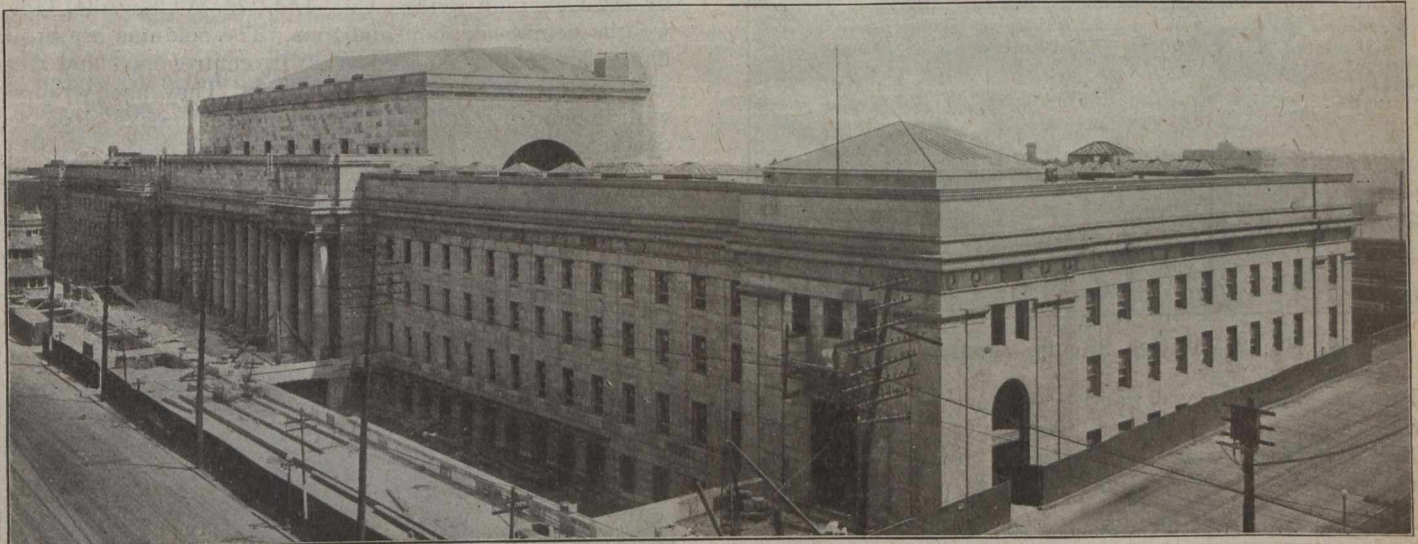


PAGES

MISSING

The Canadian Engineer

A weekly paper for Canadian civil engineers and contractors



View facing north-west corner. Photograph taken August 3rd, 1918

Toronto Union Station An Imposing Structure

Will Be Ready For Use Next Spring—Active Work Began in 1915—Brief Description of the Chief Sub-Contracts and List of Those Who Are Mainly Responsible For the Most Important Building of Its Kind in Canada

WITH a frontage of about eight hundred feet, the new Union Station at Toronto is bounded on the east by Bay Street, on the west by York Street, on the north by Front Street, and on the south by the railroad tracks that border the waterfront. It is only a few hundred feet east of the old station that has served the travelling public for many years, but which is inadequate for modern requirements.

The general contract was let by the Toronto Terminals Railway Company to the P. Lyall & Son Construction Co., Ltd., of Montreal, in July, 1914; but, with the exception of about a month's preliminary work, active operations were not commenced until a year later.

Brings were made by Smith & Travers, of Sudbury, Ont., in November, 1915, and were found to be typically representative of the Lorraine formation underlying the city of Toronto and its suburbs. This formation consists of alternating layers of sandstone and compact gray shale, with occasional bands of limestone. It is generally overlain by a varying thickness of stony glacial clay. The formation is dense and compact when undisturbed, but the shale bands soon disintegrate upon exposure to the air. The upper layers of bed rock were sometimes found to be disturbed, or tilted, and mixed with clay or gravel. After penetrating this disturbed zone, the solid, flat-lying formation was reached. It was, therefore, found

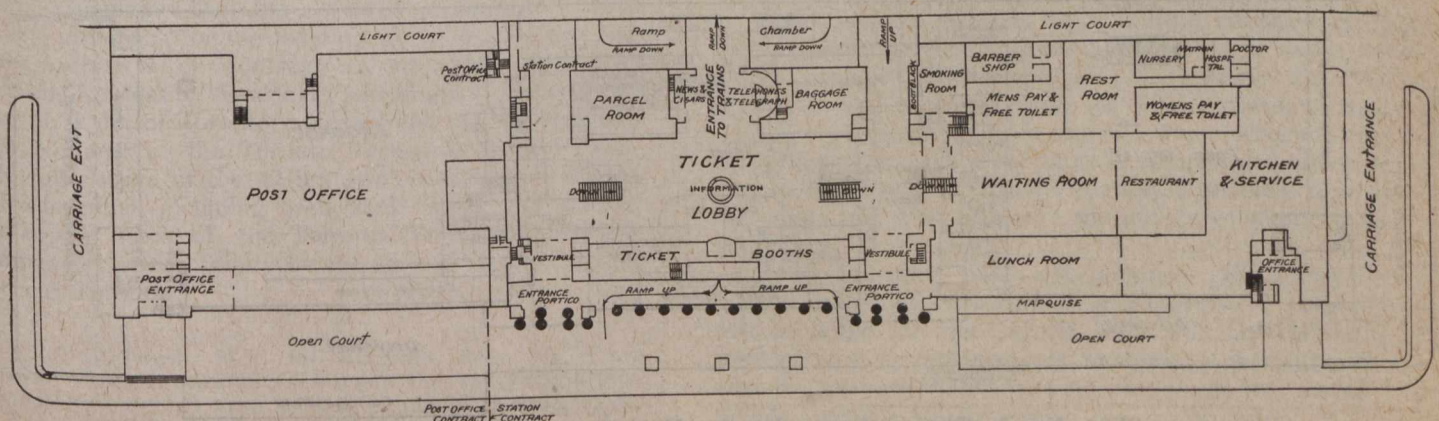


Fig. No. 1—Plan of Main Level, New Union Station, Toronto

desirable to excavate to a depth of a few feet below the solid surface before placing the footings.

The caissons were carried to shale at an average elevation of -3.6, the datum used being mean Lake Ontario level. The caissons were from 4 ft. to 6½ ft. square.



Fig. No. 2—Station Site on January 1st, 1916

The sub-basement was carried to elevation -2. Seepage was overcome by Barrett Specification waterproofing. The foundation walls are concrete, carried up to grade at elevation 8.6. The column footings and piers are cir-

building. The rapid progress made subsequently is evidenced by Fig. No. 3, a similar view one year later.

The building is practically a steel skeleton structure. The outer walls are faced with Indiana limestone, backed by wire-cut brick supplied by the National Brick Co. The design follows the Greek style of architecture. Geo. Oakley & Sons, Ltd., of Toronto, have the sub-contract for the cut stone work.

The structural steel, which was fabricated and erected by the Canadian Bridge Co., Ltd., of Walkerville, Ont., weighs nearly six thousand tons. The columns are broad flange H-sections, spaced at 26 ft. centres east and west and 22 ft. centres north and south. They are wrapped with expanded metal, and fireproofed by means of poured concrete.

A sub-contract for the fire-proofing was let to the Crescent Concrete Paving Co., Ltd., of Toronto, and included the guniting of the roof trusses, erected by the

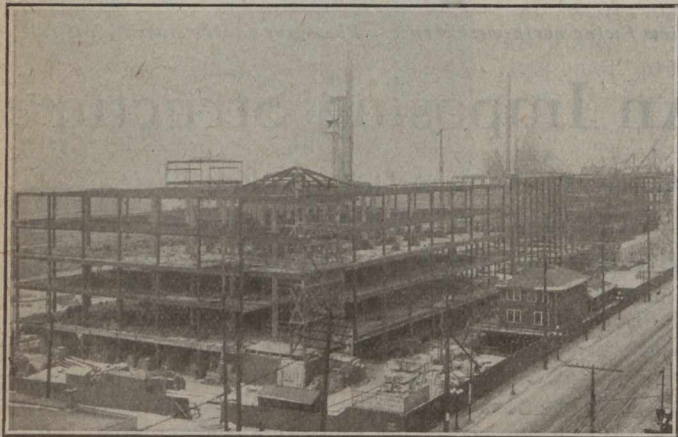


Fig. No. 3—Steelwork on January 1st, 1917

cular, and vary from 4 ft. to 6½ ft. in diameter. The lowest footing was carried to elevation -16.5.

Fig. No. 2 shows the appearance on January 1st, 1916, of the site of the new station. The photograph was taken from a point facing the north-east corner of the

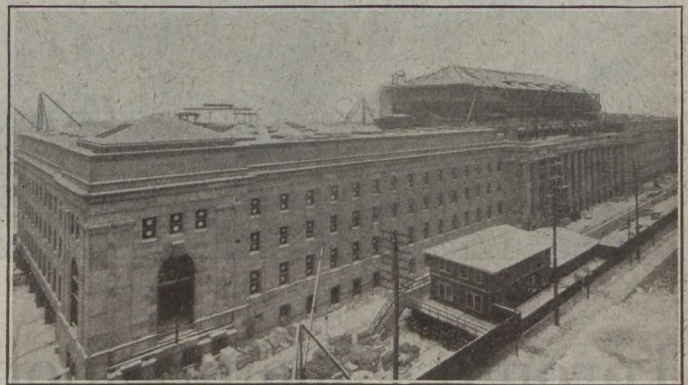


Fig. No. 4—Progress by January 1st, 1918

Macfarlane, Douglas Co., Ltd., of Ottawa. The Carmichael Waterproofing Co., Ltd., Toronto, have the roofing and waterproofing contract. The roof was built according to the Barrett Specification. The interior partitions are mostly hollow tile, furnished by the Dominion Fireproofing Co., Ltd., of Winnipeg.

The construction of the building is divided into two contracts, the eastern wing (about one-third of the total area) being devoted to post-office requirements, the remainder forming the railway, or station, contract.

Fig. No. 4 shows the progress made during 1917. Fig. 6 is a closer view of the main entrance, the dignity and impressiveness of which is enhanced by twenty-two large stone pillars. Each of these pillars is built in three sections. Each section weighs nearly nineteen tons and was turned from a stone weighing about 30 tons. They

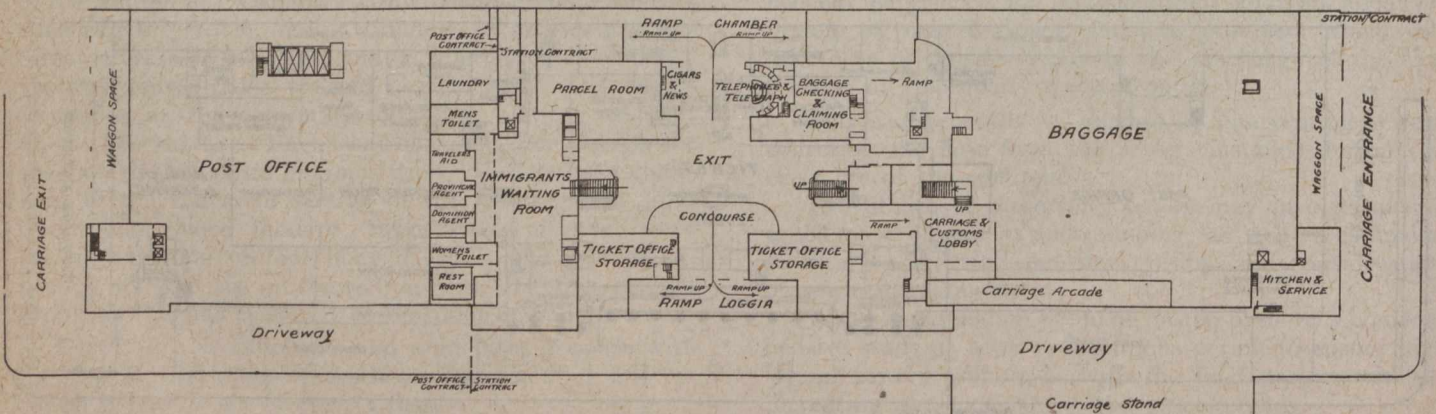


Fig. No. 5—Plan of Lower Level, New Union Station, Toronto

were turned to the correct diameter at a specially constructed plant at Sarnia, Ont. The shaft of each pillar is 32 ft. high and has an average diameter of 5 ft.

In front of and at both ends of the building is a reinforced concrete retaining wall, permitting access to and from the lower level. The sub-contractors for the wall were the Church, Ross Co., Ltd., of Montreal.

The general plan of the lower level is shown as Fig. No. 5, and Fig. No. 1 is the plan of the ground floor. The whole of the main floor is of reinforced concrete, terra cotta arches forming the upper floors.

The plumbing below ground level and all drainage work was constructed by the Bennett & Wright Co., of Toronto. Wells, Newton & Co., of New York City, were the sub-contractors for the plumbing above ground level and for the heating and ventilating apparatus.

The Trussed Concrete Steel Co. supplied the steel sash for the main section of the building, all other sash being wooden.

Provision is made for twenty elevators, including both freight and passenger, and for an escalator to handle

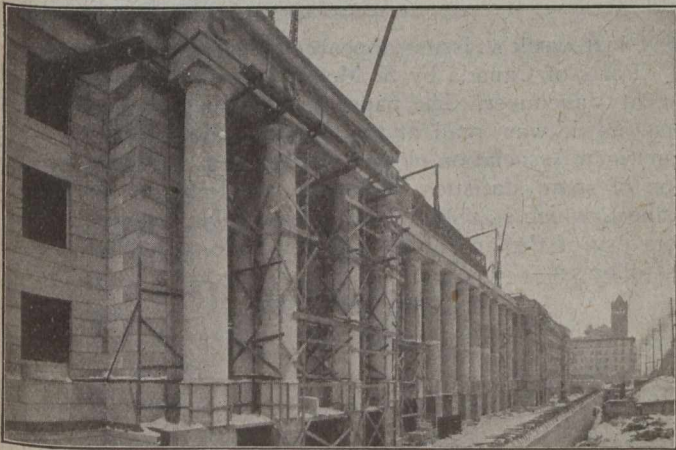


Fig. No. 6—Twenty-Two Big Pillars Add to the Majesty of the Main Entrance

baggage. The Turnbull Elevator Manufacturing Co., Ltd., of Toronto, have the sub-contract in the post-office wing, but the Otis-Fensom Elevator Co., Ltd., of Toronto, are building the equipment for the station contract. Adequate iron stairs also provide ready access from one floor to another, and the main floor and the lower level are connected by ramps.

The electrical equipment was installed by the Canadian Comstock Co., Ltd., of Montreal.

The ceiling over the main ticket lobby and ramp chamber is a feature of the building, and was constructed by the Gustavino Co., Inc., of Boston, Mass.

The architects for the building were the Toronto Terminal Architects, of Montreal, an association formed by the firms of Ross & Macdonald and Hugh C. Jones, with John M. Lyle, of Toronto, as associate. J. R. Ambrose, chief engineer of the Toronto Terminals Railway Co., is in full charge of the design and construction of the entire terminal, including both track layout and station. The capital stock of the Toronto Terminals Railway Company is owned jointly by the various steam railways entering Toronto.

J. C. McIntosh, M.P. for Nanaimo, upon his recent return to Victoria, confirmed the report that the Federal government has decided upon a steel shipbuilding programme for Vancouver Island.

Letters to the Editor

LETTER TO THE EDITOR

No Security of Tenure in Municipal Positions?

Sir,—In reference to your editorial, "Security of Tenure," in the September 19th issue, I may mention two matters which are not only averse to the interests of engineers, but which are also detrimental to the public welfare.

The municipality which Mr. Bennett served was famous for maladministration, and, having squandered its resources, is now under the control of a commissioner appointed by the Provincial Government. The reason may be found, I think, in:—

First,—The system of electing the entire administration annually, and so preventing any continuity of policy.

Second,—The liberty given to inexperienced men to spend vast sums of money without any check as to the necessity or value of the expenditure.

The effect of the first method is much as Mr. Bennett describes. A council may be elected by interests whose policy is against the public weal, and whose schemes may have been thwarted by an engineer desiring to honestly serve the community.

It is quite natural that under these conditions an engineer may become a time-server, for if he attempts to withstand the policy, his resignation will soon be demanded or his position made unbearable. Or, by the power mentioned, the council may determine to spend large sums of money with the avowed object of finding employment for one section of taxpayers, or to secure contracts for interested parties. To do this they often embark upon engineering schemes which cannot be justified, but which, if the engineer objects to carry them on, would mean his dismissal.

If councillors were elected for a period of years there would always be on the council some men who understand the value of the men in charge of the work and the necessity of some continuous policy, and the engineer would be protected in some measure from the machinations of interests whose policy he deemed it best, in the public interest, to withstand.

But far greater protection would be secured to the engineer, and the public would benefit commensurately, if before any scheme involving capital expenditure could be carried out, an enquiry and investigation had to be conducted similar to that provided for under the Local Government Act of England.

Under present methods there is little incentive given to municipal engineers to carry out what is really the chief function of an engineer; that is, to design the work so that it may be executed in the most economical way.

When the engineer feels that the whole scheme is not justified, and that the expenditure is all arranged to benefit certain sections or interested parties, is it likely that he will study and plan to secure the utmost economy in the details?

If, on the other hand, the engineer knew that the scheme would be investigated by a competent authority able to judge the merit of the plan, and with power to appoint an inspector not only to examine the plans, but also the execution and cost of the work, the smallest details would have to receive careful attention.

Much of the time of a municipal engineer is taken up with the acquisition of local knowledge, which, though it has little commercial value for the engineer, is of immense value to the community, and the constant change of administrative heads results in a great waste of public money.

Much discussion takes place at nearly every election as to the value of the engineer's department, and the first so-called economy of a new council is often to reduce the staff or the salaries. How few councillors, however, realize that the difference of an inch in the diameter of a watermain or a trunk sewer may mean more than the annual expenditure of the engineer's department, and that it is local knowledge which enables an engineer to decide whether the inch is necessary or not!

The position of municipal engineers in Canada will be strengthened, and the public will be protected against wasteful and extravagant expenditure, just so soon as engineering schemes dependent upon capital expenditure have to be subjected to review by a competent authority free from political control, and all engineers should cooperate to secure this, and so help to raise the status of the engineering profession as a whole and of municipal engineers in particular.

A. G. DALZELL,

Formerly Assistant City Engineer of
Vancouver.

Vancouver, B.C., October 1st, 1918.

Planning Rural Highways

Sir,—As a highway engineer I was greatly interested in W. M. Stewart's article, "Planning a System of Rural Highways," in your issue of September 5th. I would like, however, to take exception to the statement that "Diagonal roads for rural districts, while possessing many advantages, are usually out of the question owing to the waste of land and inconvenience to farmers."

The first reason, at least, does not hold, because it is a notorious fact that our present road allowance represents a tremendous waste of land. Imagine it! Nearly 300 acres of road allowance to every township. Practically 4 per cent. And of these road allowances probably less than 20 per cent. are improved in any way. The improvements in general occupy about 50 ft. of the right-of-way and the remaining 49 ft. remains a breeding place for weeds and a direct loss. The saving which could be effected by cutting down our road allowance would provide many miles of diagonal roads.

As to the second reason, "Inconvenience to farmers," it is a certainty that cross-country roads will many times repay the individual farmer who is lucky enough to be contiguous to one. A diagonal road can scarcely be anything else than a main road, so why not locate them along the railways? They cause no further inconvenience than the railroad has already caused; they will become a connecting link and reduce mileage between towns and villages; and lastly, material for surfacing in districts where such is not to be found locally becomes available at every point because of the fact that it may be brought in by rail and deposited where needed. Would not such a highway along the main line of the C.P.R. from Portage la Prairie to Brandon, through the sand hills, appeal to any highway engineer?

It is a fact that up to the present the idea of diagonal roads has not occurred to the average rural council.

Where title has been secured to old diagonal trails and where natural conditions demand them, the diagonal road is looked upon with extreme favor.

There are a number in Manitoba, but I am familiar with only a few, such as that running southwest from Winnipeg to Sperling, the Oak Point Highway, the Brandon Valley Road, the Portage Highway and the Colonization Road. The Colonization Road and the Oak Point Highway both form an important part of the highway system of the district in which I am interested. They have proved their value, and it appears to me that now is the time for further additions of such roads. I would like to see further discussion on the subject.

D. M. MAWHINNEY,
Municipal Engineer,
Rural Municipality of
Rockwood, Manitoba.

Stonewall, Man., September 28th, 1918.

PRINCE RUPERT TONNAGE

IN last week's issue appeared an article on Western Ports of Canada by S. McClay, harbor commissioner at Vancouver. The paper as published was complete just as it was read at the Boston convention of the American Association of Port Authorities, with the exception of some statistics regarding the tonnage of Prince Rupert, which statistics were not available last week. By courtesy of the author we are now able to publish these as follows:—

Year 1916-1917

<i>Coastwise.</i>	
ARRIVED.	DEPARTED.
465,479 tons	504,361 tons

<i>Foreign.</i>	
ARRIVED.	DEPARTED.
535,170 tons	309,789 tons

Year 1917-1918

<i>Coastwise.</i>	
ARRIVED.	DEPARTED.
471,550 tons	565,507 tons

<i>Foreign.</i>	
ARRIVED.	DEPARTED.
254,916 tons	124,693 tons

"CEDARS" PLANS AN EXTENSION

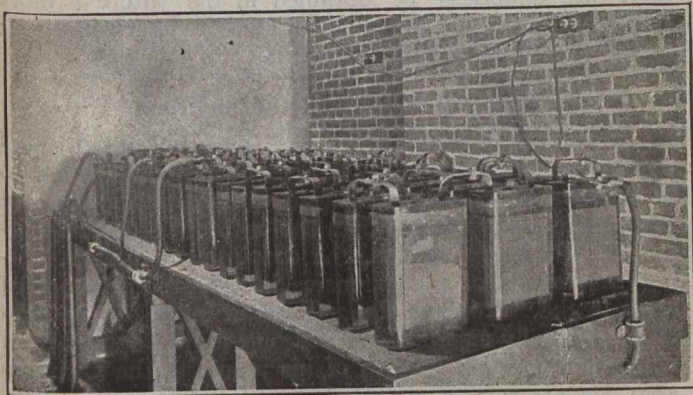
APPLICATION has been filed with Sir Henry Drayton, power controller for Canada, by the Cedars Rapids Power Co. for permission to export power to New York State. The company contemplates additional development at its plant near the Soulanges Canal, but claims that the increased output could not all be sold in Canada, though really required in New York State, and it asks permission to export any surplus that there may be after Canadian requirements are satisfied.

The Hamilton, Ont., Board of Health has ordered the installation of a sewerage system, at an estimated cost of \$30,000, in the Brightside Survey.

MOUNT ROYAL TUNNEL STORAGE BATTERIES

FOR working switches and for emergency lighting at such times as the regular power supply might fail, the Mount Royal Tunnel and Terminal Company, Ltd., of Montreal, have equipped the new tunnel with Titan storage batteries.

The accompanying illustration shows the installation in the west portal sub-station. The outfit consists of 64



Installation at West Portal Sub-Station

cells in glass jars, with a rated capacity of 135 ampere hours. The current requirement for switch operations is a maximum of 75 amperes for a period of four to eight seconds.

The cells were sealed and fully charged when installed. The connections were bolted, so that the installation required but little time. The batteries were furnished from stock by the Northern Electric Company, Ltd., and were working within a day after the receipt of the order.

ANNUAL MEETING OF AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS

THE twenty-fifth annual convention of the American Society of Municipal Improvements was held October 2nd to 5th at Buffalo, N.Y., and was attended by about 175 delegates.

Among the Canadians present were A. F. Macallum, Works Commissioner of Ottawa, past-president; Chas. H. Rust, of Toronto, who is also a past-president of the society; Capt. F. A. Dallyn, of the Ontario Board of Health; R. O. Wynne-Roberts, of Toronto; R. J. McClelland, city engineer, of Kingston, Ont.; W. P. Near, city engineer, of St. Catharines, Ont.; W. A. Morris, of the Asphalt and Supply Co., Montreal; and B. E. Smith, of the Barrett Co., Toronto.

While the number of delegates in attendance at the convention was somewhat smaller than in previous years, the discussions of reports and papers was spirited.

The executive committee was given power to determine whether a convention be held in 1919 or not. If they decide to hold one, it will be in New Orleans.

Arthur Young and Co., of Chicago, have been employed by the Civil Service Commission to classify the "civil servants" in such manner that they will be entirely under the commission's control and for the purpose of giving better service to the public. The Chicago firm was engaged in the capacity of "efficiency engineers."

POLLUTION OF BOUNDARY WATERS*

By Capt. F. A. Dallyn

Provincial Sanitary Engineer for Ontario

THE keynote of the final report of the International Joint Commission relative to the Pollution of Boundary Waters seems to me to lie in a paragraph which appears under the heading, "Inadequacy of Common Law." This paragraph reads as follows:—

"When settlements had been made along our boundary waters to an extent that urban communities commenced to grow, and sewerage systems in consequence of this growth began to be installed, such was the immensity of these rivers that settlers living farther down stream probably neither noticed nor protested against the discharge into them of what was relatively an infinitesimal amount of pollution. When these communities, therefore, installed sewerage works, they took advantage of the diluting powers of the river, and resorted to the simple and inexpensive expedient of discharging into them their sewage in its raw condition. The custom of doing so has now become universal. The selfishness of vested interests, familiarity of evil conditions, which has begotten an indifference to both the doing and the suffering of wrong, an ill-directed spirit of economy averse to the assumption of financial burdens to remedy what was before regarded as an existing or potential evil to other communities, and the disinclination to change ingrained in humanity, have resulted in a situation along the frontier which is generally chaotic, everywhere perilous, and in some cases disgraceful. The common law having proved inadequate to the task of controlling affairs, it has been supplemented or superseded by legislative enactments, which in their practical workings have about as signally failed."

It is to be observed from this that the Commission was entrusted with a most delicate problem, that of suggesting the nature of the international intervention where the custom of both countries had resulted in an invasion of common law and, as a further consequence, a direct contravention of treaty obligations.

Section 7 of the conclusions of the Commission is probably the one of most vital interest to-day. This section is as follows:—

"In order to remedy and prevent the pollution of boundary waters, and to render them sanitary and suitable for domestic purposes and other uses, and to secure adequate protection and development of all interests involved on both sides of the boundary, and to fulfil the obligations . . . of the Treaty, it is advisable to confer upon the International Joint Commission ample jurisdiction to regulate and prohibit this pollution of boundary waters and waters crossing the boundary."

To appreciate fully what this recommendation involves, one is forced back to the premises from which this recommendation naturally follows. This is found in portion six of the final report, under the heading of "Limits of Permissible Pollution and Standards of Sewage Purification."

It appears to the writer that the Commission does not ask for authority to regulate as it may deem advisable—without limit—but that it recommends that some authority (itself appearing as the most natural) be clothed with power to regulate as consistent with the spirit of treaty obligations and in a manner consonant with their findings and conclusions.

Limits of Permissible Pollution

To determine the extent of remedial treatment required in each particular case would involve consideration of the varied lines that have been followed by the Commission throughout the present enquiry; the existence

*Excerpts from address delivered October 3rd, 1918, to the American Society of Municipal Improvements.

of pollution and of harm, actual or potential, to domestic or other uses, to public health or property; the results of the engineering studies of feasible remedies; and the economic facts relating to the conservation of stream resources. It would require the balancing of the value of remedial measures in the terms of public good against the cost of the requisite improvements.

On the one hand, it is evident that the paramount importance of public health and the binding obligations of the treaty must be borne in mind. These make impossible the recommendation of such lenient remedial measures as would work economic injustice or would endorse officially the continued spoilation of a natural resource to the injury of the citizens upon both sides of these waters.

Must Not Be Unreasonable

On the other hand, sewage treatment requirements must not be made so excessive and unreasonable as to involve the cities and towns along these waters in an expenditure entirely unjustifiable. They should be reasonable and feasible from the standpoint of engineering construction or adaptability to local conditions, of the availability of necessary lands, of out-falls and incident structures, and of costs.

In view of the fact that pollution in the Detroit and Niagara Rivers, and its transboundary effects therein, are much greater than in the other boundary waters, these two rivers will be treated in one class and the remaining boundary waters as another class.

The problem of necessary bacterial purification of the sewage discharged into the two former is one of extreme perplexity, owing to the difficulty or impossibility of obtaining definite and ample data and the relative importance to be attached to many of the factors which enter into it.

After a great deal of consideration, the Commission has, in view of all the circumstances of the case, come to the conclusion that for the present, and as an immediate step in the way of restoration of the purity of these streams, the communities responsible for the discharge of raw sewage into them should purify it to such an extent that the resulting average cross-sectional pollution in each river will not exceed the limit of safe loading for a water-purification plant.

In other words, the standard of purification required of these communities should be such that the streams, after receiving their treated sewage, would have a mean annual cross-sectional average of B. coli not exceeding 500 per 100 c.c.

Compliance with the requirements of this standard would not impose upon the riparian communities along these rivers discharging their sewage therein a burden which would be unreasonable or greater than that ordinarily imposed upon urban communities which purify their sewage.

Water and Sewage Standards Both Tentative

It necessarily follows that this standard of sewage purification, being based upon a tentative standard of safe loading of water-purification plants, must itself be tentative. The growing appreciation of sanitation, the consequent demand for a higher degree of purity in water supplies, and the constant improvement that is taking place in the processes of sewage treatment tend to make a proper standard of sewage purification one of ever-increasing stringency. The discovery of a new and much more economical, or possibly a profitable, method of dis-

posal of sewage, for example, would naturally lead to the adoption of a stricter standard of permissible pollution in heavily polluted streams. Furthermore, any limit of permissible impurity that might be established, even temporarily, for a given stream must be influenced largely by strictly local consideration.

The data necessary for the formulation of a fixed standard, either of sewage purification or of water purification, are not sufficiently well established at the present time. By more precise methods of experimental study there will doubtless be obtained in the future a more ample and accurate command of facts, which will admit of the determination of a more definite standard.

Bacterial Standard Not Sufficient

In view of the difficulties and uncertainties of bacteriological technique, it is distinctly advantageous to have, if possible, a working rule which is more accurate and readily determinable than the bacterial standard suggested. Professor Phelps, the consulting engineer, taking the results of the extensive investigations reported upon in the "Progress Report" as an index of the conditions actually existing, worked out, as will appear from his calculations on page 9 of his report to the Commission, such a rule or standard.

He found that if the sewage of the cities be diluted in a stream flow to four cubic feet per second per capita of the population, the resulting water will contain approximately 500 B. coli per 100 c.c. If the dilution is proportionately less than this, a corresponding degree of purification of the sewage will be necessary to maintain the final stream condition. Further investigations will no doubt make possible a more accurate statement of these relations, but, as the entire matter of standards is always subject to revision in the light of accumulated knowledge, it is considered that for all purposes of a present enquiry, the practical equivalence of the dilution and the bacteriological standards may be accepted.

Standards for Boundary Rivers

These standards are not applicable to rivers other than the Niagara and Detroit, but it is in no sense to be inferred, however, that remedial or protective measures are not required in their case, where the dilution, based upon the entire cross-section of the stream, exceeds in every instance four feet per second per capita of the population.

The view of the advisory engineers is adopted that no untreated sewage should be discharged into boundary waters, but the Commission considers it inadvisable at the present time to prescribe what the amount of treatment should be in the case of these remaining rivers. The sewage from each community along their banks must be considered by itself in respect of the degree of purification that is necessary, basing the standard on the reasonable use of the waters, the practical possibilities of remedial and protective measures, the economic value of stream purification, and also the economic value of stream pollution, proper regard being had to the public health.

After giving much attention to the question of standards of purification in these six boundary rivers, the Commission has come to the conclusion that the fixing of standards for them and the subsequent modifications of these standards, from time to time, should be left to some authority clothed with the necessary power to deal with the question. This authority should also have power to vary, from time to time as conditions demand, the standards of sewage purification in the Detroit and Niagara rivers.

It is forced upon the writer's attention that the finding of the Commission cannot but result in Federal interference both on the part of Canada and of the United States, for their finding in no uncertain language recites that treaty obligations have been violated, and the violation has imperiled public health and the property of both countries.

It remains to be seen whether public sentiment of the two countries will be strong enough to override the petty interests of corporation, state and provincial executives, and succeed in expressing, through the authority of some international board of control, the unity of their interests; and by the restoration of our boundary waters to a state of purity natural to their present and future uses, erecting a flaming and enduring beacon to guide us toward a better judgment of the obligations of modern civilization.

MAINTAINING OLD ASPHALT PAVEMENTS IN BUFFALO*

By C. E. P. Babcock† and J. A. Vandewater‡

WITH the expiration of guaranties of the first asphalt pavements and the assumption of repairs by the city out of its general fund, a detailed record was entered and carried on. Having had no experience in the cost of asphalt repair, and little, if any, information being obtainable in this country, it was perhaps as much an engineer's curiosity or wonder, rather than a pre-determined appreciation of the magnitude and importance of knowledge of cost of future repairs, which developed our present method of recording.

From printed reports the cost of each street, each year, can be ascertained. As the life of asphalt pavements in Buffalo is (with few exceptions) twenty years or over, these records have assumed a considerable volume, and the question arose as to whether their value justified the space and the cost of printing year after year.

Fortunately, it was decided to continue the record, leaving off the early details and publishing the area and cost in detail for ten or more years back.

As example:

- Cost of repair before 1910.....Total and rate.
- Area, cost and rate since 1910 in detail, Annual.

This seems to have satisfied the objection, and probably this method will be continued.

These tables are beyond the interesting stage and have become a necessity, and are more referred to than many other mere tables, for this reason: the question always arises as to whether a street has received an adequate repair, whether the city should carry it on. As two-thirds of repaving is assessed, of course the local desire is to postpone the local expense, regardless of the engineer's advice. These tables, showing yardage and cost of repair, form a basis for argument and determination. Beside this we locate and plot on cross-section paper every patch repaired, using different colors for each year. These plottings show not only the yearly repair, but more important, where repair overlaps previous re-

pair. The contractor guarantees his work from December 31st of the year in which they are made for one year. Therefore, if a repair is made overlapping the joint of a repair under guaranty, an allowance of six inches is made and not charged to the new guaranty.

Heretofore our contracts were made on the basis of a square yard repaired. For our resident asphalt contractors this seemed a fair basis, because, after experience, they knew about the amount of the season's work and the material required for it.

In 1908 our investigation showed that of the original depth of the asphalt, viz., 1½ inches of binder and two inches of wearing surface, about 52 per cent. depth binder was used in repair and about 82 per cent top (see 75 and 78 per cent. later on).

If an outside company wished to bid on the square yard basis they would not have had this experience. With

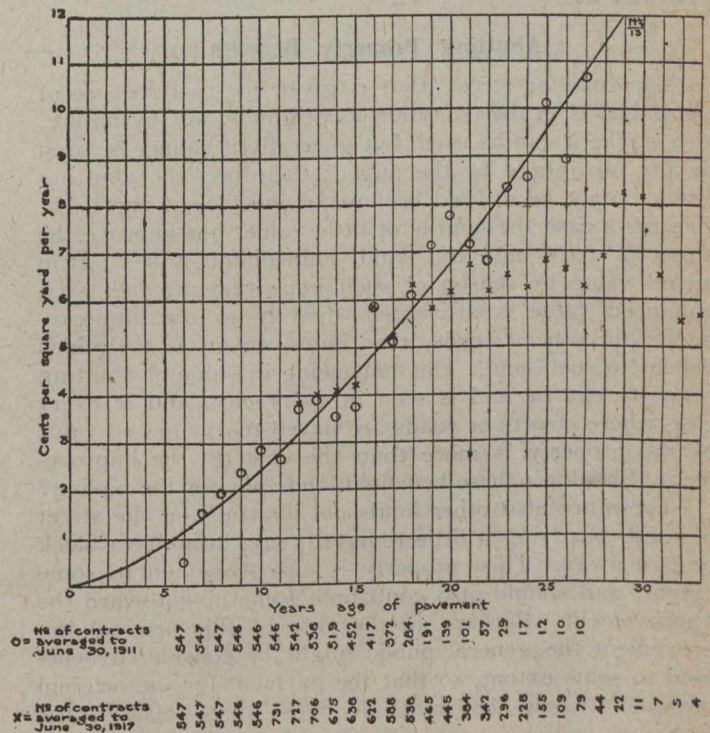


Diagram No. 1

Showing average cost of repairs per square yard on all sheet asphalt pavements at different ages to date of condemnation—with curve $\frac{N}{13}$. Pavements laid previous to 1898 on 5-year guaranty; after 1898, on 10-year guaranty.

our own knowledge of the conditions we felt that our contract should be made on something different than the square-yard measurements for the material used. It is, of course, known by the engineers and contractors that the binder costs less per cubic content than the wearing surface.

While there probably was not a pre-fixed idea of the contractor when his bid was submitted, that he could manipulate the use of the binder and top to his advantage, yet the opportunity was there, and in a city contract an opening of that kind is open to criticism, if not something worse.

Therefore, after collecting the data available, the Department of Public Works authorized a new specification, the principal factors in which are that both top and binder are purchased at the plant of the contractor by cubic

(Continued on page 331)

*Paper presented October 3rd, 1918, to American Society of Municipal Improvements.

†First Assistant Engineer, Buffalo, N.Y.

‡Assistant Engineer in charge of repairs, Buffalo, N.Y.

WHO SHALL PAY FOR PAVING?*

By Ellis R. Dutton

Assistant City Engineer, Minneapolis, Minn.

WHO shall put the *pay* in *paving*? Those who receive the benefit. The question and answer are stated in the shortest, most logical and equitable manner. There is no question but that the improvement of a street or road is a benefit, else such improvements would not be made. Streets and roads are made for the accommodation of the general public and abutting lands to facilitate communication among peoples.

This is the basic idea—that the use of the roads and streets should be free, and that the public as a whole should pay for the improvement of such thoroughfares. This may look good on the face of it, but let us see how it works out.

Abutting Property Benefits

The road or street that is given for the free use of the public is in the condition as originally left by nature, and maybe it can be used, but generally it cannot be used to any advantage by the public; therefore, the abutting lands cannot be utilized because of insufficient approach. In such a case the land is of little value, but improve the street or road and the land immediately takes on an added value by reason of such improvement, and such enhanced value is attributed directly to the improvement; in other words, the improvement is a decided benefit to such land. This enhancing in value of abutting property can be and is seen in every city, and in every case where streets or roads are paved the increased value of the property is more than the cost of the improvement. Shouldn't these benefited lands pay for the paving?

There are also other lands not abutting on the street or road, but lying a little removed, say, in a city a block or so away. This property is also benefited to some extent, and should also contribute something toward the improvement. Perhaps in the case of this original improvement the general public might be considered benefited to some extent, so that the payment for the original pavement would be made by these three classes, the larger of which is naturally the abutting land, and in much less proportion the contiguous land, and the general public. In a great many places the whole cost is paid by the abutting property, and in others the general public pays for the street intersections, etc., paying its part of the total frontages. In no city has it been successful to compel the general public to pay a very large part of the expense, as they will not stand for it, and, therefore, no work will be done.

Financing By Instalment Payments

For the purpose of financing the work and making the annual payments against the abutting property reasonable, the governing body should provide the funds as a loan and make the time of yearly pavements extend over a term of years, say, from five to twenty years.

After this original pavement is paid for, the abutting property should not be called on to pay for another pavement, as the road, when it is completed, is turned over to the operating department, so to speak, similar to railroad management.

While we are speaking of railroads, did you ever notice the similarity between roads and railroads? The

*Paper read last week at the Buffalo Convention of the American Society of Municipal Improvements.

construction is done by bonds and stocks in railroads, and by bonds and abutting property holders in roads. After construction it is turned over to the operating department, which is the management in railroads, and expenses for maintenance, betterments and operation are paid by the traffic rates. In the case of roads, such maintenance, repairs and renewals should be paid by the users of the road, in the shape of license or wheel tax, proportioned to use. Another striking similarity is also shown in the increased loads, trains and engines in the case of railroads, necessitating almost complete reconstruction of the roadways, bridges, etc., to permit of such increases. So, in the case of the improved roads, the increased loads and the development of the auto trucks have necessitated the reconstruction of many roads and the building of better and more substantial road surfaces. In the case of the railroads, the users pay for these improvements, and why not so on our roads? It surely would be unfair to the abutting property owner to be obliged to pay for the repairs of his road, which were made necessary by reason of the use of the road by persons that did not contribute to its original cost. Make the persons benefited pay for the cost of what they use. Is it fair for me to pay for a pavement to be used by you for your personal benefit?

Ruthless Overloading

Another feature of the present-day use of roads is the general tendency to increasing the loads enormously without any regard or reference to the ability of the pavement to hold up under these loads. There are millions of yards of improved streets and roads in the country, costing millions and millions of dollars, which are being destroyed by ruthless overloading, and all of this has been paid for, not by the users or abusers, but by the property owners, who receive almost no benefit from this abuse. Who shall pay for this destruction and reconstruction? Surely the users.

But before total destruction, regulations should be made by the authorities as to allowed loading, so as to prevent the road's destruction, and, if heavier road surfaces are necessary, to provide funds and methods for such heavier roads. The government and public are beginning to awaken to this fact, and are asking why should we provide a smooth and economical roadway without cost to private parties to use for their personal benefit. Some of the license laws of our state are a farce when they license a light passenger car or a heavy six-ton truck for three years for five dollars. Make the tax or license commensurate with the use and destruction of the road surface.

Collect Statistics Quickly

There is another item of destruction to road surfaces, and that is climatic conditions, and perhaps the general public might be entitled to pay for such deterioration, but it would be small compared to the use.

Investigation and statistics should be made and collected to provide some basis for these license fees, and it should be done quickly or there will be no pavement left to use. Make the persons benefited pay for the paving.

Following is a partial list of Canadian patents recently issued through the agency of Ridout & Maybee, Toronto:—Arthur G. L. and Harry C. W. Neighbour, means for pumping fluids; Percy A. Robbins, settlers for fluid mixtures; Norman S. Stuckey, apparatus for carrying on mining operations underground; Geo. W. Sinclair, processes for granulating calcium cyanamide.

DRAINAGE—THE MOST IMPORTANT CONSIDERATION ENTERING INTO ROAD CONSTRUCTION*

By James H. MacDonald

Ex-State Highway Commissioner of Connecticut

NINETY-NINE per cent. of all the trouble that we have in regard to our roads is due to a lack of intelligent understanding of the great question of drainage. The time allotted to me in this lecture, without transgressing on your patience, is not long enough to begin to tell you of the evils that come from a lack of knowledge of how to intelligently drain and the necessity for drainage. So I shall have to be content with selecting from out of many things that would naturally occur and take up what I call the salient features of this great question of drainage.

The thought I had in my mind was to present something of a little local color, and I hardly dared do that until I had made a little local investigation. Through the courtesy of Mr. McLean, I was taken out and shown all of the beauties of the city and of your highway. I wish you had a road like that all over Canada; it would be a desideratum. There are certain general principles to be followed in road-building that are standardized, and that is why it is that the Society of Engineers have got together, knowing very well in these days of men striving to gratify their personal ambition or to better their condition financially, they supersede gentlemen who have spent many years making an investigation into these great principles of engineering science, and they are set aside. And so this great society has got together from all over the country, and they have standardized certain principles that are to be followed in regard to everything connected with road-building, from the simplest form of construction—the split log road drag—up to the highest attainment we have along economical lines. So you have an opportunity to select from these gatherings and similar ones you are brought in contact with, experiences that have cost the places where these gentlemen come from millions of dollars to acquire that intimate personal knowledge and experience which has been profitable to them and ought to be profitable to every convention in which they are called upon to take part.

Hog-Back Road Inefficient

If I take up some of the primary steps in road-building, it is to fix more intelligently my mind on my subject-matter than it is to undertake to teach you anything new, although terms differ somewhat in different cities and states in regard to different features of the road.

The angle of repose is supposed to be that which will naturally hold itself in position in whatever position it may be called upon to sustain. When you have brought down your grade to what it should occupy in its finished position, have an angle that will hold itself and will not let slip or slide, but act as the support it is intended to be. In some places where we put in a road to get ready for future work, it is not always that we have a chance to cut down to build the edge of the shoulder which intervenes between the gutter and the roadbed or travelled path of the road. So it is necessary for us to build up the shoulder with material to protect that which

is enclosed in the roadbed proper and put it where it shall remain and hold it in place.

The hog back road is not an economical road, but one of the most expensive, because, instead of having an eighteen-foot road as you figured to do, you have just the width of the tires of the vehicles that use that road, about four inches of road, which is actually what you get when you have paid for eighteen feet, because you cannot use the rest of the road with safety. You either have to keep in the centre or go into the ditch, and there is generally very poor surface drainage, for after that road has been used a little while the whole of the traffic is concentrated in the centre of the road, and you have three gutters instead of those provided, and no matter if you paid \$190,000 for its construction, it is not only unsafe, but it is not an economical road. By not having your road a proper grade to carry off your water and to furnish the traffic with every inch of that road upon which to travel, it is necessary to reduce the grade down to a certain percentage that it ought to have in accordance with the traffic it is called upon to bear and the material with which it is constructed.

Rubble Centre Drains

We many times have a road where it is impossible to introduce centre drainage and get access for the water, so that whatever is brought down to that centre drain is carried down to the side drain, so it is necessary to put in a shallow centre drain with a tile at the base carrying it across, and in many instances it is necessary to put in a Telford construction.

What I consider one of the best and most efficient drains we can put into any place—and I have found in my practice, covering eighteen years, that there has been no underdrain that I have ever put in that has equalled it in efficiency, in its carrying capacity and in its seepage power—is the old-fashioned English and Scotch drain, known as the rubble centre drain. The width of the ditch would be three feet at the top and 18 inches at the base, and two side stones are put in with an opening of six inches and a covering stone. This is covered with sod or hay, and on that the building of the road is commenced. Big stones, then gravel.

I have never had any use for blind drains. A drain that does not seep the water into it and take it out of it, in my judgment, loses ninety-nine per cent. of its efficiency, and so I have always advocated putting the boulder or stop at the end and throwing it off into the sides and away into the ditches, and I have never known a single case of that class of road to have ever broken down or failed to answer for the purpose for which it was built.

It is bad practice to carry water along through a cut down a grade for a long distance. I have found it splendid practice and to add to the life of the road to intercept the water by carrying it down into a catch basin with a stop, and carrying the face of that catch basin back to the line of the slope so that it is removed from any possible obstruction in the way of traffic in the future. It relieves the congestion and no end of trouble and wash-outs that often result in carrying water through a cut for a long distance.

Water Breaks and Warts

I never could see any use for thank you mam's. I always prefer to lay my thank you mam's lengthways with the road and not crossways. The only grade break that will do the work efficiently is the cross road grade,

*Address delivered at the Fifth Annual Congress of the Canadian Good Roads Association.

which is put on the road from the centre to the gutter. It used to be the custom to dump a lot of gravel into a mud hole, and the result was that we had a wart road with a bump on each side, and a useless, endless expense, and something very uncomfortable to ride on. In the building on my specifications that was a great lesson to me, as I taught my people to dump their load on the side of the road and shovel every particle of that load over into the mud hole, and thus have a uniform wearing surface which would be fully up to the best standard of efficiency that any road could expect to be in by way of intelligent repair. And so in putting the stone on the road or the putting of the gravel on the road, I have religiously followed that idea of not allowing any forks to be used to pull the stone over the road or any shovels to knock the head over the bank slope.

Rim Edge Cobble Gutter

There is such a thing as laying stone wrong. In one of my sections I found that in a cobble gutter laid down a grade of about four per cent. a twig had caught in one of the cobbles that was laid across the road instead of lengthwise with the run of the water. Leaves and sand were caught by it and made a scientifically constructed dam, and the water worked over on to the road and cut out what cost us \$150 to repair when a child could have gone out and lifted the obstruction off. So I have always found it good practice to lay my cobble gutters so that they would clear themselves by laying them with the longest diameter of the cobble with the run of the water.

Neglect of the shoulder often does much damage to a road, for it holds up the water before it can get to the gutter and injures the road. We have found it good practice to build the shoulders of gravel and stone. Our work is all done by the patrol system. We had to contend with the idea that where men took a contract to look after several miles of road that the gutter began to encroach upon the travelled path of the road as the contract was not quite so profitable as formerly, and the road scraper would go through with an up-and-down track where it should require three with our width of road.

The whole principle of drainage, in my judgment, is summed up in this way: the trivial things mean a lot. The three things to observe are: get the water out of your road, get the water off your road, and get the water away from your road, and you will have a well-drained road.

Sub-grade Road

We have always found it good practice where we have clay soil to contend with and we have to take care of the sub-grade drainage to not build our roads level across on the sub-grade, but to carry the same contour or grade as we have on the finished roads. We find that when we do that we have the opportunity to seep out from the metal or the gravel by a little sub-drainage of ordinary gravel or crushed stone into the gutter proper that water which would naturally come through by any leakage from above or seepage from the side, so that it would come into the gutter and relieve the sub-grade of the moisture and protect our road. It also furnishes a foundation. Half of the cracks that appear in any road, no matter what it may be, whether it is brick or cement, or whatever is the foundation of the road, is due to the lack of lateral support or an improperly built sub-grade, or has material which will invite moisture, introduce frost and make trouble. If you look into it carefully you will find that the greatest trouble has come from the lack of proper drainage of the sub-grade.

We had a splendid lecture yesterday by Col. McKendrick. It was a question of expediency, something that would take care of the immediate necessities of the hour, and he did not dwell on that particular feature of it in regard to reconstruction that is so necessary there. There is an obligation and responsibility resting on engineers that weighs them down heavily to-day, and when they had to build a road that cost \$25,000 to \$30,000 a mile they built a Telford road, which is one of the finest roads for drainage and foundation that can be built.

Telford Foundation

To make a Telford base we use a stone that we find in the meadows or in the ledges or in the trap dykes, and we take the broadest edge of the depth of the stone and place it down so that it will have a firm base to rest on. We lay it in courses across the road from six to twelve inches long and eight to twelve inches high when first put in. We set every stone vertically so that it will stand on its own base. We don't allow any mess of small stone, but we take and wedge up all the joints between the stone and give it the same contour on the base of the sub-grade as we do on the top.

We have a Telford base that is not only good for foundations, but the finest drainage we can have. It is good for a thousand years. There is no wear. We have found that if the contractor yields to the temptation to get an extra width of stone when he puts on the macadam construction, it has a tendency to dry out the road if not artificially moistened, but, so far as sustaining power is concerned, there is nothing to equal the well-built Telford road. The uniform placing of the stones is an important matter, because without uniform pressure on the part you are improving, you are going to develop a weakness in your road.

Corduroy Road

I have taken the limbs off the trees and have made bundles of faggots twelve inches in diameter and put them in a road, leaving the branches out in the fields to protect the wash, and it has carried the traffic for fifteen years without any settlement or trouble. I have used logs of wood and faggots in the centre drain, and another system is to cut out the centre of logs, boring holes through and carrying the water to the sides.

Railings Along the Ditches

The best is a six-inch top, driven in with sixty-penny nails, with a two-inch brace piece and an 8½-inch post every twenty-five or thirty yards.

Drainage at the Seepage of a Bank

We have found that the old system of putting in a pocket at the entrance end of the pipe through which the water was to percolate through the pipe and into the well had lost its usefulness by reason of the fact that it was stopped up by clay or ooze coming down through. And so we found it good practice to put in a little foundation of cement and about twelve inches of gravel or crushed stone around the pipe, and that will keep the drain open for all time. We have always found it good practice to plough drain at the top of the bank to take care of the drainage from the top and leak it down through the cobble gutter.

We have also found it good practice to put in an intersecting drain. We have tried in simple ways to take this great question of drainage and to improve on our wrong methods, and to bring home to the mind the importance of the question of drainage in the consideration of every road-builder in the country. I have always said,

no drainage, no road, and no matter what you may do, whether your road cost you ten dollars or a hundred thousand dollars, if you don't have proper drainage for sub-grade work and proper surface drainage, and have the carrying off of the water after it gets off the road properly and intelligently taken care of, the length of life of that road is very short.

Discussion

The President: It is every road-builder's experience that the greatest mistakes made in road-building are due to improper drainage. We have all seen thousands of dollars wasted by neglect of this important question.

B. Michaud: Do you think there is any type of stone foundation that is equal in value to the Telford foundation and more economical?

Mr. MacDonald: I don't think so. The question of foundation is like butter—good, better, best.

Mr. Michaud: I put the question because I find that with us it is impossible to lay the Telford foundation on rural roads because skilled labor is so scarce, and we have to lay our foundations out of crushed stone, arranged from four to five inches, and to roll it and fill it.

Mr. MacDonald: I thought I had made it plain in my address that the Telford base not only answered the purpose of drainage, but also of foundation. In this great question of highway construction I have always appreciated the fact that poor people have poor ways, and in all my talks I have always tried to bring in not the sword, but peace, and so I have recommended on every platform, use the material that you have in your own locality in preference to importing material, if that material will take care of the traffic that that particular road or improvement is called upon to sustain.

I have used sand foundation, I have used flat stones to make a sustainer. In the early days we used to build a calico road and lay it across the sand foundation, and put the stone on that, and afterwards we learned to use a light roller and put on water and gradually beat it down until it would sustain the weight of metal. I have built splendid foundations of gravel which took care of the road.

Of course, the foundation of a road is simply determined by the traffic it is called on to sustain, so that it is "many men, many minds." I confess that the finest road, for resiliency and comfort, is a well-built gravel road, and I like a gravel road, and I have built it in two-inch courses of the coarser gravel as a bridging and a finishing course, putting in a foundation of two to three inches, longest diameter of the stone, and rolling that down three or four inches, and then putting on another treatment of gravel, from one to two inches longest diameter of the stone, and in that course having eighty per cent. gravel and twenty per cent. binding material.

Then I finish it up with a two-inch treatment of sixty per cent. gravel and forty per cent. binding material, rolling each course in so that when finished it would be homogeneous and monolithic in character. I have sometimes put down on shifty foundations a treatment of branches and things of that kind as a hold-up, and I have taken field stones out of the meadows. I have taken broken brick. In other words, I have utilized everything that I could find in that particular locality so as to save the prohibitive price that would occur in bringing foreign materials in. And so I would advocate here. Some of the finest roads I have seen have been built with a lighter foundation than the Telford. In the early days the farmers would go in, and thought that their Telford foundation consisted of digging a great drain, the entire width

of the road, three or four feet deep, and taking the oxen and stoneboat and dragging in great boulders.

There was no outlet for the water or attempt to change grade. They felt that was the way to build a good, solid road, and they did it, and when we came to build a grade and change the alignment, it was the most expensive road we had to contend with, because it was almost impossible to get those boulders up. This is the day of the veneer in everything. We have to learn to utilize what we have and make it do. And I believe the scientific treatment of roads will result in a lighter construction, but more dense, and a greater attention to the question of underdrainage. Take care of that and you will be surprised what a lighter construction will stand up and give good service.

Mr. Fraser, Quebec: With regard to the question of side drainage, one of the difficulties we have met with is to provide an outlet. Very often they have to be put three feet below the sub-grade and it is hard to provide an outlet.

Mr. MacDonald: As your roads become more popular you will have to resort to one of two things. Either put in a system of side drains underneath, which are reached by drops, or you will have to put up guard-rails. With us we have many a man with a thirty dollar horse and a four dollar wagon who is looking for an opportunity to get an easy living at the public's expense by going into these ditches. You will find your machines skidding over into them, and probably there will be loss of life. And as the road becomes popular you will have your speeding, and that will lead up to accidents, and so the question is whether it would not be more economical to drain it out to a side drain. Sometimes we have to go into some convenient meadow and make pockets—well holes to seep out the water in the road and discharge it so as to take care of it.

Frost and Blind Drains

You are in a splendid position to-day, for you have all the mistakes and all the waste of money that we have shown in the handling of this great question. Every man should have access to his home, and there never should be anything done in the way of public improvement paid for out of the public purse for which an abutting owner is taxed, whether it is a farm or building lot, if it is for the public good.

Mr. Fraser: What do you think of the trench stone-lined drain? The cross lines were built across the road, three feet deep and one and a half feet wide, with no outlet.

Mr. MacDonald: Any drain that will keep the water off the roadbed and keep it from heaving will do good. But I never had a great deal of use for a blind drain by reason of the fact that the frost makes all kinds of trouble, going down sometimes five feet and heaving the road, the water staying in and freezing. But where you have nothing else to do and no way to accomplish anything else, the end justifies the means until a better provision is made.

Mr. Gray, Ottawa: Have you had any experience in draining a road with agricultural tile?

Mr. MacDonald: Yes; we have taken that and put in the drains where we could not get the stone by putting down a plank on the bottom and putting in the tile on top of the plank, and then arranging with nailing or some other way of fastening so that the joints would not dodge, and then cover with gravel or broken stone. We have never laid it on the dirt because the leakage would allow the joints to dodge and press it down.

Mr. Gray: I made some myself on a very level piece of road, and in place of putting them in the centre path on the bottom of each side ditch, I put them down one and a half feet, and they worked very well. We have had them in for four years.

Mr. MacDonald: Our trolley system runs parallel with our roads, and in the spring of the year, when the earth is surcharged with water, it has forced water up through the pavement and made no end of trouble. We have intercepted that with a system of drainage such as you suggest. We have put in the gravel to keep it from clogging up and covered that with hay.

Mr. Howland suggested that the cesspool method would obviate the blind drain.

Mr. MacDonald: We have long stretches of road where we cannot get any drainage without making a pocket and providing an artificial drain. Ultimately, the thing will have to be taken care of, and they are beginning to learn in our eastern states that a one per cent. grade is the minimum on a dirt gutter. It was not up to us when we had so little travel. We never thought of automobiles in the early days, and so we are learning everything connected with these things, and now that we are getting fifteen-ton trucks they have got to be cared for.

Roads and Bridges Too Weak

I calculate that out of the 200,000 miles of roads built in the United States up to a few years ago, we have not one-quarter of them, and not ten per cent. of the bridges over our streams and rivers that would carry the traffic safely over them to-day. But we have got to take that up and we have got to commence all over again. That is why we are here to tell you of the things we neglected to do, so that you may gain the full benefit of that experience we have gone through.

Mr. Drinkwater: With regard to the traverse French drain across the travelled area of a road, do you think it is advisable to build that drain deeper than the full depth of the side ditches? That is to say, if the ditches are two feet below the finished grade of the road, is it advisable or a judicious expenditure to make those cross ditches blind drains three and a half feet deep?

Mr. MacDonald: I don't think so, because it would be an engineering problem in which it would suggest that water will not run up hill, and that your side ditches are made for a particular purpose, to draw your water out of the road and away and not into your blind drain.

Mr. Wray: With the ordinary joint is there not a tendency to block and cause difficulty in keeping the drain clear?

Mr. MacDonald: We have never had any trouble. We sometimes cover with muslin or have some little covering at the joint. The main thing we want is to ensure by a spike or something put in on the side of the road that will keep the alignment of pipes, that joints will not dodge.

Before installing our glazed tile in the culvert we fit all pipes on the bank. I am referring to the regular D drain that butts up flush. We lay them on the board, we put down our guides so as to get the exact level straight through, and we put down our members so as to cover that, and we put the tile on that board straight through and measure to see they are accurate, with a spike on the side to hold them in place and keep flush and butt up close, and we cover that over with a little muslin, and put over that fifteen to eighteen inches of gravel or crushed stone and cover that with hay.

The great trouble, if they are carelessly done, is that the sand percolates through and works the joints out, and the last condition is worse than the first. Your tile drain should do two things: seep out the surrounding ground and carry it through.

Mr. Gray: Do you think it absolutely necessary to put a board under a tile drain pipe?

Laying Tile Drains

Mr. MacDonald: I would prefer that to laying it down even on a clay bed, because the ooze that will come through will soften the bed under your joints and they will get loose with nothing to hold them. The board itself will make a protection for your pipe remaining in its alignment. I presume you could get along without it, but it would be at the risk of some trouble with your pipe later on.

Mr. Gray: Having had considerable experience in laying tile, I have never yet put on a board. My reason would be that, although the condition of the soil under that tile may change somewhat, oozing could not well take place if the tile was properly laid. If your lumber is not uniform all the way through and some spots decay before others, then your tile drops and away your drain goes. I have had occasion to take up a good deal of tile, and last year we took out some drains that had been in twenty-four years and they were just as clean and level as the day they were put in.

Mr. MacDonald: That might be. I have known tiles been down for many years, and I have taken up spruce and hemlock thirty to forty years in the ground in a good state of preservation. The wood itself would guarantee that there was no buckling there—it could not buckle very well; whereas in my experience I have known tile all awry and gone to pieces, and there was nothing to prevent it. The wood helped to make the protection. However, if you have had that experience, continue it so long as it makes you a return for the money invested.

No Planks Under Culverts

Mr. Fraser: Would you recommend putting planks under a pipe culvert?

Mr. MacDonald: No; we don't put them under a pipe culvert.

Mr. Fraser: Or concrete culvert?

Mr. MacDonald: No; we have cemented up the joint and put them in that way. There is a sufficient surface to make a sustainment all through. See that they are level bedded, so that the bell goes down and furnishes its own bridging, so that there is no possibility of snapping or breaking. I have not laid much cement tile. I was afraid to put them down where the ends were open for fear of the frost making trouble, but if I were I would not put plank under them.

Mr. Drinkwater: Is it detrimental to a tile to be porous? Some say that the field tile, being non-porous, is better than the cement tile, which might be porous.

Mr. MacDonald: It depends altogether if you want a vehicle to carry water through or a vehicle to absorb water into. If you want a light tile drain for land drainage it would be a great deal better to have a porous tile. If you wanted to have it to carry through the culvert into the sewer I would suggest you have a double thick salt glazed tile. My idea of a tile is that the seepage comes in at the end. The objection often raised is that the cement tile, being porous, is not a fit tile to be put into a drainage system, while a clay tile, being non-porous, is.

E. F. Caldwell: The clay tile takes in the moisture from the joints, and also because of its porosity. It goes through a different process than the cement tile. One is set up by seasoning process, and the other by burning, and there is quite a difference in the two. You take a brick and put it into a pail of water and you find the absorption is different from that of a cement brick. We have never used in my state a cement tile. We have seen them laid as concrete and have had to take them up and lay other pipe that would be salt glazed to carry our conduits because they broke at the joints and disintegrated and went to pieces. And we gradually eliminated it, and I have not seen any cement tile laid for land drainage or anything of that kind, but thousands of feet of clay pipe for drainage.

Cement vs. Clay Tile

Mr. MacDonald: That just shows how much we are gaining every day, because in some parts of the country it is coming to be understood, and farmers are claiming that the cement tile is the best, that it will stand more hard usage, and if they ever do fill up they can be cleaned out and put back again without any chance of breaking, while in the other case there is a great percentage of breakage. I have no brief for either one. I am only speaking of my experience, but we are using the other pipe. If you gentlemen here are finding out new uses for the cement pipe we will be glad to use your experience and profit by it.

Col. W. H. Sohler: When we have laid a drain pipe for a culvert, instead of building a concrete culvert we have always dug our trench deeper than the pipe and put something underneath it—quite a little material so as to keep its alignment, broken gravel or some material that would drain itself.

Mr. Caldwell: I would like to find out whether the seepage of a tile made of cement is detrimental to that tile if it is stronger than the ordinary field tile.

Depends Upon Materials and Workmanship

Mr. MacDonald: I tried to introduce into my state, and went so far as to secure a patent for a metal-protected collar and sleeve of a cement pipe by reason of the expense that towns had to enter into to secure access to these larger clay double thick salt glazed pipe, so that we could get a perfect union. The great fault with the other pipe was the irregular burning of the pipe and the lack of being able to dip them, and I felt if I could get a collapsible core and jacket and put on a metal-protected bell and mould this through and dip them in asphalt, such a pipe would supply a long-felt want, for they could be made right on the job and save expense. So I am very friendly with cement pipe, but I don't believe that it would be advantageous or economical to use a cement pipe in place of what we have now on a question of economy.

Mr. Caldwell: I had occasion to put in ten thousand feet of tile, and put in cement tile because we could not get clay tile, and I don't like the looks of them. A great many of the men who were using clay tile claim that they are porous, and that the water runs through the tile. That is not so. The water going into a field tile goes in through the joint, and nowhere else. The claim that has been made for the draining of a field by cement tile is that it is porous enough, and you can lay the joints closer together, getting away from all chance of sand getting in the joint, and enough water will go through the tile itself to supply that drainage. It is easy to try yourself. Take a field tile, block up the ends solid and put into a

pail of water. It would remain dry. A cement tile will not. How long it will last I don't know. Agricultural clay pipe is not porous. You have to be careful not to lay it too close together or you will not allow the water to get in.

Mr. MacDonald: Take a flower pot and stop it up and fill it with water, and put timothy on the outside. It will grow, and when you take the water out it drops off, which shows that a clay pipe is porous and does absorb and take in water.

Mr. Drinkwater: Both clay and cement pipe differ in the manufacture and material used. Clay pipe in some districts will let water through like a sponge, that is, pipe made from loam clay. The clay pipe made from shale clay, which is burned and vitrified, is almost non-porous. In cement it depends on the size of sand and the quantity of cement you use. You can build a cement tile that will be as tight as any vitrified type ever made, provided you use enough cement, and it will be just as indestructible as the other.

MAINTAINING OLD ASPHALT PAVEMENTS

(Continued from page 325)

measure, the price including delivery on the work; and that the asphaltic cement for painting joints is paid for by the gallon delivered.

The cost of the street work includes labor, the chopping out of patches, laying material and cleaning up. This we pay for by the square yard.

Our contract also provides for relaying concrete base, unless the city performs the work with its own force.

Also for paving in trenches with binder $1\frac{1}{2}$ inches deep and top $1\frac{1}{2}$ inches deep and labor—a price being bid—

For trenches under 80 square yards.

For trenches between 80 and 480 square yards.

For trenches between 480 and 1,000 square yards.

For trenches over 1,000 square yards.

If two or more trenches of this kind are within one-half mile one from another and are repaired as a continuous work, the sum of their areas is the area on which payment is made.

By this specification the city uses all of either the binder or the top as its engineer requires and pays for the amount actually used. Our specifications quote that the average depth experience was for binder 1.12 inches, top 1.57 inches, or 75 and 78 per cent. of original depth, and this definition we make for the information of the bidder.

Less Binder Being Used

In the 1917 work we found that we used about 0.87 inch average depth of binder and 1.57 inch of top, or 58 and 78 per cent., respectively. The reduction in binder is partly due to the fact that our pavements are becoming thin. Those laid prior to 1892 were laid on one-half inch cushion instead of binder, and these require little, if any, binder in repairs. Our specifications provide that when the old pavement is less than two inches deep, binder shall not be used for repair.

Bids for repairs are received early in the calendar year, giving the contractor time to order his material and to arrange his organization.

As soon as the weather permits, usually in March, an inspection of all pavements is made, conditions are

noted, and a list of streets to be repaired is prepared, streets in the downtown or business section and the principal thoroughfare being taken care of first. We endeavor to repair all our asphalt pavements at least once a year, and this has been done with a few exceptions. Pavements that have unusually heavy traffic are repaired twice a year when necessary.

Work is begun about April 1st, and usually continues until about December 1st. The pavements to be repaired are marked out by what we term an Asphalt Locator, who is assisted by boys who measure up and locate the patches, and a man to record same in field book. The contractor also furnishes a man to keep a record of the size of the patches, and his records must correspond with those made by city's locator. The repair gang then follows, chopping out, relaying the new material and cleaning up, a gang laying from 750 to 1,000 square yards per day, depending upon the size of the patches. All old material

might recommend, but is influenced by the funds available. The last five or six years the appropriation for this purpose has been very fair.

The contract price has varied from 74 cents to \$1.39 per square yard, laid up to December 31st, 1917, and on account of the high cost of labor and material this year the rate may run somewhat over \$1.80 per square yard laid.

Up to June 30th, 1917, \$2,899,781.00 has been expended on repairs to asphalt pavements, the average rate per square yard in area of the streets repaired being \$0.0653 and on the area maintained \$0.0451.

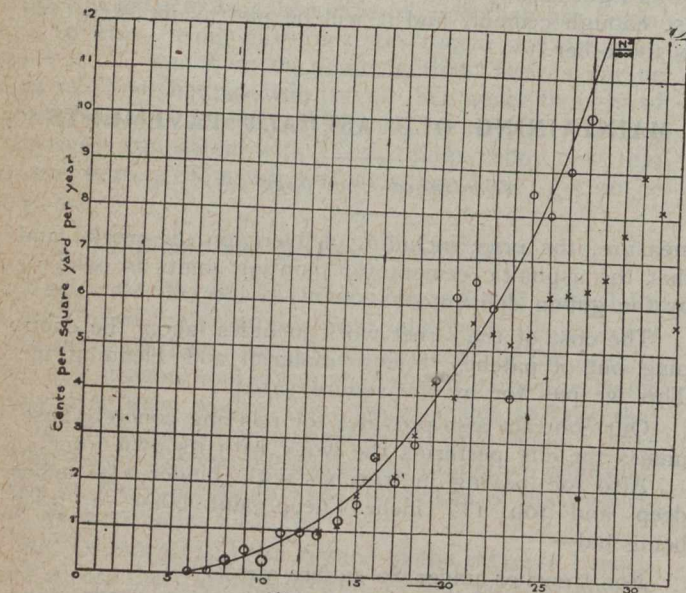
In 1917 a gas-driven cutting machine was devised by one of the contractors to cut out patches, action similar to that of a pile driver. It is not altogether satisfactory, particularly on old pavements, where it often breaks contiguous pavement. Our experience is not sufficient to warrant an extended criticism. A rather specious argument for its use is that it acts as a sort of balance wheel for labor and axes, when the labor looks for higher wages; but for good workmanship we have not found a mechanical cutter that compares with a man and axe.

It should be recognized that additional life is added by making adequate repair.

Cannot Establish Exact Relation

It is perhaps not possible to establish an exact relation between the advisable expenditure on repair as compared with the life of a pavement; because of the variables: 1st, cost of labor and material; 2nd, continuation of proper maintenance; 3rd, increase or change in traffic, but the curves computed by the city engineer and published herewith, show the experience we have had in Buffalo. It will be noticed that the parabola is falling off as the old pavements are replaced.

Sixty-four million three hundred thousand-year-yards repair of paving, carrying five-year guaranty prior to 1898 and ten-year guaranty on pavement laid since 1898 show an average annual rate of \$0.045 per square yard. The present average age of all asphalt pavements under city maintenance is about 21.7 years.



Years of pavement	○ No of contracts averaged to June 30, 1911	× No of contracts averaged to June 30, 1917
3	278	277
5	275	277
7	275	277
9	275	277
11	275	277
13	275	277
15	275	277
17	271	276
19	245	276
21	234	274
23	208	273
25	157	270
27	106	269
29	78	265
31	59	241
33	31	225
35	10	197
37	9	150
39	8	103
41	6	72
43	6	43
45	6	20
47	6	14
49	6	8
51	6	7
53	6	4

Diagram No. 2

Showing average cost of repairs per square yard on asphalt pavements without car tracks where streets were fit and well constructed—with curve $\frac{N^3}{1800}$

is the property of city and removed to dump provided by contractor or wherever the engineer may direct.

The work is done by two large gangs, consisting of about 75 to 100 men each, foremen, teams, trucks and rollers. There is also a small gang employed repairing cuts made by the Bureau of Water, plumbers, corporations and others, and two gangs where necessary.

During the last fifteen years, or up to June 30th, 1917, about 3,000,000 square yards of asphalt pavement have been maintained annually, the greatest number of square yards being 3,139,731 in 1911, and the least 2,858,634 in 1916.

The average cost per square yard on total yardage maintained has varied from \$0.0162 in 1903, due to the small appropriation available for this purpose, to \$0.0827 in 1913; the average for the last fifteen years was a little over five cents per square yard. But this rate does not represent the necessity of repair which the department

PUBLICATIONS RECEIVED

Air Compressors.—Bulletin K-303, issued by the Canadian Ingersoll-Rand Co., Ltd., Sherbrooke, P.Q., describing class EL-2 two-stage straight line air compressor. The bulletin indicates the advantages of tandem arrangement for certain classes of work where economy of space is to be combined with the convenience of two-stage compression. It gives details of construction, including leaf valves and other features. It is claimed that the short-belt drive with which this compressor can be furnished is an advantage where space is very limited.

Ore and Rock Crusher.—The Jenckes Machine Co., of Sherbrooke, P.Q., have just issued a revised bulletin on their ore and rock crusher. This machine is of the Farrel-Bacon jaw type, having semi-steel frame, semi-steel swing jaw, steel pitman and toggle bearings, and is made in sizes from 10 in. x 7 in. to 42 in. x 36 in. The bulletin includes useful tables on percentages of crushed stone through varying perforations and sizes of crushed stone. The bulletin is distributed by the Canadian Ingersoll-Rand Co., who are sales agents for the Jenckes Machine Co.

SASKATCHEWAN ENGINEERS DRAFT BILL FOR PROVINCIAL LEGISLATION

AT the forthcoming session of the Saskatchewan Legislature, a bill will probably be introduced for the purpose of "closing the profession" within that province. A rough draft of the proposed bill has been prepared by the legislative committee of the Saskatchewan Branch of the Engineering Institute of Canada, and has been sent to other branches of the Institute for discussion and suggestions.

"It should be recognized," says Carl P. Richard, chairman of the legislative committee of the Saskatchewan Branch, "that this draft is admittedly incomplete; the time at the disposal of the committee appointed was very limited and its members are aware that certain sections are capable of improvement and others are yet required.

"For instance, a section defining the conditions under which candidates should be admitted is needed. But this and other points, it is hoped, will be brought out in the discussions by the various branches.

"With regard to section 11, subsections (d) and (e), it should be noted that the aim is to compel such engineers to join the provincial institute and qualify under the residence clauses, hence the limitation of the permit to one year only.

"It is hoped to get this bill into such shape that it can be brought up at the forthcoming session of the Saskatchewan Legislature, and, as uniformity of provincial legislation along these lines is desirable, the Saskatchewan Branch would be glad to have any suggestions or draft bills from the other western branches as soon as possible."

Following is the text of the act drafted by Mr. Richard and the other members of his committee:—

Text of the Draft Act

His Majesty by and with the advice and consent of the Legislative Assembly of Saskatchewan enacts as follows:—

Short Title

1.—This Act may be cited as "The Engineering Profession Act."

Interpretation

2.—In this Act, unless the context otherwise requires, the expression:—

(a)—"Engineer" means any person registered under the provisions of this Act and qualified to practise as an Engineer in Saskatchewan.

(b)—"The Institute" means the Engineering Institute of Saskatchewan.

(c)—"Council" means the Executive Council of the Engineering Institute of Saskatchewan.

(d)—"Chairman" means the Chairman of the said Engineering Institute of Saskatchewan, or the officer presiding for the time being at any general meeting of the Engineering Institute of Saskatchewan.

(e)—"Registrar" means the Secretary-Treasurer and Registrar of the Engineering Institute of Saskatchewan.

(f)—"Board" means the Board of Examiners.

3.—An Engineer in the meaning of this Act is a person equipped with that species of knowledge which qualifies him in the art of economically directing the great sources of power in nature for the use and convenience of man as exemplified in the design and construction of roads, bridges, towns, cities and railways; telephone, telegraph, light and power systems; power

machinery, mining, metallurgical and chemical plants; drawing, planning and laying out of rural and urban settlements; sanitary disposal of human and trade wastes; collection, storage, purification and distribution of public water supplies; fire protection of villages, towns and cities; training and control of rivers, lakes and natural resources; methods of financing the preparation, adoption and construction of all public works; and who is registered under this Act and qualified to practise as an Engineer in Saskatchewan.

The Engineering Institute of Saskatchewan

4.—The Engineering Institute of Saskatchewan hereby incorporated is the Saskatchewan Branch of the Engineering Institute of Canada heretofore incorporated (See Session of 1918 Dominion House), under the name and style of The Engineering Institute of Canada, and all Corporate Members of the Engineering Institute of Canada, and of the Canadian Mining Institute upon being duly registered as hereinafter provided, and all other persons who shall hereafter be duly registered shall while so registered be members of and form the Engineering Institute of Saskatchewan, and the said Institute shall be a body politic and corporate with perpetual succession and common seal.

5.—The Institute shall have power to acquire and hold real estate and to alienate, mortgage, lease, or otherwise charge or dispose of such real estate or any part thereof as occasion may require; and all fees, fines and penalties receivable and recoverable under this Act shall belong to the Institute.

By-Laws

6.—The Institute may pass by-laws not inconsistent with the provisions of this Act, for:—

(a)—The government, discipline and honor of its members;

(b)—The management of its property;

(c)—The maintenance of the Institute by levying contributions or otherwise;

(d)—The examination and admission of candidates for the practise of the profession.

(e)—All other purposes reasonably necessary for the management and working of the Institute.

(f)—All by-laws or changes thereto shall be prepared by the Council, and shall, before becoming effective, except as hereinafter provided, be ratified by two-thirds majority of the members of the Institute in good standing.

(g)—Provided, however, that the Institute at any annual or special meeting may pass resolutions for the guidance of the Council in the preparation of the by-laws, which resolution may be either imperative or advisory, or both, and any by-law prepared and passed by the Council in accordance therewith and not inconsistent with the provisions of this Act shall become effective on the passing thereof or according to the terms and conditions recited therein.

Executive Council

7.—(a)—There shall be an executive council for the management of the Institute to consist of a chairman, vice-chairman, registrar and five councillors, to be elected and hold office as hereinafter provided.

(b)—A chairman shall be elected yearly, and he shall act as presiding officer at all meetings of the Executive Council and Institute; voting only when the votes are evenly divided. He shall countersign all certificates, cheques and official documents of the Institute. On re-

tirement he shall hold office as councillor for the next succeeding year.

(c)—The vice-chairman shall be elected yearly, and shall have all the powers of the chairman during the absence of the latter.

(d)—A registrar shall be elected yearly, and shall also be the secretary-treasurer. His duties shall be to attend all meetings of the Council and Institute; keep accurate and approved minutes of all such meetings; keep a set of books showing the financial condition of the Institute, a register of all members—their residence, occupation, and a synopsis of their engineering experience. He shall sign all certificates, cheques and official documents of the Institute, and at the end of each fiscal year he shall prepare a financial statement of the affairs of the Institute countersigned by two auditors. He shall be bonded for the sum of \$1,000. He shall also perform such duties as directed by the Council. He shall receive such remuneration as directed from time to time by the Council.

(e)—Five councillors shall be elected by a majority vote of the members of the Institute for the first year after the coming into effect of this Act. Thereafter only three members each year shall be elected. The councillor receiving the largest number of votes at each annual election shall act for two years. The retiring chairman shall constitute the fifth councillor.

(f)—Two auditors shall be elected at each annual meeting, and they shall audit the accounts and books of the Institute for the ensuing year.

8.—The functions of the Council shall be:—

(a)—To carry on the business of the Institute.

(b)—To adjudicate on such matters as are referred to it for decision.

(c)—To supervise the register kept by the registrar.

(d)—To make such schedule or schedules of minimum fees to be charged for engineering services rendered under the provisions of this Act.

(e)—To prepare the by-laws of the Institute, subject to their ratification by the members.

(f)—To formulate and enforce a code of professional conduct.

(g)—To suspend or dismiss a member for malpractice as hereinafter provided, or on conviction of a criminal offence.

(h)—To draw up an annual report on the affairs of the Institute for submission to members at the annual meeting.

Meetings

9.—(a)—The Annual General Meeting of the Institute for the transaction of business and election of officers and members of the Council shall be held at such place and time as the Council may appoint. Due notice of such meeting shall be given by the registrar to each member of the Institute by circular letter mailed to his registered address not less than two weeks previous to such meeting. Fifteen members to form a quorum.

(b)—Special general meetings of the Institute may be called when deemed necessary by the Council, or on written request of five members addressed to the registrar setting forth the reason and object for such meeting. The registrar shall thereupon give due notice of such meeting to each member of the Institute setting forth the object of the meeting.

(c)—Meetings of the Council shall be held when necessary. At least six meetings shall be held each year. Three members of the Council shall form a quorum at such meetings.

10.—All elections under this Act shall be by ballot in the manner according to the by-laws of the Institute.

Who May Practice

11.—(a)—Only such persons shall be entitled within the Province of Saskatchewan to take or use the name and title of "Engineer," or any abbreviation thereof, either alone or in combination with any other work or words, or any name, title or description implying that he is a member of the Institute, or act as engineer in designing, laying out, advising on, constructing or superintending the construction of any public work or any work upon which public money is expended, the cost of which shall exceed \$500, who are members of the Institute hereby incorporated and registered as such under the provisions of this Act.

(b)—Practicing Engineers in Saskatchewan who are not members of the Engineering Institute of Canada may be registered within one year of the passing of this Act without having to submit to examination provided that their credentials are approved by the Board. In case of men from Saskatchewan on active service having approved credentials, the year for registration is to date from their return to Saskatchewan.

(c)—Non-resident corporate members in good standing of the Engineering Institute of Canada, and Canadian Mining Institute, shall, on payment of the prescribed dues, be granted a permit to practice for a period not exceeding one year.

(d)—Qualified engineers who are members in good standing of British or Foreign Engineering Institutes and Societies, upon presentation of qualifications satisfactory to the Council, and upon payment of the prescribed dues, shall be granted a permit to practice for a period not exceeding one year. Such permits are not to be renewed except to allow for consideration by the Council of the Engineering Institute of Canada of a bona fide application for admission to the Engineering Institute of Canada.

(e)—Non-resident consulting engineers shall be given temporary permits by the Institute in case of employment by cities, corporations or any public body, but such engineers shall only act in an advisory capacity to an engineer registered under this Act.

Residence Within Saskatchewan

12.—No engineer shall be registered under this Act unless he establish an office or take up his residence in the Province of Saskatchewan, except:—

(a)—Engineers holding temporary permits as hereinafter provided.

(b)—Consulting engineers holding temporary permits as hereinafter provided.

(c)—Engineers employed by the Government of Saskatchewan, urban or rural municipalities, public or private corporations, shall be deemed to have an office and be resident if registered as being employed in the Province of Saskatchewan by the above bodies.

Partnership

13.—In case of two or more engineers carrying on their practice in co-partnership, each person whose name appears as a member on the firm shall be registered under this Act.

Corporations and Joint Stock Companies

14.—No Corporation or Joint Stock Company shall be registered under this Act, but such Corporation or

Joint Stock Company may employ duly registered engineers to act as executive engineers.

Advertising

15.—It shall be unlawful for any person not registered under this Act to advertise or put out any sign or other device for the purpose of or a view to indicating to the public that he is entitled to practice as an engineer within the meaning of this Act.

Seal

16.—Every engineer registered under this Act shall have a seal, the impression of which must contain the name of the engineer, his place of business, and the words "Registered Engineer, Saskatchewan," with which he shall stamp all engineering reports, working drawings, tracings, specifications and contracts prepared and issued by him for use in the Province of Saskatchewan.

Suspension for Misconduct

17.—(a)—The Council may, in their discretion, fine, suspend, or fine and suspend, or dismiss from the Institute any Engineer guilty of negligence or misconduct in the execution of the duties of his office; the Council shall not take any such action until a complaint under oath has been filed with the registrar and a copy thereof forwarded to the party accused, except in a matter which has transpired or been brought to light by testimony under oath before the board of examiners, when a formal complaint in writing, signed by the chairman or two members of the board, shall be a sufficient ground of action. The Council shall not suspend or dismiss an engineer without having previously summoned him to appear to be heard in his defence, nor without having heard any evidence under oath offered in support of the complaints or on behalf of the Engineer. The chairman of the Council, or person acting as such in his absence, or the secretary, is hereby authorized to administer oaths in such cases. All evidence shall be taken in writing or by a duly qualified stenographer.

(b)—Any Engineer so suspended or dismissed may, within thirty days after the order or resolution of suspension or dismissal, appeal to a judge of the Supreme Court from such order or resolution, giving seven days' notice of appeal to the Council, and may require the evidence taken to be filed with the proper officer of the court, whereupon such judge shall decide the matter of the appeal upon the evidence so filed, and confirm or set aside such suspension or dismissal as to him may seem just, without any further right of appeal; and if the suspension or dismissal be confirmed, the costs of such appeal shall be borne by the Engineer.

(c)—Unless the order or resolution of suspension is set aside on such appeal, or the judge or the Council otherwise order, the Engineer so suspended or dismissed shall not practise further except (in case of suspension) upon expiry of the period of suspension. Pending an appeal, the Engineer so suspended or dismissed shall not practise.

(d)—The Council may suspend or dismiss from the Institute any member convicted of a criminal offence by any court of competent jurisdiction, and may remove his name from the register.

Penalties

18.—Any person offending against any provision of this Act shall be liable on summary conviction to a fine of not less than \$25 and not more than \$100 for every

day during which such offence continues, and in default of payment, to imprisonment not exceeding six months. And no fee charged for work done in contravention hereof shall be recoverable.

Evidence

19.—The certificate of the registrar under the Seal of the Institute shall be prima facie evidence of registration or non-registration, as the case may be.

Examinations

20.—(a)—Examinations for admission of candidates to the Institute shall be conducted by a Board of Examiners composed by two members of the Institute to be appointed by the Council, and two members of the engineering faculty of the University of Saskatchewan, which Board shall be under the chairmanship of the Dean of the engineering faculty of the University of Saskatchewan. The Chairman of the Board shall only vote when there is a tie.

(b)—The registrar shall act as secretary to the Board of Examiners.

(c)—Examinations shall be held at the University of Saskatchewan at such times as specified by the Council.

(d)—Each member of the Board before assuming the duties of an examiner shall take and subscribe an oath of office in the Schedule of this Act before a Notary Public or Commissioner for Oaths, which oath shall be filed with the registrar and kept with the records of the Institute.

(e)—Fees to be charged for examinations shall be fixed by the Board.

GOVERNMENT SHOULD NOT BUY G.T.R., SAYS LORD SHAUGHNESSY

"FOR the government to take over the Grand Trunk Railway would be an act of stupendous folly," said Lord Shaughnessy, upon his return to Montreal, after an 8,000-mile inspection trip.

"This is a democratic country," continued his lordship, "and if the people say they want to own a railway—they must get it. Whether that is wise or not is not the question, as far as the democracy is concerned; but I simply remark that in taking any steps toward the nationalization of the railways of this country, the greatest caution should be observed, considering the great interests that are at stake and the economic and financial fabric which might be thereby endangered. Now the government has gone a certain length in the process of nationalization, and it may feel, under the pressure of circumstances, that it may have to go further. It may feel that it must take over the Grand Trunk Pacific; but to take over the Grand Trunk would, in my opinion, be an act of stupendous folly.

"The Grand Trunk is a great international system, rendering important service—rendering reciprocal service, with its feeders, as between the eastern and western states, and occupying a vital position in the transportation interests of the country. In other words, the Grand Trunk is a great transportation entity, rendering service which is indispensable. The Grand Trunk Pacific was undertaken by a certain management, which, in a measure, had the project forced upon it by a government then in power, which was more incompetent than the management of the road that consented to it.

"But, of course, if the people express a desire for a particular policy, railway or other, the will of the people must prevail, but one may express the hope that in the working out of this nationalizing policy—if that be what the government is committed to—that regard will be had to the vital interests at stake, and that caution shall wait upon the actions to be taken in the premises."

ONTARIO WORKMEN'S COMPENSATION*

By Samuel Price

Chairman, Ontario Workmen's Compensation Board

THE Workmen's Compensation Act now in force in the Province of Ontario came into effect in 1915. It made a radical change in the rights of workmen and the liability of employers in respect to accidents. In the industries to which it applies, the right of the workman is no longer founded upon negligence or breach of duty of the employer; it is enough if the accident arises out of and in the course of the employment. The injured workman is entitled to 55 per cent. of the amount of earnings he loses, or of the amount it is estimated he is likely to lose, by reason of the injury, or in fatal cases his widow and children or other dependants are entitled as provided in the act. The award is made by the Workmen's Compensation Board, and no action lies in the ordinary courts.

This new system of law applies to the industries enumerated in schedule 1 and schedule 2 of the act. The employers coming under schedule 1 are required to contribute to an accident fund out of which the compensation is paid; the employers coming under schedule 2 are individually liable to pay the compensation as accidents occur. (Sections 4 and 5.)

The new law applies to municipal corporations, public utility commissions, other commissions managing or conducting any work or service owned by or operated for a municipal corporation, boards of trustees of police villages, and school boards. I will use the word "municipality" hereafter as including all these bodies.

Municipal Operations Covered

Municipalities are in schedule 2 unless, upon application, the board places them in schedule 1. The law covers, however, only such activities of a municipality as would be covered if carried on by a company or individual—namely, the activities or operations enumerated in schedule 1 and schedule 2 of the act. (Section 2 (2).)

Road and street making and electric power systems, for instance, if the workmen are in the employ of the municipality, are covered, because these operations are included in the schedules of the act; but a fire department or police force is not covered, because they are not included in the schedules of the act.

Among the activities of a municipality which are covered are road, street and sidewalk making and repairing; gravel pits, quarries and stone crushing; bridge building; construction and operation of electric power or light systems, gas systems and street railways; sewer construction; building of all kinds, including repairing; construction and operation of waterworks and municipal abattoirs, where not less than four workmen are usually employed; and street cleaning, scavenging, removal of snow or ice and construction or operation of telephone lines, where not less than six workmen are usually employed.

Among the things not covered are hospitals, police forces, fire departments, markets, public health departments, parks departments, municipal coal and wood yards or stores, jails, poor houses and cemeteries.

For Workmen Only

It is remembered also that even in the departments of work covered persons engaged merely in clerical work and not exposed to the hazards incident to the nature of the work carried on in that department are not covered; thus, a bookkeeper or office hand in the waterworks or street railway department, whose duties do not take him through or around the plant or railway, would not be covered. This is because office help not exposed to the hazard of the industry is not included in the definition of "workman." (Section 2 (1) (p).) The board has held that a meter reader of a gas or electric department is covered, because he is to some extent exposed to the hazard of the gas or electricity.

Mayors, Reeves, members of council and municipal clerks and treasurers are not covered. They are not within the definition of workman. Municipal tax collectors, assessors and solicitors are not considered to be covered. A caretaker or a scrub woman looking after the city hospital or looking after the town hall would not be covered, but a caretaker

or other help employed around the electric plant or gas works would be covered.

Under an amendment passed in 1916 (section 76a), the municipality may apply to the board to have any department of work or service not covered brought under the act and put either under schedule 2 or schedule 1. Under this amendment also the municipality may apply to the board to transfer any department of work or service from schedule 2 to schedule 1, thus converting the individual or direct liability of the municipality to pay for accidents as they occur into a liability to pay an annual assessment to the board and have the board pay for any accidents that may happen. This, in other words, is insuring with the board, and is really better than ordinary insurance, because the municipality is freed from even primary liability for accidents. The board, however, has never accepted applications to place policemen or members of a fire department in schedule 1. This is, because it was felt that the nature of these employments was such that the hazard should not be added to any of the classes of industry in schedule 1. A municipality in schedule 2 may, of course, like any other employer individually liable, insure with an insurance company to indemnify it against any compensation which it may be liable to pay under the act.

Contractors are Separately Liable

It is to be remembered always that it is only workmen in the employ of the municipality that the municipality is liable to pay or provide compensation for. If the municipality lets the work to a contractor, it is the contractor that is primarily liable, but in such case it is the duty of the municipality to see that the contractor pays his assessment to the Workmen's Compensation Board, otherwise the municipality is itself liable to pay it. (Sections 10 (3) and 98.)

In addition to paying compensation to injured workmen, the act also requires the employer in schedule 2 cases, and the board in schedule 1 cases, to provide all injured workmen with necessary medical and surgical aid and hospital and skilled nursing services for a period not exceeding one month from the date of disability. If the municipality fails to furnish this where under obligation to do so, it will be liable to pay for necessary medical aid services procured by the workman or anyone in his behalf. (Section 44a.)

Municipalities under schedule 2 that have accidents are also liable to pay to the board their proportionate contribution toward the small balance of administration expenses not provided for by the government. Last year this amounted to the rate of \$1.40 for each ordinary accident, a death claim, however, being reckoned as equivalent to five, and a permanent disability case to three ordinary accidents. The board notifies the municipality of the amount. (Section 103.)

It may be of interest to mention that during 1917 there were 38 municipalities in the province that had accidents for which compensation was awarded. The total number of municipal accidents compensated during 1917 was 173, of which 157 involved only temporary disability, 16 permanent disability and 11 were death cases. The compensation during the year amounted to about \$40,000. The amount of compensation awarded by the board in all industries under its jurisdiction during 1917 was \$2,913,085.81.

Award in Six Days

When an accident occurs, the municipality is required by the act to notify the board of it within three days. (Section 99.) Upon receiving notice of the accident blank forms for the necessary information are sent by the board to the employer and the workman, to be filled out and returned. A form is also sent for a report from the attending surgeon. Further information is asked for where deemed necessary, or investigation by an officer of the board is made where the circumstances appear to require it. Award is made by the board and notice of it sent to the municipality and to the workman. The municipality may pay the workman the amount direct and forward the board the workman's receipt, or may remit it to the board, making the cheque payable to the workman. If it is a schedule 1 case, the board, of course, itself pays the compensation. The average time elapsing between completion of reports and the making of the first award by the board is six days. Further bi-weekly awards are made on the day they fall due if the information warrants.

Where the injury results in permanent partial disability, that is dealt with after the close of the temporary total or temporary partial disability, and after the workman has

(Concluded on page 338)

*An address delivered at the Convention of the Ontario Municipal Association.

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FERTILIZER FROM SEWAGE SLUDGE

ORGANIC suspended matter in sewage is conserved by the activated sludge process. By dewatering the sludge it can be converted into a valuable fertilizer. This was demonstrated fully by Col. Nasmith's experiments, described in our issue of May 2nd, 1918. In editorial comment published in that issue it was said:—

"It now remains for someone to solve the problem of dewatering activated sludge, in order to make its use commercially feasible. With the world's growing knowledge of the chemistry of colloids, the solution of the dewatering problem may not be far distant."

Since the publication of the above-mentioned article there has been received the fourth annual report of the Sewerage Commission of the city of Milwaukee, Wisconsin, in which is recorded experiments in the reduction of sludge to fertilizer by means of preliminary and secondary sedimentation, pressing and drying.

The liquors in the aeration tanks contain suspended matter and water in mixtures varying from 99.4 to 99.8 per cent. of moisture. By passing the liquors through settling tanks, the moisture was reduced to 96 per cent. or slightly less. Sulphuric acid mixed with sludge tends to dehydrate the sludge if the mixture is heated. Settled sludge containing about 98 per cent. moisture was dewatered in 2 1/4 hours to 91 per cent. by the acid process, but the expense is said to be \$2.00 per million gallons of sewage treated.

Experiments made last summer in pressing sludge in a Worthington Press and in a Simplex Plate Press

showed that the moisture can thus be reduced to 80 per cent. or a little less. But press cake carrying 75 to 80 per cent. of water cannot be sold as fertilizer. It must be dried to 10 per cent. of moisture.

During 1917 the Milwaukee commissioners dried several tons of press cake in a small, experimental, semi-direct heater. The fertilizer obtained carried 4 to 18 per cent. moisture. Experiments, it is announced, had previously been tried with an indirect dryer, obtaining fertilizer with from 4 to 10 per cent. moisture. This latter product had a good value as plant food and was produced without creating a bad odor or nuisance from dust. The semi-direct heater was not provided with suitable gas cleansing apparatus, therefore objectionable odors escaped. By washing and burning the gases, as is done by some packing houses and other manufacturers of fertilizers, or by mixing with the gases the fumes of burning creosote and then discharging the mixture into the stream of sewage about to undergo purification, it is thought that odors could be avoided sufficiently to permit the successful use of semi-direct heaters.

Tests of the dried fertilizer showed that it contained 4.4 per cent. of nitrogen, figured as ammonia, on a basis of 10 per cent. moisture. These results are very satisfactory if they have been economically successful. Unfortunately, the Commission gives no idea of the cost of the whole process as compared with the commercial value of the product. We would suggest that an accurate account of costs be kept in future experiments and that a balance sheet be included in the next annual report, showing income from sale of fertilizer, cost of its production and profit and loss. Of course, such a balance sheet would be fair to the process only in case the experiments be enlarged upon a commercial scale. A balance sheet covering operations with a small, experimental plant would be of little value as a criterion of the practicability of the scheme's commercial application.

Milwaukee has been a leader in experiments with activated sludge. Sewage disposal owes much to T. Chalkley Hatton and the other engineers associated with him. It is to be hoped that they can obtain sufficient funds from the Commission to undertake upon a small commercial scale the manufacture of fertilizer from activated sludge. If they could make such an undertaking a practical success, the world of science would be still further indebted to them.

CENTRAL EMPLOYMENT SERVICE

SHORTAGE of man-power in war industries, aggravated by an almost universal practice of labor stealing and poaching, has necessitated drastic innovations in the United States in order to protect both employers and employees, to lessen unnecessary and expensive turnovers, and to increase the production of essentials.

The United States War Labor Policies Board, with the approval of President Wilson, has centralized in the United States Employment Service of the Department of Labor all problems relating to the supply of common labor. Independent recruiting of unskilled workmen by manufacturers employing more than 100 men can no longer be generally done, although there are certain exempted cases. Labor must be recruited with the knowledge and co-operation of the United States Employment Service, in order to prevent any community from being drained of labor, and in order to use local supply so far

as possible for local demand. It is expected that the ruling will soon be extended to include all classes of skilled labor.

The necessity for this regulation is evident when in Pittsburgh, for instance, there are advertisements urging men to go to Detroit, while in Detroit street cars are posters asking men to go to Pittsburgh. Constant shifting of labor cannot fail to have a deteriorating effect on economic effort.

Personal liberty is not seriously affected, however. Anyone is free to quit his position and go elsewhere in search of work, but employers are forbidden to solicit such moves by advertisements or personal canvassing or by any other means.

By means of an order-in-council, Canada should follow this United States example. Most Canadian manufacturers are strongly in favor of such an order being issued at once. Conditions are becoming worse right along. Many manufacturers are losing and hiring hundreds of men every month. One prominent Canadian munition manufacturer states that his whole force of fifteen hundred men is entirely replaced at least every three months.

PERSONALS

CAPTAIN FRÉDÉRIK ALFRED DALLYN, C.E., sanitary engineer of the Ontario Board of Health, left Toronto last week for Siberia, where he will be in charge of water

supply and housing in connection with the Canadian Expeditionary Force. Captain Dallyn has received a staff appointment in the Canadian Army Hydrological Corps. He was born June 6th, 1885, at Hamilton, Ont., and was educated in the public and high schools of that city. He graduated with honors in the class of 1909, Faculty of Applied Science, University of Toronto, and the



following year was a post-graduate student in sanitary engineering. After graduation he had charge of the Board of Health's experimental station at Toronto, and two years later he was appointed provincial sanitary engineer.

ALBERT E. GHYSENS has been appointed engineer for the city of Verdun, P.Q., in succession to A. S. Clarson, who has resigned.

H. B. STEVENS, of the Canadian Pacific Railway System, has recently been appointed assistant superintendent at Havelock in place of R. G. Edwards.

HON. C. A. MAGRATH, fuel controller of Canada, has returned to Ottawa from Nova Scotia, where he was called in connection with the strike in the Pictou field.

Mr. Magrath has announced that the strike has been settled.

W. McNAB, valuation engineer of the Grand Trunk Railway, has been appointed chairman of the valuation committee, which is formed of Grand Trunk officials, in accordance with the act of the United States Congress directing the Interstate Commerce Commission to secure the valuation of all the property owned or used by the common carriers. The Grand Trunk Railway comes under this act, being owners of lines in the United States. Arthur Crompton succeeds Mr. McNab as valuation engineer.

OBITUARY

LIEUT. SYDNEY ALBERT LANG has died in the officers' hospital, St. John, Quebec, of Spanish influenza. He had been serving with the Canadian Engineers in St. John, New Brunswick, for the last year, never being able to go overseas on account of a defective knee. In 1913 he graduated in engineering at Toronto University and went to Chili, South America, as a mining engineer, returning to Toronto a year ago for the purpose of enlisting in the Canadian army. He joined as a private, but was only a short time in the service when he was given a commission in the Canadian Engineers.

ONTARIO WORKMEN'S COMPENSATION

(Continued from page 336)

recovered from the injury as fully as he is likely to recover. Awards for serious permanent disability and awards to widows and children are in the form of a monthly pension.

The outstanding features of the present law are its simplicity, speed and inexpensiveness. The intricacies and technicalities of the old law and procedure have been abolished. Legal assistance is unnecessary. The board insists upon dealing directly with the parties. We eliminate the lawyers not because we object to them—personally I would rather deal with them than with any other class of the community—but because the intention of the act is to make their services and the consequent expense unnecessary. Under the present law compensation to workmen for accidents in their employment has become the general rule rather than the exception; the employer is no longer troubled with vexatious litigation; there are no costs and expenses; and practically everything paid by the employer goes direct to the workman or his family.

Employees not covered by the new system of law may pursue actions for damages against their employer in the ordinary courts, and in several respects their case there is made easier than it used to be by the provisions of sections 106 to 108 of the Workmen's Compensation Act. With this, however, the board has nothing to do, except that in case any question arises as to the right to pursue such action that question is to be determined by the board. (Sections 15 and 64 (4).)

The workman's right to bring an action against a party other than his employer, where such party has caused the accident, also still continues, except where that party is an employer in schedule 1, and where such a right of action exists he must elect whether he will pursue it or claim compensation through the Workmen's Compensation Board. If he does the latter the employer in schedule 2 cases and the board in schedule 1 cases, is subrogated to his rights against the third party. (Section 9.)

The seven building inspectors employed by the city of Montreal have all received notice to tender their resignations, as the city commissioners desire to reduce the staff to five. A competitive examination will be held to determine the five who will be re-appointed.