PAGES

MISSING

The Canadian Engineer

A weekly paper for Canadian civil engineers and contractors

Waterworks at St. Thomas, Ont.

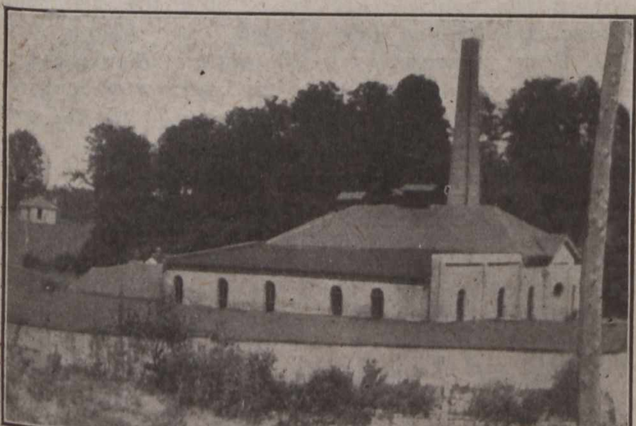
Supply Is from Creek and Thirty-Two Artesian Wells—Water Is Aerated, Coagulated, Filtered and Chlorinated — Algal Growths in Well Water Avoided by Eliminating Exposure in Open Reservoir — Brief Description of Plant and General Outline of Methods of Treatment

By R. O. WYNNE-ROBERTS
Toronto, Ont.

ST. THOMAS, Ontario, a city of about 17,000 population, is an important centre which is served by five steam railroads and two electric railways, the London and Lake Erie and the London and Port Stanley. The waterworks are situated about 1¼ miles north of the civic centre, on the Kettle Creek, which meanders along the valley and drains about fifty square miles of catchment.

The first waterworks were constructed in the city in 1874, and in 1890 the present works were erected. A concrete dam, 90 ft. long, with 3-ft. flashboards, crosses Kettle Creek and impounds water, the surface of which extends upstream for a few miles when the dam overflows.

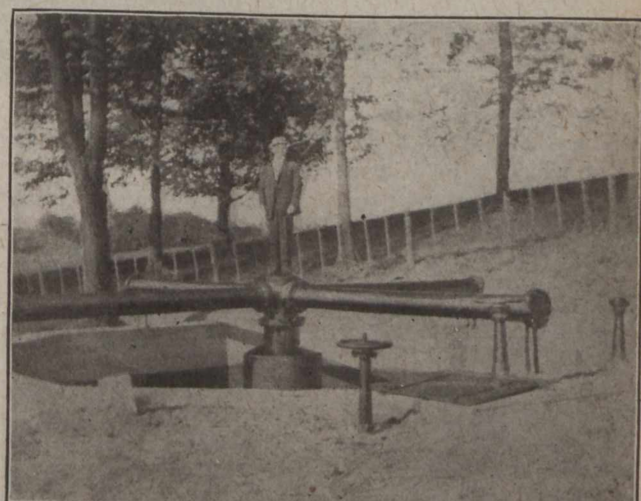
The water gravitates from the creek to a 7,000,000-gallon open reservoir. There are also about thirty-two 5-inch artesian wells sunk to a depth of 135 to 165 feet on both banks of the creek. This water flows through pipes direct to the pump well. The fact that the water from the creek is more or less turbid, according to the season, the amount of comminuted clay that is carried; and the fact that the water from the wells is practically devoid of dissolved atmospheric oxygen, create a few problems of interest.



St. Thomas, Ont., Pumping Station

The mains from the wells have a scour outlet into the creek for the purpose of flushing out any fungoid growths therein. When well water was exposed in the open reservoir, algal growths were found to occur and the quality of the water was deteriorated, but by eliminating the exposure the trouble was obviated. Since the change was made in the storage of well water, no algal growth has taken place and penmatella, an organism which depends upon algæ for its sustenance, has disappeared.

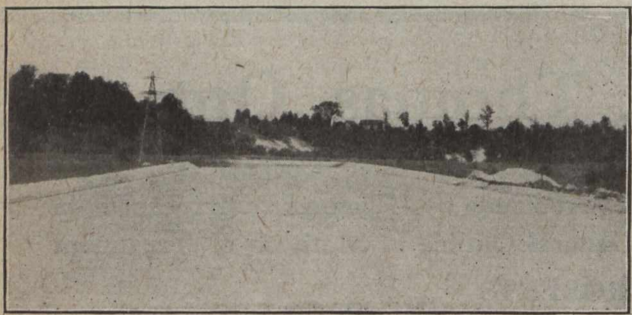
A few years ago the city mains were found to be coated with crenothrix filaments which, becoming detached, soon decayed and caused disagreeable conditions. Investigations were made and the remedy was found to be a process of aeration.



Aerator at St. Thomas, Ont., Waterworks

The water is drawn from the reservoir, dosed with alum at the average rate of one-half grain per gallon. Hypochlorite of lime is used. The pump raises the water and forces it through the aerator. This aerator consists of four arms, each made of ten-inch iron pipes, 12 feet long, having two rows of ⅞-inch holes drilled along the top centre line and one hole underneath at each of the four ends for drainage purposes. The water is forced up the centre vertical pipe and through the perforations, and in its passage through the air, falling into the basin, it absorbs sufficient atmospheric oxygen. The water then passes into a coagulation basin, where the alum causes the mud to settle, and afterwards gravitates through a 20-in. main into six Hyatt filters, each 8 ft. diameter by 20 ft. long. These were originally installed as pressure filters, but were changed to act as enclosed gravity filters. (As the water leaves the coagulating basin, a further dose of one-half grain of alum per gallon is added.)

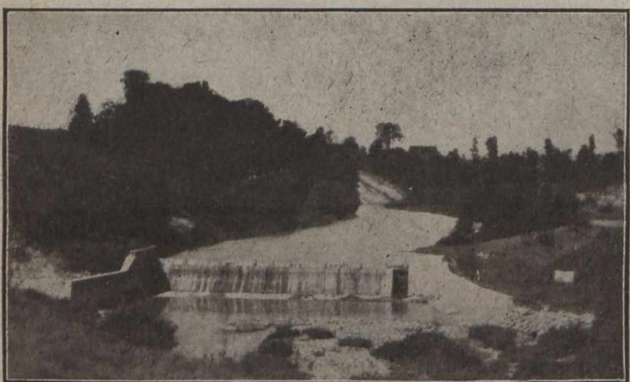
After being filtered, the water gravitates into a 900-000-gallon clean-water tank, which adjoins the pump-house. The pumps draw the water here and deliver it to the city through 14-inch and 18-inch mains at 80 lbs. normal and 120 lbs. fire pressure.



Settling Basin, 7,000,000 Gallons Capacity

There is an elevated steel water tank, having a capacity of 500,000 gallons, built by the Des Moines Steel Co. This tank is 46 feet in diameter, 58 feet deep to the hemispherical bottom, and the top water level is 144 feet above the street. The standpipe connecting the mains to this tank has an electrically-controlled altitude valve, which can be thrown out of or into commission by an ordinary switch at the pumping station. This valve can be operated to permit the tank to supply water when the pumps are not working and to cut off the tank when the fire pressure is on.

There are three Goldie-McCullough steam boilers, one of which is held in reserve, each 72 inches diameter and 16 feet long, with one hundred and four 3½-inch tubes; and one 5-m.g.d. Allis-Chalmers compound condensing steam-driven pump, working against 150 ft.



Dam in Creek, Affording 25,000,000 Gallons Storage Capacity

head. The plungers of the pump are 13⅜ inches; the high-pressure cylinder, 18 inches; the low-pressure, 34 inches; the stroke, 24 inches; the suction, 20 inches; and the discharge, 18 inches. There are also two 2-m.g.d. auxiliary pumps built by Worthington Co. An Ingersoll-Rand air compressor, belt-driven by an Alley & McLellan high speed vertical compound steam engine, furnishes compressed air for the purpose of cleaning out the wells when they are plugged with sand. A Canadian Boving Co.'s pump, driven by a 60 h.p. motor, is used to raise the water from the suction well to the aerator.

The hypochlorite of lime is dissolved in a concrete tank, the quantity that is prescribed by the chemist being put into the upper tank and thoroughly mixed. The solution is then discharged into a lower tank and its contents are decanted into the suction main each day. The alum is dissolved and decanted in a similar manner, but this solution is tested for strength by means of a hydrometer.

There were 1,816 metered services on December 31st, 1917, and 2,222 unmetered, or a total of 4,038 services. The annual consumption (1917) was 662,285,000 gallons, which averages about 106 gallons per capita per diem.

During the recent dry spell the consumption increased considerably, causing the storage to be somewhat reduced and necessitating precautions being taken to prevent inordinate consumption of water The cost of fuel has increased from $4.69 per million gallons in 1912 to $13.68 in 1917, whilst the total cost of pumping was $19.24 and $26.42, respectively. The cost of fuel alone has increased over $5 per ton during the last two years, and the quality is now inferior.

One of the Largest Elevated Steel Water Tanks in Canada

A. F. McLachlin, the chemist, conducts the chemical analyses and bacteriological examinations, and he has found that the water investigations involve a series of problems, because the solution of one problem apparently affords nature an opportunity to create another. This does not imply that the treatment of water is ineffectual, but it makes the study full of interest to those who are imbued with a desire for fuller knowledge of the subject.

T. Allan, the superintendent of the pumping station, has been in the employ of the St. Thomas waterworks department for nearly forty years, and the waterworks foreman, L. Bowlby, has served over twenty years. S. O. Perry is secretary to the water commission, and Mellis Ferguson, B.A.Sc., is city and water engineer. To these gentlemen the writer is indebted for the above information.

More than one-quarter of the urban population of the United States and Canada, or about 12,000,000 out of some 41,000,000 people, is now paying more than the "standard" 5-cent fare for its street car rides, according to American Electric Railway Association.

Nine thousand people witnessed the keel-laying ceremonies this week at the Foundation Company's shipyards at Victoria, B.C., the commencement of a contract for twenty ships for the French Government being celebrated in the city by a half-holiday. Premier Oliver officiated at the laying of the first keel. Subsequently the last of the previous lot of vessels being constructed by the Foundation Company was launched.

Upon request of the Hamilton-Guelph-Owen Sound Good Roads Association, the Public Highways Department of the Province of Ontario sent one of its engineers, Mr. Huber, over the proposed route last Tuesday, with representatives of the various municipalities through which the road will pass. One of the biggest problems between Guelph and Hamilton is the mountain, where some time was spent in discussing the possibility of straightening the road by means of a fill, thus eliminating all the dangerous curves and reducing the grade very materially. It was estimated that this work would cost about $500,000.

Letters to the Editor

Effect of Time of Mixing on Strength of Concrete

Sir,—The writer desires to express his appreciation of Prof. Duff A. Abrams' paper, "Effect of Time of Mixing on the Strength of Concrete," published complete in *The Canadian Engineer* of July 25th, August 1st and August 8th, 1918.

Prof. Abrams deserves much credit not only for his work in connection with the making of the elaborate series of tests involved, but also for the painstaking care with which he has co-ordinated and analyzed the results of the tests and has thus placed the information obtained in an easily readable and thoroughly understandable form. The paper should be read carefully by all interested in concrete and should prove of especial interest and value

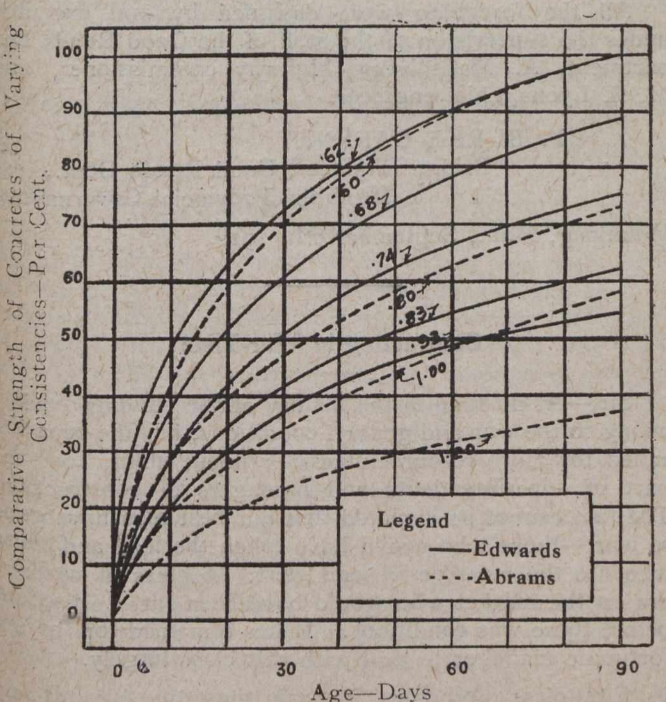


Fig. No. 1—A Comparison of the Strength of Concretes of Varying Consistencies, Based Upon Cement-Water Ratios Taken from Independent Tests

Above Diagram is Based upon the Following Two Diagrams, Figs. 2 and 3.

to engineers, architects, construction superintendents, inspectors and foremen engaged upon concrete design and construction work.

Insofar as the making of concrete is concerned, the importance of a more scientific method of proportioning the ingredient materials, and of a more definite knowledge of all the factors which tend to produce widely varying results affecting the strength and permanence of structures composed wholly or in part of concrete, must not be underestimated. Both safety and economy demand that as complete knowledge as possible should be obtained concerning all the elements involved. The increasing appreciation of such knowledge is evidenced in the number of papers and discussions appearing in the technical press and elsewhere.

However, we too frequently listen to such "stock arguments" as "Building codes specify an 'excessive' factor of safety"; or, "In this or that structure poor materials and poor workmanship were used"; all of which is intended to prove that a poorly built structure "still standing" is perfectly reliable for all requirements. Building codes are almost invariably conservative, but—

"The old order changeth, yielding place to the new."

And past experience gives proof that the "excessive" factor of safety will be reduced when improvement in concrete making has reached a stage warranting a change.

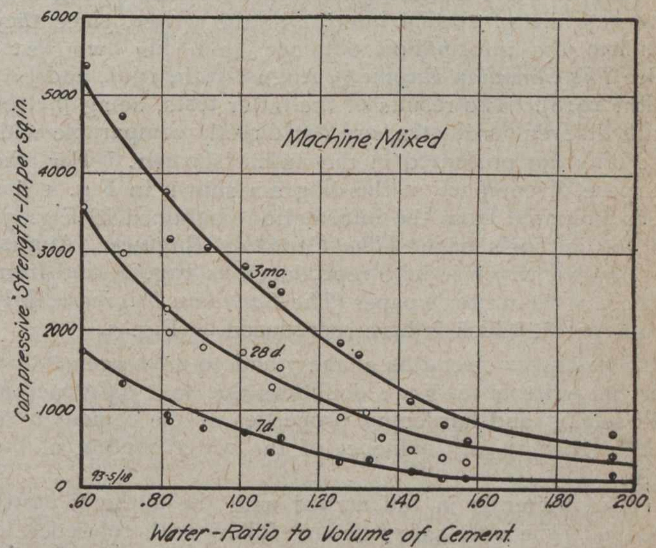


Fig. No. 2—Influence of Water on the Strength of Concrete

Reproduction of Fig. 31 of Prof. Abrams' Article.

That progress along these lines has not kept pace with the advancement made in reinforced concrete design is a well-known fact.

For very good reasons the "stock argument" man gives us no information concerning just what factor of safety exists in a structure "built with poor materials and poor workmanship," but fortunately just such experimental tests as those made by Prof. Abrams give us very conclusive evidence as to the influence of various factors entering into the workmanship portion of concrete making. An accumulation of such factors reduces the factor

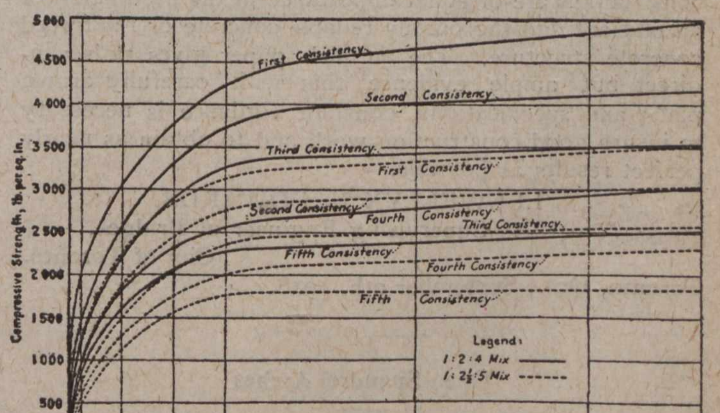


Fig. No. 3—Compressive Strengths of Test Cylinders—Consistency of Mix Tests

Reproduction of Fig. 2 of Capt. Edwards' Article.

of safety below unity, and the inevitable result is a collapsed structure with possibly an attendant loss of life.

So far as the writer is aware, the author's (Prof. Abrams') paper presents the first published data giving information concerning the effect of rate of rotation of mixer drum on the strength of concrete and the effect of time of mixing on the wear of concrete. It coincides with the writer's paper (see *The Canadian Engineer*, July 11th, 1918) in giving the first available data relating to the influence of the consistency of the mix on the wear of concrete. The range of the writer's tests is small as compared with those made by Prof. Abrams.

The results of the author's tests to ascertain the influence of the consistency of mix upon the strength of concrete are of special interest to the writer, since they confirm the information obtained from his own tests. (See *The Canadian Engineer*, August 16th, 1917, and July 18th, 1918). The results of the latter tests, being platted with different ordinates, are not directly comparable with the diagram presented in the author's paper. For the purpose of comparison the diagram shown in Fig. 1 has been prepared from the information contained in Fig. 31 of the author's paper (*The Canadian Engineer*, August 1st, 1918), which is here reproduced as Fig. 2, and from Fig. 2 of the writer's paper (*The Canadian Engineer*, July 18th, 1918), which is here reproduced as Fig. 3.

The higher strengths at the 7 and 30 days ages shown for the writer's tests are doubtless due to a difference in the setting and hardening properties of the cement used rather than to any influence of the water content of the mix.

The writer is in full accord with the author's statement: "The only safe rule to follow with reference to water in concrete is to use the smallest quantity of mixing water which will give a plastic or workable mix, then provide plenty of moisture for the concrete during the period of curing which follows setting and hardening of the cement."

In no other way is it possible to secure a dense cement matrix which will produce a concrete possessing the greatest possible strength, toughness and other desirable physical properties.

The author's conclusion, "There is no further increase in strength after the concrete is thoroughly dried out," although directly contrary to a common popular conception, is borne out by the results secured by other investigators.

The writer has consistently claimed that design and construction are of equal importance in the production of an efficient and thoroughly reliable concrete or reinforced concrete structure. The author's paper gives rather indirect but ample evidence that with carefully drawn plans and specifications, constant vigilance is necessary to insure good construction work and to obtain as nearly perfect results as possible.

LLEWELLYN N. EDWARDS,
Supervising Engineer of Bridges,
City of Toronto.

Toronto, Ont., September 9th, 1918.

Open Spandrel Arches

Sir,—As supplementary to Mr. Barber's list, I append herewith a list of reinforced concrete bridges of the open spandrel arch principle, in the province of Manitoba, built under the Good Roads Department of the Provincial Government.

Although the principle involved is the same in each case, three distinct types of bridges are represented in the list—the open spandrel arch proper, in which the deck is above the level of the crown; the "half-through arch," in which the deck occupies an intermediate level between the crown and springing line; and the "bowstring," in which the deck is at springing level. The last two types are an adaptation of the principle to a condition frequently obtaining on the prairie, maximum waterway requirements with limited headroom. It is believed that the Riverview Arch is the first bowstring to be constructed in the Dominion, and that it is the longest span of this type on the American continent. Some of the bridges in the list are at present under construction but as Mr. Barber's list purports to be complete to 1918, they are included:—

	Clear Span Main Arch.	Number of Spans.	Type.
Arden Arch No. 2, 1916..	55 ft.	3	Spandrel
McKinnon's Arch, 1916 ..	40 "	3	"
Riverview, 1917	86½ "	1	Bowstring
Rat Creek, 1918	50 "	3	"
Mill Creek, 1918	50 "	1	"
La Salle River, 1918......	50 "	1	"
Willow Creek, 1918	50 "	1	"
Arden Arch No. 3, 1918..	50 "	3	Half through
Arden Arch No. 4, 1918..	50 "	3	" "
Edward's Creek, 1918	38 "	1	" "

All the foregoing were designed by and executed under the supervision of the staff of the Good Roads Department, A. McGillivray, highway commissioner, and M. A. Lyons, chief engineer.

P. BURKE GAFFNEY,
Bridge Engineer, Good Roads Dept.,
Manitoba Provincial Government.

Winnipeg, Man., September 6th, 1918.

Contracting in War-Time

Sir,—At no time in the history of the building trades, owing to the war and general conditions, has the occasion called for more resourcefulness or latent ability on the part of superintendents and managers of construction. The fact cannot be disputed that our best men have gone to war,—those who would have taken the lead and those who are the most active and alert. A class of workers are on the market who would have been at a discount before these war conditions. It has remained for the unfortunate manager to deal with this class largely.

First-class mechanics, if not in the army, have at any rate disappeared from sight,—men who had learned their trades thoroughly. It is rather to be deplored that the unions have been so busy arranging hours of labor, wages, disputes, etc., that little was ever done to keep the supply efficient.

If it had not been for the efforts of public-spirited men who have advocated trade and technical schools, we would be worse off than ever. We often hear the remark, in referring to the shortage of skilled men: "You can get the men if you pay the price." I venture to submit that this is not now true; the men one gets now even when the price is paid are too often of the class I have mentioned before: incompetent boosters, men who have by the situation named acquired "cheek." Under the above conditions, and the writer is speaking from long experience, it has been impossible to make any money, and money has been lost on nearly every job taken by contract which was estimated even on a good chance of profit and away ahead of pre-war prices.

We all know lots of things have entered in to make the cost higher,—materials, delivery, etc., but I am dealing with labor only at this time. "Well," the reader will say after this apparently pessimistic arraignment of the above undisputed facts, "what are we to do, or what do you propose as solution?" It is no doubt true that in the past some managers have had a too easy time; that is, the hard-worked, trustworthy under-foreman and superintendents have, like the sergeants in the British Army, been the backbone of the concern, in the sense of pushing the work and taking the brunt of the responsibility.

That time is gone, and it is now up to the managers, etc., to get out and hustle themselves, and to scheme ways and means to assimilate the conditions which obtain, and shall we say that this closer touch will not be beneficial in the long run? The manager has found out he has got to really manage, not delegate it to others; also that more time has to be spent in detail and arranging the several kinds of work.

Do the thinking, have a pattern or plan of every man's work, do not spare yourself, scatter your brains everywhere, leave nothing to chance, forget you ever had understudies to do your work, work harded than ever. Then watch the result!

CHAS. TAYLOR,
General Superintendent,
Raymond Construction Co.

Toronto, Ont., September 5th, 1918.

Proportioning Mortars and Concretes

Sir,—In your editorial section of July 4th, 1918, some comment is made on articles published lately by Prof. Abrams, of the Lewis Institute, Chicago, and Capt. Lewellyn Edwards, of Toronto. You remark that Capt. Edwards does not recognize that the compressive strength depends only upon the water/cement ratio. Capt. Edwards did not have the work of Prof. Abrams before him when he made his investigations and perhaps did not apply Prof. Abrams' methods to his results.

Capt. Edwards has kep: the consistency consistent in the series of mortars, in which he proportions 1 gm. of cement to 13 sq. ins. of sand area, his idea being to eliminate variations due to the consistency factor, so that his result would compare the sands and not with effect of diluting the cement with more or less water.

On examination of the figures in table 7, page 29 of the issue of *The Canadian Engineer* of 11th July, 1918, it would appear that far from being any discrepancy between the results of these workers, they are in complete accord.

An error has been made in recording the ccs. of water for Sand C in this table. The figures 134.5 ccs. should be 168 ccs. Correcting these figures, the table can be rearranged as below:—

Strength Tests: Composition of Mortars—Test Series No. 1
Cement Content, 1 g.: 13 Square Inches

Sand Letter	Surface per 1000 gms. sq. in. = S	Water to Gage the Sand $= \frac{S}{210}$	Cement By Wt. gms.	Cement By Vol. ccs. C	Water for Mortar ccs. = M	Ratio of Cement to Aggreg. by Wt.	Water/Cement Ratio $= \frac{M}{C}$
A	5,857	28.0 ccs.	450.5	299	128	1:2:22	.428
B	5,106	24.4 "	392.0	260	111.5	1:2:55	.429
C	7,684	36.6 "	591.0	392	168.0	1:1:69	.429
D	6,758	32.2 "	520.0	345	148.0	1:1:92	.429
E	12,816	61.2 "	986.0	654	280.5	1:1:12	.429
F	6,769	32.3 "	521.0	345	148.0	1:1:92	.429
G	4,182	19.9 "	321.5	213	91.5	1:3:11	.430
H	6,565	31.3 "	505.0	335	143.5	1:1:98	.428
I	6,565	31.3 "	505.0	335	143.5	1:1:98	.428

One cubic foot of cement has been taken at 94 lbs. and the column for grams of cement converted to ccs.

It is evident that the reason why Capt. Edwards obtains the same strength for the sands of different granulometric composition is that the water/cement ratio is constant.

In series No. 2, where the ratio surface area/cement is varied, if the water/cement ratio is plotted as abscissa in Fig. 9, instead of the ratio surface area/cement, a series of straight lines is also obtained.

Prof. Abrams remarks that for a small range in the water/cement ratio this ratio plotted against compressive strength gives a straight-line tangent to the curve which is obtained by varying the water/cement ratio over a wide range. The strength is, therefore, proportional to the water/cement ratio, and when this ratio is kept constant, constant strength results even with sands of widely varying granulometric composition such as were used by Capt. Edwards.

A straight-line relation also holds between the volume of water required to gage the sand and the surface of the sand per unit weight.

The grading of a sand is, therefore, a measure of its surface area and, as Capt. Edwards has shown, the water required to gage the sand is proportional to this area. Apart from the cement which in these tests was kept at normal consistency, the grading of the sands was the only factor causing the different water absorption for the sands used.

It would seem, therefore, that the grading determines the water content and since this water content is the basis of all Prof. Abrams' work, it seems inconsistent on his part to give so little consideration to the grading.

It is assumed, of course, that we are discussing plastic mixtures and not those in which the cement is supersaturated with water. Then, of course, so much harm has been done the mixtures by the action of the water on the cement that the grading of the mix is indeed a secondary consideration. As has been shown by both Abrams and Edwards, the effect of the excess water is to reduce the cohesion between the cement particles and also the adhesion of the cement to the aggregate particles.

It would be interesting to know what figures Capt. Edwards obtained for absolute density of his mortars. In tests made for the Greater Winnipeg Water District in 1917 it was found that in well-worked concrete the absolute voids and the water content were practically identical. It would seem, therefore, that the recent work of Prof. Abrams and Capt. Edwards simply proves the law expressed by many early workers on concrete mixtures, namely:—

That for a given percentage cement and given consistency the strongest concrete is that having the highest density or the lowest absolute voids. Expressing the law according to Prof. Abrams, the strongest concrete is that in which the water/cement ratio is lowest. Expressing the law according to Capt. Edwards, the strongest concrete is that in which the surface area of aggregate/cement ratio is lowest.

There have been so many articles written on the proportioning of mortars and concretes that one is apt to become confused by the various principles advanced by approaching the subject from different angles and it is important that those engaged in concrete proportioning should be able to keep their minds clear on the basic principles of concrete proportioning in the midst of all these newly advanced facts. It seems to the writer that the work of Prof. Abrams and that of Capt. Edwards are singularly in accord.

H. M. THOMPSON,
Laboratory Engineer,
Greater Winnipeg Water District.

Winnipeg, Man., August 30th, 1918.

Circular Housing Plan

Sir,—There is a certain type of mind to whom things must never be other than obvious, if misunderstanding is to be avoided. The charge of dullness cannot, fortunately, be levelled at engineers as a class. However, once in a while, there is met a member of the profession who seems to become confused by the inverted sentence. He will accept words in their conventional sense only. When writing to such a person one must use the baldest terms, never be anything but specific and—dull.

All of which is inspired by a reading of the article in your August 29th issue, written by Mr. Lamb, and particularly that portion of it paragraphed under the sub-head, "A Champion of 'Liberty.' "

Mr. Lamb therein quotes from a letter written to him by myself at his request. There was no suggestion from him that publicity in any measure would be given, either to his production or to my comment, otherwise I might have attempted to convey my meaning in more direct and possibly more dignified terms.

I don't think it was quite fair of Mr. Lamb to insert within his production the particular part of my letter he selected without including the context.

I submit herewith the entire letter. I know now that I should have placed marginal notes against each paragraph, after the manner of the author of "The Ancient Mariner." Mr. Lamb would then have understood that I wished to draw his attention to a factor which is sometimes overlooked in problems of the sort he is dealing with, and of which, in reading his paper, I saw no recognition.

Experienced engineers know that anything can be done with inert material. It may be made to take and keep, and its performance therein predicted, any form, or shape, or position, in conformity with physical Law. Nothing, to the same degree, is possible with human beings. Hence, it can be said that an engineer's greatest trials come from his experience with men, and the success he has with them is the measure of his professional value.

I know that Mr. Lamb's greatest trouble will be caused, not by the material, or design, or position of his buildings, or their services, but by the men with whom he will have to deal before he can start construction, and by the men who will inhabit the houses after they are erected.

The desire to improve the conditions under which too many human beings are obliged to live is laudable, and should be followed by action. It is a short-sighted, dull person, particularly if an engineer, who would oppose such a purpose; and he may be neglected who would discourage such enthusiasm as Mr. Lamb displays.

If my letter to Mr. Lamb has a trifling sound, it is my misfortune, but I trust that there are many who will not see that quality alone in it.

Mr. Lamb's problem, and his treatment of it, are not new. Up to the point where he leaves it, it has no difficulties whatever. Nor can its reasonableness, or the good judgment used in its development, be questioned. From all angles it is attractive, but the greatest factor in the whole is not in Mr. Lamb's formula. When it finds its way in, and its value is determined, then, and then only, can the solution be found. Mr. Lamb may then be surprised to discover how the difficulties have disappeared.

It would be unfortunate if no discussion follows Mr. Lamb's article. It contains much material and is excellently handled. The question is one of great public importance, and one on which no one has greater claim to be heard than the engineer. We have heard a great deal during late years of the negligible position in public affairs held by the engineer. It may be that some fault lies in himself, possibly in the way he has of allowing certain abuses to continue, which, to be abuses, no one knows better than he, without raising his voice against them. Here is a subject capable of great development in the way of plain talk. It would at least be interesting to see how we may rise to it.

My letter to Mr. Lamb was as follows:—

Dear Mr. Lamb,—About your housing problem, I really don't know that I can give any valuable comment. The project is not altogether new. Similar, in principle, plans have been produced by many engineers. You have, though, made a very attractive layout with reference to sunlighting, and with reference to the distribution of the service by means of the common underground duct. Your economic result of a yearly charge, bearing ratio of ten to one in favor of your plan, is remarkable, and if you have included every expense in your studies, there should be no trouble in getting your proposals before the proper people.

That they will be adopted, and acted on, is another question. My good friend, Mr. ——, has been working on schemes like this for years. Although he has never said so, I'm inclined to believe he regards the public as a stubborn ass. Here in this province we have a perfectly good law, under which a municipality is empowered to give any kind of assistance in the way of stock participation, bond guarantees or tax remission to any company or syndicate who will undertake the construction of model houses, but the act is still virgin, although it has been in the statutes for several years.

Mr. —— can't understand why the provincial secretary's office is not all clogged up with applications for charters under the act. Nor why the municipalities are not organizing the fire departments or the police forces into housing companies. He says: "Here we have a splendid plan. If the provisions of this legislation are taken advantage of, we will have no slums erected; people can live in decent, sanitary houses. Cleanliness will be forced on them. If they don't like it at first, they will gradually come to it."

"Cleanliness is next to godliness," he quotes. "What better than a godly, virtue-loving people, loving their neighbor, even the collector and the landlord, and all this millenialism brought about by the use of this Housing Act? All we need are whole-souled, altruistic landlords or syndicates, content to make little or no money, merely satisfied with knowing they are leading the people to righteousness and the love of God."

My friend never uttered the last sentence, but if he had, I'm sure he would have found the solution of his perplexities therein, at least partially.

Consider the slum. Where can better returns on capital invested be found? At least a neat forty or fifty per cent. per annum. Good, easy money. Empty houses —very few the year around, because the kind of people who must live where they can are in number as the sands of the desert. Who owns the slum? Why, the most respectable and honored and wealthy people in the land. Even the churches have money invested in it.

Where would you get your money for your model houses? If you get any, you must get it from the folks who have it; but these folks are already in the slum business, and the slum returns forty or fifty per cent.

And the folks who live in the slum. If they have dirt and filth and disease, they also have something they would not have in the model settlement—Liberty. In the slum there are no rules to break other than those made by the corner policeman, and the slum policeman is human, generally. A man can quarrel with his wife, discipline his family, get drunk, do anything short of burning down the blasted place, that he feels like doing. Everything he couldn't do in the model settlement is permitted in the slum.

The nature of man changes slowly, and the change comes from within. It's a mistake widely held by uplifters and such, that externals are a great influence. Show a man soap where no soap was before, and immediately he is seized by a passion for being clean, internally as well as externally. If not prevented, he'll eat the soap. In this they are mistaken.

Did you ever get the story of his life from a man who had charge of a model settlement and the people therein? If not, meet one some day and get him talking. You'll learn that there are very reasonable reasons why folks move out of the places as soon as they can.

Of course, you have not the regulation of the slum in mind, nor the people who live in slums. It's a different class you would build for. But the problems which appear in the slum and in the industrial model settlement differ only in degree from the ones showing in the rented residence and the private park with community service. They are exactly of the same kind. On the one hand you have the landlord making good money from sham homes; on the other hand you have the tenants chafing against rules.

But, you say, these parks could be laid and the buildings erected by people who wish to own them and live in them, and the rules (of course, there must be rules where the use of a common service is made) may be made and agreed to by themselves. When the lion lies down with the lamb and the Ethiopian changes his spots (I may have the quotation mixed) you will get rid of the grouch; and it's grouch that causes all the trouble; and the grouch is each one of us. Not all the time, but in turn.

Besides, if I am going to live in my own house, I'm going to design my own house. It's not going to be like Brown's or Jones', either.

"Yes, but the waste!" you say. "Why not cut it out?" You show a ratio of ten to one in favor of the community plan. I'll agree with you, the present way is wasteful, but is human, and it's profitable. So there you are.

There's lots more to say on this subject, and I'd like to say it. If you reply, we may develop the matter into a philosophical paper between us. I'm sure the subject has as much hidden it in as has the matter of clothes, and you remember what old Carlyle did in the gents' furnishing line.

J. M. LEAMY,
Provincial Electrical Engineer.

Winnipeg, Man., September 4th, 1918.

LONG SAULT POWER

COMMENTING editorially upon the proposal to allow the Aluminum Co. of America to build a submerged weir in the St. Lawrence River, the Toronto News says: It would be unfortunate if the United States government should "scramble" unwittingly a cherished Canadian plan of conservation. Three or four times private power interests either in Canada or in the United States have sought vainly to secure the privilege of hydro-electric development along the St. Lawrence. The Long Sault has had a great attraction, since the head of water is enormous and the fall considerable. The rapids have never interfered with eastward navigation. A good-sized island separates the river into two channels, the Canadian one being the larger. Generally navigators choose the Canadian channel. Indeed, the southerly and narrow channel is almost wholly neglected, though it is safe and sufficiently commodious for vessels. The Ashburton Treaty between Great Britain and the United States provided that both these channels should be maintained for the use of shipping.

Some years ago a power plant at Massena, N.Y., secured the privilege of drawing off a certain amount of water by canal, using it, and returning it to the St. Lawrence at a point a few miles eastward. An immense aluminum-producing plant has been established at Massena, and it is now crowded with war orders. Often in winter ice collects in the south channel and seriously interferes with the water supply in the canal. To overcome this difficulty and to increase the aluminum output materially, the company desires to dam the southern channel by a sunken weir. The American War Department supports the application, which has been made to the International Joint Commission.

The hope of Ontario and of the Canadian Government is to establish on our side of the river some time in the future a great "hydro" developing plant under public ownership, which will do for Eastern Ontario what Niagara is doing for this section of the province. If a system of co-operation between the government of New York State and that of either Ontario or Canada could be arranged for the joint development of the latent power, that would be so much the better. In any case, the aim of our public men has been to prevent private interests from securing development rights in the stream and putting unnecessary burdens upon the consumer. Aside altogether from Canadian treaty rights in the south channel, the establishment with our consent of a private weir in the river might establish rights which would be difficult to extinguish in view of future power developments.

The Canadian Government has not the slightest desire to interfere in the production of necessary war materials. For that reason it is prepared to consent to the building of the weir under two conditions: (1) that satisfactory evidence of its necessity shall be presented, and (2) that the structure shall be removed at the end of the war. Possibly the United States Government is not sympathetic towards publicly-owned power development and distribution. Yet when it considers the amount of coal which has been saved by the use of Niagara power throughout Western Ontario one would imagine that it would abate its individualism for a time in the interests of conservation if not in those of neighborliness.

London building permits for the month of August amounted to $55,760, compared with $31,255 in August last year. The total for the year ended August 31st, was $394,320, compared with $515,435 for the corresponding period last year.

NO SECURITY OF TENURE IN CANADIAN MUNICIPAL POSITIONS?

THERE is no place in the world to emigrate to like Canada—except England. That is the conclusion that has been reached by S. Barlow Bennett, an English engineer now resident in Colorado, U.S.A., who has evidently had unhappy experiences in Canada. Mr. Bennett has written a letter to the Municipal Engineering and Sanitary Record, of London, Eng., complaining about conditions in Canada, particularly in regard to the municipal engineering field and the lack of security of tenure in such positions in this country. Mr. Bennett's letter was dated July 23rd, 1918, and was published in the English paper on August 22nd. He says:—

"I have noticed the controversy re 'The Institution of Municipal and County Engineers,' and was really glad to see the statement in the letter of Mr. Reginald Brown that both Medical Officers of Health and Sanitary Inspectors have security of tenure. That certainly is excellent progress, and the Institution of Municipal and County Engineers should not stop until they have obtained the same concession. It is only too true that to the poorly paid men, insecurity of office is a very serious matter.

"I was interested, too, in your editorial in the same issue concerning the efforts of municipal officials for security of tenure in Australia, and to learn that 'after thanking the Minister the deputation withdrew.'

"In the towns and cities of Canada, whether large or small, it is important that it should be known that it is an annual occurrence to 'fire' some of the municipal officers. There would be no 'sport' in the elections if the politicians were to be deprived of this, their accustomed privilege.

"Jealousy, petty spite, and a determination 'to get' at somebody, dominate the whole of the elections.

"A man who can hold a responsible position for two years is something of a rarity. Let me warn any municipal official in England from emigrating, if he thinks of obtaining or being able to hold a similar position in the Dominion of Canada. As to security of position, it is a complete farce. I know of a municipality—no names, hush!—where the Council 'fired,' *i.e.*, asked to resign, the municipal Clerk, the Fire Chief, the Medical Officer of Health, the Chief of Police and the Waterworks Superintendent, all at one sitting.

"Again, I know of another case where, after the elections, every man employed by the municipality got notice to quit, even the Magistrate. Fortunately, however, for him, he was under the jurisdiction of the provincial, and not the municipal, council.

"Then these wise 'guys' went into committee, and, as each one had some one he wanted to 'fire,' they had to compromise with one another. 'You vote to fire my man and then I'll vote to get your man in,' or out, as the case might be. This not only goes on with municipalities, but even with the Provincial Councils. They 'fire' everyone, from the Chief Engineer to the Chinese janitor. In another province, when the election campaign began, some of the members of the party in power went the round of the offices touting for subscriptions to the party funds. Of course, if the official wanted to keep his position, why, he subscribed accordingly, of course.

"Let me conclude by saying that there is no place in the world to emigrate to like Canada—except England."

In commenting editorially upon the above letter, under the heading "Nepotism in Canadian Municipalities," the Municipal Engineering and Sanitary Record says:—

"Municipal officers in England, after perusal of the letter on 'Canadian Municipalities: How They Fire Their Officers After Municipal Elections,' by Mr. S. Barlow Bennett, of Colorado, U.S.A., which appears elsewhere in this issue, will feel disposed, we believe to congratulate themselves that the vicious system of municipal administration which obtains in Canada is little known in this country. Mr. Barlow Bennett, who is the author of that excellent text-book, 'Technical Plumbing,' went out to Canada several years ago, and was a successful engineer to several Canadian municipalities. He is consequently well qualified to describe from personal experience the trials which engineers, and indeed all municipal officials, have to undergo. A pernicious practice obtains in the Dominion, he assures us—and it is only confirmatory of information previously in our possession—of annually 'firing,' *i.e.*, discharging municipal officers on personal and political grounds.

"The elections, we are told, would be devoid of 'sport' if the successful candidates were deprived of this acknowledged privilege. In the case of one municipality this was carried to such an extent, we learn, that the Council 'fired' its Clerk, Fire Chief, Medical Officer of Health, Chief of Police and Waterworks Superintendent all at one sitting. Not only do municipalities perpetrate these gross irregularities, he assures us, but the Provincial Councils are also similarly infected, and they sometimes 'fire' every officer, from the Chief Engineer to the Chinese Janitor.

"Municipal officers in this country have their share of trials and of vendettas, but such reckless and madcap treatment of officers as is perpetrated in Canada is practically unknown with us. We suppose that some palliation for the singular practices of these municipalities is due to their juvenescence and we predict that wisdom will develop with age. Those who suffer, however, most heavily from the insensate practice in thus discharging public servants are the ratepayers, and very heavily must they suffer too. For the officials, convinced as they inevitably must be on appointment to office that their tenure can only be short, have the temptation set before them to take opportunities for promoting their own interests in preference to those of the ratepayers. It is an incitement to dishonesty, and to disregard the concerns of the citizens. There is no inducement for the officials to ensure, as is done in England, that their subordinates and workmen discharge their duties efficiently, nor for engineers to promote essential and necessary schemes which impose a serious demand upon their skill, both in design and construction.

"Money is cheaper in the Dominion than it is in the Old Country, but deliberate waste of it which is encouraged by the practices described is reprehensible. Capable and thoughtful men of affairs and business men abound in Canada, and their influence should, we suggest, be exercised to promote sane and healthier methods in local government. None of them, as they well know, could maintain success if their staffs were treated in the quixotic fashion which is characteristic of that of the municipalities. Possibly this aspect of the case has not occurred to them, nor have they realized that their municipal taxes are unduly increased through it. The most efficient remedy for the abuse which has grown up would be for the Dominion Government to pass a statute providing for security of tenure to State and Municipal Officials. In the meantime, however, Municipal Officials in the Homeland will be wise enough to accept the warning offered by our correspondent not to emigrate to Canada in the expectation that they will be able to hold similar positions in the Dominion."

FUELS OF WESTERN CANADA*

By James White
Deputy Head, Commission of Conservation, Ottawa

THE principal fuels of Western Canada are coal, natural gas, petroleum, electricity, peat and wood. Coal is, of course, much the most important fuel of Western Canada, and ranges from the lignite of the prairies to the semi-anthracite of the Rocky Mountains. * * * In Western Canada, electric energy in large quantities for use as fuel is not economically available at the present time except in certain favored localities in southern Manitoba and southern British Columbia.

In Manitoba, there are on the Winnipeg River two developed powers and seven undeveloped powers ranging from 9,900 to 57,300 h.p. at 75 per cent. efficiency on a 24-hour basis and assumed minimum flow of 12,000 sec.-ft. With a regulated flow of 20,000 sec.-ft., these powers would range from a minimum of 12,300 h.p. to a maximum of 95,500 h.p. The total power with unregulated river (12,000 sec.-ft.) is 249,300 h.p. and with regulated river (20,000 sec.-ft.) is 418,500 h.p.

The Grand Rapid of the Saskatchewan has 32,600 h.p. with an assumed minimum flow of 4,500 sec.-ft. It is not improbable, however, that the flow sometimes falls to about 3,500 sec.-ft.

There are large powers on the Nelson, Churchill and Athabaska rivers, at Fort Smith Rapids on the Slave and at Vermilion and Peace Canon on Peace River, but detailed information respecting the low-water flow of these rivers is not available. In some instances, low banks and lack of concentrated fall would make development very costly.

In British Columbia there are many important water powers. Some of the principal powers near centres of population or possible large commercial developments are:—

On the Kootenay, at Bonnington Falls, 125,000 h.p., and at Lower Bonnington, 22,000 h.p., at Stones Byers, 50,000 h.p.; on the Pend d'Oreille, near Waneta, four powers ranging from 32,000 to 73,000 h.p., at Long Rapid on the Columbia, 30,000 h.p.; 52,000 h.p. at upper site on Stave River and 52,000 at lower site; 30,000 h.p. in Nahatlach River; in Adams River, 30,000 h.p.; Bridge River tunnel, 70,000 h.p.; south fork Quesnel River, 90,000 h.p.; Campbell River, a possible 100,000 h.p.; Jordan River, 25,000 h.p. at present and 38,000 h.p. ultimate; Coquitlam Lake, 84,000 h.p.; Bear Mount Canon on the Cheakamus, 40,000 h.p.; Powell River, ultimate development, 32,000 h.p. It has been estimated that there is 200,000 h.p. in the Fraser between Yale and Lytton and 100,000 in the Thompson River Canon but owing to the railways in these canons, it is doubtful whether these powers can be developed.

With anthracite coal at $10 per ton and burned at 50 per cent. efficiency and with electric energy at one cent per kilowatt-hour, the coal will yield 14,000 B.t.u. for one cent as compared with 3,412 B.t.u. from the electric energy for one cent. This demonstrates that, on this basis, heating by electric energy would be four times as costly as with coal. The 2,100,000 inhabitants of Western Canada would require not less than 10,500,000 electrical horse-power for heating alone.

As the hydro-electric energy already developed in Western Canada aggregates about 359,000 h.p. (76,000 in Manitoba, 33,000 in Alberta and 250,000 in British Columbia), it would require 29 times this amount to heat the homes in Western Canada. Again, as the total electric energy already developed in the whole of Canada is only about 1,800,000 h.p., it would require nearly six times this amount to replace the fuel used in the Prairie Provinces and British Columbia.

Again, the total water power in the Prairie Provinces is about 3,500,000 h.p., and in British Columbia, 2,500,000 h.p.* Even assuming that it would be possible to utilize the powers in the northern portion of the Prairie Provinces and British Columbia and the numerous small powers, the aggregate would still be 4,500,000 h.p. short of the heating requirements of that region.

Peat

During the last half century, numerous attempts have been made in Canada to manufacture a commercial peat fuel. In 1910, Dr. E. Haanel, director, mines branch, stated that, up to that time, the attempts "have been failures and very little peat fuel is at present available.

"The chief cause of most of these failures has been in the ignorance of the nature of peat on the part of those who have engaged in the production of peat fuel. In several instances the bogs chosen for the work have been unsuitable for the purpose in view. A proper investigation of the bog previous to the commencement of operations was seldom made; consequently, methods entirely unsuitable for the utilization of the bog in question have been employed, and the result has been failure. These failures, involving as they did considerable loss of capital, have created a profound distrust of everything connected with peat and the utilization of peat bogs."

Peat, as found in nature, contains about 10 per cent. combustible matter and 90 per cent. water, the removal of this exceedingly high proportion of water constituting the great problem for the peat engineer. Dr. Haanel states that it has been "demonstrated, once and for all, that the water content of raw peat can not be reduced much below 80 per cent. by pressure alone, and the process of wet carbonizing, upon which large sums have been expended, has not, up to this time, proved a success. In fact, it may be safe to make the statement that any process for the manufacture of peat-fuel which depends upon the employment of artificial heat for the evaporation of the moisture will not prove economic. The only economic process in existence at the present time is that which utilizes the sun's heat and the wind for the removal of the moisture."

A. Anrep, mines branch, Department of Mines, has investigated eighteen bogs in Manitoba. He reports that there are bogs in the Winnipeg River district containing 1,860,000 tons of peat fuel, 25 per cent. moisture.

With its enormous coal resources, however, Western Canada will, for many years, depend upon coal and wood for heating and cooking. At the present time, the high labor cost, alone, is sufficient to render peat manufacture an unprofitable enterprise.

In Western Canada, to meet the abnormal conditions created by the war, peat may be prepared and stored on a small scale by farming communities and villages where such are situated near peat bogs. Such fuel supply would not only increase the fuel supply, particularly during the autumn and spring, but would release railway cars that are urgently needed for other purposes.

*Excerpts from paper delivered August 9th, 1918, at the Saskatoon meeting of the Engineering Institute of Canada.

*This is exclusive of 400,000 horse-power for power possibilities on rivers like the Fraser, Thompson, Skeena and Naas, where, because of the proximity of railways or possible interference with the salmon industry, economical development is, at present, debarred.

The water in the peat should be reduced to 25 to 30 per cent. before it can be used as fuel. The season for drying peat begins as soon as the frost is out of the ground and ends in September. The bogs should be drained and the turf removed from its surface. The peat is cut in blocks about 9 ins. by 4 ins. and from 3 to 6 ins. thick. At the end of about four weeks they are ready for storage. During this period they should be kept covered and should be frequently turned. The quality of such peat is inferior to machine peat, but in many localities it will supplement the insufficient supply of better fuel.

Peat has about one-half the heat value per pound of best anthracite and its specific gravity is about one-half that of anthracite. Therefore, to obtain from peat the same number of heat units as from a specified amount of coal requires about four times the volume of peat.

Wood Fuel

From a fuel standpoint, the principal trees of the Prairie Provinces, east of the Rocky Mountains, are, in approximate order of importance; the jackpine, spruce, poplar, tamarack and birch.

In British Columbia and the Rockies there are numerous fuel woods, most of the wood used as fuel being the refuse from the sawmills. Douglas fir, yellow or bull pine, spruce and cedar furnish most of the wood fuel in this area.

In a discussion by the Forest Products Laboratories, Montreal, of the heat values of dry wood, it is stated that the below amounts of wood have equal heating value to one ton of anthracite: 1.00 cord of birch, 1.15 cords of tamarack, 1.20 cords of Douglas fir, 1.50 cords of jackpine, 1.55 cords of poplar, 1.60 cords of hemlock and 2.10 cords of cedar.

The above comparison is based on the supposition that the calorific value of the coal is 13,000 B.t.u. but the grade of coal received in Canada last winter was much less, possibly as low as 10,000 B.t.u., which, in comparison, would decrease the above stated quantities of wood by 23 per cent.

Fuel Shortage

A fuel shortage next winter is highly probable. Dr. Garfield, United States fuel administrator, states that "an alarming shortage" faces the United States and Canada if the quantities of coal demanded by the various sections of the country are actually required. What will happen if they prove to be conservative statements?

The New England and Atlantic States will receive increased allotments of anthracite this year, to provide for the increasing concentration of industrial population in these States. Curtailments have been ordered in the Central and Northwestern States and Western Canada.

This year the requirements of Canada and the United States will be 100,000,000 tons greater than last year, whereas there will probably be a deficiency of 50,000,000 tons. To offset this deficiency, we have better quality of coal, conservation and restriction.

It is estimated that the coal mined in the United States last year contained 30,000,000 tons more impurities than in pre-war times, or, that 600,000 carloads were hauled and paid for both as to coal and as to transportation. This is half of the shortage predicted for this year.

It is estimated that each per cent. of impurity reduced the efficiency of the coal 1.5 per cent. more. According to these percentages the American railways did about 75,000,000 tons of useless hauling last year. Effective measures have been taken to avoid the wastes of last year.

ENGINEERING INSTITUTE OF CANADA ELECTIONS AND TRANSFERS

At a meeting of the council of the Engineering Institute of Canada, held August 27th, 1918, in Montreal, the following elections and transfers were announced, in addition to those mentioned in last week's issue:—

Penrose, James Alexander Munroe, of Winnipeg, elected junior member. Mr. Penrose was born in 1892 at Kildonan, Man., and was educated at Manitoba University. In 1917 he became assistant engineer of the Good Roads Board, Winnipeg.

Porter, John William, of The Pas, Man., transferred from associate member to member. Mr. Porter was born at Aberdeen, Scotland, in 1877, and educated at Gordon's College. In 1906 Mr. Porter was appointed assistant engineer of Coldwater-Victoria Harbor for the Canadian Pacific Railway, and a year later became assistant engineer of the Toronto-Sudbury line. He is at present chief engineer of the T. H. & B. R'y.

Slinn, William Harmon, of Kingston, Ont., transferred from student to junior. Mr. Slinn was born in 1891 at Regina, Sask., and graduated in science in 1916 at Queen's University. He is assistant to C.R.C.E., Military District No. 3, Kingston, Ont.

Stockton, Robert Summers, of Strathmore, Alta., elected member. Mr. Stockton was born in 1872 at Oquawka, Ill., and was educated at the Colorado School of Mines. After considerable experience in surveying work, he became professor of mathematics and surveying at the Colorado School of Mines. In 1903 he was appointed engineer in the U.S. Reclamation Service and from 1911 to date has been in charge of the western section, C.P.R. Department of Natural Resources.

Wilson, John Melville, of Toronto, Ont., transferred from associate member to member. Mr. Wilson was born in 1883 at Toronto, and in 1908 graduated from the University of Toronto in civil engineering. He became assistant city engineer of Toronto on construction of waterworks, and was placed in charge of the installation of the high-pressure fire system. In 1911 Mr. Wilson started business as a contractor, building subways and waterworks, and engaging in general municipal work. At present he is district engineer at Toronto for the Department of Public Works, Ottawa, in charge of all work in Central Ontario.

Yarrow, Norman Alfred, of Victoria, B.C., elected associate member. Mr. Yarrow was born in 1891 at London, Eng., and educated at the University College School. He served three years at apprentice with Napier & Son, of London. In 1914 he became purchasing agent of Yarrows, Limited, Esquimalt, B.C., shipbuilders and contractors to the British Admiralty and the Canadian Government, and later was appointed general manager of the company.

"Discovery of manganese on Vancouver Island is being hailed on the Pacific coast as one of the most notable finds of minerals that Canada has known for some time," says the Toronto "Globe." "Mineralogists who have made inspections of the area in which the discovery has been made have stated that the property near Cowichan Lake is one of the finest prospects yet uncovered. Hon. William Sloan, Minister of Mines for British Columbia, expressed himself as much impressed with the latest mineral development at the coast. The first discovery was made in the vicinity of Shaw Creek, near the upper end of Cowichan Lake, on Vancouver Island. A subsequent discovery of a deposit of this mineral was found in the divide between the Cowichan and Chemainus Rivers, at a point readily accessible by aerial tramway of the Cowichan branch of the Esquimalt & Nanaimo Railway."

QUEBEC BRIDGE BOOKLET

An attractive booklet of sixteen pages and cover, entitled "The Quebec Bridge," has been issued as an advertisement by the Canadian Government Railways, and can be had free of charge upon application to the general manager, C. A. Hayes, Moncton, N.B.

The centre two pages are devoted to a reproduction in several colors of the painting of the bridge recently finished by Frederick Rummell. There are also colored illustrations of the central span being towed into position and of the raising of the central span.

History of the Bridge

Most of the following information, which is reprinted from the booklet, appeared in the September 20th, 1917, or previous issues of *The Canadian Engineer*, but in view of the fact that the bridge has just been finally tested and taken over by the government, its repetition now may not be untimely:—

"The idea of a railway bridge across the St. Lawrence at Quebec originated as far back as 1853, at which date there was no other bridge across the river at any point. A New York engineer, named Serrell, made surveys and prepared plans for a railway bridge on the suspension principle, to be located somewhere near the site of the present bridge. The estimated cost was $3,000,000. Whether the cost was considered too great an obstacle, or whether it was a lack of courage on the part of engineers, nothing further was done, and the first bridge erected across the St. Lawrence was built at Montreal. This was the Victoria tubular bridge, opened for traffic in 1860, and built by Robert Stephenson on the model of one he had previously erected over the Menai Straits, on the line to Holyhead, Wales.

"The project for building a bridge at Quebec to connect that city with the south shore of the St. Lawrence lay dormant until 1882, when M. W. Baby obtained a charter to erect a bridge. He had associated with him A. L. Light, a well-known engineer, who interested some of the engineers of the then newly completed Forth Bridge in the undertaking. The idea then advanced was to erect a bridge on the cantilever plan, which the erection of the Forth Bridge had demonstrated to be the last word in big bridge designing. This second proposal also failed to get beyond the project stage.

The Collapse in 1907

"The third attempt was made in 1887, when the Dominion Parliament incorporated the Quebec Bridge Co. with an authorized capital of $1,000,000. The company's powers were extended in 1891, and in 1897 they were revived and confirmed, new interests, led by S. N. Parent, then mayor of Quebec, and afterwards premier of the province, having obtained control of the company. U. Barthe became secretary of the company, and United States capitalists were interested. A New York engineer undertook the designing of the bridge, and E. A. Hoare was chief engineer in charge of all local work. The same site on which the present bridge is built was selected, work was started on the substructure in August, 1900, and was completed at the end of 1902. From that time forward the erection of the steel work went on apace, and was carried on without interruption until August 29th, 1907, when the south cantilever arm collapsed.

"The Dominion Government then appointed a commission to investigate the cause of the catastrophe, with the result that the government undertook to complete the bridge as a Dominion Government work, and in 1908 appointed a board of three engineers to prepare plans.

"The board made very exhaustive studies of various possible designs, both suspension and cantilever. Tenders were called on cantilever designs, with invitation to submit alternative tenders on the bidders' own designs. One German, one English, and one American firm bid on the board's designs, but the St. Lawrence Bridge Company bid only on their own alternative K-truss designs, and received the contract.

Only One Canadian Tender

"The government had invited both the Dominion and Canadian bridge companies to tender on the new Quebec bridge, but it was thought that if the Canadian bridge companies were to present a solid front in the bidding —in other words, to pool their organizations, experience and facilities—that Canada would have a better chance of being successful in the bidding, and the Canadian Bridge Company, therefore, joined with the Dominion Bridge Company as joint owners of the capital stock of the St. Lawrence Bridge Company, and the only bids made by any Canadian firm were submitted in the name of the St. Lawrence Bridge Company.

"Work was started promptly by the contractors, both for the substructure and for the superstructure, and everything went on so successfully that the St. Lawrence Bridge Company expected to complete its work at the end of 1916—earlier than was estimated. September 11th, 1916, was set for floating out the suspended portion,—the centre span. The centre span was erected at Sillery, about three miles below the bridge site. After it had been completely assembled and riveted up, the span was placed on specially constructed scows, and thence, guided by tugs, was floated into position under the cantilever arms of the bridge. Many simple spans have been lifted into place where they could be handled from barges with ordinary derrick cars, but the Quebec Bridge span was by long odds the largest span of any kind that had been constructed. It was the first attempt that was ever made at hoisting a span of such an immense weight and size by hydraulic hoists.

The Accident in 1916

"The first part of this work had been successfully completed, and the 640-ft. long span had been raised several feet when, owing, as was afterwards ascertained, to the failure of a portion of one of the castings in the hoisting apparatus, the span slipped, crumpled up and fell to the bottom of the river. The fullest investigation was made in the matter, and it was found that there was no defect in the span or in the plan, and that the other sections of the bridge had received no damage from the accident. The company immediately put in hand the fabrication of the steel for a new span and began to prepare for its being placed into position. This was done, and the new span was ready for erection at the time of the September high tides, 1917. The method of erection was not changed except that extra precautions were taken in connection with the manufacture and getting in place of the hoisting apparatus. The hoisting proceeded steadily and the lift was completed September 20th.

"The length of the clear span is greater than the distance between St. Catherine and Craig Streets, Montreal. The length of the suspended span exceeds the distance between St. Catherine and Dorchester Streets, Montreal, and would almost cover the Champ de Mars. The width of the bridge is 28 feet greater than the width of Bleury Street, Montreal. The height of the base of rail above low water is greater by 15 feet than the height of Horse Shoe Fall at Niagara. The distance from the low water level to the top of the main posts is equal to the combined height of the Eastern Township Building and the towers of the Notre Dame Church, Montreal. The bridge is wide enough between the trusses to accommodate two railway tracks, a driveway for vehicular traffic and two concrete footpaths for pedestrians. The quantity of stone used in the main and anchor piers is greater than that used in the foundations of all the buildings in the city of Quebec. The south anchor pier is higher than the Canada Life Building, Montreal. Nearly 3,000,000 rivets were used in the superstructure. It is estimated the bridge, when completed, will cost $15,000,000.

"The Quebec Bridge connects the Canadian Government lines on the south of the St. Lawrence with the government lines on the north, and is the link which shortens the distance between Halifax and Winnipeg by two hundred miles. It is the connecting link also between the two vast transcontinental systems and the railways reaching the Atlantic seaboard.

Ten Railways Seeking Service

"Ten important railways are seeking interchange of traffic at Quebec. The bridge will be the means to that end. On the south side of the river are the two government railways, the Grand Trunk, the Quebec Central and the Delaware and Hudson Railways. On the north side are the Government Railways, the Canadian Pacific, the Canadian Northern, the Quebec and Lake St. John, and the Quebec and Saguenay Railways.

"It gives the shortest connection between the immense pulp mills and pulp forests of Northern Quebec and the markets in the Eastern States.

"So intense has become the traffic over the Victoria and Lachine bridges at Montreal that in recent years both have had to be rebuilt and double-tracked.

"Already approaching a thousand cars a week are crossing the bridge, and passenger trains via the Canadian Government Railways are using it between Quebec and Montreal. What, then, when the world turns from war to peace? With the development of Canada and the vast expansion of Canadian trade, which is confidently expected, no very optimistic vision is necessary to foresee the important part the Quebec Bridge will perform in the immense increase of traffic which must necessarily result."

OVERSEAS CLUB FOR CANADIAN ENGINEERS

CANADIAN engineers in the Imperial Army have formed a club, says a letter received by the secretary of the faculty of Applied Science and Engineering of the University of Toronto.

The club has been established at the headquarters of the R.E.O.C. Battalion, Kelham, Notts, and the secretary is a Toronto alumnus, A. E. Berry, of St. Marys, Ont., who graduated in civil engineering in 1915.

The objects are to promote friendship among Canadians in the Royal Engineers and to give information regarding casualties to the next of kin or other enquirers.

Membership is open to officers and cadets who are Canadians by birth or who have a personal interest in Canada.

CLAY RESOURCES OF SOUTHERN SASKATCHEWAN

THE importance to the whole Canadian West, of the clay resources of Southern Saskatchewan, cannot be overestimated. There is an abundance of high-grade clays suitable for the manufacture of stoneware, Rockingham ware and white earthenware. The fireclays of the eastern section will make a No. 2 grade of refractory, while the more plastic clays should find a use as bond-clays in the making of retorts and other special refractory shapes. They are also adapted to the manufacture of architectural terra-cotta, paving brick, face brick and all varieties of burned clay products for structural purposes. A useful purpose is served, therefore, by the "Report on the Clay Resources of Southern Saskatchewan," that has just been issued by the Mines Branch, Ottawa, of which Dr. Eugene Haanel is director. The report was prepared by N. B. Davis, M.A., B.Sc., assistant engineer of the Ceramic Division, working under the direction of Joseph Keele, chief engineer.

The report is based on field work carried on during the seasons of 1915 and 1916, and on laboratory tests conducted in the ceramic laboratory of the Mines Branch during 1915, 1916 and 1917. Its publication is a further contribution to our knowledge of the economic minerals of Canada.

Province Excels in Fireclays

The Province of Saskatchewan excels in the quality and quantity of that class of raw refractories known as fireclays; and in addition to this valuable material, possesses other argillaceous deposits, from which can be manufactured practically the whole range of structural clay products; a fact of vital importance to a region almost entirely devoid of native timber and building stone.

The report by Mr. Davis contains information not only regarding the geological position, exact locality and availability of each deposit from which the clay samples were collected, but gives an account of the behavior of the materials tested in the laboratories, thus determining scientifically their qualities and adaptability for use in the clayworking industry.

The report is printed in booklet form, over 100 pages and cover, with a number of illustrations. It is accompanied by two large colored maps. The following information is reprinted from the introductory paragraphs of the report:—

Saskatchewan is comparatively a new province with respect to the rest of the Dominion. Within the last fifteen years settlement has been very rapid, and the handiest and easiest materials of construction have been used. In the early days there was a lack of stone or wood for the construction of places of habitation for man and beast, hence the settler turned to the sod, and built himself rude shelters of this material.

American Materials in Demand

With the dissemination of the knowledge that the prairie lands promised rich harvests of grain, small settlements, favorably located regarding transportation, rapidly grew to towns and cities. During this feverish and optimistic period building materials of the best were required in abundance, and at short notice. The resources of the province were unknown, and established structural materials were looked for in the American market. In supplying this demand the American brick makers as far south as St. Louis, and east to Pennsylvania, reaped a harvest. While this rush was on, only two common brick plants and two face brick plants were in operation, and that for only part of the time.

On the strength of the boom a plant was built at Claybank before the coming of the Canadian Northern Railway to the locality, but, unfortunately, the railway was not available until the wane of the building boom. This plant at Claybank, owned by the Dominion Fire Brick and Clay Products Co., has turned out a fine range of flashed brown face brick, made by the dry-press process from the refractory clays of the Fort Union formation. At present, the company is concentrating on the production of refractories, and the outlook is very promising. The product made should be equal to the standard firebrick imported from the United States.

One of the oldest and largest plants in the Claybank area is that of the Estevan Coal and Brick Company, located on the bank of the Souris valley, one mile south of Estevan. It is producing an excellent red face brick made by the dry-press process, and common, buff, stiff-mud brick.

Six miles south of this, at Shand station, the Maple Leaf Mines, Limited (Shand Coal and Brick Co.), operate a stiff-mud brick plant, using buff-burning calcareous clays. The product is an excellent grade of common wire-cut brick.

At Weyburn, the Weyburn Brick Company operated a dry-press and stiff-mud plant for a number of years; but it has been shut down since 1914. The raw materials present some difficulties, and, should the plant be operated again, it would be well to consider using the refractory clays of Yellow Grass and Halbrite. East of Weyburn, at Arcola, the Arcola Brick Works operate a stiff-mud brick plant for making common buff brick.

In the oldest settled part of the province, along the main line of the Canadian Pacific Railway, several small, soft-mud brick plants have been manufacturing common brick, but at present only one, that of the Broadview Brick Company, is in sufficient repair to operate. The product is a good grade of common buff brick. This plant was not working during 1916-17.

At Pilot Butte, east of Regina, the Pilot Butte Brick Company have a small soft-mud brick plant making a rather low grade of common brick from clay found in irregular pockets in a glacial outwash plain. The plant was operated during part of 1916. At times in the past, small local brick yards have been in operation at Balcarres, Moose Jaw, in the Qu'Appelle valley north of Indian Head, and at Wolseley.

Sewerpipe or stoneware clay is being shipped outside the province to Medicine Hat, for the manufacture of sewerpipe, sewer block, flue lining, wall coping, and stoneware pottery. No plant for the manufacture of these wares has yet been established in Saskatchewan.

Railways

Until recently, rail transportation has been lacking in the most valuable clay areas. The Portal-Moose Jaw branch of the Canadian Pacific Railway has served the Estevan field for a number of years, but the important refractory clays do not occur there.

Just three years ago the Canadian Northern Railway completed its Avonlea-Gravelburgh branch, as far as Claybank in the Dirt Hills, and made the high-grade clays of this locality available. However, the market for high-class face brick broke about the time the railway was laid down, and the plant at Claybank suffered accordingly. During the past two years the same Canadian Northern Railway branch has been constructed farther west, and made available the clays of the north end of Lake-of-the-Rivers, near Mitchellton.

Four years ago the Canadian Pacific Railway started its Weyburn-Stirling line; and since then has tapped the clays of the south end of Lake-of-the-Rivers and of the Frenchman River valley. The line is now completed as far west as the Alberta boundary, and it is hoped that the time is not far distant when connection will be made with the construction east from Stirling, Alberta.

South of the Canadian Pacific Railway the Canadian Northern Railway Company has a branch line extending westward to near the southeast end of Willowbunch Lake. If this line is completed along the proposed route, it will open up the clay and lignite areas immediately to the north of Wood Mountain.

Fuel Supply

At present, most of the fuel used is brought by rail over the main line of the Canadian Pacific Railway from Alberta. It is mostly a semi-bituminous coal, and, because of the long haul, the price is high. In the Estevan field a certain amount of the local lignite is utilized, but its full efficiency is not being realized.

Extensive tests carried on at the fuel testing plant of the Mines Branch, Department of Mines, Ottawa, have shown that the lignites are ideal for making producer gas for power generation in a gas engine. No steaming tests have been made, but the analysis points to its successful application in this way under suitable mechanical conditions.

Lignite of the same age as that at Estevan is being used with decided success in the plant of the Hebron Fire and Face Brick Co., Hebron, North Dakota. The gas is used in a large Richardson continuous kiln, burning fireclay face brick.

Recent development in methods of firing intermittent kilns with gas, indicate that it is a great saving in fuel and kiln expense. The so-called Underwood system has been installed in a number of American plants, and is worthy of investigation.

The gas producer has come to the clayworking industry to stay, and the clayworkers of Saskatchewan, and the West generally, should not be slow to adopt it as an economical means of converting a poor fuel to a high-grade one.

Natural gas has not been struck, as yet, in commercial quantities anywhere in the southern part of the province. Preparations are being made to sink a well at Eastend, in the hope of getting a cheap fuel to aid in the local development of the clays.

That satisfactory progress is being made in connection with the work on the Halifax shipyards is stated by the managing director, Roy M. Wolvin. The graving dock is working to capacity day and night, and the number of men employed has recently been doubled. On the completion of the plant the company will proceed to build the 10,000-ton vessels contracted for by the Dominion Government. The largest ocean freighters now being built in Canada are 8,400 tons, constructed at the Vickers yard in Montreal.

The Canadian Stewart Company, contractors on the Toronto harbor work, have entered an appeal against the assessment by that city of $102,100 on 10 11-100 acres of land leased by them on the water front south of Front Street. The land is assessed at $10,000 an acre, and the buildings at $1,000. The contractors' business assessment amounts to $25,525. In their reasons for appeal they say: "We are cancelling our lease with the G.T.R. as of June 30th, 1918, and at present are moving our plant away from this site. Most of the plant has been sold and the balance is being moved to the foot of Cherry Street, to the site of our work for the government and the Toronto Harbor Commission."

RESEARCH COUNCIL'S FIRST ANNUAL REPORT

THE first annual report of Dr. A. B. Macallum, administrative chairman of the Honorary Advisory Council for Scientific and Industrial Research, has been published in a forty-page pamphlet. What the Council has already accomplished, and the problems it is now at work upon, are summarized. Apart from the work of the Council in connection with the development of the lignite deposits in Western Canada, to which publicity has already been given, the special problems investigated with good practical results may be briefly enumerated as follows:—

A special study was made of the commercial use of tar fog, as applied to plants in Canada engaged in the distillation of coal, wood, the liquid products resulting from the manufacture of producer gas, etc. A new process has been found which will be utilized by several distillation plants in Canada in the near future.

An investigation was made into the commercial feasibility of utilizing for heat and light on the farms of the Prairie Provinces the enormous quantities of straw, estimated at twenty million tons, now annually burned. It is expected as the result of experiments now being conducted that retorts and distilling apparatus of very simple design and automatic in operation can be supplied to the farmers at a cost of about five hundred dollars each, with the full equipment necessary for heating and lighting their buildings from waste straw.

Results of Experiments

The results of fog signalling experiments undertaken at the instance of the Council forecast a new type of signal for use in the St. Lawrence River and the Gulf, thus making an important contribution to the safety of St. Lawrence Navigation.

Studies and experiments on the composition of sulphite liquor waste in Canadian pulp mills, enormous in quantity and destructive of fish life in streams, have given results which point the way to the commercial utilization of at least the sugar it contains to furnish alcohol for industrial purposes.

Experiments are also being conducted in regard to the production of a rust-resisting wheat, the necessity for which is seen from the fact that annually more than twenty million dollars is lost through rusted grain in the Prairie Provinces.

These are but some of the problems which the Council has been working on for the past year. The brief mention of all the subjects on which it has been asked to make special inquiry covers two full pages of the report and includes some seventy problems of applied science.

Briquetting of Lignite

In regard to the utilization of the undeveloped lignite products in the Prairie Provinces, an illuminative chapter is given in the report. Largely as a result of the work of the Council, the first briquetting plant is now being erected near Estevan under a joint arrangement of the Federal Government and the Provincial Governments of Manitoba and Saskatchewan. Owing to the delay in adopting the recommendations of the Council as made last year, the plant will not be producing until next year, but there is every reason to believe, the report says, that "it will blaze the path to the utilization not only of the fifty-seven billions of tons of lignites of Saskatchewan, but also of the vastly greater quantity of the better grades of this fuel in Alberta."

The report further notes in this connection that the success of the initial plant "will induce private capital" to go into this enterprise, and eventually several plants may be erected which will supply the half a million tons that will be required to replace the anthracite hitherto imported into Manitoba and Saskatchewan from Pennsylvania, thus retaining in the country about five million dollars now annually spent abroad for the supply of this fuel.

Steps have been taken by the Council to determine the equipment and man-power for research in Canada, now sadly deficient as compared with other countries, and to create permanent organizations for research by industrial groups, by the aid of which Canadian industries may be assisted to develop, by the application to that end of the most advanced scientific processes, and thereby enabled not only to meet the needs of the home market, but also to compete with their rivals abroad. In this connection Dr. Macallum says:—

Of Paramount Importance

"This question is one of paramount importance to Canada in view of the intensified application of science to industry which elsewhere will be fostered after the war by the State, and also through private enterprise. It has been ascertained that not two per cent. of Canadian industrial concerns have research laboratories, and only about ten. per cent. have routing laboratories, chiefly for the elementary testing of materials.

"The provision for research, either in pure science or in science applied to industry, has been and is utterly inadequate to our needs, and unless vigorous action be taken, and soon, to reorganize our industries on scientific lines, wherever possible, Canada will face a very serious industrial crisis in the years following the war. The annual budget of the Massachusetts Institute of Technology exceeds the total of the annual expenditure of all the Faculties of Applied Science in Canada."

Research Institute Recommended

Dr. Macallum recommends the establishment at Ottawa or some other centre of a Research Institute, having the function of the Bureau of Standards at Washington, or of the National Physical Laboratory of Great Britain. Attached to the institute, it is suggested, should be laboratories that may be at the disposal of guilds or associations for research which may be founded by the various Canadian industries, each in its own line or the companies which are unable individually of undertaking experimental investigation with the object of improving their manufacturing processes.

The report goes at some length into the detail of establishing such an institute and the formation of trade guilds for research into common problems. It may be noted in this connection that splendid results have already been achieved in England since the war began through government-assisted industrial research. The British Parliament has voted one million pounds sterling for a five-year budget for this purpose. In Canada, the Parliamentary appropriation to assist the work of the Council for Scientific and Industrial Research is comparatively absurdly small.

In Dr. Macallum's summing up of the argument for the creation of a Central Research Institute, he says:—

"The work of the proposed institute would powerfully aid the development of scientific industrial research in Canada by stimulating the Canadian universities to increase their resources and facilities for research and thereby to direct into the ranks of science the ablest of their young graduates desirous of qualifying for a career, whether in pure science or in science applied to Canadian industry. It would place at the service of Canadian industry a factor which would insure its success in the strenuous international trade competition which is near at hand. It would, above all, enable the nation to direct its energy towards the economic and right utilization of its untouched stores of national wealth, in order that it may bear, with some degree of ease, in this and the next generation, the almost Atlantean financial burden it is assuming as a result of its playing its part in the present world struggle."

EXPERIMENTAL STUDIES OF CONCRETE*

By Duff A. Abrams
Professor in Charge, Structural Materials Research Laboratory, Lewis Institute, Chicago

TO the engineer of a generation ago, concrete was known as a substitute for stone masonry in the construction of massive works, such as foundations, bridge piers, abutments and arches, retaining walls, dams, breakwaters, fortifications, etc. Concrete offers a high resistance to compressive stresses but is somewhat deficient in tensile reisistance. Reinforced concrete is a combination of concrete with steel in such a manner that the steel members take the tensile stresses and thus form a structural unit of a new type. In certain members, such as columns, the steel assists in taking the compressive stresses.

Reinforced concrete as an important structural material is a development of the past twenty years. From a small beginning reinforced concrete has come to be one of the most important materials of construction. At the present time it is widely used for buildings, roads, pressure pipes, ships, and almost an infinite variety of other purposes which touch every phase of modern life.

May Design With Confidence

Exhaustive experimental studies of reinforced concrete have been carried out by many investigators in the United States and Europe. These researches have developed a large fund of information, so that well-informed engineers are now able to design and build reinforced-concrete structures with the same confidence that has characterized the use of other structural materials.

Concrete is a combination in suitable proportions of three entirely different materials: cement, water and aggregate. It is notable that our knowledge of the properties of concrete and concrete materials has not kept pace with the developments in the field of reinforced-concrete construction. It may seem somewhat anomalous to say that at the present time we know a great deal more of the properties of reinforced concrete than of concrete. If we make certain assumptions as to the properties of the concrete to be used, we can design reinforced members and structures which will perform their proper functions. However, it is impossible for the engineer to estimate in advance with any degree of certainty the strength and other properties of the concrete made from definite proportions of given materials which are mixed and placed in a given manner. This condition has resulted from a lack of a complete analysis of the principles of concrete mixtures and has led to rule-of-thumb methods of selecting materials and proportioning.

The problems which generally confront the engineer in designing and estimating the cost of concrete structures are as follows:—

1. What quality of concrete is most economical?

2. Are the aggregates near at hand suitable?

3. Of several aggregates, all of good grade, which is the best for the purpose?

4. What tests shall be made to determine the suitability of aggregates?

5. How shall the materials be proportioned, mixed and placed in order that concrete of the highest quality may be produced at lowest cost.

6. What is the effect of certain changes in the proportions of the materials?

7. What is the effect of exposures or service conditions on the permanency of the concrete?

The aggregate constitutes 75 to 90 per cent. of the weight of the material in concrete; this makes it important that aggregates which are found near at hand be used if they can be shown to be suitable.

Present Knowledge is Incomplete

Our present knowledge as to the fundamental properties of concrete and the exact manner in which the character and the proportions of the constituent materials influence the strength and other properties is by no means complete. When we consider the almost endless variety of materials available for concrete aggregate and the numberless combinations which may be made in the size of aggregate and the relative proportions of cement, water and aggregate, it is not surprising that many divergent opinions are now current as to the influence of these factors.

Lack of definite information on many of the questions raised above has led to a demand for a more comprehensive study of the properties of concrete and concrete materials. In an effort to supply this information, the Structural Materials Research Laboratory was organized in 1914. This laboratory is located at Lewis Institute, an educational institution in Chicago. The work of the laboratory is carried out through the co-operation of the Institute and the Portland Cement Association. The Portland Cement Association includes practically all of the manufacturers of Portland cement in the United States, Canada and Cuba. The work of this laboratory is an example of the co-operation, not only of the manufacturers in an effort to solve the problems arising in the use of their product, but also a striking example of the successful co-operation of an engineering college with a manufacturing industry of international scope.

Advisory Committee Controls Laboratory

The control of the policies of the laboratory is vested in an advisory committee consisting of representatives of Lewis Institute and the Portland Cement Association. The association is represented through its committee on technical problems, of which F. W. Kelley, Albany, N.Y., is chairman.

The laboratory is supplied with all necessary equipment for both physical and chemical experiments. There is now a permanent staff of 23 employees engaged in this experimental work. Tests are now being made at the rate of about 50,000 per year.

Experiments already carried out have shown that the most elemental principles of concrete mixtures have escaped notice in the practical use of the material and in

*Address to the American Society for Testing Materials.

the tests heretofore reported. Exhaustive studies of the properties of concrete made of the same materials mixed in widely different proportions have brought out many new facts. It has been shown that the size and grading of the aggregate and the quantity of cement used affect the strength of the concrete solely due to their influence on the relative quantity of water required to produce a plastic mix. Other factors being equal, a coarse, well-graded aggregate gives better results in concrete than a fine aggregate, solely due to the fact that a plastic mix can be produced with a smaller quantity of water when the coarse, well-graded aggregate is used. Increasing the quantity of cement in the mix produces no beneficial result unless we at the same time reduce the relative quantity of mixing water used. This conclusion should be contrasted with the feeling of security which is reflected in all text-books, specifications and building codes, due to the use of richer mixes of concrete, with no reference whatever to the water factor. These experiments and others carried out on closely related lines have furnished the foundation for a correct theory of concrete mixtures and for a rational method of proportioning the constituent materials. A brief discussion of one phase of these investigations was published in an article by the writer in Engineering-News Record. (The same article was published in the Concrete Highway Magazine and in *The Canadian Engineer.*)

Colorimetric Test

A study of the effect of organic impurities in natural sands has led to a colorimetric test made by digesting the sand in a dilute solution of sodium hydroxide. This test has proven of great value in the preliminary examination of sand samples. The use of this test will no doubt have an important influence in preventing inferior or defective concrete work due to the presence of organic loam and similar materials in concrete sands. This study of organic impurities in sands was inaugurated through the co-operation of Committee C-9 on concrete and concrete aggregates of the American Society for Testing Materials, of which S. E. Thompson, Boston, Mass., is chairman. The first year's study was financed by Committee C-9. For a brief description of the test see Circular No. 1, Structural Materials Research Laboratory, "Colorimetric Test for Organic Impurities in Sands."

Many other phases of concrete work have been the subject of experimental research. The following may be mentioned as among the more comprehensive studies:—

Influence of various factors on the resistance of concrete to impact and abrasive stresses.

Standardization of tests of cement, aggregates, concrete and concrete products.

Study of the relative merits of different materials for concrete aggregate.

Study of the interrelation of strength, density, modulus of elasticity and other properties.

Study of the physical and chemical properties of cement.

Effect of fineness of cement on the properties of concrete.

Effect of various admixtures in concrete.

Study of concrete in alkali soils and waters.

Influence of rolling, tamping, vibrating and other methods of manipulation on the properties of concrete.

Storage of commercial liquids in concrete.

Field tests of concrete and concrete aggregates.

Study of the performance of concrete mixers.

Development of a suitable concrete of light weight for use in ships and other floating structures.

Effect of age and curing conditions on the properties of concrete.

New uses of concrete give rise almost daily to demands for information which is not now available. It is one of the functions of this laboratory to supply this demand as to the best method for adapting concrete to untried construction. The use of concrete in the construction of ocean-going ships is one of the most striking developments of the world war. Ship construction demands concrete of high strength and light weight. Such information as we have collected on this subject has been placed in the hands of the U.S. Shipping Board.

It is the policy of the laboratory to co-operate with technical societies and other testing laboratories to the fullest extent. Experimental work has already been carried out in co-operation with the following committees of the American Society for Testing Materials: C-1 on Cement; C-6 on Drain Tile; C-9 on Concrete and Concrete Aggregates, and with the Committee on Concrete Products of the American Concrete Institute. The results of this research work will become available for the information of all concerned as soon as the experimental work along a given line is sufficiently complete that definite conclusions are available.

While these experimental studies are being carried out through the co-operation of the cement manufacturers, it should be noted that none of this work has been directed toward the solution of strictly manufacturing problems or with a view to economics in the operation of cement mills. The aim has been to render every assistance in the development of improvements in the quality of concrete, and to adapting concrete to meet the demand for structural material in new fields. This broad-minded policy on the part of the manufacturers is a reflection of the most advanced ideas of business ethics which finds expression in the theory that the obligation of the manufacturer does not end in the production and sale of a first-class product, but extends as well to rendering every service in his power to assist his client to a proper use of the product to the end that it may serve its purpose in the most economical manner.

These researches will undoubtedly exert an important influence in rationalizing concrete and reinforced concrete construction, to the end that better and more permanent work will be secured at a lower cost. Such benefits as may be derived from these experiments will come to the general public.

MAY CARRY OUT PRINCIPLE OF THE DRAYTON-ACWORTH REPORT

It has been officially announced that a temporary Board of Directors, working in conjunction with the Dominion Government, will administer the C.N.R., probably for some time. Negotiations for the purchase by the government of the Grand Trunk Railway are being continued, and, until some conclusion is reached, it is unlikely that a permanent board will be appointed. At present the C.N.R. is being administered by D. B. Hanna, A. J. Mitchell and Major Bell, Deputy Minister of Railways. The main difficulty in regard to the Grand Trunk, it is understood, is the Grand Trunk Pacific, but hope is expressed that a solution will eventually be found.

Eventually, should the government succeed in acquiring the Grand Trunk, it is proposed to appoint one board to control, under corporate management, the whole system of government railways from coast to coast.

In this connection it will be recalled that the Drayton-Acworth report recommended the incorporation of a new public authority, known as the Dominion Railway Company, and that the Canadian Northern, Grand Trunk and Grand Trunk Pacific be transferred to that new authority.

DAMAGE DUE TO ELECTROLYSIS

According to a report on the subject recently issued by the United States Bureau of Standards, electrolysis often causes much damage to water and gas distribution systems. The damage is said to be due to electric currents which have been using a pipe as a conductor, leaving the pipe and removing a part of the metal in doing so. Electric corrosion occurs only when and where the current leaves the pipe; but this may be at insulating joints, where it passes from one pipe to the next through the earth, as well as where it leaves the pipe line permanently.

Such corrosion, by removing the metal from the exterior of pipes, causes a pitting that may develop into holes in the pipe; or the pitting may be so general over a given area as to weaken the strength of the pipe. Holes so caused may leak water or gas for years unsuspected, and probably more or less of the "unaccounted for" water can be charged to electrolysis. Pipes weakened by general corrosion may give way at any time of unusual pressure, although originally sufficiently strong for all emergencies. The losses due to electrolysis of water mains, therefore, include lost water as well as the value of the pipe that is deteriorated to the point where it must be renewed. And the many forms of danger and possible loss resulting from a lowering of the strength of the pipe are apparent to any waterworks man.

Street Railway Currents Responsible

When electric current flows through a continuous metal conductor it causes no chemical change. When it passes through an electrolyte, however, chemical decomposition occurs at the electrodes, where the current enters and where it leaves the electrolyte. Pure water is not a conductor, electrolytic or otherwise, of electricity, but becomes so by the addition of even minute amounts of salts, either acid or alkaline. The water held in most soils contains dissolved salts, such as chlorides, nitrates, etc., and furnishes an electrolytic conductor for stray currents. The electrolytic action that takes place where current enters a pipe from the ground is not detrimental to the pipe.

Practically all of the current that finds its way to underground pipes comes from street railway tracks. The current that is sent out through feeders and trolley wires passes through the motors of the cars and from them, through the wheels, to the rails. The rails are supposed to conduct the current back to the power house, but seldom if ever retain all of it, some portions leaving the rails through the ground for other conductors, such as underground pipes. The less the resistance the rails offer to the passage of the current and the greater the resistance offered by the ground and by pipes or other conductors near the rails, the less will be the amount of current that leaves the rails and traverses such other conductors.

Methods of Prevention

The methods of reducing or preventing entirely the electrolytic corrosion of pipes may, therefore, be classified as those reducing the resistance of the rails (or other return conductor), those increasing the resistance of the path from rail to pipe, other methods of reducing the flow from rails to pipe, and those calculated to minimize the effect of the current that flows in the pipes. The first remedy must be applied by the railway officials; the second and third may be applied by either railway or waterworks officials, or both; and the fourth may be applied by the waterworks officials. The last is but a palliative, and chief reliance should be placed on the first three, the first being most effective.

A comparison (which cannot be carried too far, however), may be made between the conditions that cause electrolysis and parallel systems of canals. Suppose that two canals with porous banks run side by side, each set at some depth into the ground. One of these leads to a power house, which pumps water from it, this water being pumped through a main that parallels the canal and discharges into it at intervals; the other has no outlet, nor any source of water supply except such as seeps through the ground from the former. Assume that for some reason the seeping of water from the latter canal (which we will call B) into the ground causes a deterioration of the canal which it is our aim to prevent. At any point where the water in canal A is higher than that in B, there is a tendency for the water to seep through the ground from A to B; and where the height in B is greater than that in A there is a tendency for flow in the opposite direction. In each canal there are baffles at frequent intervals, those in canal A representing the rail joints, those in canal B representing pipe joints. Both canals are lined with dry rubble, so that, although porous, the banks are not eroded by high velocities.

Comparison With Parallel Canals

If the baffles nearly fill the canal, the flow past each baffle must be largely through the ground around the baffle, and there will be a considerable fall in surface level at each. This can be prevented by supplying a by-pass around each baffle.

Given canal B empty and canal A full at its upper end, there will be a tendency for water to seep from A to B, the rate of such flow depending upon the height to which the water has risen in B and the porosity of the soil. This difference in level between A and B at any point is known as "potential difference." The fall in surface level in canal A per 1,000 feet is called "potential gradient." The potential gradient decreases as the size of canal A increases and as the obstruction offered by the baffles is decreased by by-passes or in other ways.

Since there is no outlet for canal B, if water flows into it from A there is a tendency for the water to stand at the same level throughout the length of B. But since there is a fall in level in A, such level near the power house will be lower than that in B, and water will flow back from B to A near this point. It is this flowing back that causes the damage to B. This damage is somewhat similar to a wear of joints between the rubble lining, and increases with the velocity of flow—that is, given a certain amount of seepage from B, the damage at any point increases with the concentration of seepage at that point.

Remedies for Seepage

If the baffles in B should practically fill the canal it would be possible to thus keep the water level at all points in B at a level with or lower than the water in A; but this might cause a flow around the baffles by seepage through the ground, which seepage would cause damage at every point where it left the canal. Also a connection could be made between B and A at the power house end of A, thus eliminating seepage from B at this point, but this would increase the amount of water flowing in B, and might cause considerable by-pass seepage around the baffles if these caused any obstruction. (Most joints in mains offer more or less obstruction to current flow.)

The remedies or palliatives of the damage done by seepage from canal B may be classed as follows, and will be referred to by number in comparing with actual methods employed for electrolysis:—

1. Painting with cement or plastering the inside of canal B; may be effective for a time, but seldom continues efficacious for long.

2. In some way keeping the ground water at all points higher than the water in B at that point.

3. Keeping canal B as far from A as possible; also avoiding bringing the two canals near together for short distances only at the lower end, which would concentrate the seepage from B.

Basin With Special Lining

4. Placing between A and B, parallel to B and connected with it by a short trench, a short canal or narrow basin from which the seepage can take place, thus limiting the damage to this basin, which can be given a special lining. Applicable only to short stretches.

5. The baffles in B may be made to practically dam off the canal into sections, each section being kept at the level of the water in A by ground seepage. If the hydraulic gradient of the water surface in A is kept low, the seepage around each of the dams in B will be so small as to do little or no damage. The more frequent these dams, the less the difference of water level on the two sides of each and the less the seepage around each. This plan so reduces the seepage at any one point as to make its effect negligible; and if the dams are numerous enough, the ground only slightly porous, and the hydraulic gradient in canal A is kept flat, there may be no appreciable seepage around the dams.

6. Seepage from canal B at the lower end can be largely prevented by placing numerous connecting channels between the two canals at this section, through which channels will take place the flow that keeps the two at the same level; or a channel may be carried from B directly to the power house. Each of these will probably increase the flow in B, and, while it will eliminate seepage at the lower end, it will increase that around the dams or baffles unless these can be eliminated (that is, unless all resistance in pipe joints can be eliminated, which is not practicable where the pipe is already laid.)

7. If the hydraulic gradient in A were made level there would be no seepage from B, and the flatter it is kept the less is such seepage.

8. If canal A were made watertight there would be no flow of water into B and no flow from it to A.

Drain to Carry Seepage

9. If a drain were laid near A and lower than the water in it and ample to carry the seepage from A, there would be no seepage from A into B.

10. Pumping out the ground water from a sump near the power house would serve if it kept it below B throughout its length, but otherwise might increase the damage.

11. Any method of decreasing the perviousness of the soil between A and B would lessen the amount of water seeping between them.

12. A number of drainage pipes or channels run from a reservoir at the power house and connecting with the canal at intervals would tend to reduce the fall in gradient in A, especially if the baffles furnished a considerable obstruction to the flow.

13. Locating the power house at mid-length of the canal will reduce the total fall in gradient; and increasing the number of power houses will have the same effect.

In all the above, the principal feature in which the electrical problem differs from the hydraulic is that in the former the damage to B results solely from water passing from B into the ground. In other respects the parallelism is quite close.

HUNTER STREET BRIDGE, PETERBOROUGH

As exclusively reported last week in the Construction News Section of *The Canadian Engineer*, Frank Barber, of Toronto, has been appointed as consulting engineer in connection with the design and construction of the high level reinforced concrete arch bridge across the Otonabee River, at Hunter Street, Peterborough, Ont.

The bridge will have a roadway 56 feet wide carrying two street car lines. Distance between curbs will be 42 feet with two 6-foot sidewalks. While the total length of the bridge, including fill, will be about 1,800 feet, the bridge proper, including approaches, will be approximately 1,000 feet long.

The estimated cost of the bridge, as prepared by the city engineer, R. H. Parsons, is about $300,000.

The bridge, when completed, will connect the main part of the city with the business and residential district across the Otonabee River. The building of this bridge grows out of an agreement made with the Quaker Oats Company. The matter was voted upon by the ratepayers and was carried by a large majority. It is expected that the work will be completed by the end of 1919.

SLIDE HITS GIANT STEAM SHOVEL

"BATTERED and broken by hundreds of tons of clay that crashed down upon it from the cut, the great Bucyrus shovel in the northern end of the Hydro Canal cutting near the whirlpool is out of commission for some time to come," says a daily press despatch from Niagara Falls, Ont.

"An avalanche came down from the face of the cut and from the left bank. The great machine was driven backward about thirty feet, broken lose, and partly dismounted from the truck on which it travels. Its backward movement saved it from being buried and more seriously damaged. Several workmen had a very narrow escape. The boom of the shovel was torn off, thrown to one side, and badly fractured in two places. Yesterday's rain was probably the cause of the slide.

"The cutting is about ninety feet deep, and the stratum exposed is mostly of quicksand character. Above this is a great bed of red clay, and at the surface several feet of top soil. It will be a difficult piece of work to dig the huge shovel out of the dirt surrounding it. A revolving locomotive crane was brought up from the forebay works near Queenston to assist in the excavation."

GOVERNMENT CONTROLS STEEL INDUSTRY

THE government, through the War Trade Board, took over the control of steel production in Canada on the 3rd inst. The board is vested with full authority to give directions to the different companies as to the extent and character of their product, taking into consideration the facilities of each concern. By the order-in-Council which is being passed, the board's powers will be extensive in the supervision and direction of steel production and manufacture in Canada. It does not refer, however, to the financial or general management of the concerns. The object is to co-ordinate the producing power so as to ensure the greatest efficiency as well as the maximum of production.

The measure has become necessary owing to the shortage of steel in the United States, due to the great and constantly increasing demand for war purposes. This, it is explained, makes it imperative that the greatest possible economy in production be exercised along with co-operation by the different companies.

The War Trade Board will co-operate with producers to bring about the proper measures, and it has authority to enforce such orders as it may deem necessary. Each steel plant will be assigned a certain kind of work.

Basic as well as war industries in Canada have need of supplies, and they must, to the extent of our ability, be provided in Canada owing to the tremendous demands upon the American steel industry.—From The Monetary Times, Toronto.

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Principal Contents of this Issue

MUNICIPAL ENGINEERING CONFERENCES

ONE of the most valuable functions of engineering societies is that of bringing the members together for fraternal intercourse,—of holding meetings where engineers can exchange ideas without restraint and under the mellowing influence of a pipe of tobacco and a cup of coffee.

Such meetings can be organized by any group, but for the moment we desire to emphasize the desirability of such conferences by the municipal engineers employed in the smaller towns and counties, because their vocation tends to deprive them of the opportunities that are open to men engaged in large centres. Municipal engineers are apt to become insular because they are separated by distance from others following the same profession. Municipal engineers are called upon to solve similar problems in their own special way, and the different solutions are often most instructive. Municipal engineers lose many opportunities for study because they have no distinctive section of any organized society to bring them together in visits to various engineering works. The opportunities which are thus lost to municipal engineers cannot be appraised in dollars and cents. Until after a few conferences are actually held, such meetings and visits cannot be fully appreciated as agencies for welding the municipal engineers into a really active organization.

Free, educative conferences would be welcomed to all cities and towns by the local authorities, and probably the smaller municipalities would afford as abundant opportunities for inspection, study and discussion as would the large cities.

Municipal engineers of the smaller cities and towns probably comprise sixty per cent. of the total number of men so employed, and they would no doubt rejoice in meeting their brethren in the profession.

There appears to be a decided desire among engineers for greater recognition from the public. One way of attaining this object is to be ever present in the mind and vision of the people. Local conferences would undoubtedly help to create a healthy public appreciation of the services rendered by municipal engineers.

UNION WAGES AFTER THE WAR

IN a recent speech at Montreal, Mr. George L. Berry, general president of the International Printing Pressmen's and Assistants' Union, brought up a question that had been universally expected but which had not previously received much serious attention in Canada. Mr. Berry stated his belief that many employers already are planning to cut down wages after the war, and that workers should begin to prepare themselves to meet any new conditions that might arise.

If there is any movement on foot such as Mr. Berry suggests, it certainly is not of a very extensive kind. Probably not for a century has there been a time in Canadian industrial history when the outlook was more uncertain than it is just now, and manufacturers and other employers of labor are too busily engaged dealing with the problems of the present to make arrangements for a future period the conditions of which cannot be foreseen. The future depends upon how long the war lasts, the economic arrangements which are included in the peace terms and the internal developments which take place in our own country. In these events labor is interested just as much as is capital.

The rapid rise in the cost of living since 1914 has been accompanied by an increase in the wage scale in almost every occupation. With a very few exceptions, however, there is none in which the wages represent an increase in the power to purchase commodities. The reverse is in fact the case, and in this way the wage earner who does not contribute through the income tax, corporation tax, etc., has been required to bear his share of the cost of the war. If prices retain their level fairly well after the war and business activity is fairly good, the present wage scale will undoubtedly be maintained. On the other hand, if prices decline to any extent, as is expected, labor interests must recognize the fact that their remuneration will be reduced accordingly. The argument of increasing cost of living has been universally used in advocating wage increases, and workers must be prepared to accept the argument of declining prices as sufficient cause for wage reductions.

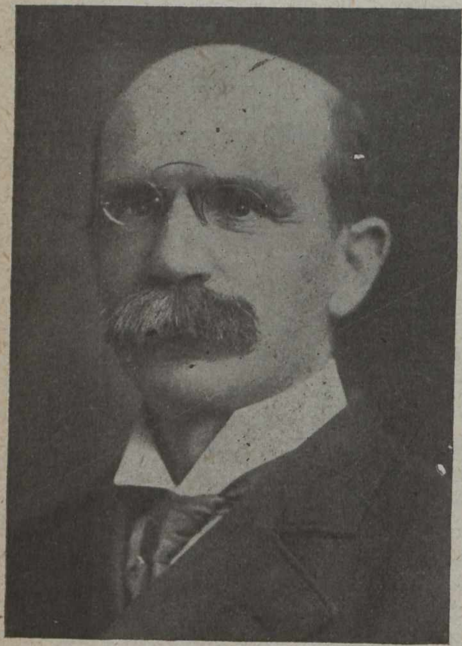
Mr. Berry stated that the membership of the union would fight to the bitter end any attempt on the part of the employers to reduce wages and that it is a patriotic duty to keep wages high. No doubt he had in mind the continuance of the present cost of living and industrial activity. If these factors alter, however, and wages should accordingly reduce, employees have no cause for complaint unless the reductions be made with undue haste. It is ordinarily the case that during a period of rising prices the wage earner is at a disadvantage because prices and industrial profits increase more rapidly than does the remuneration of labor. In other words, the wage earner is always a little behind. On the other hand, it is supposed that during a period of falling prices he has the advantage because it is harder to reduce wages, which are fixed more or less by custom and agreement, than it is for prices to fall in the open market of supply and demand.

PERSONALS

L. W. Bourassa, C.E., has recently been appointed city engineer of St. Johns, Que.

W. H. Carter, of the contracting firm of Carter, Halls and Aldinger, has been elected president of the Winnipeg Board of Trade.

Charles H. Rust, who was city engineer of Toronto for many years prior to 1912, and who has been city engineer of Victoria, B.C., for the past six years, has returned to Toronto. Mr. Rust will be associated with the Toronto Railway Co. and allied enterprises, and it is thought likely that he will have charge of the engineering end of the company's interests in regard to the possible purchase by the city of the company's assets in 1921, when the franchise expires. Mr. Rust is a past president of the Engineering Institute of Canada and of the American Society of Municipal Improvements. Upon leaving Victoria, Mr. Rust was presented with an illuminated address, signed by the twelve city department heads, commemorating his services to the city. He was also given a handsome travelling bag by the employees of his department. The design of the address is a modernized adaptation of sixteenth century illumination. At the top is the Rust family coat-of-arms. At the bottom is a view of the Sooke Waterworks, one of the outstanding monuments to Mr. Rust's work for Victoria. Mr. Rust was born in Essex, England, December 25th, 1852, and was educated at Brentworth Grammar School. He began professional work under the late Frank Shanley. In 1877, Mr. Rust entered the employ of the city of Toronto as a rodman; in 1881 he was appointed assistant municipal engineer and in 1892 took complete charge of the city's work, although he was not appointed as city engineer until February, 1898. Mr. Rust is a member of the American Society of Civil Engineers and of the American Waterworks Association, and also of the two societies above mentioned.



Frank Tissington, until recently engineer with Archibald & Holmes, contractors, of Toronto, has been appointed manager of the Coleman Fare Box Company, Toronto.

Frank M. Preston, for the past two years assistant city engineer of Victoria, B.C., in charge of the sewer department, has been appointed city engineer, succeeding C. H. Rust, resigned.

Arthur Sande, construction engineer in charge at Dominion Canners, Limited, Simcoe, Ont., has been engaged as construction engineer for the Kipawa Fibre Co., Limited, Temiskaming, P.Q. The George A. Fuller Co. has the general contract, amounting to about $5,000,000.

W. Percy Near, B.A., B.A.Sc., city engineer of St. Catharines, Ont., has been appointed fuel controller for that municipality. Mr. Near did very capable work last winter in voluntarily assisting in the direction of the work of obtaining fuel, and it is generally recognized in that city that his strenuous efforts then were mainly responsible for the relief of a very serious situation.

Dr. J. W. S. McCullough, Medical Officer of Health for the Province of Ontario, has been offered appointment as medical officer of the stationary hospital which is to go to Siberia with the Canadian expeditionary forces. Dr. McCullough holds the rank of lieutenant-colonel. Since the beginning of the war he has attended to all sanitary matters in Military District No. 2. It is said that leave will be granted to him by the province and that Dr. Bell, Provincial Inspector, will assume Dr. McCullough's duties until the latter's return.

OBITUARIES

Lieut. Chas. E. Peers, of Toronto, is reported killed in action. Lieut. Peers was assistant engineer of the Sault Ste. Marie Canal and went overseas in 1916.

Lieut. Hugh D'Alton Livingstone, B.A.Sc., of Brantford, Ont., was killed in action on August 27th. His father is Police Magistrate W. C. Livingstone, of Brantford. Lieut. Livingstone graduated with honors in the class of 1913, Faculty of Applied Science and Engineering, University of Toronto.

Flight-Lieut. James D. Cook, of the Royal Air Force, has been killed in Germany. Lieut. Cook, after training at Ontario camps and in Texas, received his commission and went overseas in January, 1918. He was a graduate of the School of Practical Science, Toronto, and left a position with the Turner Construction Co., New York, to enlist in Toronto.

The resignations of Sir William Mackenzie and Sir Donald Mann from the board of the Canadian Northern Railway are in the hands of the government. Nearly all their associates have also resigned from the board.

The road from Tillsonburg, Ont., through Courtland and Delhi to Simcoe, and east to the county boundry of Norfolk, and that from Port Dover through Simcoe and Waterford, and north to the county boundary, have been designated as inter-county roads, to be maintained by the Province of Ontario. This announcement has been officially made by the Provincial Highways Department. Another announcement is expected to be made in the near future that the road from Woodstock to Port Burwell, through Ingersoll and Tillsonburg, will also be designated as an inter-county road.

The Royal Commission on shipyards, which has been in session at Montreal and other places daily since August 6th, 1918, inquiring into labor disputes which have arisen in shipyards in Montreal, Quebec, Levis, Three Rivers and Sorel, on Tuesday of this week saw, as one important result of its work, the signing of an agreement which will assure uninterrupted construction work for the duration of the war in four yards where strikes were threatened. Other shipyards are expected to follow suit. The agreement is to date from September 1st, 1918, and continue in effect for the duration of the war. Its main conditions are a nine-hour day instead of ten hours; time and a half for all overtime, and in certain cases double time; after February 1st, 1919, scale of pay to be revised in accordance with any increase or decrease in cost of living as shown by the Labor Department; and disputes to be finally referred to a Board of Conciliation, with no halt to ship construction during the Board's deliberations. The firms signing this agreement are: Fraser, Brace & Company, Limited, Montreal; Davie Shipbuilding & Repairing Company, Limited, Lauzon, Levis; The Quebec Shipbuilding & Repair Company, Limited, Quebec; Quinlan & Robertson, Limited, Quebec.