those who must continue their peace-time activities, including the labour which must still be employed in war on the manufacture and supply of goods for export and to provide the necessities of life for the non-military population, which includes those engaged in the manufacture of war stores, you will readily admit, firstly, that the number of men in uniform must represent but a small part of the population engaged directly in war work, and secondly, that the man-power problem requires the most intricate, detailed planning in peace.

The man-power question involves age, sex and skill.

Industrial labour can be diluted in emergency to some extent by women, children and others, who would normally be considered unfit for such work. The limits imposed on dilution through the necessity of continuing to employ young, able-bodied men in those tasks for which women and children are totally unfitted, are rather surprising.

As regards such highly skilled work as the manufacture of armaments, where the margin of error allowed is sometimes as low as half a ten-thousandth of an inch, the position is still more difficult.

There are hundreds of thousands of skilled workers in industry, whom you must on no account take into the armed forces, unless it be to absorb them into work similar to that for which they have trained in civil life. In principle the "enlisted man," as the Americans call him, must be drawn as far as possible from unskilled labour.

Even so, you may need more skilled labour in industry in war than in peace. You will certainly need it in some branches of industry. How is it to be provided?

First of all, there must be some sort of labour census in peace, which will enable you to transfer labour in emergency from the luxury trades to the armament industry.

Then you must make up your mind to risk a certain lowering of the quality standard and, in order to permit this, must, as I have already stated, simplify as far as possible the designs of your war stores. Lastly, there is the question of some sort of instruction in peace-time in order to provide a reserve of skilled labour for emergency.

The problem of providing man-power is not any more important than those involving the supply of raw materials for industry and subsistence, the provision of adequate plant and machinery, and of transportation facilities, and lastly the question of finance.

Provision of Raw Materials

First, as regards raw materials, most countries now develop their domestic resources and invent substitutes for those materials which they lack. This is a war measure, to resist the application of economic pressure by enemies. It involves also the maintenance of large reserves of certain products which must be imported.

In theory the U.S.S.R. and the British Empire (but *not* the United Kingdom alone) might be made self sufficient, and potentially the United States also.

War-time requirements of most supplies greatly exceed those of peace-time. For example, even with the most stringent economy and rationing, a first-class power with a large navy, army or air force, will require in war a much greater quantity of petroleum products than it consumes in peace.

This is by no means due solely to a greater demand from the armed forces in war. The minimum essential requirements of mobilized industry, transportation and civil life may well equal that of all the armed forces added together. In this matter as in all others, the armed forces must bear in mind that the collapse of the economy of the non-military section of the nation, who represent well over 90 per cent of the population and something like three-quarters of the total national war effort, whether it be due to under-nourishment, shortage of raw materials or a lowering of the standard of life below what is bearable, must entail the collapse of the armed forces as well.

Plant and Machinery

Next, in connection with plant and machinery, two special difficulties arise. Most of it will be worked in war twice or three times as hard as in peace. It will therefore wear out quicker and require replacement more often. Secondly, much of the machinery used to manufacture armament stores cannot be used for other purposes. It is what is called "special purpose machinery" and therefore will not normally exist in peace-time industry to a sufficient extent to manufacture the immense quantities of armaments needed in war.

Both these difficulties can only be overcome by careful research and planning conducted over a long period in peace, and by putting into effect certain devices which have been thought out for the purpose by industrial mobilization experts.

In helping to find a solution to these problems, the armed forces can and must play a part. They must permit as many as possible of their war stores to be designed as far as possible on the lines of similar goods used generally in peace. Further, where this is not possible, as in the case of many armament stores as opposed to articles of equipment, the armed forces must permit reasonable modifications of design, if quantity production is required.

Anything more wasteful of time, money and energy it would be hard to imagine than, say, an unjustifiable demand for a special shape of spade, shovel or blanket for armed forces' use, when types normally manufactured in peace by the thousand are ready to hand. Or, again, the design by two different armed forces of, say, two different types of fuzes, when one would really suffice in practice for both purposes.

Transportation

I will not dwell long here on the subject of transportation planning in connection with industrial mobilization, since I think that by now its necessity and its nature will already have been made sufficiently clear. You may have to import increased weights of certain raw materials in war, but the shipping to do so may not readily be available and additional tonnage cannot be created in a day. You will have to carry increased quantities of materials and semi-manufactures between your factories and from them to the points of consumption. You will have to alter the intensity and flow of traffic along shipping lanes, ports, roads, railways or canals. All these possibilities have, in so far as possible, to be foreseen and guarded against, or alternative routes and methods considered.

Finance

In connection with finance it must be noted that in war all countries must sooner or later import considerable quantities of certain commodities from abroad. Most countries must continue to trade, as in peace, with such other countries as are neutral, unless prevented by enemy interference.

The only means by which, in the long run, a country can pay for its imports, is by exporting goods of equivalent value. Therefore, not only has the export trade of the country in war to be considered, and as far as possible planned in peace, but allowance has to be made for labour, machinery, raw materials and transport facilities wherewith to manufacture and carry your export goods. The national energy expended on this essential purpose cannot, at the same time, be utilized to manufacture war stores or for other immediate warlike purposes.

Thus national economic planning for war emergency must cover every national activity comprised under a very broad definition of man-power, raw materials, agriculture and food, industry, transportation, trade and finance.

Economic mobilization planning takes time; far longer than does planning for military mobilization, though, like the latter, economic mobilization plans must be kept up to date to fit in with ever-changing world economic conditions.

Co-operative Planning

The question of economic mobilization is of direct concern to naval, military, and air officers who are planning strategic operations, for the following reasons:

First, no plans for economic mobilization can be completed until the armed forces have made up their minds what they will need in war in men and *matériel*, and that if thereafter they change their minds, they must risk a failure in supply. This, however, is by no means all.

Actually, however efficient may be the plans for the mobilization of national economy and the quantity production of war stores in emergency, no significant output of war stores, on the scale that the armed forces will require in war, can be expected for several months after the outbreak of war.

Here again, although the armed forces and the economic war staff must co-operate, the onus of responsibility rests first with the armed forces to decide what the wastage and expenditure of war stores will be during the period required to mobilize industry and to get output, though it is the duty of the economic war staff to state how long that time-lag will be and to ensure it is no longer.

In considering this question, the armed forces staffs will do well to recall that their proposed mobilization reserve of war stores, that is to say, the war stores necessary to bring the armed forces up to a war footing, and the war reserve of war stores necessary to maintain the forces mobilized in the first instance in the field until they can be supplied direct from the output of mobilized industry, consist of exactly the same types of goods.

You can, for example, use 18 new aeroplanes to form a new squadron, or you can use them to replace others put out of action in an existing squadron. The armed forces staffs must decide in the light of the existing or assumed situation whether they will use the stocks of arms available as a mobilization or as a war reserve. But they cannot use them for both purposes at once.

This may seem absurdly obvious, but it applies to the enemy as much as to your own forces and is a fact often forgotten when estimating the possible strength of the enemy at various stages of the campaign.

Next, it is no use to draw up strategic plans demanding the use of armed forces which cannot be armed or maintained in active operations for the period of time necessary to bring those operations to a successful conclusion. Equally, it is useless to plan to use forces in places or under conditions where it is impossible to supply them with the war stores necessary, even though those stores may be available elsewhere.

For example, you may plan to lock up a force at a certain place with a view to holding out until large reinforcements can arrive on the scene. If so, it is essential to calculate the estimated wastage and expenditure of war stores for the period of resistance envisaged, and to be sure that they are either immediately available *in situ*, or can be supplied from other sources.

The same idea may be taken into consideration when considering the enemy force attacking your fortress. This force must be adequately supplied with war stores or else must sit idle, admiring the scenery. To supply it will demand ships to convey the stores. The destruction of any of these supply ships might have far reaching consquences. The economic war staff will be able to assist in many ways in arriving at conclusions of this kind which may, in certain circumstances radically affect strategic plans.

If fighting is in progress close to an industrial district at the disposal of one side or the other, many items of armament or equipment, rendered unserviceable owing to minor defects, can rapidly be repaired. If, however, the action is being fought out of reach of industrial facilities, the wastage and expenditure of war stores will be correspondingly larger. In other words, the stocks at the disposal of the naval, military or air force in question, to enable them to continue their resistance, must be proportionately greater.

One other point is of importance. Most nations—with certain important exceptions—are armed with weapons of their own special design. Consequently they cannot get further supplies of armament from outside sources, unless arrangements have been made in peace for this very purpose. A six-inch shell will not fit into a 155 mm. howitzer. Facts of this kind affect calculations of the probable enemy strength, as well as our own and that of our allies, at various stages of the war.

All will be well if the staffs of our armed forces on the one hand give due consideration to these problems, and if on the other hand the economic planning is carried out with the care and circumspection demanded where our very national existence is at stake.

Finally, I suggest that neither the armed forces nor the economic war staff should try to invade what is properly the sphere of the other, but that by mutual understanding, forbearance and co-operation, the four defence forces of a country should work together for the common good.

THE MANUFACTURE OF WIRE FOR USE IN WIRE ROPES

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The failure of two important suspension bridges during construction, early in 1929—the Mount Hope Bridge across Mount Hope Bay on the main road between Providence, R.I., and Newport, and the Ambassador Bridge between Detroit and Windsor—focused the attention of engineers and the general public somewhat unfavourably upon suspension bridges and wire rope in general. As a result, the wire industry, and bridge engineers who still believed that in suspension bridges lay the answer to many construction problems, gave fresh consideration to the processes of steel production and adequate methods of testing the final product. In regard to the failure of these bridges it was found that, in their construction, a new departure had been tried and found wanting—the use of a tempered wire had given results far from the desires of the designers, and resulted in a costly failure. In the completion of these bridges cold drawn wire was used and it is with the manufacture of this product that this paper is concerned.

Part I—THE MANUFACTURE OF BRIGHT WIRE FOR WIRE ROPES

The manufacture of wire for use in wire ropes is perhaps the most exacting task of the wire engineer. Constant checking is necessary during production in order to ensure the safety of the finished rope, whether intended for lifting, haulage, or suspension.

The Rod

The rod from which the wire is to be drawn is rolled in the rod mills by hot process, cooled and then sent to the wire mill for cold drawing. It should be explained that the hardness of the high carbon rod which we shall consider, will vary from end to end of the rod; the modern continuous rod mill is coupled so close and runs at such a speed, that the front end of the rod is rolled, and is being finished before the back end of the 30 ft. billet has emerged from the reheating furnace. Theoretically, the temperature of the rod as it emerges from the finishing pass, should be uniform end to end, and well above the critical temperature for the analysis of steel under consideration. Coils are cooled slowly in a covered conveyor. Nevertheless, due to the fact that the outer layers of a coil cool more quickly than the inner ones, there will be a corresponding, and somewhat haphazard variation in microstructure along the rod's length.

The process known as 'patenting' is designed to remove these differences in hardness caused by ingot structure and non-uniform cooling, and to produce a uniform structure known as sorbite which is best adapted to withstand the subsequent stresses of wire drawing.

The patenting of the rods is performed in a muffle furnace which may be from 40 to 100 ft. in length—the most common length is 50 ft.—through which, in a reducing atmosphere, as many as forty wires are drawn at a deliberate uniform speed. The temperature of the rod reaches the critical temperature, generally in the first third of the furnace, and increases gradually toward the outgoing end. This method of heating produces a decidedly uniform austenitic structure. As the work emerges from the furnace, some three to four hundred degrees above the critical temperature, it is quenched in air, salt or lead to produce an entirely sorbitic structure. Few traces of crystal boundaries can now be seen microscopically, but when the rod is eventually hard-drawn in order to obtain the correct tensile strength, the wire takes on a quasi-fibrous structure.

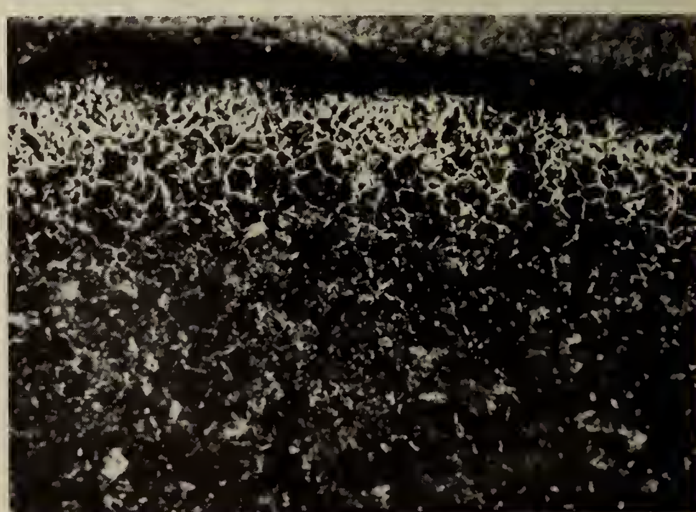

Fig. 1—Structure of high-carbon wire before "patenting"

The following table is the actual result of air-patenting upon a heat of 0.82 carbon bridge cable rod, and will illustrate the increase in uniformity by patenting. It should be noted that, due to the faster strand-by-strand cooling the patented wire has a higher tensile and elastic value

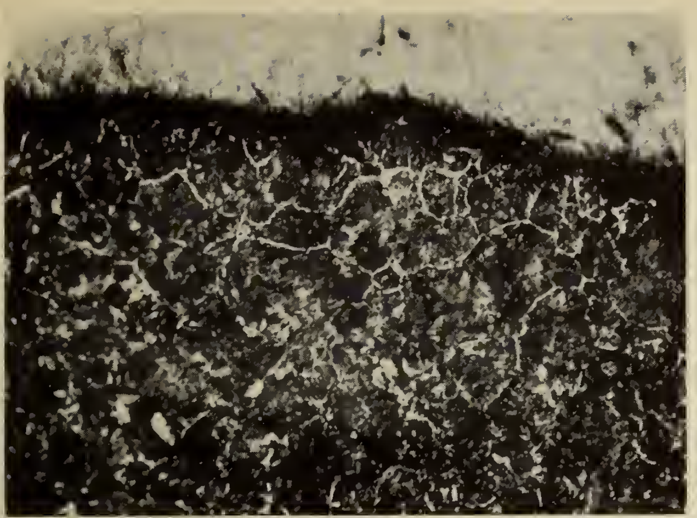

Fig. 2—Structure of high-carbon wire after "patenting" showing sorbitic structure

than the original green rod, and has a commercially uniform hardness.

	Tensile Strength lb. per sq. in.	Elastic Limit lb. per sq. in.	Elong'n. in 2 in. Per Cent	Red'n. of Area Per Cent	Torsions in 8 in.
Rod (Green)..	140-155,000	94-104,000	13-14	23-28	5- 8
" (Pat'd.)..	153-159,000	106-109,000	13-14	26-30	9-11

Figures 1 and 2 show the micro-structure of the rod in its original and final (sorbitic) condition.

Wire Mill Operations

On leaving the patenting furnace the rod has taken on an oxide scale composed of the three iron oxides, Fe_3O_4, FeO, and Fe_2O_3. This being hard and brittle must be removed before the rod can be drawn.

The solution of these oxides is carried out in acid baths—generally muriatic or sulphuric acid is used for the purpose; the latter is more frequently used. This process leaves a clean white scale-free surface. To assist lubrication, neutralize free acid, and to prevent rusting, the rods are dipped in a strong lime solution which covers them completely with a fine coat of special wire-drawing lime; continual analysis of baths, control of temperature and the use of inhibitors ensures clean rods, free from deleterious hydrogenation and consequent embrittlement. The rods are then baked in ovens, after which they are ready for the drawing operation.

Electrolytic pickling is now being used to ensure smooth pickled surface and freedom from acid embrittlement.

In the drawing operation, the wire is pulled at constant speed through a die, the inside shape of which more or less resembles a funnel. Regular drafting and proper lubrication are absolutely necessary to this operation, and, as a result, these points must be carefully guarded in the manufacture of wire for wire rope.

During the drawing operation, the rod enters the die on roughing frames—heavy equipment which gives the original drafting operation—taking with it the lime coat and a plentiful supply of powdered soap lubricant. As it enters the bell-mouth of the die it strikes the reduction area where size is reduced, until the desired draft is made, and it leaves by an opening in which the sides are parallel, and of which the measurement gives the size of wire desired on this particular draft.

This operation may be performed on continuous or single block equipment. The former type is illustrated here (Fig. 3).

The rods enter the machine at the left, and are drawn continuously six passes at one operation to the finishing block at the right hand side. Soap lubrication is most usual. Automatic speed controls on individual blocks control tension of the wire. Speeds up to almost 1,000 ft. per min. are obtained in drawing rope wire on such machines, in contrast with single block drawing at 250 ft. per min. In spite of the increased speeds, physical properties show great improvement.

Figure 4 illustrates the general shape of these dies.

An idea of the power required for each draft may be had from the fact that for the flow of steel in the die, the pressure must exceed the elastic limit. The actual pull is given by the formula:

$$DP = M(A-a)\ (1+\cot\frac{\alpha}{2})\ K$$

where DP = Die pull.

M = Mean yield point of undrawn material.

$(A-a)$ = Difference in cross sectional area before and after drawing.

$\frac{\alpha}{2}$ = ½ throat angle of die.

K = Coefficient of friction varying from 1.25 to 3.00 dependent upon draft.

As an example of the use of this formula, in drawing 13 gauge spring wire to 15 gauge—a fairly heavy draft,

$M = 235{,}000$ lb. per sq. in.

$(A-a) = .002418$ sq. in.

$1+\cot\frac{\alpha}{2} = 1+\cot 16^0 = 4.4271$

K = coefficient at 30 per cent red'n. = 2.0

Whence the die pull equals 932 lb. The actual force necessary, therefore, to draw wire on a fourteen-block bench with varying wire sizes from five rod to 16 gauge can be imagined, and requires stability in every feature of the design of the equipment used.

Variable speed redrawing blocks are used to continue drawing after the roughing operation. The use of the term roughing is a misnomer when one considers that drafts must be maintained to 1/2000 in. and to regulated draft percentages, taking care of die angles, percentage reduction, and lubrication at every step.

In many cases intermediate patenting is necessary between the drawing operations. To do this, the material is drawn to a size which will give a definite reduction, and patented at uniform speed as in the rod, but with allowance in heating rate and cooling time to give the desired structure and physical properties. It is then recleaned and drawn to finished size on lighter equipment, a typical form of which is illustrated in Fig 5.

Fig. 3—Modern continuous rod frame

Patented wire enters the machine at the left side and is drawn continuously through as many as twelve dies. Predetermined drafts and conical sheaves minimize stoppage as reduction proceeds, and the wire is wound on the finishing block at the right. Wet lubrication is most usual in this type of equipment. Speeds of 900 ft. per min. are now used continuously, contrasting with former single hole drawing speeds of 150 ft. per min.

Changes of Structure During Drawing

Important physical and microstructural changes take place during drawing. Figure 6 is a graph showing that as reduction proceeds, the tensile strength rises; the rise becomes very rapid after a 40 per cent reduction has taken place. The upper limit of drawing for best results on rope wire is about 85 per cent of the area after patenting. As the tensile strength increases the elongation falls very rapidly to a constant value of about two to three per cent after 30 per cent reduction.

The effect of drawing on microstructure is shown by Fig. 7, illustrating the elongation of grain in a 40-45 carbon rope wire during reduction. Steel of this particular carbon content was chosen because the grain elongation is clearly discernible. The effect is increased as the carbon value rises.

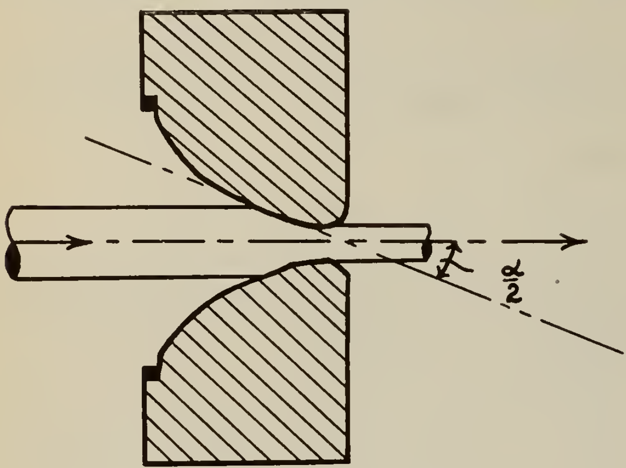

Fig. 4—Wire-drawing die

Testing

The finished wire is now removed to the testing department where it is examined at each end of every coil to determine whether all the coils meet the physical requirements.

Generally speaking, there are six grades of high carbon rope wire as follows:

Grade	Torsions Required Minimum On 100 Diameters	
80/ 90 Long Tons......	35	Cast Steel
90/100 " "	34	Mild Plow
100/110 " "	32	Best Plow
105/115 " "	31	Green Strand
110/112 " "	28	Green Strand
120/130 " "	25	Special Green Strand

Some manufacturers maintain somewhat lower standards in torsional values than those shown in the above table.

Part II—CORROSION AND HOT GALVANIZING OF STEEL

Historical

The first recorded experiments in the production of zinc coatings by the hot-dipping method appear to be those of Melouin in 1741. Hot tinning was well known in France at this time and Melouin closely copied the process hitherto applied to tin—namely, dipping the sheets in a bath of the molten metal.

The next advance was made in 1802, when salammoniac was introduced in place of resinous fluxes.

Nearly thirty-five years later Sorel was granted a French patent for a zinc coating process which had practically all the essentials of the process as it is known to-day. His coated products were investigated by the French naval authorities, who presented a very favourable report on their resistance to sea-water corrosion. It is interesting to note that, at almost the same time, Crawford of England was patenting, in the latter country, an almost identical process, and that Crawford's patent rather than Sorel's is given the credit for the commercial development of the galvanizing industry in England and America.

The coating of wire was one of the first large scale commercial applications of the process to be carried out mechanically. It was not until 1846, however, when Morewood and Rogers patented an equipment which controlled the uniformity and thickness of the coating, that any real advance was made in mechanically processing galvanizing sheets.

In the last fourteen years much more attention has been paid to the scientific control and operation of the process, with the result that galvanizing is at last after two hundred years, assuming its proper position as a protective coating.

Corrosion and Zinc

When two different metals in intimate contact are exposed simultaneously to corrosive attack by a solution, the one having the greater solution-pressure—the more anodic metal—corrodes or dissolves, and by so doing prevents, in a very large measure, corrosive attack upon the other.

Metal exposed to the atmosphere, even in comparatively dry weather, soon becomes coated with a thin film of moisture. It is therefore in contact with an electrolyte, and passes into solution until the osmotic pressure of its ions becomes equal to the electrolytic solution-pressure. In the case of iron, however, another condition arises, namely, the prevention of the state of equilibrium by the formation of an insoluble hydroxide and the removal of ferrous ions from the solution. The degree of concentration, therefore, does not correspond to the solution-pressure, and as long as water and oxygen are present, the corrosive process continues and is assisted by local currents set up as a result of the heterogeneous nature of the iron.

It would thus appear that, in order to prevent iron from rusting, all possibility of direct contact between iron and an electrolyte must be precluded. This may be done by coating the metal with a sealing layer, or by depriving it of the faculty of sending ferrous ions into solution. Rawdon[1] carried out the classical research on preferential attack.

Fig. 5—Modern continuous fine rope wire frame

His conclusions were, in part, that zinc and cadmium afforded protection by themselves being dissolved, and that it was to the preferential attack of these metals that the protection of iron may be attributed. So long as the coating remains intact—small breaks are still protected—the corrosion resistance of the coating determines the life of the coated article.

It may be interesting to note in passing the nature of the corrosion of zinc itself. It has been stated by Bengough[2] that the corrosion of zinc varies directly with time. J. E. Maconachie[3], however, in his results has shown that the rate of corrosion of zinc is not constant. His interesting experiments indicate that corrosion begins at a number of definite points in sheets, and spreads over the specimen until the original smooth surface is uniformly roughened. This was shown to occur in about 48 hours. Thereafter

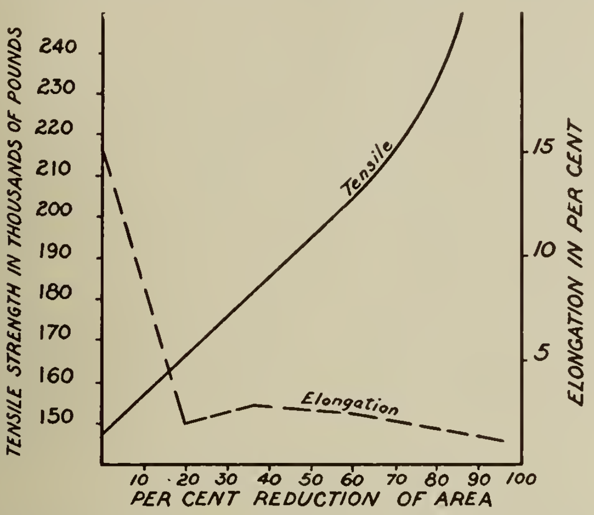

Fig. 6—Graph showing rise of tensile strength with reduction

pitting developed. The problem of periodicity in the dissolution has been studied in detail by Hedges and Meyers[4], who found pronounced periodicity in the rate of evolution of hydrogen. The frequency of the periods was shown to decrease rapidly with time and with decreasing concentration of the reagent in the corroding medium. Maconachie showed that at times the weight of the specimen increased during corrosion, while at others, it decreased.

It has been shown by Evans and his co-workers that the corrosion product film on zinc in itself forms an effective carrier for the ready diffusion of oxygen to the metal surface. This corrosion action

$$Zn + 2H_2O = Zn\,(OH)_2 + H_2$$

has been demonstrated to be reversible, and this is no doubt the reason for fluctuations in the corrosion of coated metal.

The Operations of Galvanizing

Under this heading will be considered: pickling, fluxing and the hot galvanizing operation itself. It is a well known

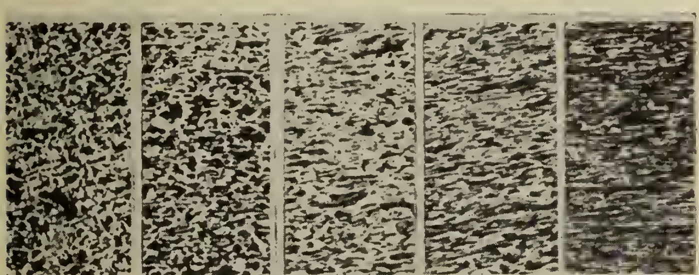

Fig. 7—Changes in grain structure during drawing

fact that the surface of the steel to be galvanized has a profound effect upon the perfection of the finally coated article; if pitted, or even scratched, the resultant gas inclusions produce corresponding roughness of the final coating.

Pickling is often considered to be only incidental to the galvanizing process, rather than an important operation with far-reaching consequences. As a general rule, wire carries but little appreciable scale, so that the pickling operation resolves itself into a mere dissolution of light oxides and iron. Muriatic acid, the usual solvent in hot galvanizing operations, acting upon the oxides causes the formation of ferric salts, ferrous salts, and water; acting upon iron it forms ferrous chloride and evolves hydrogen. This may be better illustrated by three equations:

(1) $Fe_3O_4 + 8HCl = 4H_2O + FeCl_2 + 2FeCl_3$

(2) $FeO + 2HCl = FeCl_2 + H_2O$

(3) $Fe + 2HCl = FeCl_2 + H_2$

The increasing temperature as the wire continues in process will have caused the gas bubbles, which have been intergranularly absorbed, to expand, thus producing humps beneath the zinc coating. This may, in part, be avoided by maintaining the pickling solution at such low temperature and strength as may be sufficient for process at the speed used.

It should be remembered, moreover, that a hot-water wash after pickling is an absolute necessity, since cold water has but little effect when muriatic acid is used as the pickling agent.

Temperature of Water	Solubilities	
	$FeCl_2$	$FeCl_3$
20 deg. C.	40.7	91.8
90 deg. C.	51.3	530.7

The above table illustrates the effect of temperature upon the solubilities of the chlorides of iron, and will emphasize the need of hot water as a solvent for chlorides of iron.

The Fluxing Operation

The first fluxes applied directly to the galvanizing bath were organic in nature, until, as already mentioned salammoniac was introduced early in the 19th century. It is certain that salammoniac type fluxes react directly with the zinc of the spelter pan, since, if pure NH_4Cl were placed upon the hot metal at the temperatures of galvanizing (840 deg. to 880 deg. F.), and no combination were possible, it should sublime almost instantly. Actual experiment has shown the vapour tension of ammonium chloride to exceed the atmospheric pressure at 629 deg. F., more than two hundred degrees below the working temperature of the bath.

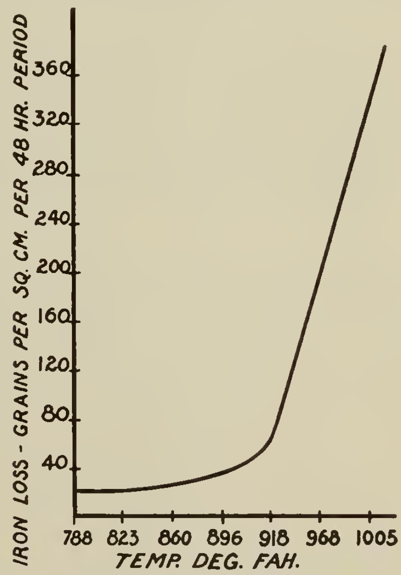

Fig. 8—Variation of iron loss with temperature of galvanizing bath

Therefore, since all the flux does not disappear, it follows that chemical combination must take place between NH_4Cl and Zn, and Zn must be taken into the molecule.

The double salt, zinc ammonium chloride is now widely used in the galvanizing industry, the reason being obvious when the following reactions are considered:

(1) $Zn + 2NH_4Cl \rightarrow Zn(NH_3)_2Cl_2 + H_2$

(2) $Zn\,(NH_3)_2Cl_2 \rightarrow Zn(NH_3)Cl_2 + NH_3$

By the use of the double salt, the first reaction, involving the evolution of hydrogen and resulting in the loss of ammonia in the second, is in part avoided, and the attendant loss of flux is reduced. It has been determined[5] that with decrease of NH_3 content, the flux rapidly loses its power, and new material must be added. The reaction of flux with a metallic oxide is believed to be of the following order:

(1) $MO+NH_4Cl-M(OH)Cl+NH_3$

(2) $M(OH)Cl+Zn(NH_3)Cl_2-Zn(OH)Cl+NH_3+MCl_2$

Working on the theory that the formation of these zinc alloys depends directly upon the rate of dissolution of iron, and that this in turn depends upon the time-temperature factor, the author has conducted a series of experiments upon speed and spelter temperature. Iron dissolution in low carbon steels below 500 deg. C. (932 deg. F.) appears to vary according to the equation [6]:

$$L=N\sqrt{t}$$

where L—Loss of weight in grams per sq. meter

N—Factor obtained by

$$\text{Log}_{10}N=2.702-\frac{1256}{T+273}$$

Where T = Temp. in deg. C.

t—Time of immersion in minutes.

From this formula it is evident that a decrease in t or T will result in lowering the loss L.

It should be remembered that no coating is produced upon the wire, until the wire has reached the temperature of the bath. When the material is removed from the bath, the iron and zinc are above the melting point of pure zinc (419.4 deg. C or 787 deg. F.). This readily explains spangle formation in sheets. The excess of heat is released, and as the crystals form, the heat of fusion is given up. Since the iron and the zinc alloys are in intimate contact, the heat must pass through the zinc permitting slow cooling and large spangle formation. If, on the other hand, the metal be pitted or irregular, the low conduction of the gases contained in the cavities will result in spotty cooling and irregular spangles. Some importance may thus be attached to large spangles when seeking clean, unpitted galvanized sheets.

High and Low Carbon Steels

It is a well known fact that higher carbon steels galvanize more readily and give a more adherent coat than do those of low carbon content. Considering this fact in the light of the alloy formation theory, the bonding structure between metal and alloy FeZn is considerably thicker in high carbon stocks.

The second alloy layer is much thinner in the case of the higher carbon stocks. The practical result of these comparative structures, due to the brittleness of the second alloy layer, lies in the fact that the higher carbon stocks may be bent to an appreciable degree before cracks become apparent. As a result, the conclusion may be drawn that the only hope of producing better bending qualities in galvanized wire or sheets is the elimination of the brittle alloy layers. Under present mechanical conditions, however, this is unattainable in hot galvanizing, but by balancing temperatures and time of immersion, as already shown, a condition may be reached which, for each particular stock, will produce maximum bending properties. Since wire used in wire rope is generally of the high carbon variety, peeling is not a problem.

Dross and Its Formation

In any spelter pan constructed of iron, there is a certainty of iron contamination and consequent alloy formation. Of course no alloy will be formed until saturation is completed —at about one per cent iron and naturally this condition will become evident more quickly in small pans than in larger ones.

If normal operating values were applied in $L=N\sqrt{t}$, namely T = 860 deg. F., t = 1 minute, then L = 9.817 grs. per sq.m. per min. While this value may appear insignificant at first glance, it nevertheless amounts to a considerable figure over a period of a few months, and in time the pan becomes worn out. The greatest metal solution generally occurs at the end of the pan where the comparatively cold work enters the spelter. The constant rising of hot metal from the depths of the pan—differences as great as 80 degrees F. have been noted between upper and lower layers of the pan—seems to result in the production of eddy currents which in turn produce rapid corrosion of the pan near the end where the work enters.

The sudden change in the curve showing variation of iron loss with temperature, (Fig. 8) is due to the fact that at the temperature of 890 deg. F. approximately, there is a sudden change to higher iron alloys. Under 900 deg. F., the alloys show a rhombohedral structure and exist in the form of long slender, needle-like crystals. Above this temperature, they become pyramidal, and are built up of many sided hexagonal plates. As the temperature is increased, the crystals lose zinc.

Considering an equilibrium between iron and zinc at higher temperatures, a drop in temperature causes the alloy to take up iron, until the maximum figure is reached just before solidification. The rapid rise in iron content in a galvanizing bath would lead to the conclusion that, in order to prevent excessive drossing and consequent loss of zinc, it is necessary to use a zinc which is low in iron. The American Society for Testing Materials has recommended the following grades of zinc slab:

Grade	Pb Max.	Fe Max.	Cd Max.	Al Max.	Pb Fe Cd Max.	Spec. A.S.T.M.	U.S. Army & Navy Spec.
Spec. High Grade	0.010	0.005	0.005	0	0.01	Tentative	—
High Grade.....	0.07	0.03	0.07	0	0.10	1	A
Intermediate....	0.20	0.03	0.50	0	0.50	2	B
Brass Special....	0.60	0.03	0.50	0	1.00	3	C
Selected........	0.80	0.04	0.75	0	1.25	4	D
Prime Western..	1.60	0.08	—	—	—	5	E

Where the coated article is not to be deformed, the less pure grades of zinc are used; where bending properties are desired, however, it is preferable to use the grades carrying only small amounts of cadmium and lead.

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Abstracts of Current Literature

Contributed abstracts of articles appearing in the current technical periodicals

COAL MINING IN EUROPE

Engineering, October 13, 1939

Abstracted by A. A. Swinnerton, a.m.e.i.c.

It is stated in a bulletin on 'Coal Mining in Europe,' recently issued by the U.S. Bureau of Mines in Washington, that the European bituminous-coal deposits are, in general, much more difficult to work than are similar deposits in the United States. The authors, Messrs. G. S. Rice and I. Hartman, point out that the coal beds in Europe are thinner and the workings much deeper, some in Belgium reaching, in fact, a depth of 4,000 ft. Moreover, in continental coalfields, the beds are frequently inclined, folded and faulted, and, owing to the pressure, the coal is friable. The efficient application of coal-cutting machines, therefore, is difficult or impossible except in the case of mines in the United Kingdom, and pneumatic picks are employed to break up the seams of friable coal. Little or no explosive is used in Continental mines and the close timbering necessary at the coal face renders impossible the employment of large mobile loading machines of the American type. Compared with those of the United States, the coal resources of many countries in Europe are small, hence every effort is made to extract as much of the coal as is economically possible. The working of seams down to 18 in. thick, in Belgium and France, is made commercially profitable by the simultaneous mining of a group of beds, which can be reached from one set of shafts, and in certain Belgian mines, as many as 10 or 12 beds are worked simultaneously. The resources of the higher-grade coals are somewhat limited in Europe; true anthracite is found only in South Wales and a few localities in Germany. On the other hand, anthracite coals, in which the volatile matter is low, and coking coals, are fairly widely distributed in Great Britain and Germany.

In Europe, some form of long-wall system, with complete or partial packing or back filling, is the mining method most widely adopted. This facilitates roof control and reduces the risk of subsidence of the upper beds and of the surface. At some French collieries, filling material is quarried on the surface and lowered into the mines. The stowing with sand and gravel by hydraulic methods is now practised extensively in Germany and to some extent in France and Belgium. Stowing by the pneumatic blowing of waste and crushed debris has recently been introduced into Germany, but, to lessen the risk of damage to buildings on the surface, the hydraulic method of stowing with sand and gravel has been found to be preferable. Two shafts, at least, are always provided, one of which is a downcast or intake-air shaft, while, for large mines, two or more hoisting shafts, for serving the various main levels, may be provided. The cages employed usually have two or three decks, each of which has room for two or three pit tubs. Recently, skip hoists, as used in America, have been introduced in several mines, in which case separate hoists are employed for the men. Pithead structures and surface buildings are constructed with a view to permanence and are of steel, brick, or concrete. The shafts themselves are circular or elliptical in cross section and are always built of non-combustible material, usually consisting of iron or steel in the upper portion, through water-bearing ground, and of concrete in the lower portion. The main haulage ways, in Continental mines, are generally level; they cut across the strata to strike the dipping coal beds and may be connected to higher or lower levels by short underground shafts and slopes. In collieries in Great Britain, where the beds dip less steeply and where, usually, only one bed is mined at a time, endless-rope haulage is employed. In Continental mines, Diesel locomotives of approved types have largely supplanted rope haulage in the main levels. Pit-tub tracks, along the face workings, are now rarely used except in mines in the United Kingdom. Conveyors of all types are used along the coal face and to transport coal away from it, and main conveyors, in the inclined gateways, discharge into pit tubs on the level haulage roads.

The daily output of coal, per underground worker, is much lower in Europe than in American collieries. This is due to a number of factors, namely, the working of much thinner coal beds; the inability to employ coal cutters and large loading machines; the frequent moving of conveyors; the requirements in regard to back filling; the need for closely timbering the face and for providing strong permanent supports for roadways under the high roof-pressure of deep mines; and the frequent necessity of driving cross workings and underground auxiliary shafts. The result is that the total number of all the men employed underground is five or six times that of the men actually producing coal at the face, in striking contrast to the situation in collieries in the United States, where between 60 per cent and 70 per cent of the underground employees are producing at the face. The daily wages of European miners are low compared with those of American miners; they range, in fact, from one-fourth to one-half of those earned by colliers in the United States. Men in Europe, however, work approximately 50 per cent more days per annum than do those employed in the average American colliery, hence, the annual gross income of a European miner, including certain allowances and benefits, is not much below that of his confrere in the United States. Furthermore, housing conditions, pit-head baths, and changing facilities in Europe, are generally on a much higher scale than in the United States, where mining villages are often of a more or less temporary nature owing to the short life of the average colliery.

The accident rates for underground workers, per 1,000 men employed in all European countries, are much lower than in the United States and this applies with still greater force in France and Belgium. This favourable position is due to more stringent statutory restrictions, to close inspection on matters relating to explosives, electric power and methods of lighting, but above all, and despite the fact that European roof strata are generally weaker, to the utilization of better roof supports. Moreover, as already stated, only about 20 per cent of the men work at the face, the most dangerous place in a mine, as compared with 60 per cent or 70 per cent in the United States. In the first decade of the present century, explosions in American mines caused fatalities, the total number of which was second only to those due to falls of roof. Thus, in 1907, upwards of 900 colliers were killed as a result of explosions in the United States. The annual number of fatalities, however, is now relatively small, largely owing to researches conducted by the Bureau of Mines, which is officially co-operating with the leading European mine-safety research stations. Not only have systematic investigations been conducted on such matters as ventilation problems, explosives, mining machinery, miners' lamps, and stone dusting and other explosion-prevention methods, but increasing attention has been devoted to the supervision and education of the mining personnel.

BEARINGS WHICH RUN AT 90,000 R.P.M.

Abstracted by Robert Williamson, London, Eng.

No matter what the branch of engineering, if there are incorporated revolving or oscillating parts examples can be quoted of applications where either ball or roller bearings are fitted—in aeroplane engines, bakery machinery, cinema apparatus, cream separators, gear boxes, windmills, meat choppers, doors, sunblinds and hundreds of other uses.

The satisfactory running of ball and roller bearings in actual service depends entirely upon meeting operative conditions in all respects. Owing to the many applications to which bearings can be put, it follows that a bearing manufacturer has to be thoroughly conversant with the type of work his products are to be called upon to perform before making recommendations to his client.

Not only must he know the general nature of the application, but he must also have data as to speeds, the value of maximum and minimum journal and thrust loads, fluctuations, if any are present, and particulars of the duration of the duty, whether the bearings will have to work intermittently, or for a continuous number of hours each day.

It also follows that the manufacturer must have the completest possible range of bearings at his command. In this respect, British makers, with a long experience of meeting bearing problems of all kinds, are particularly well equipped. One firm, for instance, can supply over seven thousand sizes involving many types, and to ensure consistent accuracy has its master gauges periodically checked at the National Physical Laboratory of Great Britain. Balls are guaranteed to be within one ten-thousandth of an inch of standard both as to sphericity and size.

This varied production covers bearings for exceptionally high speeds and for ultra-precision duties. British bearings have been made to run at speeds of 90,000 r.p.m. Bearings for ultra-precision work are fitted with specially balanced cages and manufactured to finer tolerances than the standard product.

In the design and throughout manufacture, quality and the ultimate life of a bearing are in no way sacrificed to the consideration of cost. The diametral clearance between the inner and outer races and the balls, or rollers whichever the case may be, is fully controlled and bearings are made to predetermined limits.

The ball elements are manufactured as standard units and these units are incorporated in the complete design of a bearing. Balls and rollers are made of high grade steel, hardened and finished to exact dimensions, and can withstand the heaviest loads to which they may be subjected with the minimum loss of friction.

For certain special applications, rollers and bearings where the roller length is equal to many times the diameter are employed. Known as "needle" type roller bearings, the principle underlying their design is similar to that of other forms of cylinder roller bearings. Though they are not intended to displace the standard bearing types, they have proved exceedingly successful when applied to such equipment as aeroplane engine parts, camshafts, free-wheel arrangements, and big ends for motor cycles. A needle roller bearing fitted to a 4-in. dia. shaft was run for a considerable period at 800 r.p.m., and when inspected, showed no signs of wear.

When in actual service, bearings are subject to stresses not always possible to calculate, and a factor of safety is usually necessary. A bearing running continuously throughout the day, for instance, will have a much shorter life, the length of which is directly dependent on the relation between the bearing capacity and the load being carried, than one running only at intervals. Consequently, a larger factor of safety must be allowed for in the former case.

Load carrying capacity is based on working at normal temperatures, but where excessive temperatures are encountered it is necessary to adopt a further safety factor. While bearings can be run at temperatures much higher, 300 deg. F. is the maximum at which efficiency can be guaranteed.

USE OF DIESELS BY RAILROADS CONTINUES TO GROW

Society of Automotive Engineers Journal
November, 1939

Abstracted by R. G. GAGE, M.E.I.C.

Diesel horsepower used for switching service on railroads increased from 4,500 in 1923 to over 288,000 in 1938, an increase of 6,300 per cent. But this development of the diesel for switching operations has been unspectacular and has not been widely publicized. Consequently many people never heard of a diesel until the advent of the diesel-powered streamlined train.

Many roads replaced steam trains in local and branch line service with rail cars in an effort to furnish service that would at least break even. The designers and operators of the gas rail cars were chiefly concerned with low cost transportation and no particular attention was given to high speed or comfort. Consequently, the majority of these cars were powered with engines of relatively low horsepower and were designed for speeds of 60 m.p.h. or less. With the traveling public demanding more speed and greater comfort, the old rail cars were obsolete. At the same time, through passenger traffic had decreased to the point where many trains were being operated at a loss. It was quite apparent to many rail executives that to attract passengers back to the rails and put the passenger trains on a paying basis, it would be necessary to develop modern, up-to-date, comfortable, high-speed trains that could be economically operated.

The diesel had proved satisfactory in switching service but the engines used on switchers did not have enough power to handle heavy passenger trains. By utilizing modern materials and departing from conventional car design, light-weight trains were developed that could be handled by the newer diesels.

The first of these trains was placed in service in 1934 and was a three car train powered with a 600 hp. diesel. Today, diesel locomotives from 600 to 6,000 hp. are handling main line passenger trains over eight million miles a year. The following table shows the number of these units placed in service each year from 1934 to 1938, inclusive, the total horsepower of these units and average horsepower per unit:

Year	No. of Units	Total Hp.	Average Hp. per Locomotive
1934	1	600	600
1935	11	11,120	1,010
1936	7	15,300	2,185
1937	10	24,060	2,406
1938	15	54,000	3,600

It is interesting to note that the total horsepower installed and the average horsepower per locomotive increased each year so that the total horsepower installed in 1938 was 90 times that installed in 1934 and that average horsepower per locomotive increased from 600 to 3,600 hp.

It is almost impossible to make an accurate comparison of costs of steam and diesel power on passenger trains. A study of published data on several diesel and steam high-speed trains indicates that the average operating expense per train mile of the diesels is considerably lower than the average operating costs of the steam streamliners. On a car-mile basis, they are more nearly equal as the average number of cars per train is less on the diesel powered trains.

ELECTRIC EAR CHECKS MACHINES

Machine Design, September 1939

Abstracted by MECHANICAL ENGINEERING, NOVEMBER, 1939

Flaws in running machinery can now be detected by an "electric ear." This device, called an industrial noise analyzer, measures the intensity of sound at any preselected pitch without picking up any other factory noise. Should there be any variation from the normal sound-frequency intensities (revealed in previous tests), the instrument warns the operator that his machine is defective and may "freeze up" or break down.

To manufacturers of assembly-line products, which heretofore have been tested by ear, this device will also be of great value. A manufacturer of canned liquid foods, for instance, found that in sealing the cans an occasional pellet of lead solder would fall into the mixture and bring complaints from customers. A special type of "electric ear" was developed for him which would pick up only the frequency of the sound of the lead pellet rattling in a can. Attached to the production line, the device dropped out all cans which betrayed the tell-tale sound.

The analyzer consists of three parts: first, a microphone which converts the noise produced by the product under test into electrical impulses; second, the electrical wave filters which pass from the microphone to the amplifier only the frequency bands of the squeals or hums which occur when a faulty product is tested; and third, the amplifier and the meter which gives a visual indication of the power level in the band being passed. If the meter reading varies from the normal, a defect is indicated. This makes it possible for even the most unskilled worker to detect defects by just watching the dial of the instrument.

TRUE TEMPERATURE

A mathematical method of computing the effects of radiation on the readings of thermometers is set forth by Dr. David Dropkin, Westinghouse Research Associate in the College of Engineering, Cornell University, in Bulletin No. 26 of the Engineering Experiment Station, just off the press. The fact that neither the dry-bulb nor the wet-bulb thermometers, employed in the usual psychrometers for determining humidity in the air, indicate the true temperatures, because they may both be affected by radiation from surrounding objects, was pointed out in a previous bulletin from this Experiment Station. With especially designed apparatus, data have now been secured and equations developed to calculate the corrections for radiation of thermometers under varying conditions. It is well known that a thermometer, unshielded from radiation, and intended to measure the air temperature, may be greatly affected by surrounding objects which have a different temperature from that of the air. This makes it difficult to obtain the true temperature.

In Dr. Dropkin's bulletins, means for correcting observed temperatures are given which apply even to thermometer bulbs of different sizes. Such corrections are particularly important in attempting to get the relative humidity with the usual apparatus, since the key for obtaining the humidity is the difference between the wet-bulb and dry-bulb temperatures. Small errors in this difference make large errors in the results, so that the true moisture content of the air may vary considerably from that calculated from uncorrected thermometer observations. Dr. Dropkin found that under certain conditions, with low air velocities in a duct, the error in obtaining the difference in temperature of the two thermometer bulbs was as much as 39 per cent.

A HUNTED SUBMARINE

The Engineer, October 13, 1939

The dramatic story of the Cammell-Laird built submarine which while on patrol duty in the North Sea came into contact with enemy forces and escaped after being practically disabled by depth charges, was officially released to the Press on Thursday evening, October 5th. It is a remarkable tribute to the way in which British submarines are built, the reliability of their engines, and the resourcefulness of the engineering and navigating staffs. The submarine left our shores on patrol duty, and passing through a heavy gale found herself early one morning at her allotted patrol area in enemy waters. The detonation of a depth charge close to her showed, however, that she was being hunted, and she went to the bottom and remained silent to await events. During the next hour six explosions were recorded as the enemy searched for the submarine with sweep wires, electrically operated bombs, and depth charges. In the following hour the bombardment was intensified and explosions followed at the rate of one every two minutes, after which the sounds grew more distant. About tea-time a sweep wire was again heard along the top of the hull, this time followed by a series of bumps and a shattering explosion. The lights were extinguished, and above the shattering of glass was heard the hiss of escaping air and the drip of water. Examination of the machinery showed that both engines and one propelling motor were damaged and that there were many leaks in the compressed air system which raised the air pressure within the hull to a dangerous point. The lieutenant in command called a conference and it was decided to surface the ship, and if necessary to fight to the last. On reaching the surface and equalizing the air pressure, an attempt was made to crawl away with one propelling motor. The periscope had been smashed and the wireless gear destroyed, but the engineers set out to effect what repairs they could. Three hours after they had surfaced the engineers reported that the starboard engine was ready for use and two hours later the port engine was also ready. The wireless installation was made to work again by the wireless operator and it was then possible to send a message warning other submarines and a call to the base for help. The latter brought destroyers, and enemy aircraft, which had twice passed near to the submarine but had not seen it, were engaged and driven off. The submarine was able to return to her base in due course, after involuntarily undergoing trials which had tested to the full her design, construction, and workmanship, and the indomitable courage and resource of her officers and crew.

THE OPERATION OF THE CENTRAL REGISTER

Engineering, October 13, 1939

According to a notice circulated to its members by the Institution of Civil Engineers, the enrolments of technically qualified men in the Central Register, compiled by the Ministry of Labour from particulars obtained by the various specialist institutions and societies, now total some 74,000, of which approximately 13,000 are grouped under the heading of "General Engineering." To the end of August, more than 3,000 requisitions had been made by Government Departments, and the Ministry had been able to satisfy these requirements from among the engineers and other technical men whose names were on the Register. During the first week of the war, also, the Ministry arranged with the Admiralty and the War Department to supply the names of registered engineers whose qualifications were suitable for the technical fighting forces, and a selection of suitable men is now in hand. It is emphasized, however, that the fact of their names being on the Register does not debar registered engineers from accepting commissions in technical units, such as the Royal Engineers; but the Government is anxious that trained engineers should not enrol in the non-technical side of the Army, in which their special training and experience would be wasted. It is particularly urged, too, that engineers who have registered, and who are already in employment, should not write to the Ministry to express their readiness to undertake work of national importance. Those on the Register, however, who are unemployed, may, and should, do so. "Registrees" (apparently the adopted official term) are asked to exercise patience and to accept the assurance that, by so doing, they are serving the best interests of the country at the present time.

REDUCTION OF NOISE IN BUILDINGS

Trade and Engineering, September 1939

The Department of Scientific and Industrial Research has just issued a report on the reduction of noise in buildings (Building Research Special Report No. 26, H.M. Stationery Office, 1s. net). The work described has been carried out jointly by the National Physical Laboratory and the Building Research Station. Though finality has not yet been reached in the investigations, it is clear from the report that certain broad principles have now emerged from the work, the appreciation of which should materially assist architects and builders in dealing with the problems involved in meeting the general desire for quieter homes.

The report recommends that the actual problem of noise reduction in a new building should be attacked along three different lines: (1) By careful planning, so that external and internal sources of noise are as far removed as possible from those parts of the building where quiet is most needed; (2) by suppressing or reducing internal noise, preferably at its source; and (3) by providing a structure which will as far as possible prevent the transmission of noise from one part of the building to another.

Importance of Planning

There is a tendency, the report continues, to consider the structural question as the vital one and to neglect the other approaches. This is wrong, for the desired degree of quiet is obtained most economically by giving equal consideration to all three of these aspects. Indeed, while the provision of a sound insulating structure is often essential, the suppression of noise at the source and protective planning can reduce considerably the degree of structural insulation required, and therefore the special cost of insulation. Moreover, it should be realized that in some cases the structural methods at present known are insufficient to provide adequate insulation even if the cost does not matter.

Disturbance through internal noise can be reduced by careful placing of rooms used for different purposes.

When everything possible has been done by judicious planning and by suppression of noises at their source, attention can be directed to structural insulation. The complexity of the problem arises from the multiplicity of the different kinds of sounds which have to be eliminated and the variety of paths by which these sounds may travel. For example, a man walking on a floor sets the floor in vibration, and this in turn generates in the air sound waves which reach the walker's ears as air-borne sound. Similarly an air-borne sound wave is produced in the room immediately below. In addition, the floor vibrations travel laterally and are communicated to walls in contact with the floor and to the structure generally. Such structure-borne noise may travel a considerable distance with little attenuation, with the result that the noise of footsteps is heard in many rooms. Similarly, the sound of machinery, lift motors, pumps, etc., in rigid contact with the structure may be conducted to very remote parts of the building. In experiments in a reinforced building it was found that sound generated by a loudspeaker in a room 50 ft. away was not much less in intensity than that in the room next to the room containing the loud-speaker itself.

Reduction of Air-borne Sound

Dealing with the sound insulation of single walls, the report points out that there is a definite relationship between the average sound-reduction factor of a single homogeneous wall and its weight. The nature of this law is, however, such that small additions to the weight have less and less effect as the weight of the partition increases. Thus, while the difference between 4½ in. and 9 in. brickwork is five decibels, it would be necessary to use 18 in. brickwork to get an equal further reduction. Thus, better results can be obtained with very much less weight by the use of double-wall construction in which the two walls are isolated from each other. To obtain the best results for practicable double partitions it is also necessary to insulate the edges of each leaf as far as possible from the surrounding structure. It is sometimes recommended that the cavity of a double partition should be filled with granular or other loose sound-absorbent. Such a filling, the report states, is most unlikely to improve the insulation because, although it helps by functioning as an absorbent, it also acts as a bridge and conducts vibration directly from one leaf to another.

In general, the properties governing sound insulation against air-borne sound by floors are similar to those for walls. It is likely, the report states, that most reinforced concrete floors afford insulation which is roughly equivalent to 4½ in. brick work—that is, of the order of 50 decibels. The few tests which have been made upon the insulation provided to air-borne sound by timber floors suggest that a well-constructed floor and ceiling of joists, boards, and lath-and-plaster finish, weighing perhaps 12 lb. to the square foot, has an average reduction factor of about 45 decibels. This value for the reduction factor of a floor would not apply if, through shrinkage from various causes, cracks have appeared between the boards. Such cracks allow sound to pass very freely, unless the floor is covered right up to the skirting with some such material as linoleum. The importance of the transmission of sound through cracks applies with even greater force to doors and windows. It has been found, for example, that a one-quarter in. crack round a wooden door two in. thick admits four times as much sound of medium frequencies as the door itself, while a considerable amount of sound may pass through an uncovered keyhole.

If good sound insulation is required from a window, the first necessity is again to ensure a very close fit. If a tight fit is obtained, the reduction factor depends almost exclusively on the weight of the glass used, and varies from about 24 decibels for glass one-fifteenth in. thick to 37 decibels for glass one-half in. thick. Good sound insulation of external walls, therefore, often necessitates the use of double windows and artificial ventilation. With double windows where 21 oz. glass is used, the space between the sheets should not be less than four in.; with a heavier glass the spacing may be reduced, but in all cases the greater the spacing the better will be the insulation.

Intruding Noises

The problem which usually faces the architect is that of selecting a type of construction which will reduce external noises to a background level which is tolerable in different situations. Data given in the report show, for example, that in a hospital ward intruding noises should not reach a level higher than, say, 25 phons. In some cases, advantage can be taken of the fact that the existing background in the listener's room tends to drown the intruding noise. Experiments suggest that an intruding noise of moderate loudness will be masked in this way when it is about 30 phons below the background noise in the listener's room. Tables included in the report give values for the equivalent loudness of a number of indoor and outdoor noises.

The report states it is less difficult to confine air-borne noises than impact noises, such as the noises due to footsteps overhead. While a useful improvement can be obtained by the use of floor coverings, such as pile carpets on thick underfelt, the most effective solution so far obtainable lies in the provision of a concrete floor insulated from the structural floor. Some further improvement up to about 10 phons can also be gained by the use of a floating ceiling below the structural floor. In conclusion the report states that when all the present evidence is reviewed it appears that probably the only satisfactory way of preventing excessive sound transmission in large buildings will be to break the continuity of the structure, and it may even become necessary to construct units—such as complete flats—as separate boxes floating upon suitable insulation. Experiments on these lines are in progress and are promising.

FIFTY-FOURTH
ANNUAL GENERAL MEETING
AND
GENERAL PROFESSIONAL MEETING
THE ENGINEERING INSTITUTE OF CANADA

Toronto - *Thursday and Friday... February 8th and 9th, 1940*

The Toronto Branch has set up a special committee

under the chairmanship of A. E. Berry, M.E.I.C., to handle all arrangements

All sessions will be held at the Royal York Hotel, Front Street

PROGRAMME

Thursday, February 8th

10.00 a.m. - Annual Meeting
12.30 p.m. - Luncheon
2.30 p.m. - Annual Meeting continued
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

10.00 a.m. - Technical Sessions
12.30 p.m. - Luncheon
2.30 p.m. - Technical Sessions
Evening - Free for social gatherings of your own selection

See the January Journal for full details

Editorial Comment...

THE PRESIDENT COMPLETES HIS TOUR

The custom of presidents of the Institute visiting branches from coast to coast has been firmly established for many years. The value of such visits cannot be overestimated. All branches report that activities are greatly affected thereby, and that much of the success of the year's programme is due to the impetus provided by the President's visit. This year's President has just returned from the west where meetings in ten cities have concluded a cycle that embraced every branch in Canada.

It is a pleasure to publish herewith a communication reporting on the tour.

"Having just completed a tour across Canada in the course of which I visited many branches of the Institute, I have been asked by the editor to write a short note on the impressions I have gained. This I am glad to do, because such a tour, beginning as it did on the Island of Cape Breton off the Atlantic coast, terminating on Vancouver Island in the Pacific and including every branch of the Institute, cannot fail to have a very definite effect upon one's views.

"Should any member of the Institute feel doubtful about the future of the Institute or about the place it occupies in the eyes of the professions and in the life of Canada, I most heartily advise him to make a visit, as I have done, to the various branches. He would find the members of the branches enthusiastic in their interest; he would find them actively engaged, not only in carrying on the affairs of their branch, but also in carrying on the wider activities of the Institute as a whole; and he would be delighted with the spirit of co-operation with other engineering bodies which has developed.

"Of even greater importance, this visiting member would see the members and branches of the Institute working whole-heartedly with other scientific and non-scientific bodies, for the promotion of the general welfare of the nation. In fact he would then realize, as never before, the ever increasing importance of the Engineering Institute and its members in the national economy. For some years now we have tried by various formal means to bring about schemes of co-operation between different engineering groups. Today one cannot avoid noticing the very active, if informal, co-operation which exists, not only among engineers, but between engineers and other bodies. I feel that this new spirit which has quietly developed in recent years is very largely due to my immediate predecessors in office.

"Another thing which will be most forcibly impressed on this touring member will be the unusually fine types of men which he meets in all the branches and the very important and frequently leading part which these men play in their communities. Of course he has previously realized the truth of this in his own branch, but possibly he has never thought of the Institute as a whole in the same light. Now he sees the picture in true perspective. It has been said of the engineer that probably no man has more to say worth saying and that no one is less capable of saying it. But conditions have changed; this is no longer true. Though the engineer is not given to bragging about himself and his work, yet the high standards of integrity and competence displayed by the profession are speaking perhaps more eloquently than he himself could do. Consequently, the public is now according to him wider recognition and responsibility than formerly. This recent trend must necessarily be of great importance to the individual as well as to the profession as a whole.

"As I have intimated, a president's tour of the branches is indeed a memorable experience. The loyalty and support accorded him; the genuine friendliness which he finds everywhere, as well as the gracious and abounding hospitality shown him, all leave memories which will be cherished for the rest of his days.

"I cannot conclude without again expressing the great pleasure it has given me to meet so many members and also my sincere appreciation for the kindness and courtesy shown my wife and myself during our recent visits to branches. We wish to express to all members our hope that their Christmas may be very pleasant and that the New Year may bring them an ever increasing store of happiness."

H. W. McKiel.

GREETINGS TO COLUMBIA UNIVERSITY

A feature of the cancelled British-American Engineering Congress which was to have taken place last September was the presentation of congratulatory greetings from the several engineering societies to Columbia University on the occasion of the seventy-fifth anniversary of the founding of the School of Engineering. This ceremony was postponed until November 27 and on that date Past-President H. H. Vaughan attended as a representative of the Engineering Institute. The following report sent to the chairman of the International Relations Committee describes the functions.

"Agreeable to your request, I attended the Convocation of Columbia University in observance of the seventy-fifth Anniversary of the School of Engineering.

"The Convocation was held in Low Memorial Library and was presided over by Dr. Nicholas Murray Butler, who was accompanied on the platform by trustees of the University, the Alumni receiving the Egleston Medal, the representatives of engineering societies presenting greetings and a number of notable personages.

"From the programme of the proceedings you will note that many of the guests on the dais were familiar to all engineers for their distinction and ability. I presented the illuminated address bearing the greetings of The Engineering Institute of Canada, explaining to President Butler the deep regret of President H. W. McKiel at his inability to be present, that Dr. J. M. R. Fairbairn had been called away on important business and the honour had consequently descended on my shoulders and I was very glad to be present and to make the presentation.

"In the evening a banquet was held at the Waldorf-Astoria Hotel, the guests principally consisting, of the Alumni and their ladies. There were two head tables, at one of which Dean Barker was the toastmaster and handled his duties exceedingly well. A notable speech was made by Dr. Compton of the Massachusetts Institute of Technology and President Butler then made a speech which I consider one of the finest to which I have ever listened. Apparently the evening was enjoyed by all and I wish to thank you for the opportunity extended to me to represent the Institute at this noteworthy gathering."

H. H. Vaughan.

THE FIFTY-FOURTH 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 1940 will begin at Headquarters at eight o'clock p.m. on Thursday, January 25, 1940, 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 York Hotel, Toronto, Ontario, at ten o'clock a.m. on Thursday, February 8, 1940.

L. Austin Wright,
General Secretary.

TRIBUTE

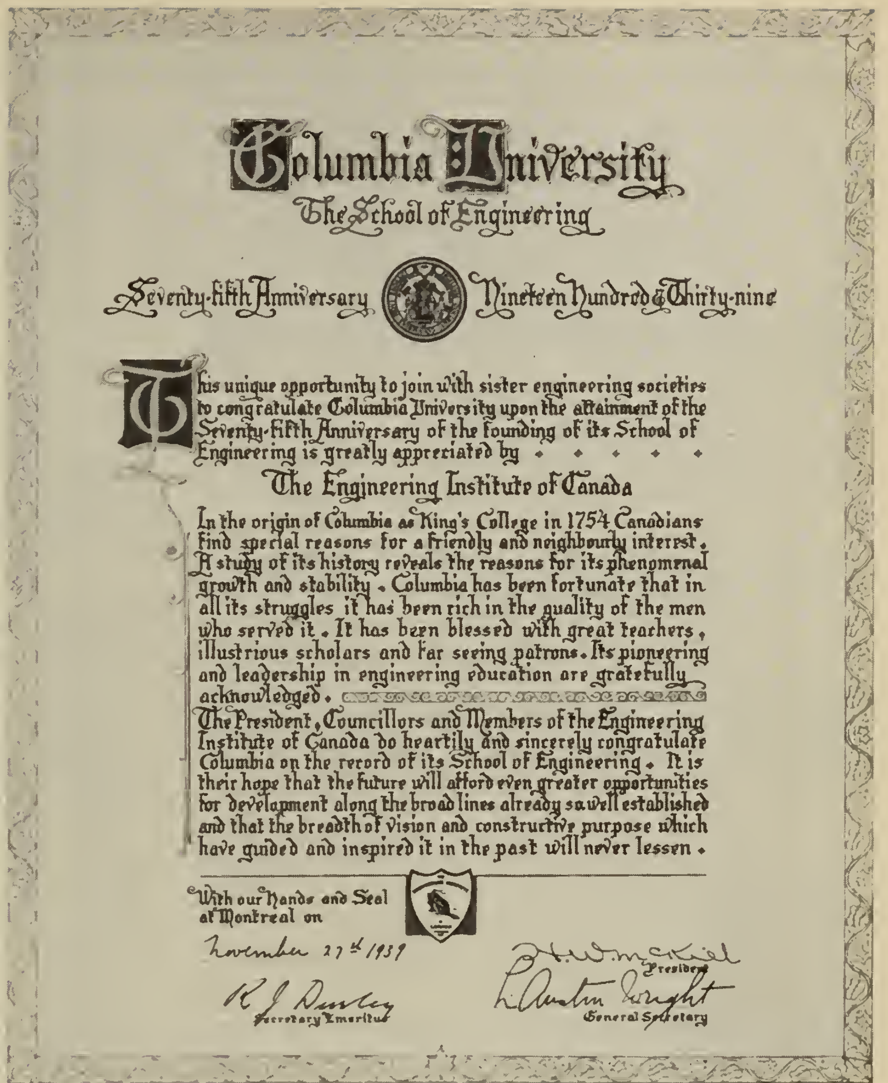
Recently the Montreal Gazette devoted over a column to a leading editorial in the form of an eulogy of Major-General McNaughton, M.E.I.C. It referred to him as "the worthy successor to the beloved commander of the Canadian army during the last war, General Sir Arthur Currie."

The editorial outlines many of Major-General McNaughton's characteristics and accomplishments, and concludes with the following appreciation:—

"This is the man to whom has been entrusted the direction and leadership of our First Division to go overseas to fight side by side with the British and the French forces now in France for the defence of our general liberties. The families of the men under his command will repose in him a confident faith as a leader of outstanding skill and a General who may be relied upon to see to it that there is never, so far as his determination can make it certain, any shortage of guns—big guns—for the Canadian troops. He is under no delusion as to the magnitude of the task which faces the Allied forces. 'It will,' he said, 'be a long struggle, and we are going to need the whole of our resources and the whole of the resources of our Allies, the French.'

"Canada is fortunate in having at its service in this great task a man who enjoys the full confidence of the men under him and of the nation as a whole."

All engineers in Canada rejoice with other citizens in the thought that the affairs of the country's active forces are in the hands of its most worthy commander, and they are also pleased that an engineer has reached this high place and brought further honour to his profession.



Columbia University
The School of Engineering

Seventy-fifth Anniversary Nineteen Hundred & Thirty-nine

This unique opportunity to join with sister engineering societies to congratulate Columbia University upon the attainment of the Seventy-fifth Anniversary of the founding of its School of Engineering is greatly appreciated by

The Engineering Institute of Canada

In the origin of Columbia as King's College in 1754 Canadians find special reasons for a friendly and neighbourly interest. A study of its history reveals the reasons for its phenomenal growth and stability. Columbia has been fortunate that in all its struggles it has been rich in the quality of the men who served it. It has been blessed with great teachers, illustrious scholars and far seeing patrons. Its pioneering and leadership in engineering education are gratefully acknowledged.

The President, Councillors and Members of the Engineering Institute of Canada do heartily and sincerely congratulate Columbia on the record of its School of Engineering. It is their hope that the future will afford even greater opportunities for development along the broad lines already so well established and that the breadth of vision and constructive purpose which have guided and inspired it in the past will never lessen.

With our Hands and Seal at Montreal on
November 27th 1939

H. W. McKiel, President
R. J. Durley, Secretary Emeritus
L. Austin Wright, General Secretary

Illuminated address presented by the Institute to Columbia University

BENEVOLENT NEUTRALITY

The following letter was received by a past-president of the Institute from a friend in the United States. The opinions expressed are of course personal but are of interest to Canadians, because the American papers and magazines we read are prepared for the American market, and personal viewpoints such as this may give us a truer picture of what is really in the hearts of the American people.

Dear ———

Here this crazy war is in its third month and I haven't written a word to any of my British or Canadian friends to tell them how very much we are with them in this desperately unwelcome and tremendously necessary job. In spite of Lindbergh and Landon I don't think it is at all needful for real Americans to tell real Canadians or Britishers that we think this is our fight just as much as it is yours; just as much as it was our fight the day the first German foot went into Belgium in 1914. It took us nearly three years to find it out then, and I fear it will take something calamitous to wake us up to it now.

Such talk as Colonel Lindbergh and Senator Landon indulged in doesn't worry Canadians any, but it has a bad effect in Latin America. You may recall a talk we had in your office several years ago about a lot of annexationist bunk I had heard talked on a train the previous night, and how shocked I was to hear it. As a good American I have always felt that Canada as a part of the British Empire was a great source of strength to us, in giving the Empire such an important stake in North America.

Sincerely,

PROPOSED AGREEMENT WITH NOVA SCOTIA ASSOCIATION

On page 534 will be found the full text of an agreement which is being submitted for approval to the members of the Association of Professional Engineers of Nova Scotia as well as to members of the Institute resident in that province and to all councillors. It is expected that the result will be announced in January.

A GOOD START

The announcement of the Minister of Highways of the new Quebec Government that he is retaining Mr. Ernest Gohier, an appointee of the defeated administration, as Director-General of Roads, was good news to other citizens as well as engineers. Such an action is not only a real tribute to Mr. Gohier, but also reflects credit on the government.

In Canada the history of political parties should record more events of this kind than is actually the case. One can well feel more confidence in a government that respects honest ability, and declines to sacrifice it to political patronage, than in one that removes competent officers for no other reason than to reward its own friends and workers. If the new government can maintain the high standard that this decision establishes, the province will indeed be fortunate.

The Institute is proud that one of its members has deserved and received this fine compliment.

MEDALS FOR MEMBERS

Two members of the Institute were honoured in Toronto on October 11. The occasion was a banquet—the final function of a triennial reunion of the Engineering Alumni of the University of Toronto, and the principal feature was the presentation of medals "for achievement" to C. R. Young and A. S. Runciman.

The Engineering Alumni Medal is a new development. This is the first time there has been a presentation. The purpose of the award is, generally speaking, to honour some engineer whose work has been outstanding from an engineering viewpoint and whose attainments have not previously been recognized by some similar award. There will be general satisfaction that such worthy candidates were selected for the first ceremony.

Following are the citations which were read by A. M (Tony) Reid, who incidentally was the one principally responsible for the whole idea.

Mr. President:

There are some engineers who accomplish so much in the course of their careers that time does not permit more than an outline of their achievements.

In 1905, there was one young man given an honour degree by our university. After building a solid foundation of practical experience in industry, he turned to commence a long, successful teaching career. In time, well-merited promotions came and to-day we know this graduate as the head of an important department in our University.

It is not easy to weigh the influence that a great teacher exerts on the thousands of students that meet him day by day; more is transmitted than can be measured or appraised. And in the case of this graduate, his finely prepared text books will guide thousands of engineers for many years to come. This alone, Mr. President, we consider an achievement of first magnitude, but it is only part.

The nice balance maintained between the practice of engineering and its study with a view to the training of the young engineers, has kept him alert to the needs in both fields. This, Mr. President, represents an ideal seldom reached.

But again these educational and engineering achievements are not all. Perhaps the most difficult task of our time is to bring order in our complex, and often confused, social organization. The transportation problems of our country have been challenging our governments for years, but at long last, we have a white light on this baffling problem. This book in my hand is entitled "Report of the Royal Commission on Transportation."

If you were to search through it diligently you would find the name of the graduate I am about to propose, noted simply as a member of that commission. It does not say that this economist-engineer spent almost two years directing and preparing the mass of facts contained in these pages. It does not explain how these facts were marshalled into orderly sections, how the sections formed major factors, how the main factors led to a recommended course of action to the Government.

Clarence R. Young

The Government has already adopted portions of the recommendation, but full effect has not yet been given to this great economic study. It may not be for years to come, yet we are convinced that here is one of the most noteworthy contributions in the field of public engineering service which Canada has seen.

So, Mr. President, it is my privilege and honour to commend to you this engineer who has given so greatly of his talents for the well-being of our profession, the University and the country,

CLARENCE RICHARD YOUNG

to receive the Engineering Alumni Medal for outstanding achievement.

★ ★ ★

Mr. President:

We live in a richly endowed country. Years ago our forefathers worked long and late to wrest a comfortable living from the land. Slowly at first, then with increasing momentum, our great rivers were harnessed and there were sent forth millions of horsepower slaves to do our bidding.

If we were privileged to view our country from a great height, we would see a huge web with staunch lines arising from whirling dynamos in white-foamed rivers to central distributing points, and from there to millions of threads of decreasing fineness until the hair-like lines enter nearly every factory, mine, and home, far and near.

When we press a button and flood our homes with light, we little think of the organization and scientific exactitude required to build and maintain this great, finely-balanced system of unlimited power.

From the group of men associated in this great work I should like to select one for special mention. This engineer received his degree in 1911 in electrical engineering and joined one of our great power enterprises at the beginning of its growth.

There, for almost twenty years, he has guided the very intricate communication systems without which energy would not throb through over three million outlets. During these years existing equipment often could not meet the new demands made upon it, and thus we find our graduate developing apparatus of unprecedented usefulness. As each new problem presented itself, it was his task to seek the solution.

Thus he met and solved the problem of multiple communication on telephone wires strung along high tension line circuits. In the contest which transmission engineers wage against the forces of lightning he has made a contribution which may well spell a major defeat for these forces and ensure continuity in the supply of electric current.

As a result of consistent success in a most difficult technical field, this graduate soon was regarded as a leader in his profession. And so, Mr. President, we now have one of our members whose scientific achievements have in a large measure paved the way and made it possible for us to enjoy without interruption the great benefits from the harnessing of our water powers.

Arthur S. Runciman

I am deeply privileged to commend to you, Mr. President,

ARTHUR S. RUNCIMAN

to receive the Engineering Alumni Medal for outstanding scientific achievement.

MEETING OF COUNCIL

A meeting of the Council was held at the Palliser Hotel, Calgary, Alberta, on Saturday, October 14th, 1939, at nine o'clock a.m.

There were present: President H. W. McKiel in the chair; Vice-President P. M. Sauder; Councillors J. Haddin (Calgary), W. R. Mount (Edmonton), J. Robertson (Vancouver) and the General Secretary. The following were also present by invitation: Past-President S. G. Porter; Past Vice-President H. S. Carpenter, representing Councillor A. P. Linton, of Regina; Past-Councillors G. N. Houston, P. J. Jennings, T. Lees, H. J. McLean, F. M. Steel and R. S. Trowsdale; I. M. Fraser, chairman of the Saskatchewan Branch and President of the Association of Professional Engineers of Saskatchewan; S. G. Coultis, J. McMillan, F. J. Heuperman, and J. R. Wood, chairman, vice-chairman, secretary-treasurer and member of executive, respectively, of the Calgary Branch; C. E. Garnett, chairman of the Edmonton Branch, and A. J. Branch, chairman of the Lethbridge Branch, and G. A. Gaherty, of Montreal, chairman of the Committee on Western Water Problems, and of the proposed committee on Industrial Mobilization.

The President expressed his pleasure at being able to hold a council meeting in the City of Calgary, from which it was hoped that Council would be able to get the viewpoint of the west and the middle west on Institute affairs.

Mr. Bennett having advised that this committee on the Training and Welfare of the Young Engineer would appreciate some guidance, discussion took place, particularly with regard to the conditions for student membership prizes. As a result, it was decided that the matter should be left for the present as it now is, namely, that upon request Council will grant free student memberships for one year to supplement cash prizes offered by any of the branches.

There was also discussion in regard to the questionnaire which had been sent out by Mr. Bennett's committee. It was pointed out that the Institute had no intention of going into vocational guidance, but merely wished to offer advisory service to the engineering schools. It was thought that suggestions might be made to the schools for the improvement of their courses of training. It was felt that engineering courses should be confined largely to fundamental subjects, in order that the training should be a foundation for any branch of engineering work.

In regard to employment, the Secretary stated that the Institute was co-operating with Colonel Smythe of the Technical Service Council, and also with the Association of Professional Engineers of Ontario.

The President announced that Mr. Gaherty had agreed to accept the chairmanship of a Committee on Industrial Mobilization, and Mr. Gaherty expressed the opinion that sub-committees should be established in each branch of the Institute to explore such basic questions as the substitution of local products for imported articles, and the local production of war materials. Mr. Gaherty felt that an unselfish approach to these questions would lead to co-operation between different sections of the country. He asked whether the Institute wished to go into the sociological and economic questions connected with economic mobilization. Following further discussion, Mr. Gaherty was appointed chairman of an organizing committee, with power to name the other members of the committee.

The President reported that when he had visited the Lakehead Branch, informal discussions had taken place as to the possibility of transferring that branch from Zone B (Province of Ontario) to Zone A (Western Provinces). While he was not authorized to make any definite request, he would like to get the opinions of the councillors in the western branches. From the discussion which followed it appeared that the western branches would be sympathetically inclined towards such a transfer if it were requested by the Lakehead Branch.

Vice-President Sauder, chairman of the Alberta Sub-Committee on Professional Interests, reported that the question of professional co-ordination in the province was receiving attention.

The Secretary reported on discussions with Professor French, chairman of the Past-Presidents' Prize Committee, regarding possible action to promote the submission of papers in competition for this prize. Professor French felt that in order to carry out the purpose of the founders of the prize, some changes were desirable in the rules governing the award.

Mr. Fraser reminded members present that money was available for the travelling expenses of speakers in the prairie provinces, and requested that members should keep the matter in mind, and advise him of any possible or prospective speakers.

It was unanimously resolved that this western meeting of Council express to Past-President Challies its deep sympathy in the loss which he had recently suffered in the death of Mrs. Challies. The secretary was directed to convey this message to Dr. Challies.

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

ELECTIONS

Members	1
Associate Members	1
Juniors	1
Students admitted	2

TRANSFERS

Junior to Associate Member	1
Student to Associate Member	1

COUNCIL MEETING, CALGARY, ALTA., OCTOBER 14, 1939
(Standing, left to right) G. N. Houston, R. S. Trowsdale, G. A. Gaherty, C. E. Garnett, A. J. Branch, J. R. Wood, W. R. Mount, H. J. McLean, S. G. Coultis, J. McMillan, F. J. Heuperman, T. Lees, J. Haddin
(Sitting, left to right) S. G. Porter, P. M. Sauder, President H. W. McKiel, General Secretary L. A. Wright, J. Robertson, I. M. Fraser, H. S. Carpenter, I. M. Steel, P. J. Jennings

PROPOSED AGREEMENT

BETWEEN THE INSTITUTE AND THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF NOVA SCOTIA

The proposed agreement printed below is in the form recommended by accredited representatives of the Council of The Institute and of the Association of Professional Engineers of Nova Scotia. It is now published in The Journal pursuant to By-law No. 76.

The executive committees of the Halifax and Cape Breton Branches of The Institute have approved of this agreement.

MEMORANDUM OF AGREEMENT made in duplicate at the City of , in the Province of , this day of 193

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 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 193 , hereinafter called "the Institute."

Party of the First Part

and

THE ASSOCIATION OF PROFESSIONAL ENGINEERS of Nova Scotia having its Head Office at the City of Halifax, in the Province of Nova Scotia 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 193 , hereinafter called "the Association,"

Party of the Second Part.

WHEREAS it is desirable in the interest of the Engineering Profession that there be close co-operation between the Institute and the Association; and

WHEREAS such close co-operation will be promoted if, so far as it is practicable, there is effected—

(*a*) A common Membership in the Province of Nova Scotia of the Institute and the Association;

(*b*) A simplification of existing arrangements for the collection of fees;

(*c*) A reduction in the total fees payable by those who are members of both the Institute and the Association.

NOW, THEREFORE, the parties hereto agree with each other as follows:

1. All persons who are, on the date of this Agreement, registered as Professional Engineers under the Provisions of Chapter 186 of the Statutes of the Province of Nova Scotia, for the year 1920, and subsequent amendments thereto, and who are not on the date of this Agreement, Corporate Members of the Institute, shall under the provisions of this Agreement become Corporate Members of the Institute on and after said date, while resident in the Province of Nova Scotia, subject to the terms and conditions of this Agreement, as hereinafter set forth provided such registered Professional Engineer shall notify the Registrar of the Association in writing within ninety days of the date of this Agreement that he does desire to become a Corporate Member of the Institute.

2. Subject to provisions set forth in Clause 1, registered members of the Association who at the date of this Agreement have reached the age of thirty-five years shall be accorded the status of "Member" (M.E.I.C.) in the Institute and those under thirty-five years of age shall be accorded the status of "Associate Member" (A.M.E.I.C.) in the Institute and after reaching the age of thirty-five shall be automatically transferred to the status of "Member."

3. Any person registered as a Professional Engineer in the Association subsequently to the date of this Agreement and who is not a Corporate Member of the Institute at the date of said registration, shall become a Corporate Member of the Institute and shall be accorded the class of membership in the Institute warranted by the age, experience and professional qualifications of such person according to the By-Laws of the Institute and the decision of the Council of the Institute. Any person over thirty-five years of age classed as "Associate Member" (A.M.E.I.C.) may, if dissatisfied with such classification apply to the Council of the Institute for the status of a Member (M.E.I.C.) and shall be entitled to have his classification and qualifications for same reviewed by the Council of the Institute.

4. Registered members of the Association shall not be required to pay the entrance or transfer fees of the Institute.

5. The Association upon execution of this Agreement shall become and be known as a Component Association in accordance with Section 32 of Chapter 34 of the Statutes of the Province of Nova Scotia for the year 1937, and in accordance with By-Law 77 of the Institute of the date hereof.

6. In lieu of the ordinary membership fees of the Institute the Association shall pay to the Treasurer of the Institute the sum of $6.00 per annum for each member of the Association who becomes a member of the Institute under provisions of Clauses 1 and 3 hereof and who has the Institute classification of "Member" (M.E.I.C.) and the sum of $5.00 per annum for each other member of the Association who becomes an Associate member of the Institute under the provisions of Clauses 1 and 3 hereof. These fees shall entitle the members of the Association who become members of the Institute under provisions of Clauses 1 and 3 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 6 of this Agreement shall not be effective until the First day of January, 1940.

7. It is agreed that the Branches of the Institute in Nova Scotia 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 hereof 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, who shall be a corporate member of the Institute and a registered professional engineer, shall be appointed annually by the four members aforesaid and the fifth member shall be Chairman of the Committee. In case the four members aforesaid fail to appoint the fifth member within thirty days from 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 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 than the per capita amounts now paid by the Institute provided, however, that such payments are made from annual revenue and in no case from capital reserve.

8. The Term of this Agreement shall be the period commencing on the date hereof and ending on the 31st day of December, 1943, on which date this Agreement shall terminate, provided either party has given to the other notice of termination at least six months prior to the 31st day of December, 1943, and if no such notice is given this Agreement shall continue after the 31st day of December, 1943, 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.

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 full advantage of its provisions.

9. The terms and provisions of this Agreement may be amended by mutual agreement, in writing, between the parties hereto duly executed by them.

10. This Agreement and the terms and provisions thereof shall not be applicable to the Institute members who are not registered with the Association.

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.

IN THE PRESENCE OF:

THE ENGINEERING INSTITUTE OF CANADA

. . . .

. . . .
President

. . . .
Secretary

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF NOVA SCOTIA

. . . .
President

. . . .

. . . .
Registrar

AMENDMENTS TO THE BY-LAWS

PROPOSED BY MEMBERS OF ONTARIO BRANCHES

In accordance with Sections 74 and 75 of the By-laws, the following proposals for the amendment of Sections 12, 13, 64 and 67 are presented for the consideration of corporate members, in advance of their discussion at the forthcoming Annual General Meeting on February 8 and the subsequent ballotting upon them.

They provide that in future the Ontario branches shall be represented by two vice-presidents, instead of one as at present.

The proposals were duly submitted to Council at its meeting on September 30, over the signatures of thirty-two corporate members. The Council then suggested a change in the wording of the proposed amendment to Section 67, which was accepted by the proposers, as provided in Section 75, and has been incorporated in the proposals as given below.

The proposed changes are shown in **bold face type.**

Section 12 (*As now proposed*)

Section 12.—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.

Section 13 (*As now proposed*)

Section 13.—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 election 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.

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.

Section 64 (*As now proposed*)

Section 64.—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.**

Section 67 (*As now proposed*)

Section 67.—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 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.

PROPOSED BY COUNCIL

In accordance with Sections 74 and 75 of the By-laws, the Council presents for the consideration of corporate members the following proposals for the amendment of Sections 2, 3, 4, 7, 32, 34 and 39, and new wording for Section 8.

These changes are proposed in order to give effect to a resolution passed at the Annual General Meeting on February 14, 1939, approving a proposal to abolish the class of Associate Member, and directing the preparation of the amendments to By-laws necessary for this purpose. Accordingly the following proposals will, in due course, be submitted for discussion at the Annual General Meeting on February 8 in Toronto, and will subsequently go out to ballot.

The proposals now submitted were approved by the Council at its meeting of November 25, 1939.

The proposed changes are shown in **bold face type.**

Following the proposals will be found explanatory notes indicating the nature of the amendments in question.

Sections 2, 3 and 4 (*As now proposed*)

Section 2.—An engineer who has been engaged as set out 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.

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 branch, or to vote on 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.

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 he 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.

Note—In the above proposals, the only change in the present sections 2, 3 and 4 is the omission of all reference to Associate Members.

Section 7 (*As now proposed*)

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.

Note—The wording of this proposed Section 7 is identical with that of the present Section 8, with the deletion of the word "associate," and provides that in future the qualifications for "Member" will be those now prescribed for the class of "Associate Member." This proposal thus replaces the present Section 7. It requires the deletion of the present Section 8 and its replacement by the following new provision.

Section 8 (As now proposed)

***Section 8.*—Upon the adoption of these By-laws, all Associate Members of the Institute shall *ipsofacto* become Members, and the present class o "Associate Member" is hereby abolished.**

Section 32 (As now proposed)

Section 32.—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.

Note—This change simply omits any reference to Associate Members.

Section 34 (As now proposed)

Section 34.—The annual fees payable by Montreal Branch Residents shall be as follows:

		If paid on or before March 31st.
Members	$12.00	$11.00
Juniors	7.00	6.00
Students	2.00	1.00
Affiliates	11.00	10.00

The annual fees payable by all other Branch Residents shall be as follows:

		If paid on or before March 31st.
Members	$10.00	$ 9.00
Juniors	5.00	4.00
Students	2.00	1.00
Affiliates	11.00	10.00

The annual fees payable by Branch Non-Residents and Non-Residents shall be as follows:

		If paid on or before March 31st.
Members	$ 8.00	$7.00
Juniors	4.00	3.00
Students	2.00	1.00
Affiliates	11.00	10.00

Honorary Members shall be exempt from annual fees.

In accordance with the above schedules, if paid on or before March 31st of the current year, a deduction of one dollar will be allowed on the annual fees of all grades.

Note—This proposal omits all reference to the class of Associate Member, and suggests changes in the present scale of fees for Members which will give the Institute a revenue comparable with, but not less than, the present. To this end, Council proposes an increase of *one dollar* in the annual fee of present Associate Members on their automatically becoming Members. This increase would be needed to compensate for the resulting reduction in the fees payable by the present Members.

At present, Associate Members resident in Montreal pay *two dollars* more than those residing elsewhere. It is proposed to continue this difference after they become Members.

Personals

News of the Personal Activities of members of the Institute, and visitors to Headquarters

W. D. Black, M.E.I.C., has recently been elected a member of the executive committee of the Bank of Canada. He is president of the Otis-Fensom Elevator Company, Limited, Hamilton, and past-president of the Canadian Manufacturers' Association.

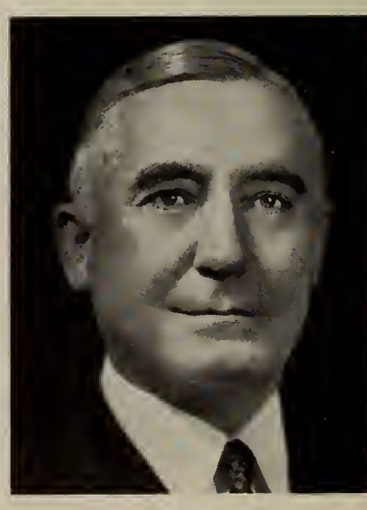
J. B. Challies, M.E.I.C., has been appointed to fill the directorate left vacant by the death of Julian C. Smith, M.E.I.C., on the board of directors of the St. Maurice Power Corporation. Mr. Challies is secretary and vice-president of the company.

Prof. A. R. Greig, M.E.I.C., has received a temporary appointment as professor of mechanical engineering at the University of Alberta in place of Dr. C. A. Robb, M.E.I.C., who was appointed chief of the gauge department, War Supply Board, Ottawa. Although he had retired from active teaching at the University of Saskatchewan two years ago, Professor Greig had retained the position of superintendent of building.

L. J. Belnap, M.E.I.C., president of the Consolidated Paper Corporation Limited, has recently been elected president of the Dominion Glass Company Limited, succeeding the late Sir Charles Gordon. He obtained his B.Sc. degree in electrical engineering from the University of Nebraska in 1898. Upon graduation he entered the Wagner Electric Company at St. Louis as a draughtsman and later became an engineer on transformer design. In 1902, he came to Montreal as erection and service engineer for the Canadian Allis Chalmers Limited. In 1903 he was appointed district manager and later manager. In 1911 he became vice-president of Rudel, Belnap Machinery Company, Montreal, a position which he occupied until 1925. During the Great War, he was assistant director of War Supplies for the British War Mission in Washington, D.C., from 1917 to 1919.

From 1919 to 1925, Mr. Belnap was president of Rolls Royce of America, Springfield, Mass. In 1936, he was appointed president of the Worthington Pump and Machinery Corporation, New York, a position which he left in 1931 to become chairman of the board of directors. He came back to Montreal in 1931 as president of the Consolidated Paper Corporation. He is also chairman of the board of the U.S. Hoffman Machinery Company, New York.

In June of this year, he received from his Alma Mater, the University of Nebraska, the honorary degree of Doctor of Engineering.



L. J. Belnap, M.E.I.C.

Major Hugh A. Lumsden, M.E.I.C., of Hamilton, Ont., has been appointed, by the War Supply Board, field inspection engineer of construction for the central district. Major Lumsden is a Councillor of the Institute.

K. R. Chestnut, M.E.I.C., of Fredericton, N.B., has received the appointment of field inspection engineer for the Maritime Provinces with the War Supply Board, Ottawa. He was graduated in civil engineering from the University of New Brunswick in 1904 and he obtained his degree of M.Sc. in 1907. Until 1914, he was engaged in railway engineering successively with the National Transcontinental Railway Commission, and with the Grand Trunk Pacific Railway. He was later connected with the construction of the Canadian National Railways Ocean Terminal at Halifax and also the Halifax shipyards. After three years spent in highway and bridge construction and land surveys, he went to the United States where, until 1933 he was engaged on construction of various projects of importance. After his return to Canada, he was for a few months in 1935 engineer for the town of Devon, N.B., and later in the same year he joined the engineering staff of the National Harbours Board at Saint John, N.B. His last position was on the construction of the Newfoundland Airport.

W. E. Lovell, M.E.I.C., professor of electrical engineering at the University of Saskatchewan, is taking over the position of superintendent of buildings at the University.

I. R. Tait, A.M.E.I.C., has been appointed chief engineer of Canadian Industries Limited, to succeed L. de B. McCrady, M.E.I.C., who has relinquished his position with the company. Mr. Tait received his B.Sc. degree from McGill University in 1913 and upon graduation he entered the Canadian Westinghouse Company Limited at Hamilton and spent two years in the testing department. He joined the C.I.L. as an electrical engineer in 1915 and has been assistant chief engineer since 1929.

Elizabeth MacGill, A.M.E.I.C., is shown after the first flight of the trainer airplane which she designed, and which was built under her supervision at Fort William. The others in the picture are J. M. Fleming, Chairman of the Lakehead Branch, L. Austin Wright, General Secretary, and P. E. Doncaster, Councillor.

W. H. Moore, A.M.E.I.C., has recently joined the engineering staff of the Canadian Industries Limited in Montreal. He holds the degrees of B.Sc. and M.Eng. in electrical engineering from McGill University. For the past nine years he has been on the engineering staff of the Canadian Marconi Company, engaged in research, development and design work on radio transmitting equipment.

Clarence A. Cook, A.M.E.I.C., who was teacher at Bedford Road Collegiate, Saskatoon, Sask., has joined the Royal Canadian Air Force.

H. Alton Wilson, M.E.I.C., has been appointed general superintendent of the Stephens Adamson Manufacturing Company of Canada Ltd. in charge of their Canadian plant at Belleville, Ont. This firm is engaged in manufacturing material handling equipment.

Lt.-Col. J. A. Macphail, M.E.I.C.

Lt.-Col. J. A. Macphail, M.E.I.C., who has recently retired from Queen's University after thirty-five years activity in the engineering school, was paid many tributes at a recent meeting of the Kingston Branch at which President McKiel was present.

William Kay, A.M.E.I.C., has accepted the position of mechanical superintendent in the Kapuskasing mill of the Spruce Falls Power and Paper Company, Limited. After having served a seven-year apprenticeship with the C. Walmsley Atlas Iron Works in England, he was transferred, in 1923, to the C. Walmsley Canadian Works in Longueuil, Que., and acted as erection supervisor and production manager until 1928, when he became connected with the Dominion Engineering Works Limited. In 1930, he joined Price Brothers and Company Limited at Riverbend, Que. At the time of his new appointment he occupied the position of master mechanic.

Gordon Parkinson, A.M.E.I.C., is now instructing and lecturing at the University of Saskatchewan. A graduate from the University in civil engineering in 1929, he took his M.Sc. degree from Lehigh University, Bethlehem, Pa., in 1931. From 1931 to 1936, he was employed as a designer on different projects in Saskatoon. In 1936, he became instructor in mechanical drawing at the Saskatoon Technical Collegiate, a position which he held until this year.

B. W. Pitfield, Jr.E.I.C., is the newly appointed secretary-treasurer of the Edmonton Branch of the Institute, succeeding F. A. Brownie, A.M.E.I.C., who has been transferred to Calgary. He was graduated in civil engineering from the University of Alberta in 1934. Upon graduation, he obtained employment as a draughtsman with the Canadian Industries Limited in Montreal. In 1935, he joined the engineering staff of the Northwestern Utilities Limited in Edmonton and he is now assistant engineer with this company.

Flight-Lieutenant D. G. Williams, S.E.I.C., has been transferred to the Vancouver Station of the Royal Canadian Air Force. He was previously stationed at Trenton. He holds the degree of B.Sc. which he obtained from the University of Alberta in 1933 and that of M.Sc. in 1935.

Joseph Olafson, S.E.I.C., is now employed as a draughtsman in the mechanical department of the Steel Company of Canada at Hamilton, Ont. He was graduated in mechanical engineering from the University of Saskatchewan last spring.

J. G. Thibault, S.E.I.C., has accepted a position with the Southern Canada Power Company Limited in Montreal. Since graduation in electrical engineering from the University of Manitoba in 1937, he had been employed as electrical draughtsman by the Canadian Industries Limited in Montreal.

J. G. Wall, S.E.I.C., is now employed as a radio operator at station CFNB in Fredericton, N.B. He was graduated in electrical engineering from the University of New Brunswick last spring.

J. Lorne Gray, S.E.I.C., of Winnipeg has joined the Royal Canadian Air Force and is stationed at Vancouver, B.C.

R. T. W. Allen, S.E.I.C., is now on the engineering staff of the Gatineau Power Company in Ottawa. He was graduated in electrical engineering from the University of Alberta, in 1935, and had been employed by the Dominion Government at Kelowna, B.C., as a draughtsman since graduation.

P. M. Hopkins, S.E.I.C., who was with the Lamaque Gold Mine at Bourlamaque, Que., has received a commission as lieutenant in the Royal Canadian Ordnance Corps and is at present stationed at Saint John, N.B.

Obituaries

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

Bernard Harold Cripps, A.M.E.I.C., died at his home at Lakeside, Que., on November 18th after an illness extending over a period of two years. He was born at Leytonstone, England, on January 1, 1878, and served an apprenticeship with J. and H. Gwynne, hydraulic and mechanical engineers of London. In 1902, he came to Canada and spent two years with the Laurie Engine Company of Montreal. From 1904 to 1919 he was engaged in mechanical design for various concerns in Montreal. In 1921 he became resident engineer for the Riordon Paper Company at Kipawa, Ont.

From 1921 to 1926, he was first draughtsman and then chief draughtsman with the Hollinger Gold Mines at Timmins, Ont. He came back to Montreal in 1926 and was engaged in various positions as mechanical draughtsman and designer until his illness two years ago.

Mr. Cripps joined the Canadian Society of Civil Engineers as an Associate Member in 1910.

Paul Emile Bourbonnais, A.M.E.I.C., died at his home in Montreal on November 20 after a two year illness. Born at Coteau Landing, Que., on June 15, 1888, he was educated at St. Mary's College, Montreal, and in 1914 he received his B.A.Sc. degree from the Ecole Polytechnique. Upon graduation, he joined the Quebec Streams Commission. In 1928, he was named assistant to chief engineer O. O. Lefebvre, M.E.I.C., and in 1936, he became chief engineer when Dr. Lefebvre became vice-president of the Quebec Electricity Commission. Mr. Bourbonnais conducted several survey parties examining possible hydroelectric developments on Quebec's main rivers. He made numerous studies on flow regulation of different streams and he was associated with all the Commission's major enterprises.

Mr. Bourbonnais joined the Institute as an Associate Member in 1927. For several years he was a member of the executive committee of the Montreal Branch.

R. A. Spencer, M.E.I.C., died in the hospital at Walkerville, Ont., on November 26, after a short illness. He was born at Meriden, Connecticut, on October 23, 1885. After his graduation as a civil engineer from the University of Vermont in 1908, he came to Canada and was employed for four years in the mining fields of the Nova Scotia Mining Company at Cobalt, Ont. In 1912, he joined the staff of the Canadian Bridge Company Limited as a draughtsman and later was engaged in designing and estimating work. In 1919, he was appointed assistant to the contracting engineer and in charge of the estimating department. He was also in charge of plant inventory and appraisal.

He was appointed contracting engineer in 1927 and held that position until 1937 when he became vice-president of the company. Later in the same year, the Canadian Bridge Company Ltd., of Walkerville was taken over along with four other local companies by the Dominion Steel and Coal Corporation and Mr. Spencer was named assistant general manager of the new merger.

Mr. Spencer joined the Institute as a Member in 1927.

R. A. Spencer, M.E.I.C.

VISITORS TO HEADQUARTERS

P. G. Gauthier, M.E.I.C., townsite engineer, Quebec North Shore Paper Company, Baie Comeau, Que., on November 2.

J. H. Legg, A.M.E.I.C., general superintendent, Canadian Kaolin Silica Products Ltd., St. Remi d'Amherst, Que., on November 6.

R. W. Warren, Jr.E.I.C., Regina Sask., on November 8.

R. B. Young, M.E.I.C., testing engineer, Hydro-Electric Power Commission, Toronto, Ont., November 9.

H. J. A. Chambers, M.E.I.C., sales engineer, Canadian Bridge Company, Walkerville, Ont., on November 15.

S. E. McGorman, M.E.I.C., Canadian Bridge Company, Walkerville, Ont., on November 15.

H. I. King, S.E.I.C., assistant purchasing agent, Bathurst Power and Paper Company Ltd., Bathurst, N.B., on November 16.

Lieut.-Col. N. C. Sherman, M.E.I.C., ordnance mechanical engineer, Department of National Defence, Kingston, Ont., on November 20.

Dr. Charles A. Robb, M.E.I.C., chief, Gauge Division, War Supply Board, Ottawa, Ont., on November 21.

C. B. McMillan, S.E.I.C., Saguenay Power Company Limited, of Arvida, Que., on November 23.

W. R. Manock, A.M.E.I.C., manager of Horton Steel Works Ltd., Fort Erie North, Ont., on November 24.

E. Viens, M.E.I.C., Director of Testing Laboratories, Department of Public Works, Ottawa; **W. F. M. Bryce,** A.M.E.I.C., sewer engineer, Ottawa; **J. M. Wardle,** M.E.I.C., Director, Surveys and Engineering Branch, Department of Mines and Resources; **O. Holden,** M.E.I.C., chief hydraulic engineer, Hydro-Electric Power Commission of Ontario, Toronto; **A. Lariviere,** M.E.I.C., Commissioner, Provincial Transportation and Communication Board, Quebec, on November 25.

Vice-President R. L. Dunsmore, M.E.I.C., superintendent of Halifax Refinery, Imperial Oil Ltd., Halifax, N.S., November 28.

ELECTIONS AND TRANSFERS

At the meeting of Council held on October 14th, 1939, the following elections and transfers were effected:

Member

Dickie, Frank Evans, B.A. (Acadia Univ.), M.A. (Columbia Univ.), technical assistant to the president, Aluminum Company of Canada, Ltd., Montreal, Que.

Associate Member

Sharples, William Henry, B.Sc. (McGill Univ.), struct'l. steel designer, Shawinigan Engineering Company, Montreal, Que.

Junior

McKay, Donald Wilson, B.Sc. (Queen's Univ.), junior engr., Dept. of Public Works, London, Ont.

Transferred from the class of Junior to that of Associate Member

McDougall, James Lyle, (Grad., Inst. Mech. Engrs.), mech. engr., Ontario Paper Co. Ltd., Thorold, Ont.

Transferred from the class of Student to that of Associate Member

Ferguson, James Bell, B.Eng. (McGill Univ.), asst. mgr., Pictou Foundry and Machine Co. Ltd., Pictou, N.S.

Students Admitted

Blackett, Robert Leslie, (Queen's Univ.), 331 Earl St., Kingston, Ont.
MacVannel, Duncan Pyne, (Univ. of Toronto), South House, University of Toronto, Toronto, Ont.

At the meeting of Council held on November 25th, 1939, the following elections and transfers were effected:

Member

Flood, Albert J., (Univ. of Toronto), Capt., 2nd Army Troops Co., R.C.E., North Bay, Ont.

Associate Member

Patterson, Donald Skillman, B.Sc. (Civil), (Univ. of Man.), instrumentman, Dept. of Highways of Ontario, Kenora, Ont.

Juniors

MacMillan, John Sherman, B.Sc. (Queen's Univ.), dftsman., Lake St. John Power & Paper Co. Ltd., Dolbeau, Que.
Myra, Allen, B.S. (Chem.), (Lehigh Univ.), foreman of chemical treating processes, Imperial Oil Limited, Dartmouth, N.S.
Papove, William Wasil, B.Sc. (Queen's Univ.), 806 Indian Road, Toronto, Ont.

Affiliates

Surveyer, Bernard E., (Renss. Poly. Inst.), Aluminum Co. of Canada Ltd., Arvida, Que.
McIsaac, Wilfred Joseph, (St. F.X. Univ.), industrial power sales engr., International Harvester Co. of Canada, Saint John, N.B.
Robitaille, Jean Marie, (Univ. of Toronto), surveys engr., Quebec Streams Commission, Montreal, Que.

Transferred from class of Junior to that of Associate Member

Barbour, Clarence Albert, B.Sc. (Elec.), (Univ. of N.B.), manager and sales engr., D. M. Fraser Co. Ltd., Montreal, Que.
Bunting, William Lloyd, B.Sc. (Univ. of Man.), field engr., Ducks Unlimited (Canada), Edmonton, Alta.
Fisher, Frederick S., B.Sc. (Elec.), (Univ. of Alta.), gen. equipment engr., C.P.R. Communications Dept., Montreal, Que.
Thorn, Richard, (Grad., Inst. Mech. Engrs.), 1216 Crescent St., Montreal, Que.
Tremain, Kenneth Hardley, B.Sc. (Elec.), (McGill Univ.), manager, Rogers Montreal Limited, Montreal, Que.

Transferred from the class of Student to that of Associate Member

Bruce, Rodney, B.Sc. (Mech.), (Queen's Univ.), asst. plant and heating engr., Findlays Limited, Carleton Place, Ont.

Transferred from the class of Student to that of Junior

Beaudet, Guy, B.A.Sc., C.E., (Ecole Polytechnique), city engr., Thetford Mines, Que.
Davis, Edgar Hawkins B.Sc. (Civil), (Univ. of Alta.), 10160-112th St., Edmonton, Alta.
Fromson, Sam, B.Eng. (Mech.), (McGill Univ.), mechanic and dftsman., Howey Gold Mines, Red Lake, Ont.
Ross, George, B.Sc. (Civil), (Univ. of Alta.), instrumentman and office engr., City of Edmonton, Alta.
Scott, James Munro, B.Sc. (Civil), (Univ. of N.B.), temp. asst. engr., Dept. of Public Works of Canada, Quebec, Que.

Students Admitted

Barkwell, Stewart, (Univ. of Man.), Dysart, Sask.
Cass, Lorne Osborne, B.Sc., (Univ. of N.B.), 384 Northumberland St., Fredericton, N.B.
Coote, George Frederick, (Univ. of Alta.), Nanton, Alta.
Eastwood, John Russell, B.Eng., (McGill Univ.), Laurentide Inn, Grand'Mere, Que.
Heron, William Kenneth, (McGill Univ.), P.O. Box 153, Asbestos, Que.
Horsburgh, John G., (Univ. of Man.), 847 Fleet Avenue, Winnipeg, Man.
Langley, John Gordon, B.Eng., (McGill Univ.), 239 Burnham St., Peterborough, Ont.
Mazur, John Thomas, (Univ. of Man.), Melrose, Man.
McPherson, Fred, (Univ. of Alta.), 806A Braemar St., Medicine Hat, Alta.
Ross, Donald, (Univ. of Alta.), 11723-88th Street, Edmonton, Alta.
Schulte, Theodore Milne, (Univ. of Alta.), P.O. Box 1, Strathmore, Alta.
Stanley, Don Russell, (Univ. of Alta.), 11632-96th Street, Edmonton, Alta.
Sutherland, Eric Sinclair, (Univ. of Man.), 1012 Jessie Ave., Winnipeg, Man.
Young, Hume Blake, (Univ. of Man.), 175 Arlington Street, Winnipeg, Man.

Students at the Ecole Polytechnique, Montreal, Que.

Aubry, Gérard, 2132 Bordeaux Street, Montreal, Que.
Auclair, Charles A., 3416 Parc Lafontaine, Montreal, Que.
Baril, Romain, 3478 St. Denis St., Montreal, Que.
Beaudry, Marcel, 4822 St. Catherine St. East, Montreal, Que.
Beaupré, Bernard, 4836 St. Urbain St., Montreal, Que.
Carrière, Paul, 8748 Foucher St., Montreal, Que.
Caron, Clément, 2 St. Thomas St., Longueuil, Que.
Choquet, Guy, 4364 St. Hubert St., Montreal, Que.
Cousineau, Emile, 1043 St. Denis St., Montreal, Que.
D'Amours, Albert, 2643 Bourbonnière St., Montreal, Que.
Dessaulles, Jean, 3567 Shuter St., Apt. 3, Montreal, Que.
desRivières, Edouard, 805 Sherbrooke St. East, Montreal, Que.
Falardeau, Gérard Aimé, 1630 Dezery St., Montreal, Que.
Forest, Clément, 1284 Wolfe St., Montreal, Que.
Gauthier, Gaston C., 4751 St. Denis St., Montreal, Que.
Gravel, Georges, 3646 St. Denis St., Montreal, Que.
Huot, Marcel, 1442 Montcalm St., Montreal, Que.
Lanouette, Marcel, 7 Blvd. St. Joseph West, Montreal, Que.
Larose, Gérard, 5924 Bordeaux St., Montreal, Que.
Latreille, André, 4215 St. André St., Montreal, Que.
Lacavalier, Gabriel, 2928 Masson St., Montreal, Que.
Leroux, Florian, 32 Roskilde Ave., Outremont, Que.
Letendre, Lucien, 1022 Mount Royal Ave. East, Montreal, Que.
Lord, Roger, 3410 Delorimier Ave., Apt. 2, Montreal, Que
Malo, Gérard, 2553 Notre Dame St. East, Montreal, Que.
Michaud, Maurice, 1430 St. Denis St., Montreal, Que.
Papineau, Marcel, 1566 Ducharme St., Montreal, Que.
Prudhomme, L.André, 94 McCulloch Ave., Outremont, Que.
Plante, Walter, 1430 St. Denis St., Montreal, Que.
Richard, Adrien, 1297 St. Christophe St., Montreal, Que.
Samson, Jean J., 147 Bourget St., Montreal, Que.
Trudeau, Marc R., 3488 Addington Ave., Montreal, Que.

Students at McGill University, Montreal, Que.

Balcom, Alfred Burpee, Jr., 3468 Shuter St., Montreal, Que.
Cantwell, E. Marcel, 553 Champagneur Ave., Outremont, Que.
Davis, John Frederick, 3447 Wilson Ave., Montreal, Que.
Hamilton, Alex. D., 4015 Trafalgar Road, Montreal, Que.
Hilton, Thomas Bradford, 1022 Sherbrooke St. West, Montreal,Que.
Jones, Edward Lewis, 3851 University St., Montreal, Que.
Leroux, George G., 94 Dufferin Road, Town of Hampstead, Que.
Schofield, William Douglas, 340 Ballantyne Ave., Montreal West, Que.
Ward, Walter George, 1030 Egan Avenue, Verdun, Que.
Watson, John Crittenden, 3444 Durocher St., Montreal, Que.
Webster, Geddes Murray, 1022 Sherbrooke St. West, Montreal, Que.

COMING MEETINGS

The Canadian Construction Association—Annual Meeting, January 16 and 17, 1940, at the Royal York Hotel, Toronto, Ont. J. Clark Reilly, general manager, Ottawa Electric Bldg., Ottawa.

American Road Builders' Association—1940 Road-Show Convention, January 29 to February 2, at the Stevens Hotel, Chicago, Ill. National Association Headquarters, National Press Building, Washington, D.C.

Ontario Good Roads Association—Thirty-eighth Annual Meeting at the Royal York Hotel, Toronto, Ont., Wednesday and Thursday, February 21 and 22, 1940. Thomas Mahony, secretary-treasurer Court House, Hamilton, Ont.

The Canadian Chamber of Commerce—Annual Meeting at the Royal York Hotel, Toronto, Ont., February 19 to 21, 1940. W. McL. Clarke, Secretary, Board of Trade Building, Montreal.

Canadian Electrical Association—Seventh Annual Winter Conference at the Windsor Hotel, Montreal, on January 15 and 16, 1940. B. C. Fairchild, Secretary, 804 Tramways Building, Montreal.

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*

One of the largest gatherings of the year including many visitors was privileged to hear the timely subject "**The Task Facing Canada as a Democracy Today.**" Mr. Paul Martin, b.a., m.a., l.l.m., was chosen as a Canadian representative on the League of Nations Assembly for 1938 and was well qualified to speak on this subject.

EDMONTON BRANCH

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

The Edmonton Branch of The Engineering Institute of Canada held a regular meeting at the Macdonald Hotel on the night of November 7. Immediately after dinner a number of guests from the Canadian Institute of Mining and Metallurgy were welcomed and a prospective new member for the Branch was introduced. The chairman, C. E. Garnett, m.e.i.c., then introduced the speaker, Mr. Max W. Ball, President of the Abasand Oils, Ltd., who gave an extremely interesting paper on **The Search for Oil.** Mr. Ball outlined the theories of formation and collection of oil in natural oil traps of various kinds. These traps are hunted out by the geologist. After having located the position of one of the traps the chances are about one in five that it will contain oil in commercial quantities, according to figures published in the United States for 1938. In wildcat operations on the other hand, where wells are drilled without the benefit of the geologist, the chances of striking oil are about one in twelve. This illustrates the fact that it pays to have a little consultation work done before drilling is started.

Considerable discussion followed the meeting giving rise to some interesting theories proposed by Mr. Ball and others. Mr. Julian Garrett, m.e.i.c., proposed a vote of thanks to the speaker and a very successful meeting drew to a close.

HAMILTON BRANCH

A. R. Hannaford, a.m.e.i.c. - *Secretary-Treasurer*
W. E. Brown, Jr.e.i.c. - - - *Branch News Editor*

The fall season was opened with a joint meeting of the branch and the American Institute of Electrical Engineers, held in the Westinghouse Auditorium on October 12th.

The meeting was opened by D. W. Callander, a.m.e.i.c., Chairman of the Hamilton Group a.i.e.e., who then turned the chair over to John Dunbar, a.m.e.i.c., chairman of the Hamilton Branch, E.I.C.

The speaker, Mr. John Dibblee, Member a.i.e.e., was introduced by C. H. Hutton, m.e.i.c., who pointed out that Mr. Dibblee is the assistant chief engineer of the Hydro-Electric Power Commission of Ontario. Mr. Dibblee illustrated his lecture, entitled **Operating a Large Power System,** with many instructive slides and pointed out that the System extended from Windsor to Niagara Falls on the southwest to the Quebec border on the east and covered many hundreds of square miles of territory including a large number of cities, towns and villages. The operation of such an extensive area requires a very complex system and must necessarily be divided into main branches. The operators whose duties require that they shall know how their decisions and operations concern the whole system are called system operators and those operators whose business only concerns local conditions are called local operators.

Explanation of the duties, experiences and difficulties of the chief operator at the Queenston plant was given as in him is vested the supreme control of the system. He must, under all and many varied conditions of demand, make the most economical use of the water supply and at the same time obtain the most efficient results from the units under his command. It always being observed that the volume of water allotted by the International Treaty rights from the Niagara River is never exceeded in any one day.

Mr. Dibblee paid tribute to the maintenance men who are responsible for the splendid record of uninterrupted service which has been maintained even under the most severe weather conditions. The average consumer does not realise what effort goes into the system so that he may receive efficient service 99.99 per cent of the time especially in times of sleet, ice and snow. It is only by the ingenuity and effort of all hands that such a record is made possible.

A most descriptive story of the safety devices adopted by the Hydro Electric Power Commission for the welfare of the forces and for the equipment and machinery was given, with many data regarding the work at large.

Mr. Price of the Canadian Westinghouse Company moved a vote of thanks to the speaker. Attendance, 205.

The regular monthly meeting was held in the Science Theatre, McMaster University, at 8.15 on Tuesday, November 14th, when the speaker was Mr. Tracey D. leMay, o.l.s., city surveyor and commissioner of city planning, of the city of Toronto.

Mr. leMay's subject was entitled **City Planning and Traffic Control.** John Dunbar, chairman, called on W. L. McFaul, m.e.i.c., city engineer, to introduce the speaker who pointed out that of the many wise decisions of Mr. leMay one was his coming to this country from England in 1909. His Worship, Mayor William Morrison, and members of the city council, together with other civic and county officials, accepted our invitation to attend this meeting.

The speaker referred to the value to a city of the proper care being given to city planning and particularly to the properties that are today on the outskirts of the city but in the near future will be well within the city limits.

The lecture was illustrated with many traffic charts and pictures.

This outstanding meeting terminated with a lively discussion of members and visitors and a very sincere vote of thanks was tendered by J. J. Mackay, m.e.i.c., to the speaker.

After the meeting the gathering moved to an adjoining room for refreshments which are always prepared by the management of the University. Attendance was eighty-two.

KINGSTON BRANCH

J. B. Baty - - - - - - - *Secretary-Treasurer*

On Thursday evening, Oct. 26, the Kingston Branch held their first meeting of the 1939-40 session, the following being present: Prof. J. B. Baty (speaker), R. C. Wotherspoon (visitor), G. G. M. Carr-Harris, m.e.i.c., Vice-Chairman, Dr. L. F. Goodwin, m.e.i.c., Lt.-Col. L. F. Grant, m.e.i.c., Dr. H. W. Harkness, a.m.e.i.c., chairman, Prof. D. S. Ellis, a.m.e.i.c., Prof. A. Jackson, a.m.e.i.c., H. G. Conn, a.m.e.i.c. secretary-treasurer. After the dinner Lt.-Col. N. C. Sherman, m.e.i.c., and Major P. K. Ketcheson attended the business meeting.

Minutes of the last meeting were adopted as read. Col. L. F. Grant reviewed the activities of the council for the past year.

Prof. D. S. Ellis, a.m.e.i.c., discussed the various plans underway concerning the relationship between the young engineer and the Institute.

The treasurer's report was presented in mimeograph form. On the motion of the treasurer and seconded by Col. L. F. Grant the report was adopted.

After a short discussion it was moved by Dr. L. F. Goodwin and seconded by Col. N. C. Sherman, m.e.i.c.: 1. that the Kingston Branch continue to be represented on the Kingston Chamber of Commerce; 2. that the fees for this membership ($15.00) be paid for 1939; 3. that the representative be appointed by the new executive.—Carried.

The election of officers followed: chairman, G. G. M. Carr-Harris, M.E.I.C.; vice-chairman, P. Roy, Jr.E.I.C.; sec.-treas., J. B. Baty; executive, V. R. Davies, A.M.E.I.C., M. W. Huggins, A.M.E.I.C., K. H. McKibbon, S.E.I.C., H. W. Harkness, A.M.E.I.C. (ex-officio).

After a few introductory remarks by the new chairman, Prof. J. B. Baty, of the Department of Civil Engineering, Queen's University, gave a most interesting talk on **Water Purification and Sewage Treatment—with Specific Regard to the Proposed Projects for the City of Kingston.**

Professor J. B. Baty, in charge of Municipal and Sanitary Engineering in the Department of Civil Engineering at Queen's University explained why the matters of production of an adequate and a safe water supply and the satisfactory disposal of sewage and other wastes are inseparable problems for a great number of municipalities, particularly where the municipal water supply is derived from a surface source and the same body of water is depended upon to conduct the municipal waste matter away. He drew attention to the importance of four considerations which must enter in the problem of sewage disposal, namely: hyg enic, aesthetic, economic and legal; and, he explained in more detail the several factors which control the selection or choice of a method or combination of methods of treatment of sewage. In the order of primary, secondary and complete treatment methods, the speaker described the processes which are accepted as good practice today and the units in which the processes are carried out.

In regard to water purification, it was stated that the production of a safe water supply, from the viewpoint of public health, is the first and major consideration, but, that the production of an attractive water supply as well as one generally suitable for domestic and industrial purposes is by no means of minor importance. Professor Baty traced the method of water purification by the rapid sand filtration process, and final sterilization and conditioning, explaining the theory of each step in the process and describing each unit in which the process is effected.

Since the city of Kingston has under consideration, at the present time, a joint project of water purification and sewage treatment, the proposals of the consulting engineers who were engaged to report upon the matter were outlined and reviewed for the benefit of the members of the Kingston Branch who had not had the opportunity previously of learning the details of this current local matter.

MONTREAL BRANCH

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

On October 26, Mr. W. A. Duncan presented a paper illustrated by motion pictures and slides on **Flame Hardening and its Applications in Modern Industry.** He gave a general description of the process and its applications followed by a detailed description of its use in various industries. The apparatus, technique, and control methods and cost were fully explained.

Prof. G. Sproule, M.E.I.C., presided at this meeting, prior to which a courtesy dinner was held at the Windsor Hotel.

Modern Radio Range Equipment was the subject of an address given by F. A. A. Baily before the Montreal Branch on November 2. Mr. Baily, a graduate of McGill University, has been engaged in radio transmitter development work for the Canadian Marconi Company for some years. He was responsible for the installation of numerous radio range stations across Canada. This meeting, under the chairmanship of H. J. Vennes, A.M.E.I.C., was a most interesting one. The paper, illustrated by lantern slides gave a general description of the radio range (airway beacon) equipment, as operated by the Department of Transport in Canada, outlining its method of operation.

Wing Commander D. R. MacLaren spoke to the Branch on November 9 on the subject of **Operation of Trans-Canada Air Lines** dealing with their operation and maintenance and supplementing his talk with moving pictures. The speaker served in the Royal Air Force from 1917 to 1921. He was engaged in aviation work in British Columbia from 1921 to 1937, when he was appointed assistant to the Vice-President of operations of the Trans-Canada Air Ways.

C. K. McLeod, A.M.E.I.C., presided at this meeting.

On November 16, P. L. Pratley, M.E.I.C., and D. B. Armstrong, A.M.E.I.C., spoke to the Branch on the subject of the **Lions' Gate Bridge, Vancouver, B.C.** Mr. Pratley described the design and construction features, illustrating his remarks with slides. Mr. Armstrong showed moving pictures of the fabrication and erection of the steel work commenting on the outstanding features. Mr. Pratley was consulting engineer and Mr. Armstrong engineer of fabrication and erection for the Dominion Bridge Co. Ltd., contractors for the superstructure.

Junior Section

On October 30, the Junior Section of the Montreal Branch heard Mr. John C. Newell speak on **Electrodes in Welding.** Mr. Newell, who is in sales engineering work with the Steel Company of Canada Limited at Montreal, dealt with the discovery, growth, manufacture, use, physical properties and economics of the welding electrodes, illustrating his paper with lantern slides. L. Jehu, A.M.E.I.C., was in the chair.

Marcel Laflamme, S.E.I.C., addressed a meeting on November 13 on the subject of **Fundamentals of Lighting.** His paper dealt with light control, lighting systems, lighting problems and fluorescent lamps. Henri Branchaud, S.E.I.C., presided at the meeting.

NIAGARA PENINSULA BRANCH

George E. Griffiths, A.M.E.I.C. *Secretary-Treasurer*
J. G. Welsh, S.E.I.C. - - - *Branch News Editor*

On November 7, the Niagara Peninsula Branch of the Engineering Institute, and the American Institute of Electrical Engineers (Niagara District Discussion Group), held a joint meeting at the General Brock Hotel, Niagara Falls, Ont. Mr. George Morrison, chairman of the A.I.E.E., presided. Following the dinner, the meeting adjourned to the Canadian Ohio Brass Company Limited, where Mr. K. V. Farmer, manager, conducted the engineers through the modern porcelain insulator plant.

The visitors were shown the entire process of manufacture from the pottery section, where the clay was moulded, dried and fired in high temperature kilns, to the final assembly and testing. The high voltage flashover method was used in testing individual discs. On final assembly each insulator was given a tensile test and then a tensile and high voltage test simultaneously. Similar work on the high voltage bushings proved equally interesting.

OTTAWA BRANCH

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

At a noon luncheon, November 2, Captain L. W. Murray, R.C.N., Deputy Chief of the Naval Staff, Department of National Defence, spoke upon **Defence of Trade on the High Seas.**

The defence of Britain's trade on the high seas so far appears to be proceeding satisfactorily, stated the speaker. In any defence operations, a main consideration is to prevent undue dislocation of trade. For this reason the convoy system, which necessarily slows up trade, is not resorted to any more than absolutely necessary. With trade routes converging into 'focal areas' southwest of England, however, and with shipping concentrated as it is in the neighbourhood of the home ports resort to the convoy system was only a matter of time. It was quite possible, stated the speaker, that continued destruction of enemy submarines might allow the convoy system to be taken off.

By the use of a large map of the world showing the location on the high seas of every ship engaged in bringing supplies to the British Isles on the 7th of March, 1936, Captain Murray pointed out the main trade routes and illustrated how the shipping tended to concentrate in certain well-defined trade lanes. Diversive routing away from these trade lanes so far as possible, even to the extent of adding as much as 20 per cent to the amount of the ship's travel, also assists in protection against the enemy; as well as the patrol of focal areas.

The speaker also referred to necessary protective steps against enemy aircraft and though he naturally could not give details, stated that the situation in this regard appeared to be well in hand.

The luncheon meeting was one of the largest in the history of the branch and was presided over by J. H. Parkin, M.E.I.C., local chairman.

PETERBOROUGH BRANCH

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

Peterborough Branch held its opening meeting of the season on October 12, when H. R. Sills, A.M.E.I.C., gave an address on **Vertical Shaft Generators—Some Problems.**

Mr. Sills is a member of the A. C. Engineering Department of the Canadian General Electric Co. at Peterborough, and has taken an important part in the design of many of Canada's large waterwheel generators. He is a veteran member of Peterborough Branch, and has filled at one time or another practically every executive position the branch has to offer. He is also a member of the Ontario Professional Engineers Association, and is an Associate Member of the A.I.E.E.

In his paper, Mr. Sills pointed out that the design of electrical apparatus involves the correlation of three separate circuits: the electrical, the mechanical, and the thermal. The design of a machine from the viewpoint of any one of these is a relatively simple matter; it is the correlation of the three, with their often conflicting requirements, to the best advantage which is the real problem. Mr. Sills likened the problem to an optical illusion in which one can see first one figure, then another, although the actual lines remain unchanged; it is easy to see one figure at a time, but extremely difficult to see all the figures at the same time.

Since the paper consisted mainly of a surprising number of problems and briefly their cause, effect, and liquidation, any summary would at best be an index of these problems. Mr. Sills presented this paper before the Toronto Branch of the A.I.E.E. this spring, and it appears in the November issue of Electrical Engineering, the A.I.E.E. publication.

The second meeting of the year was held on November 2, and was in charge of the Junior Section of the branch. Papers were presented by two Student Members, W. C. Moull and W. W. Rapsey. Both these men are University of Toronto graduates, and both are now on the Student Course at the Canadian General Electric Co.

Mr. Moull spoke on **Steel Mill Drives.** He stated that the tremendous forward strides made in the application of electric power to steel mill operations during the past decade had been without parallel in any other modern industry; he illustrated this by the fact that only a few years ago electricity played only a minor part in the manufacture of steel, whereas today the consumption of electrical energy by the American steel industry approaches ten billion kw. h. annually.

Mr. Moull pointed out that the modern steel industry performs two main functions, namely, rolling and drawing steel. These differ widely in nature; and the two branches were therefore discussed separately.

Mr. Moull described the main processes in each of these two branches, and discussed the alternative types of motors and control applied to each of these processes. Throughout Mr. Moull's paper, one was continually impressed by the tremendous amounts of power required for the various operations.

Mr. Rapsey spoke on **Carrier Current Telephony.** His paper gave a general description of the various systems now in use in carrier telephony.

Carrier telephony is really wired wireless; whereby a number of separate telephone messages are transmitted simultaneously on a single electrical circuit by employing a separate alternating current, called a carrier current, for each of the separate messages. This carrier current is modulated, that is, it is made to vary in accordance with the variations of current representing the telephone message. As in radio, the carriers for the different messages must differ sufficiently in frequency so that they may be separated from each other at the receiving end by the use of the proper electrical circuits.

Mr. Rapsey then described what happens when one speaks over a telephone to a long distance station by means of carrier current; he described the apparatus and the electrical circuits involved at the sending and at the receiving station, and at each repeater station.

Peterborough Branch was honoured by the presence of Dean McKiel, President of the Institute, at its annual dinner. The dinner, held on November 20, at Kawartha Golf and Country Club, was well attended.

Following dinner and the toast to the King, Chairman B. I. Burgess, A.M.E.I.C., called on R. L. Dobbin, M.E.I.C., to introduce the President.

Dean McKiel gave a short address on engineering affairs generally. In former years, said the President, engineers looked upon themselves as highly skilled technicians; but this outlook has now changed. The thinking engineer now recognizes a duty to society, and in this way is becoming a true professional man. This change has become apparent to the general public, as is evidenced by the increased interest and attention which the public is now paying to engineering affairs.

The President believes that the engineer is destined to play a role of ever-increasing importance in the world. With Canada at war, the engineers' activities are recognized as vital; the numerous leaders of Canada's war efforts who are engineers prove this point. At the end of the war, there will be a still greater need for engineers to solve the problems of adjustment which are sure to follow.

Dean McKiel paid tribute to Mr. W. A. Logan, of Peterborough Branch, who is now in his 89th year. Mr. Logan is Peterborough's oldest member; he has attended every annual meeting of the branch since it was formed twenty years ago.

Following the President's talk, the Chairman introduced Mr. Willson Woodside, of the University of Toronto, who gave an address on **The European Situation, Facts and Fancies.** Mr. Woodside returned to this country just before the war broke out, after spending the summer travelling in Europe. He had sailed to Gdynia, then travelled completely around Germany, through Poland, Bulgaria, Rumania, Italy, and France; he then went to England before returning to Canada.

Mr. Woodside drew vivid pictures of the lands he visited. The Poles, he said, were 'cocky'; they claimed 'they never counted their enemies till the battle was over.' The Italians, despite all the propaganda, were fond of the English and disliked Germans; the trend in Italy is now definitely away from the Rome-Berlin axis. In England and France, the countries were entirely different from those he had visited the previous year. In place of lack of preparedness, he found these countries ready, with no enthusiasm, with no delusions, but with a grim determination.

He discussed the possibilities of an internal eruption in Germany; he felt that this might come, but not in the near future—the German people have not yet reached the starvation point they were at in 1918. However, 'you can't say when a revolt will come because a dictatorship is always strong until ten minutes before it falls'; and although the

German people may not yet revolt, there is still the possibility that revolt may come from armed groups within the country—either a rightist revolt, headed by the army leaders, or a leftist revolt headed by radicals within the Gestapo and the S.S. troops.

The Chairman thanked Mr. Woodside for his very interesting talk, and then adjourned the meeting.

Guests at the dinner included President McKiel; Mr. Willson Woodside, of the University of Toronto; C. E. Sisson, M.E.I.C., a past-chairman of Toronto Branch; Mr. C. A. Salmonsen, of the Canadian General Electric Co.; Dr. H. V. Dobson, representing the Peterborough Medical Society; and Colonel Dewart, Lieut.-Colonel Hicks-Lyne, and Major Turnbull, of Toronto.

SASKATCHEWAN BRANCH

J. J. White, M.E.I.C. - *Secretary-Treasurer*

On October 7, the Saskatchewan Branch of The Engineering Institute of Canada held its semi-annual meeting for the current year when fifty members and friends sat down to dinner in the Saskatchewan Hotel. The Chairman of the branch, Professor I. M. Fraser, M.E.I.C., presided.

This meeting coincided with the itinerary of the President of the Institute, Dean H. W. McKiel, who attended as guest speaker of the evening. Mr. McKiel gave a very interesting address on the various subjects relating to the progress of the Institute during his current year of office and dealt at length with the aims of the Institute and its relationship with student affairs. Engineering students in the future will be divided into two classes, those with technological training and those with a broader scientific education associated with a knowledge of social and political organizations. The status of our profession is not dependent on technological developments but rather on the ideal of service. The organization of one institute in Canada as against many groups in some other countries was declared by the speaker as wise foresight since today all groups feel that they must get together in co-operative societies to discuss common problems. He particularly stressed the aim of the Institute should be the consolidation of reciprocal relations between other national engineering bodies and the strengthening of friendly co-operation within the profession in Canada.

The dinner was followed by a variety entertainment arranged by D. D. Low, A.M.E.I.C., Chairman of the Papers and Meetings Committee.

The meeting was preceded by a luncheon given in honour of Dean and Mrs. McKiel which was attended by the Council of The Association of Professional Engineers and the Executive Committee of the Saskatchewan Branch of The Engineering Institute of Canada and their wives. Immediately following the luncheon the executive committee met in round table conference with Mr. McKiel, in which a general discussion on various subjects of Institute affairs took place. During the afternoon the ladies of the branch members held a tea in the library of the Hotel Saskatchewan in honour of Mrs. McKiel and in the evening Mrs. McKiel was entertained at the home of Mrs. A. P. Linton, wife of the councillor for the Saskatchewan Branch.

SAULT STE. MARIE BRANCH

O. A. Evans, Jr.E.I.C. - *Secretary-Treasurer*
N. C. Cowie, Jr.E.I.C. - *Branch News Editor*

The fifth general meeting for the year 1939 was held in the main dining room of the Windsor Hotel at Sault Ste. Marie. Dinner was served at 7.30 p.m. after which the meeting was called to order at 8.30 p.m. Twenty-four members and guests were present and others arrived after the dinner. Vice-Chairman A. M. Wilson, A.M.E.I.C., presided in the absence of Chairman A. E. Pickering, M.E.I.C. The minutes of the previous meeting were read and adopted on motion of A. R. Clarkson, Jr.E.I.C., and R. A. Campbell, A.M.E.I.C. E. M. MacQuarrie, M.E.I.C., and C. Stenbol, M.E.I.C., moved that the bills be paid. The Chairman asked for approval or further nominations of a slate drawn up by the executive committee to comprise the nominating committee for the year 1939. F. Smallwood, M.E.I.C., and J. S. MacLeod, A.M.E.I.C., moved that the slate be approved which consisted of A. M. Wilson, A.M.E.I.C., O. A. Evans, Jr.E.I.C., E. M. MacQuarrie, M.E.I.C., A. R. Clarkson, Jr.E.I.C., and C. Neufeld, S.E.I.C.

The chairman then introduced the guest speaker of the evening, L. Austin Wright, General Secretary of the Engineering Institute of Canada, stating that as Mr. Wright was to speak on a number of subjects that evening he could not necessarily dwell long on one subject.

Mr. Wright began his address on Defence Registration, stating that he was being deluged by telegrams and inquiries by engineers at Headquarters asking how they might best serve their country. He said that the response to the questionnaire sent out last year by the Dept. of National Defence was very satisfactory; over 9,000 completed replies had been sent in. He stated that engineers were for use in industry not for general defence and stated that technical men were not to be enlisted and students had been advised not to enlist. The trouble was not to get men to enlist but men to support them. He quoted a French general who said that it required 38 men in uniform to support a tank containing two men, while it required as many as 62 men to support some types of aeroplanes. In concluding this part of his address he said that engineers were to stay where they were and if they possessed special qualifications that would make them more valuable elsewhere, doubtless they would receive word from Ottawa. He called attention to the number of engineers who are in the Defence Department.

The General Secretary then dealt with the affairs of the Institute. He noted that the financial affairs of the Institute were very good. A pleasing sign was that many senior men were applying for membership in the Institute while another notable feature was that collections of arrears in dues was progressing splendidly. The Secretary reported that the Emeritus Secretary, Mr. Durley, was feeling fine after his trip to England. He encouraged the hearing of the dramatizing of engineering projects which are a feature of the C.B.C. and would appreciate comment by the members. He spoke briefly on the ritual of the "Calling of the Engineer." There were over 7,000 pledge members in Canada.

He then spoke on that intriguing subject: the training of the young engineer, particularly dealing with the questionnaire, prepared by the Committee on the Training and Welfare of the Young Engineer. He stated that the questionnaire was divided into three parts: (1) Should the Institute guide the High School student; (2) The Curriculum at College; (3) Education after graduation. In the discussion that followed Mr. Rahilly recommended more intense study of literature at High School and felt that the student entering engineering should have some engineering experience or apprenticeship. N. C. Cowie, Jr.E.I.C., and J. S. MacLeod, A.M.E.I.C., felt that the ratio of the number who graduate in engineering to those entering was the same for all professions. No statistics were available on this question at the meeting. C. Stenbol, M.E.I.C., advocated that more draughting of mechanical drawings should be undertaken at College. He felt that engineering graduates were poor draughtsmen. A. M. Wilson, A.M.E.I.C., felt, however, that the average student had the theory of draughting. L. A. Wright felt that it was difficult to advise students. He cited where a well known engineer had once been advised to drop engineering. It was generally felt that the lines of demarcation were gradually disappearing from the various branches of engineering and a greater stress should be laid on English. C. Stenbol, M.E.I.C., and J. S. MacLeod thanked the General Secretary for his very illuminating talk and discussion.

Library Notes

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

BOOK REVIEW

Geology and Engineering

By Robert F. Legget, Assistant Professor of Civil Engineering, University of Toronto, Toronto, Ont. McGraw-Hill Book Company Inc., New York and London, 1939. 650 pp. illus., diagrs. 9¼ by 6 in. cloth. $4.50.

Reviewed by Prof. A. E. MacDonald, m.e.i.c.*

"Geology is the name given to that wide sphere of scientific inquiry which studies the composition and arrangement of the earth's crust. This book is concerned with the application of the results of this scientific study to the practice of the civil engineer . . . There is no special brand of geology applicable to civil engineering. There is, however, a special course of study possible and desirable in considering the application of fundamental geological principles and methods to civil engineering problems, and this must be complementary to the study of geology, as such." Thus Robert F. Legget, m.Eng., a.m.e.i.c., Assistant Professor of Civil Engineering at The University of Toronto, writes of the civil engineer and geology in Chapter V, Part II, of his new book "Geology and Engineering."

Here is available to engineers and geologists alike a book written in an easy, readable style which describes in a clear and interesting manner and from a practical engineering point of view the interrelation of the science of geology and the art of the civil engineer. It is a book which can be used to advantage in both classroom and practice and should prove a valuable addition to the bookshelf of the civil engineer and the geologist. The geologist need not fear encountering engineering formulae, nor the engineer too many technical geological terms and expressions.

The book consists of three parts, and a foreword by Professor P. G. H. Boswell, d.sc., f.r.s. of the Imperial College of Science and Technology, London, who says that "In the realm of science, as in other spheres, background is an important factor . . . This book is the work of an engineer with the additional training of a geologist, and I am convinced that it is planned on the right lines because it has the proper background." Part I, consisting of Chapters I to IV inclusive, is intended to be but an introduction to the science of geology and the author suggests that it may be omitted by those familiar with the fundamentals of the science, however, civil engineers in general should find it profitable reading. Part III is a reference section and brings the book to a close with four appendices containing, with other data, a glossary of common geological terms, a list of references cited in the text, and both a name and a subject index. Part II, consisting of Chapters V to XX inclusive, describes the science as applied in civil engineering and constitutes the principal part of the book. All chapters open with a pithy relevant quotation and the majority conclude with suggestions for further reading.

In Part I, commencing with an outline of geology, the various branches of the science and their correlation are reviewed and a picture is presented of what geology is, its scope, and what it attempts to do. The reader is reminded that detailed geological knowledge of the earth sphere is confined to an exceedingly thin crust, of which only about one-quarter is not covered with water and may be studied by geologists. The nature and composition of this crust is of definite interest to the civil engineer as he should know something of the main soil and rock types, their origin and structural relationship and their suitability for specific work, whether as materials of construction or as foundation beds on which to erect structures.

From the time Part II is reached, until its conclusion, interesting and practical discussions of geological problems met with in the different branches of civil engineering, such as test borings, geophysics, tunnels, landslides, foundations, reservoirs, erosion, groundwater, and soil mechanics, etc., are illustrated from modern practice drawn from world wide sources. In the chapter on preliminary and exploratory work, strong emphasis is placed on the importance of adequate preliminary geological investigations and underground exploratory work in all civil engineering operations. Records show the great value of such work and likewise the futility of its neglect. Geophysical methods are next reviewed and noted as useful tools for preliminary and exploratory work. Mention is made of their growing use in the classification of highway excavation before removal of the material.

On the subject of tunnels the author's view is that the geological adviser should first report on whether the geological conditions anticipated are favourable for tunnel construction, leaving to the civil engineer the task of deciding on the economics of the undertaking and the procedure to be followed. Attention is drawn to the care needed in writing specifications for such work, having due regard for all geological conditions anticipated and especially payment for overbreak. Some of the methods which have been used in the construction of soft-ground tunnels, such as grouting, freezing, chemical solidification, well-point installations, and lowering the underground water table, are described. Reference is made to the particular type of clay encountered in Chicago, Ill., and Winnipeg, which lends itself to removal from the working face in large slabs.

In the chapter on open excavation, embankment fills and retaining walls, the use of assumed angles of repose of materials is admitted for preliminary designs, but it is suggested that a careful geological study should be made before completion of any final designs. Among suggestions for reducing the effect of earth movements and landslides are, in the former instance, to select level ground, avoid marshy ground and keep fill material to a minimum; and keep structures well back from cuttings, such as river beds, canals, and coasts. Preventative and remedial measures for landslides are given as; consolidation of the unstable material, treatment of the unstable slopes, and correction of groundwater conditions. Some of the geological problems which had to be contended with in the construction of the Panama Canal, and have necessitated study because of serious slides since that time, are recounted in the chapter on transportation routes.

As the cost of piers and abutments for bridges usually almost equals the cost of the superstructure, and as the latter is designed on the assumption that no serious movement of the supporting surfaces will occur, the civil engineer need not be reminded of the importance of bridge foundation design. However, unless careful geological studies of the foundation bed are made to determine possible scour, lateral displacement, consolidation of materials, or failure of an underlying stratum, there is no assurance that the designer's careful calculations may not be nullified and failure occur. Defective foundation bed conditions have often been the cause of failure in dam construction. The main cause of failure of the St. Francis Dam was reported to be the nature of the rocks under the dam.

The interference with natural conditions from the impounding of water behind dams is discussed under reservoirs and catchment areas. Several instances are cited of difficulties which have been encountered and even structures abandoned because of the undetermined nature of the local geological structure. In the chapter on erosion and silting some leading and general cases, and the geological approach necessary to design and construction of this character, are discussed. Chapters on water supply and groundwater follow, and instances are cited of the serious depletion of groundwater through lack of regulation of private operations. One particular danger mentioned is that lowering of the groundwater level in unconsolidated strata may affect their bearing value and have most serious results on structures supported thereon.

Building foundations are next discussed and the author again notes that it is rarely the structural design that is to blame for foundation failures, but rather the failure of the foundation strata to give adequate support to the loads put upon them. For building work "the depth of the zone of appreciable compression . . . is from one to one and a half times the width of the building, if a raft foundation is used." It follows that materials well below the surface are appreciably stressed and that if the strata include a soft layer of material it may fail under load and cause serious settlement of a structure even though there may be no evidence of ground failure at the surface. In the case of some clays the settlement may be continuous if loaded beyond a certain limit. Modern practice endeavors to so control settlement that it will have no undesirable effects on the supported structure. Foundation troubles from settlement consequent upon the drying out of clay strata, and also from heaving due to the clay swelling consequent upon increase of moisture content, are discussed. It may be of interest to note here that this double problem is encountered in Winnipeg, a clay area, where, in one residential district particularly, exterior walls are prevented from unequal settlement, (as a result of probable dehydration of the clay under them), by artificial means such as concrete piles, and the interior upper floors and partitions are prevented from heaving when the basement floor and interior footings rest directly on the clay, (as a result of probable increase in moisture content of the large covered clay mass), by so constructing the basement partitions that any heaving of the basement floor cannot be transmitted through them to the upper floors. The basement posts can be made a few inches short initially, and wedges or shims used to make up the difference in necessary height, enabling subsequent adjustments to be easily made. The basement floor may be independently supported by the basement walls and posts, at a considerable additional cost.

An important point in the chapter on materials of construction is the advice against using aggregate for concrete which may be composed of material that will swell in the presence of water. There is always the temptation to use any rock that has to be excavated on a construction job as it provides cheap aggregate.

Soils and soil mechanics are dealt with in the final chapter. Their study by civil engineers has been made only in recent years. Advancement has been indicated in the improvement of soil sampling methods, mechanical analysis and classification of soils, and laboratory tests whose results will give practical assistance in design work.

In conclusion, this reviewer feels that the reading of Part II of this book should give the geologist a better understanding of what the civil engineer requires of him, and give the civil engineer a better appreciation of the practical value of geology in engineering.

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ADDITIONS TO THE LIBRARY

PROCEEDINGS, TRANSACTIONS, ETC.

American Society for Testing Materials:
Year Book, August, 1939.

American Society of Civil Engineers:
Proceedings Vol. 65, No. 8, Pt. 2 (Transactions number, October, 1939).

Federation des Associations Societes et Syndicats Français d'Ingenieurs:
Assemblée générale, 1939.

Institution of Naval Architects:
Transactions, Vol. 81, 1939.

National Research Council, Highway Research Board:
Proceedings of Eighteenth Annual Meeting, Washington, 1938, Part 2, Soil Mechanics and Soil Stabilization.

Nova Scotian Institute of Science:
Proceedings, Vol. 20, Pt. 1, 1938-1939.

The Royal Society of Canada:
Transactions, Vol. 33, Section 4, Geological Sciences, 1939.

TECHNICAL BOOKS

The Canada Year Book 1939:
Dominion Bureau of Statistics, Ottawa, 1939.

A History of the Growth of the Steam-Engine:
By R. H. Thurston, Ithica, N.Y., Cornell University Press, 1939. 555 pp., cloth, 8 by 5½ in. $3.00.

How to Sell and Burn Coal:
By T. A. Marsh, 5625 Kenwood Avenue, Chicago, Ill. 97 pp. paper, 6½ by 4½ paper $1.00.

The book is written in clear and non-technical language, giving examples and reasons how to select coal for manufacturing plants, commercial heating plants and residential use. One section deals with the causes and remedies of many fuel burning difficulties and is of value to service engineers on fuels or stokers or as a manual for operating engineers.

Fan Engineering:
Ed. by Richard Madison, 4th ed. Buffalo Forge Co., Buffalo, N.Y., 1938. 739 pp., 6¾ by 4½ in. leather, $4.00.

On air, its movement and distribution in air conditioning, combustion, conveying and other applications employing fans.

Physik fur Studierende an Technischen Hochschulen und Universitaten:
By Dr. Paul Wessel, 4 Wrightington St., Wigan, Lancs., England. 514 pp. illus., 6¼ by 5 in. cloth.

NEW AND REVISED SPECIFICATIONS

American Society for Testing Materials:
Standards on electrical insulating materials, October, 1939.

Canadian Engineering Standards Association:

B12 1939—Galvanized steel wire strand.
B51 1939—Canadian regulations for the construction and inspection of boilers and pressure vessels.
B52 1939—Mechanical refrigeration code.
C22.1 1939—Part I, 4th edition, Canadian electrical code.
C14 1939—Reinforced concrete poles.
C58 1939—Design of C.E.S.A. cast lead-pin threads for insulator pins of nominal diameters of 1 in. and 1⅜ in.
C22.2, No. 53, 1939—Part 2, Domestic electric clothes-washing machines.
C22.2, No. 59, 1939—Fuses (both plug and cartridge-enclosed types).

Canadian Government Purchasing Standards Committee:

Specification for petroleum lubricating oils; Aviation fuel; Procedure for the determination of gum stability of gasoline; cotton duck, single yarn, unbleached (tentative), cotton duck, single yarn, bleached (tentative), cotton duck, ply yarn unbleached (tentative); cotton duck, ply yarn, bleached (tentative); liquid petroleum asphalts for road purposes (tentative).

U.S. Department of Commerce, National Bureau of Standards:

Structural properties of "Pre-Fab" constructions for walls, partitions, and floors sponsored by the Harnischfeger corporation; Structural properties of "Twachtman" constructions for walls and floors sponsored by Connecticut Pre-Cast buildings Corporation; Structural properties of a concrete-block cavity-wall construction sponsored by the National Concrete Masonry Association; Structural properties of "Dun-Ti-Stone" wall construction sponsored by the W. E. Dunn Manufacturing Company; Structural properties of a brick cavity-wall construction sponsored by the Brick Manufacturers Association of New York, Inc.; Structural properties of a reinforced-brick wall construction and a brick-tile cavity-wall construction sponsored by the Structural Clay Products Institute; Backflow prevention in over-rim water supplies; Structural properties of a wood-frame wall construction sponsored by the Douglas Fir Plywood Association. (Reports BMS18, 20, 21-24, 28, 30).

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 B C of AVIATION

By V. W. Pagé. Rev. and enlarged ed. New York, Norman W. Henley Publishing Co., 1939. 418 pp., illus., diagrs., tables, 8 x 5 in., cloth, $2.50.

This is a simple account of aviation, popular in tone and intended for the beginner. The different types of aircraft and their design and construction are explained, engines and propellers are described, and a chapter is devoted to flying methods. Other chapters discuss instruments and instrument flying, and inspection.

THE A.R.R.L. ANTENNA BOOK

By G. Grammer and B. Goodman. West Hartford, Conn., American Radio Relay League, 1939. 139 pp., illus., diagrs., maps, charts, tables, 10 x 7 in., paper, 50c.

This book aims to provide a comprehensive guide to the design and construction of antennas for amateur transmitting and receiving stations. The theory and design of all types of antennas are described, and there are chapters on feed systems, masts, rotating mechanisms, etc.

AMERICAN DIESEL ENGINES

By L. H. Morrison. 2 ed. New York and London, McGraw-Hill Book Co., 1939. 489 pp., illus., diagrs., charts, tables, 9½ x 6 in., cloth, $5.00.

This work is planned to give the factory executive and operating engineer the information that will enable them to select the best engine for their purpose, and operate and maintain it efficiently. It includes detailed descriptions of all American-made engines. The new edition has been revised extensively.

BOECKH'S MANUAL OF APPRAISALS

By E. H. Boeckh. 3 ed. enlarged and rev. Indianapolis, Ind., Rough Notes, Co., 1937. 399 pp., illus., diagrs., charts, tables, 9 x 6 in., lea., $6.00 for manual; $9.50 for manual and tables.

The opening section describes briefly appraisal systems, the Boeckh index control for local cost figures, and the practical use of the manual. Part 2 gives structural base costs for more than a hundred types of buildings; Part 3 discusses appraisal analysis; and Part 4 is concerned with land valuation. Tax information, building nomenclature, and construction requirements are appended.

CAST IRON PIPE

By P. Longmuir. Philadelphia, J. B. Lippincott Co., 1939. 104 pp., illus., diagrs., tables, 8 x 5 in., cloth, $2.00.

The manufacture and properties of cast iron pipe are briefly described, with special reference to the centrifugal casting process. Pipe joints and methods of metallurgical control are also discussed. The book is a welcome addition to the scanty literature on pipe making.

(The) CONSTRUCTION OF NOMOGRAPHIC CHARTS

By F. T. Mavis. Scranton, Pa., International Textbook Co., 1939. 132 pp., diagrs., charts, tables, 8½ x 5 in., fabrikoid, $2.00.

This textbook provides a practical course for engineers and advanced undergraduate students. The theory of logarithms, the slide rule and functional co-ordinate papers is discussed. Many examples of nomogram construction are included.

ELECTRICAL TRANSMISSION AND DISTRIBUTION OF POWER

By H. V. Carpenter. Pullman, Wash., Students' Book Store, 1939. 84 pp., mimeographed, diagrs., charts, tables, 11 x 9 in., cardboard, $2.00.

This practical manual for students and engineers covers the physical properties of transmission lines, the regulation of both low and high voltage lines, materials for overhead lines, choice of voltage, and the mechanical features of power lines. New methods of predetermining corona losses and of plotting catenary relations are included.

ELEMENTS OF SANITATION

Edited by E. S. Hopkins. New York, D. Van Nostrand Co., 1939. 435 pp., illus., diagrs., charts, maps, tables, 9½ x 6 in., cloth, $4.00.

This textbook, intended as a general introduction to the fundamentals of sanitation and hygiene, is the work of a group of specialists. Water and sewage disinfection, public water supplies, the disposal of sewage, trade wastes and refuse, stream pollution, the sanitation of food and milk, ventilation and air conditioning, the control of swimming pools and environmental hygiene are discussed.

ENGINEERING MATERIALS

By A. H. White. New York and London, McGraw-Hill Book Co., 1939. 547 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.50.

The greater part of this book is devoted to the manufacture, heat-treatment, fabrication and properties of iron, steel and the non-ferrous metals, with consideration of the effect of methods of fabrication on the physical properties. Subsequent chapters present information on clay products, lime and cements, fuels, water and its industrial utilization, corrosion and protective coatings, and plastics. References accompany each chapter.

(The) EXAMINATION OF PLACER DEPOSITS

By T. A. Graves. New York, Richard R. Smith, 1939. 168 pp., illus., diagrs., tables, 8 x 5 in., cloth, $3.00.

Information is presented on alluvial deposits and their examination which will provide general knowledge of the subject and at the same time enable the student to make actual placer examinations. The topics covered include the description and location of placers, placer working (including economic considerations), determination of value, reports and records, and field equipment.

GRAPHIC PRESENTATION

By W. C. Brinton. New York, Brinton Associates, 1939. 512 pp., illus., diagrs., charts, tables, 9½ x 6 in., fabrikoid, $5.00.

A brief encyclopedia of methods for representing facts graphically, which covers a wide range: maps, geneological charts, statistical charts, etc. Each variety is represented by specimens, with explanations of their uses and interpretation. The use of color is covered. In addition practical advice is given on equipment and methods for making graphs and exhibits, on reproduction and on the use of graphic material. There is a short glossary.

GREAT BRITAIN, Dept. of Scientific and Industrial Research

Index to the Literature of Food Investigation, Vol. 10, No. 4, March, 1939, pp. 271-378. London, His Majesty's Stationery Office. 10 x 6 in., paper. (Obtainable from British Library of Information, 50 Rockefeller Plaza, New York, $1.35.)

This periodical provides the cold-storage and canning industries with a very useful tool. The index appears quarterly and covers more than one hundred periodicals. The entries are classified and supplied with abstracts, and an author index is provided. The storage properties of different foods, cold storage, canning and curing, by-products, sea and land transport, refrigerating equipment, etc., are covered.

HOUSING FOR THE MACHINE AGE

By C. A. Perry. New York, Russell Sage Foundation, 1939. 261 pp., illus., diagrs., charts, tables, maps, 9 x 6 in., cloth, $2.50.

The problem of modern housing is considered from many angles. Comparison is made between the methods of construction of houses and of automobiles with a view toward mass production. The neighborhood unit is examined, and the results of practical experience are set forth, with particular attention to the matter of assembling large plots in metropolitan districts. The final chapter discusses the social significance of the unit.

INDUSTRIAL STATISTICS CONFERENCE, PROCEEDINGS held at Massachusetts Institute of Technology, Cambridge, Sept. 8-9, 1938

New York and Chicago, Pitman Publishing Corp., 1939. 315 pp., diagrs., charts, tables 9 x 6 in., paper, $2.50.

This conference, held at the Massachusetts Institute of Technology in 1938, was devoted to a discussion of the application of statistics to the control of quality and industrial standardization. The papers presented show some of the industrial fields where statistical methods have been used, describe some types of statistical tools which are useful, and consider a few practical problems in special fields.

INTERNAL COMBUSTION ENGINES

By L. C. Lichty. 5 ed. New York and London, McGraw-Hill Book Co., 1939. 603 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $4.50.

In this edition of this well-known textbook, the name of Robert L. Streeter disappears from the title page and Professor Lichty assumes full authorship. The work first develops the theoretical principles and then illustrates their application to the analysis, design and operation of the internal-combustion engine and its parts. Changes include a simplification of the method of analyzing thermodynamic processes, a chapter on air-standard cycle analysis, revision of the chapters on fuels, detonation and fuel injection, more material on combustion-chamber design and air cooling, and thorough revision throughout.

INTRODUCTION TO THE STUDY OF HEAT TREATMENT OF METALLURGICAL PRODUCTS

By A. Portevin. Cleveland, Ohio, Penton Publishing Co., 1939. 246 pp., diagrs., charts, tables, 9 x 6 in., cloth, $5.00.

The major part of the book is devoted to the transformation points, hardening, quenching, tempering and annealing of steel. A supplementary chapter of experiments and examples follows each chapter of text. Malleabilization of cast irons, heat treatment of light aluminum alloys, and some general remarks on heat treatment are also included.

IRON BREW, a Century of American Ore and Steel

By S. H. Holbrook. New York, The Macmillan Co., 1939. 352 pp., 9 x 6 in., cloth, $2.50.

This book, vivacious, anecdotal and readable, tells the story of the discovery and development of the ore regions of the Great Lakes, and of the expansion of the steel industry that followed. It is a useful addition to the history of iron and steel.

OPERATION ANALYSIS

By H. B. Maynard and G. J. Stegemerten. New York and London, McGraw-Hill Book Co.. 1939. 298 pp., illus., diagrs., charts, tables, 9 x 6 in., cloth, $3.00.

The authors present practical methods of analyzing operations and determining more efficient, economical and labor-saving procedures which can be applied by any shop supervisor. The different steps are developed systematically and in detail, from the preliminary consideration of the job to the final establishment of the best procedure. The methods are illustrated by numerous examples from many types of industries.

PATENT FUNDAMENTALS

By A. Schapp of Schapp & Cole, San Francisco, Calif.; New York, Industrial Press, 1939. 176 pp., diagrs., 9 x 5 in., cloth, $2.00.

A non-technical explanation of what constitutes true invention is given, with practical examples. Other topics covered include procedure in obtaining adequate patent protection, drafting of effective claims, making assignments and issuing licenses. Essential facts about trademarks and copyrights are presented.

PIONEERS OF PLENTY, the Story of Chemurgy

By C. Borth. Indianapolis, Ind., and New York, Bobbs-Merrill Co., 1939. 303 pp., illus., 9 x 6 in., cloth, $2.00.

The growth of "chemurgy," the science of turning surplus or waste material into useful products through mechanical and chemical processes, is described in this work. The author describes the work of the important men in the field, the processes which have been developed, and the resulting products; paper pulp from cheap timber and the great number of synthetic drugs, fabrics and plastics of the present day.

THE PRACTICAL GEOLOGY OF OIL

By W. W. Porter, Houston, Texas, Gulf Publishing Co., 1938. 142 pp., illus., diagrs., maps, tables, 8½ x 5½ in., cloth, $1.50.

The introductory chapters present basic information on the constituents, methods of formation, properties, and movements of rocks. In the succeeding chapters are found the application of such information to oilfield work, well drilling and coring processes, geological exploration (including geophysical), and some production statistics. The final chapter contains a brief survey of sources of geological information.

A PRACTICAL MANUAL OF CHEMICAL ENGINEERING

By H. Tongue, with a foreword by Sir G. Morgan. New York, D. Van Nostrand Co., 1939. 560 pp., illus., diagrs., charts, tables, 10 x 6 in., cloth, $12.00.

The first four chapters are devoted to the metals used in the chemical industries and describe their properties at high and low temperatures and the methods of joining them for the construction of equipment. Chapter V covers the non-metallic materials of construction. The succeeding eleven chapters deal with steam plants for chemical works and such processes as evaporation, drying, distillation, filtration, pumping, crushing and grinding, etc., with considerable emphasis on the design and construction of process equipment. An appendix treats of the safety aspects of plant design and operation.

RECENT MARINE SEDIMENTS

A Symposium, edited by P. D. Trask. Tulsa, Okla., American Association of Petroleum Geologists; London, Thomas Murby & Co., 1939. 736 pp., illus., diagrs., charts, maps, tables, 9½ x 6 in., cloth, $5.00 ($4.00 to members and associates).

The conditions under which sediments are formed are of great interest to geologists, especially petroleum geologists, and the information which has been accumulated during the past ten or fifteen years through the study of recent sediments is very valuable for the light that it throws upon the mode of origin of the older consolidated ones. The present volume aims to summarize recent progress in our knowledge of marine deposits. Thirty-four papers by specialists are included, discussing the conditions of formation of these deposits and the methods of studying such sediments. The book is intended to supplement the "Treatise on Sedimentation" published by the Association.

RESISTANCE MECÁNIQUE DES CONDUCTEURS AÉRIENS

By P. Dévédec. Brussels, Belgium, Alliance Graphique, 1939. 61 pp., diagrs., charts, tables, 11 x 8 in., paper, 2.20 Belgas.

In this pamphlet on the mechanical strength of aerial conductors the author first discusses the cases of wires under catenary and parabolic loading. He then shows how to reduce calculations for cables to that for wires, and finishes by describing practical applications and actual conditions to be met.

ROUTE SURVEYING

By G. W. Pickels and C. C. Wiley. 2 ed. New York, John Wiley & Sons, 1939. 427 pp., illus., diagrs., charts, tables, 7 x 4 in., lea., $3.50.

In addition to covering railroad surveying, this text includes surveying for highways, transmission lines, pipe lines and canals. The treatment is concise and practical. Modern methods are presented, without detailed mathematical solutions. In this edition the material on circular curves and spirals has been thoroughly revised and a new chapter added on the string-lining method of realigning curves. Other revisions have been made throughout the book.

SCIENCE TODAY AND TOMORROW

By W. Kaempffert. New York, The Viking Press, 1939. 275 pp., tables, 8½ x 5 in., cloth, $2.50.

The great events on the horizon of science in the fields of astronomy, physics, chemistry, biology, electricity, etc., are presented in non-technical language. In addition to his exposition of these developments, the author ventures to predict some probable or possible future extensions and their influence on the social organization.

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

SENIOR ENGINEER, thoroughly experienced in steel tube manufacture. Full details of past experience, with references, should accompany first letter. Apply to Box No. 1962-V.

ELECTRICAL ENGINEER with single and polyphase metering experience capable of handling meter department and assuming responsibility. Single man with knowledge of Spanish preferred although not imperative. Location South America. Apply to Box No. 1979-V.

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.

LAYOUT ENGINEER to assist plant manager in engineering problems. Must be able to draft plans, write up specifications, obtain costs and present complete detailed plan of any layout. Applicant should be thoroughly familiar with heating, power, electrical work, conveying layouts and processing equipment. Apply Box No. 1990-V.

SALES ENGINEER with well-established firm of dealers in well-known lines of mechanical and electrical equipment. Alert, all around practical man with actual machine-shop and general draughting experience. Salary plus commission. Apply giving full particulars to Box No. 1994-V.

CIVIL SERVICE OF CANADA VACANCIES

COMP. No. 29593—A **chemist**, male, for the Food and Drug Laboratory, Department of Pensions and National Health, Ottawa, at an initial salary of $2,820 per annum. While a temporary appointment only may be made at present, this examination will qualify for permanent appointment. In the event of permanent appointment the initial salary of $2,820 may be increased upon recommendation for meritorious service and increased usefulness at the rate of $120 per annum until a maximum of $3,300 has been reached. **Duties:** Under direction to conduct specialized chemical analytical and research work in connection with alcoholic beverages; to instruct and direct assistant chemis s and junior chemists; and to perform other related work as required. **Qualifications:** Education equivalent to graduation from a university of recognized standing with specialization in chemistry or chemical engineering, preferably with postgraduate specialization with research work in mycology; at least three years of postgraduate experiences in the analysis or in the manufacture of alcoholic beverages; research ability; supervisory ability; good judgment.

Application forms properly filled in must be filed with the Civil Service Commission, Ottawa, not later than December 23, 1939. Forms may be obtained from local post office.

Candidates must be British subjects, and must have resided in Canada at least five years.

COMP. No. 29567—**Water and power engineer**, grade 1 (bilingual), resident of the Province of Quebec. In the event of permanent appointment, the initial salary of $1,560 per annum may be increased upon recommendation for meritorious service and increased usefulness at the rate of $120 per annum, until a maximum of $1,800 has been reached. **Duties:** Under dire tion, to make or to assist in making stream measurements and to assist in making field investigations or office analyses in connection with the availability, appraisal, or utilization of water resources; to prepare reports; and to perform other related work as required. **Qualifications:** Education equivalent to graduation in engineering from a university of recognized standing with one year of practical engineering experience in work or investigations connected with the use o· application of water resources, or with the power industry; 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; good physical condition; ability to speak, read and write the English and French languages fluently. While a definite age limit has not been fixed for this competition, age may be a determining factor in making a selection. **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 concerning their technical training and experience, especially as they bear on the qualifications for and duties of this position. An oral examination may be given if necessary in the opinion of the Commission.

Application forms, obtainable at the Institute Headquarters, or local post office, the offices of the Employment Service of Canada or from the Civil Service Commission, Ottawa, not later than December 27, 1939.

NATIONAL RESEARCH COUNCIL VACANCY

The National Research Council invites applications for the temporary war position of **Senior Research Assistant** to serve in the gauge testing laboratories at a salary rate from $1,680.00 to $2,040.00 per annum, the salary to depend on the qualifications of the appointee.

Duties: Under direction to make fine measurements in gauge verification and the standardization of gauges, micrometers, jigs and mechanical measuring instruments; devise instruments and methods of making such measurements; supervise a staff engaged in the routine measurement of gauges, and do other related work as required.

Qualifications: Candidates should preferably be graduates in Mechanical Engineering or Physics, with some engineering experience. Preference will be given to those with experience in making delicate mechanical measurements, and in the design and use of fine mechanical and optical instrumental devices. Experience in mechanical drawing and good eyesight are desirable. Candidates must be British subjects.

Instructions to Applicants: Applications should be addressed to the Secretary-Treasurer, National Research Council, Ottawa, from whom application forms may be obtained, and should reach him not later that **20 December, 1939**. Applicants are requested to write a general statement indicating what they consider to be their special fitness for work of the nature indicated. Should there be insufficient time to obtain the regular application forms, applicants should submit a tabulated statement containing the following information:

1. Name in full.
2. Date and place of birth.
3. Citizenship.
4. Residence in Canada (absence from Canada attending educational institutions abroad is not counted as non-residence in Canada).
5. Whether married or single.
6. Height, weight and physical fitness, and photograph or snapshot if available.
7. Academic degrees and honours, if any.
8. Positions held and other relevant items of training and experience.
9. Papers published, if any, with copies if available.
10. Languages read or spoken.
11. Date at which services available.
12. Names and addresses of **three** persons to whom reference can be made (references should be persons qualified to pass on applicant's ability as well as character).

Persons who have already filed with the National Research Council applications containing the information indicated may refer to these rather than duplicate information.

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.

ELECTRICAL ENGINEER, B.Sc., E.E. Age 39 Married, available at once for responsible position in any location. Seven years electrical experience on operation, maintenance, and construction of hydro-electric plants and substations. Six years electrical maintenance in pulp and paper mill. Best of references. Box No. 636-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 DRAUGHTSMAN, 12 years experience in mechanical and structural draughting and general mechanical design, including recently perfected new type Diesel head. Married. Age 37. B.Sc. in mechanical engineering. Employed steadily but desirous of good opportunity in Diesel or general mechanical field. Apply to Box No. 1081-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 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 months draughting. Excellent references. Speaks some French and Spanish. Will go anywhere. Available on two weeks notice. Apply to Box No. 1860-W.

TECHNICALLY TRAINED EXECUTIVE, general experience covers organization and management in business and industrial fields; including sales, purchasing, productions, accounting and costing, also industrial surveys, reorganizations and amalgamations in the United States and Canada. B.Sc. degree in mechanical engineering. Married. Canadian. Apply to Box No. 1871-W.

MANUFACTURING EXECUTIVE, B.Sc. in mechanical engineering. Married. Canadian. Experienced in munitions manufacturing and other precision work. Apply to Box No. 1872-W.

ELECTRICAL ENGINEER, B.Sc., E.E. '37, age 23, single, Canadian. Experience includes one year in large electrical factory, testing large and small motors, generators and transformers; also one year and a half on sales engineering work. Interested in permanent position with a good future. Would consider any location. References available on short notice. Apply to Box No. 1981-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.

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. 2019-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.

PRELIMINARY NOTICE

of Application for Admission and for Transfer

November 30th, 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 January, 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

ALTON—WILLIAM, of 7 Lailey St., Kingston, Ont. Born at St. Helens, Lancs., England, August 29th, 1915; Educ.: B.Sc. (Physics), Queen's Univ., 1938; 1935-37, attached to R.C.C.S. during vacations as Lieutenant for technical training; 1938-39, Lieut., Royal Canadian Signals, and at present, Lieut., No. 2 Coy., 2nd Divnl. Signals, C.A.S.F., Kingston, Ont.

References: D. M. Jemmett, L. T. Rutledge, L. M. Arkley, W. P. Wilgar, G. M. Carr-Harris.

BARTLETT—RICHARD LEAR, of 4 Geneva St. So., St. Catharines, Ont. Born at Plymouth, England, June 22nd, 1900; Educ.: 1917-18, dept. of app. science, Univ. of Sheffield. 1921-22, dept. of civil and mech. engrg., Loughborough College; 1917-18, Vickers Limited, Sheffield, as apprentice worked in gunshops, machine repair and millwright work, until enlisted in R.A.F. rating air mechanic (fitter-aero engines); 1918-20, on active service with R.A.F. in France; 1923-24, Petters Limited, Yeovil, England—mach. shops, engine erecting and test; 1925-28, Eastern Assam Tea Coy., engr. to install Diesel engine power plant, tea making machy., etc.; 1928-31, Canadian Acme Screw & Gear Co., Toronto. Machine shops, works inspection, design of production layout, machine tools; 1931-33, Wheeler Reflector Co. of Canada, Toronto. Shop foreman, charge of production and spun metal shapes, samplings, etc., fittings and assembly for industrial and street lighting fixtures; 1933-34, Veraguas Mines Ltd., Rep. of Panama, installing Ruston Diesel engines, B. & M. air compressors for Laurie & Lamb, Canadian agents, and chief mechanic of milling plant; 1935-36, Diatomite Products Ltd., plant engr.; 1936-37, Diesel power plant operating, Shawkey Gold Mining Co., Shawkey P.O., Que.; at present, engr. erector, Diesel engine dept., English Electric Co. of Canada Ltd., St. Catharines, Ont.

References: H. M. Black, C. G. Moon, A. L. McPhail, L. P. Rundle, C. W. West, N. C. Sherman, H. G. Thompson, R. E. Smythe.

BATY—JAMES BERNARD, of Kingston, Ont. Born at Taylor, Texas, U.S.A., April 5th, 1903; Educ.: B.S. in Civil Engrg., A. and M. College of Texas, 1925. 1927-29, graduate studies in civil engrg, at Cornell Univ.; 1922 (summer), rodman, Williamson County highway dept.; 1924 (summer), field worker, production dept., Standard Oil Co. of California; 1925-27, district sanitary engr., Texas State Board of Health; 1928 (summer), temp. asst. sanitary engr., Wisconsin State Board of Health; 1929 (Feb.-June), instructor in civil engrg., Cornell University; 1929-37, asst. sanitary engr., New Jersey State Dept. of Health; 1937-38, sanitary engr., technical service dept., Pennsylvania Salt Mfg. Co., Philadelphia; Sept. 1938 to date, asst. professor, in charge of courses in municipal and sanitary engrg., dept. of civil engrg., Queen's University, Kingston, Ont.

References: W. L. Malcolm, W. P. Wilgar, D. S. Ellis, A. Macphail, L. F. Grant, R .A. Low, A. E. Berry.

BONENFANT—JOSEPH, of LaSarre, Abitibi Co., Que. Born at St. Bruno, Que., Mar. 26th, 1901; Educ.: B.A., Laval Univ., Quebec, 1923. Pulp and Paper Graduate, Technical School of Three Rivers, 1927; 1924-25 (summers), classification of colonization lots, Lands and Forests Dept., Prov. of Quebec; 1926-27, groundwood dept., Can. International Paper Mill, Three Rivers; 1927 (2 mos.), highway constrn., Highways Dept., Que.; 1928-31, with the Aluminum Co. of Canada, Quebec Roads Dept., and various civil engineers on surveying of highways and streets, expropriations, maps and calculations with instruments, constrn. of streets, etc.; 1932-36, city surveying, maps and calculations, topog'l. survey, settling bounds of streets and lots, constrn. of streets and sidewalks, wood and concrete; prelim. surveying for water supply and sewerage; surveying of mining claims, mining constrn. of a roaster, etc., for the Town of Duparquet, and the Beattie Gold Mines Ltd.; Nov., 1936 to date, roads and bridges supt., Colonization Dept., Prov. of Quebec, on constrn. of roads and bridges.

References: J. A. E. Gohier, R. J. L. Savary, R. E. Joron, J. Dumont.

CAPE—GORDON, of 5a Riverside Drive, Lachine, Que. Born at Walkerville, Ont., Feb. 23rd, 1906; Educ.: B.Sc. (C.E.), McGill Univ., 1930. With the Dominion Bridge Company as follows: 1921-24 (summers), shop labour, 1926-28, shop mtce. dfting., field survey; 1930-39, welding supervisor, and 1937 to date, chief inspector.

References: R. E. Jamieson, A. S. Wall, K. O. Whyte, R. S. Eadie, L. Jehu, C. E. Frost.

CLARK—GEORGE McKAY, of 94 Springmount Ave., Toronto, Ont. Born at Glasgow, Scotland, Sept. 13th, 1905; Educ.: 1924-27, Univ. of Toronto; (completed 1st-year, dept. of civil engrg); 1927-31, junior estimator and i/c engrg. costs, payrolls and timekprs., Nelson River Construction Co., Toronto; 1931 to date, asst. to works commissioner, works dept., Forest Hill Village, prelim. surveys, dfting., sewer design, constrn. (pavements, sewers, etc.), layout and supervision, prelim. estimates, contractors' accounts and gen. municipal engrg.

References: N. MacNicol, H. M. Scott, A. A. Young, D. G. McCrone, W. Barber, W. L. Dobbin.

JOINER—WALTER STEWART, of 2316 Chilver Road, Walkerville, Ont. Born at Glasgow, Scotland, Apr. 2nd, 1902; Educ.: apprentice, Dominion Iron and Steel Co., Sydney, N.S., 1917-22; 1931-32 (nights), studied reinforced concrete design, Detroit Institute of Technology; 1922-25, dftsman. with the American Blower Co., Detroit, Dominion Coal Co., and the Dominion Iron & Steel Co.; 1925-27, dftsman., and 1932 and 1934-36, checker, Canadian Bridge Company; 1936 to date, structural steel designer, Ford Motor Co. of Canada Ltd., Walkerville, Ont.

References: A. P. Theuerkauf, W. S. Wilson, J. A. MacLeod, P. E. Adams, H. J. A. Chambers, J. E. Porter.

KAYES—WALKER HOADLEY, of 176 Madison Ave., Toronto, Ont. Born at South Shields, England, April 21st, 1909; Educ.: 1922-27, Dufferin Commercial, and Jarvis Collegiate Institute, Toronto; at present taking I.C.S. course in civil engrg.; 1932-33, bridge engrg. dept., central region, C.N.R., and from 1933-38, official inspector for bridge foundations and underwater construction (cofferdams and repairing bridge foundations); at present, dftsman., Dept. of Highways of Ontario, Toronto.

References: T. F. Francis, A. Hay, W. E. Plummer, V. S. Thompson, A. R. Hannaford.

KRUGER—GEORGE AUGUST LUDWIG, of 81½ McKay St., Ottawa, Ont. Born at Berlin, Germany, Sept. 7th, 1880; Educ.: Dipl. Ing. (Mech. and Elec.), Technical College, Charlottenburg, Germany, 1903 (of Univ. Rank); 1903-05, research lab., Allgemeine-Electricitats Ges., Berlin; 1905-07, with Franz Sauerbier, Berlin, mfr. of radiators and pumps, i-c of shops and estimating; 1907-22, with Siemens & Halske A. G., Berlin, dftsman., later representing engr. in full charge of sales installn., servicing of metering devices, X-ray machines; 1922-24, supt. of power plants, International Shipbuilding & Engineering Co., Danzig; 1924-28, in business for self, X-ray, elect'l. installns. and repairs. Dftsman. with the following companies—1928-29, English Electric Co., St. Catharines, Ont., 1929-30, Monarch Electric Co., St. Johns, Que., 1930-31, Scottish Canadian Magnesite Co., 1936-38, Candn. International Paper Co., Hawkesbury, Ont.; at present, dftsman., dept. of physics and electrical engineering, National Research Council, Ottawa, Ont.

References: B. G. Ballard, D. S. Smith, S. L. Grenzebach, J. H. Parkin, J. J. Freeland.

POTTER—RUSSELL ELMER, of New Westminster, B.C. Born at Winnipeg, Man., July 26th, 1903; Educ.: B.Sc. (Civil), Univ. of Sask., 1925; R.P.E. of B.C.; 1922-24 (summers), chainman, rodman instr'man., C.N.R.; 1925-28, student course, Allis Chalmers Mfg. Co., Milwaukee, Wis.; 1928-30, sales engr. with same company at Detroit; 1930-34, engr. in consulting office with A. C. R. Yuill, M.E.I.C., power plants, cities of Ashcroft, Grand Forks, etc.; 1934-39, city engr. for the City of Nelson, B.C., holding position of city civil and city electrical engr. in full charge of all city work, incl. public works, water, sewers, constrn., etc., and power plant transmission and distribution; at present, chief engr. (civil and elect'l.), for the City of New Westminster, B.C.

References: W. G. Swan, A. C. R. Yuill, C. J. Mackenzie, E. Smith, T. V. Berry.

PUDDESTER—ROBERT PERCIVAL, of 64 Leslie St., St. John's, Nfld. Born at St. John's, Nfld., Sept. 10th, 1907; Educ.: I.C.S. Civil Engrg., 1925-28. Home study; with the Newfoundland Railway, as follows: 1925-28, junior, engrg. dept., 1928-30, asst. dftsman., 1930-34, dftsman., design of bldgs. and structures, etc.; 1930-31, on prelim. survey and dftsman., steel and concrete machine shops; 1934 (Mar.-July), asst. engr., prelim. survey, paper storage sheds & loading piers, Port-aux-Basques; 1934-38, asst. engr., gen. mtce. of way engrg., timber inspr. for western divn., level and transit work, estimates, costs, etc., 1935 (Mar.-June), asst. engr. on prelim. surveys for paper storage sheds and loading piers at St. ohn's; May, 1938 to date, asst. engr., mtce. of way (office engr.), from Apr. to Oct., 1938, engr. i c of erection, steel freight sheds at St. John's.

References: J. W. Morris, D. G. Ross, J. B. Baird, F. C. Jewett, K. R. Chestnut.

SANDWELL—PERCY RITCHIE, of Montreal, Que. Born at London, England. Oct. 26th, 1912; Educ.: B.A.Sc. (Mech.), Univ. of B.C., 1935; Pre-graduation work with the Powell River Co. Ltd., Dept. of Public Works of B.C., Dominion Bridge Co. Ltd., Vancouver, B.C.; with the paper machinery dept., Dominion Engineering Works Ltd., Montreal, as follows: 1934 (summer), dftsman., 1935-37, engr., prelim. designing and estimating on proposals, field engrg. at paper mills, etc.; 1937 to date, asst. to the chief engineer of the dept., investigations and development of new machy., sales engrg., i-c design and drawings for 240 ton pulp drying machine, etc.

References: R. Bell-Irving, A. C. R. Yuill, A. S. Gentles, H. F. G. Letson, H. A. Crombie.

STILES—DOUGLAS DUNCAN, of 236 St. George St., Toronto, Ont. Born at Fredericton, N.B., July 9th, 1915; Educ.: B.A.Sc., Univ. of Toronto, 1939; June, 1939 to date, gen. asst. to E. A. Cross, M.E.I.C., consltg. struct'l. engr., Toronto, Ont.

References: N. B. MacRostie, J. J. Spence, R. F. Legget, E. A. Cross, W. J. Smither.

WRIGHT—WILLIAM JAMES TURNBULL, of 126 Melrose Ave., Toronto, Ont. Born at Clinton, Ont., Nov. 28th, 1890; Educ.: B.A.Sc., 1912, B.A., 1939, Univ. of Toronto; Major, C.O.T.C. Reserve, M.B.E.; 1912 (5 mos.), bridge dept., Govt. of Sask.; 1913 (8 mos.), National Paving Co., Edmonton; 1914-16, partner, Wright & Howard, consltg. engrs.; 1916-19, overseas, C.E.F., 1912 to date (except winter 1913-14 and 1916-19), on the staff of the Faculty of Applied Science and Engineering, University of Toronto, at present, associate professor of engineering drawing.

References: C. H. Mitchell, C. S. L. Hertzberg, J. R. Cockburn, M. B. Watson, W. S. Wilson, J. J. Spence, W. B. Dunbar.

FOR TRANSFER FROM THE CLASS OF JUNIOR

BUCHANAN—EDWARD TREVOR, of 72 Maple Ave., Shawinigan Falls, Que. Born at Montreal, April 13th, 1906; Educ.: B.Sc. (Elec.), McGill Univ., 1928; 1925-26 (summers), dfting., and 1928-33, commercial engr., toll telephone equipment, Northern Ele tric Company; 1933-35 (intermittent), study of economics of rlys. in Canada with L. R. Thomson, M.E.I.C.; 1935-37, mill costs and statistics, and 1937 to date, asst. master mechanic, Consolidated Paper Corporation, Shawinigan Falls, Que. (St. 1926, Jr 1938).

References: E. B. Wardle, H. O. Keay, E. R. McMulken, L. R. Thomson, R. DeL. French, H. J. Ward.

REID—KENNETH, of 1336 Carnsew St., Victoria, B.C. Born at Victoria, Sept. 17th, 1901; Educ.: B.Sc. (Elec.), McGill Univ., 1926; 1923-24 (summers), dftsman. and tracer, Northern Electric Co., Montreal; 1926-27, student test course, Can. Gen. Elec. Co. Ltd., Peterborough; 1927-28, junior industrial control engr. with same company; 1928-30, asst. engr., B.C. Electric Railway Co., Vancouver; 1930-31, asst. chief electrician, Cons. Mining & Smelting Co., Trail, B.C.; 1933-37, mtce., Victoria City Light Dept.; 1937 to date, asst. elect'l. engr., City of Victoria, B.C. (St. 1924, Jr. 1929).

References: J. N. Anderson, J. C. MacDonald, G. M. Irwin, K. Moodie, A. L. Carruthers, S. H. Frame, L. A. Wright.

STEPHENSON—STEPHEN, of Toronto, Ont. Born at London, England, June 11th, 1907; Educ.: 1921-25, Oundle School, England. (Was to have taken B.Sc., at Manchester Univ., but could not do so due to death of father. Took Oxford and Cambridge Exam. of close to same standard); Bell Telephone Course; Northern Electric Wire and Cable Course; 1925-26, student course, British Westinghouse; 1927-28, engrg. sales work in England; 1929-30, outside plant engr., Bell Telephone Company; 1931-35, manager, automobile parts and equipment business for self; 1936 (8 mos.), sales engr., Metallic Roofing Company, road supplies divn., design of small steel bridges, sale of culverts and professional advice to counties and townships; 1936-37, power apparatus and wire and cable engr., Northern Electric Company, incl. three mos. course at Montreal plant; 1937-39, engr., Whiting Corporation, changing U.S. design to meet Canadian standards, supervision af manufacture, control of production and field service on cranes, foundry equipment, railroad turntables and jacks, heavy chemical equipment (paper mill evaporators, etc.), (St. 1930, Jr. 1938).

References: H. V. Armstrong, W. H. Slinn, H. E. Brandon, J. A. Loy, A. E. Pickering.

FOR TRANSFER FROM THE CLASS OF STUDENT

KORCHESKI—WILLIAM BRUNO, of Nakina, Ont. Born at Fort William, Ont., Jan. 3rd, 1908; Educ.: B.Sc. (Civil), Univ. of Man., 1939; 1934-35, rodman, chainman, Roy Kirkup, O.L.S.; 1934, dftsman., Dept. Public Works, Canada; 1935-36, rodman, Geod. Survey of Canada; 1936-37, stope engr., Frood Mine, Sudbury; 1937, dftsman., Dept. Public Works, Canada, at Fort William; 1938, Sterola Exploration Co.; 1939, asst., Geodetic Service of Canada; at present, inspr.-foreman, Dept. of Transport, Intermediate Aerodrome, Nakina, Ont. (St. 1937).

References: A. E. Macdonald, P. E. Doncaster, G. R. Hill, J. M. Fleming, G. H. Burbidge, S. E. Fook.

McKEE—GORDON HANFORD WHITEHEAD, of London, Ont. Born at Ottawa, Ont., Nov. 30th, 1913; Educ.: B.Eng., McGill Univ., 1936. Master in Business Administration, Harvard Univ., 1938; 1935 (4 mos.), routine analyst, Aluminum Co. of Canada; 1936 (4 mos.), research asst., Shawinigan Laboratories Ltd.; 1937 (3 mos.), survey of electrochemical and metallurgical industry for investment purposes, Arthur D. Little, Chemists & Engrs., Cambridge, Mass.; 1939 (3 mos.), research chemist, Ontario Research Foundation; Sept. 1938 to date, instructor in business administration (factory management, industrial management, cost accounting, etc.), University of Western Ontario, London, Ont. (St. 1936).

References: D. S. Scrymgeour, R. DeL. French, A. C. Johnston, R. G. Bangs, E. V. Buchanan.

WATTERS—EDGAR STEEN, of Sackville, N.B. Born at Saint John, N.B., March 15th, 1912; Educ.: B.Sc. (E.E.) Univ. of N.B., 1934; 1934-37, temporary work; 1937-39, radio operator at CFNB, Fredericton, and at present, radio operator at CBA, Sackville, N.B. (St. 1934).

References: A. F. Baird, E. O. Turner, J. Stephens, E. J. Owens, A. A. Turnbull.

WELSH—JAMES GORDON, of Fort Erie North, Ont. Born at Arnprior, Ont., June 26th, 1912; Educ.: B.A.Sc. (Civil), Univ. of Toronto, 1936; 1933-34 (summers), i c party and transitman on survey parties, H.E.P.C. of Ontario; with the Horton Steel Works Ltd. as follows: 6 mos., dfting. and estimating, 3 mos., shop inspector, 12 mos., field engr., and 12 mos. to date, checker and designer. (St. 1935).

References: W. Jackson, W. R. Manock, L. C. McMurty, C. S. Boyd, C. R. Young, A. W. F. McQueen.

WILLIAMS—DAVID G., of Vancouver, B.C. Born at Bishops Stortford, Herts., England, Oct. 28th, 1911; Educ.: B.Sc., 1933, M.Sc., 1935, Univ. of Alta.; Flight-Lieut., R.C.A.F.; 1930 (summer), surveys for geol. mapping; Officer, R.C.A.F., since 1935, engaged in signals duties since 1937, and at present, Signals Officer, Western Air Command, R.C.A.F., Vancouver, B.C. (St. 1933).

References: R. S. L. Wilson, H. J. MacLeod, C. A. Robb, H. R. Webb, C. A. Davidson, D. C. M. Hume, H. B. Godwin.

SIOUX LOOKOUT-NIPIGON MAP SHEET

A new map of the Sioux Lookout-Nipigon area in northwestern Ontario is available for distribution, according to an announcement from the Surveys and Engineering Branch, Department of Mines and Resources. This map, which was produced with the co-operation of the Department of Lands and Forests, Ontario, is on a scale of eight miles to an inch and covers that portion of the province lying between longitudes 88 deg. 0 min. and 92 deg. 0 min. and latitudes 49 deg. 0 min. and 51 deg. 0 min.

The main line of the Canadian National Railways traverses the central portion of the area and the line to Port Arthur and Duluth branches off east of Sioux Lookout. The main line of the Canadian Pacific Railway traverses the southwesterly portion of the sheet.

Lake Nipigon is the most prominent physical feature of the area. It is about 65 miles long and 40 miles wide and has a shoreline of approximately 800 miles and an area of 1,590 square miles, being the largest lake wholly within Ontario. It drains into Lake Superior by Nipigon River.

English River rises about ten miles east of the station of English River, and drains north, widening into Mattawa Lake, turns south through Sowden Lake, then north-northwest by Barrel and Press lakes to Minnitaki Lake, beyond which it widens into Lac Seul and finally empties into Winnipeg River.

Sioux Lookout gets its name from the precipitous hill overlooking it. From the top of this hill in days gone by the Ojibways kept watch up and down the waterways for the warlike Sioux.

The village of Nipigon is on the shores of a beautiful bay of the same name. The village is 66 miles northeast of Port Arthur and is protected from storms on Lake Superior by several islands that form a part of a game preserve. It is 36 miles by railway from Orient Bay on Lake Nipigon, these two places being principal starting points for sportsmen.

This locality is noted for its fish and game resources. To anglers all over the continent the name "Nipigon" suggests trout. Both railway systems award annual trophies for the best trout caught in Nipigon waters. In Lake Nipigon and the adjacent lakes and rivers small-mouth bass, whitefish, pickerel, and pike are also abundant.

The region is a big game country in which moose and deer are plentiful but hunting is prohibited within the provincial game preserve to the east of the lake. To tourists other than sportsmen the area holds many scenic attractions. Many of the streams are smooth-flowing but others are quite turbulent.

The area is forested and large quantities of timber are cut and floated to the mills at Port Arthur and Fort William to be used for lumber and pulpwood.

Copies of this map may be obtained at 25 cents per copy from the Hydrographic and Map Service, Department of Mines and Resources, Labelle Building, Ottawa.

Industrial News

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

WOOD PRESERVATIVES

Osmose Wood Preserving Company of Canada, Limited, Montreal, Que., have issued a four-page bulletin featuring recommended preservatives for specific purposes and methods of applying Osmose wood preservatives. The methods described include—

1. Standard Full Length Treatment.
2. Light Surface Treatment.
3. Heavy Joint Treatment.
4. Combined Light Surface plus Heavy Joint Treatment.
5. Treatment of Groundlines of Posts and Poles.
6. Maintenance Treatment of Standing Wooden Structures.

SMALL FLEXIBLE COUPLINGS

A two-page descriptive folder is being distributed by Hamilton Gear and Machine Co., Toronto, Ont., illustrating and describing their Type "M" Flexible Couplings for Small Powers and Medium Duty. A sectional drawing, dimensions, ratings and weights are given.

HELICAL GEAR UNITS

Catalogue No. 112, entitled "Helical Gear Units, Single, Double or Planetary Coupled, in Line," has just been issued by Hamilton Gear and Machine Co., Toronto, Ont., and contains sixteen pages of valuable reference data. The book is illustrated with photographs and sectional drawings and, in addition to numerous tables, it provides specifications of the materials used and the construction of these units; directions for the selection of the correct size of reducer, and instructions for setting up and maintenance.

TURBINE WELL PUMPS

A new line of Turbine Well Pumps is announced by the Worthington Pump and Machinery Corporation of Harrison, New Jersey. For use in bored wells, these new units feature vacuum molded impellers.

Wear or abrasion in the impellers is reduced to a minimum by the use of hard, high-tensile bronze. Available with either enclosed oil-lubricated or open water-lubricated shaft bearings, these new turbine well pumps are readily adaptable to individual local conditions.

Important details of construction are illustrated in Worthington bulletin H-450-B29. A companion bulletin, H-450-B30, deals particularly with the vacuum molded impellers used in these pumps.

FREE SWINGING GROUND WIRE BRACKET

To provide a flexible support with high slip strength for ground wires the Canadian Ohio Brass Company, Ltd., Niagara Falls, Ont., has developed a new type of bracket, known as the Swing-Link. The main body casting of this bracket has a groove on the outer side which holds a link at a distance of 3 inches from the pole. The link, in turn, supports a regular suspension clamp for holding the ground wire. Since the link is free to swing on the bracket proper and there is a flexible connection between the link and suspension clamp, the device allows a ground wire to swing through a wide arc laterally, thus preventing damage to a wire when it is swayed by wind. This flexible arrangement also permits the bracket to be used for angle positions. By employing a regular suspension clamp to hold the ground wire, high slip strengths can be developed. The bracket is attached to the pole by a through bolt and is kept from turning by a lag screw. All parts are thoroughly and smoothly hot-dip galvanized. The Swing-Link can be furnished three ways—without a suspension clamp, with a 0.46-inch clamp or with a 0.60-inch clamp.

FAN-COOLED INDUCTION MOTORS

English Electric Company of Canada, Limited, St. Catharines, Ont., have recently issued a four-page bulletin No. 1140A, dealing with their Type "F" Enclosed Fan-cooled Induction Motors (NEMA Standards). The bulletin contains general specifications and a sectional drawing on which are indicated the outstanding features of these motors.

CLASSIFICATION OF COAL

The word "coal" may refer to any one of numerous types of fuel which differ in origin, physical and chemical characteristics, quality and suitability for different purposes. Any means of determining the usefulness of a coal for a specific purpose is of value to producers, dealers and industrial and domestic consumers. For this reason the American Society for Testing Materials and the National Research Council's Associate Committee on Coal Classification and Analysis have worked for the past ten years on a system of evaluating coals. The results, as they apply to Canadian coals, have been published in bulletin form by the National Research Council of Canada.

In this bulletin the bases of classification of coals by rank, grade, type and use are outlined in detail and the application of such classification discussed. A large chart shows how Canadian coals from 74 areas compare in rank, in heat-producing capacity, and in fixed carbon percentage. The areas where these coals are produced are named on the chart.

This publication N.R.C. No. 814 entitled "Report on the A.S.T.M. standard specifications for classification of coals by rank and grade and their application to Canadian coals" may be obtained from the National Research Council, Ottawa, for 25 cents.

JENKINS BROS. LIMITED ANNOUNCE NEW APPOINTMENT

Jenkins Bros. Limited, valve manufacturers of Montreal, announce the appointment of Norman L. Elliott as Ontario Manager of Sales in charge of the company's office at 204 Terminal Building, Queen's Quay, Toronto. Mr. Elliott has been a sales representative for the Company in the province of Ontario for the past five years.

Norman L. Elliott

AIR PREHEATERS

The Air Preheater Corporation of New York and Wellsville, N.Y., has just issued a new catalogue illustrating and describing the Ljungstrom air preheater. The preheater is used for recovering heat from flue gas, preheating combustion air, improving boiler efficiency, increasing steaming capacity, and effecting fuel savings in public utility and industrial steam power plants.

Two general types of preheaters are illustrated and described, which differ only in details of construction to accommodate horizontal or vertical flow of the flue gas and combustion air. Both types operate on the continuous, regenerative, counterflow principle and the form of their heating surface is such that extremely high rates of heat transfer are obtained in combination with relatively low gas and air resistance.

The heating surfaces of the Ljungstrom preheater, as illustrated, are ordinarily made from open hearth steel plates, cut to fit the various sectors of the rotor. The entire assembling operation consists only of laying the sheets together and placing each group into its cell. There are no riveted, welded, expanded, or otherwise tightened joints. Similarly, any portion or all of the heating surface can be removed from the rotor through doors in the flues adjacent to the housing, and the time required is such that this can be done during any normal shut-down period.

PURIFIERS

Sawyer-Massey, Ltd., Hamilton, Ontario, has now made arrangements to be the exclusive manufacturer in Canada for Centrifix Corporation, Cleveland, Ohio, for the latter's high-efficiency "Centrifix" purifiers for removing water, scale and other impurities from steam, air and gases. The equipment, which is fully protected by patents, causes the steam, etc. to pass between fixed tangentially-placed vanes in the purifier housing, the resulting centrifugal force removing the foreign matter through eject pipes.

IMPROVED OIL BURNER

Featuring improvements in the motor-compressor unit and the master control, a new oil burner, the DB-20, has just been announced by Canadian General Electric Co. Limited. Formex insulation, a recent G-E development which is unaffected by fuel oil and extremely high in resistance to heat, is used for the motor windings. Further changes in the motor-compressor include increased compactness and an adjustable damper air regulator for more accurate control of the combustion air supply. Refinements in the master control mechanism include higher contact pressures, greater simplicity and a dustproof enclosure to prevent the admittance of basement dust. Special insulation against sound assures quieter operation.

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.