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The Canadian Engineer

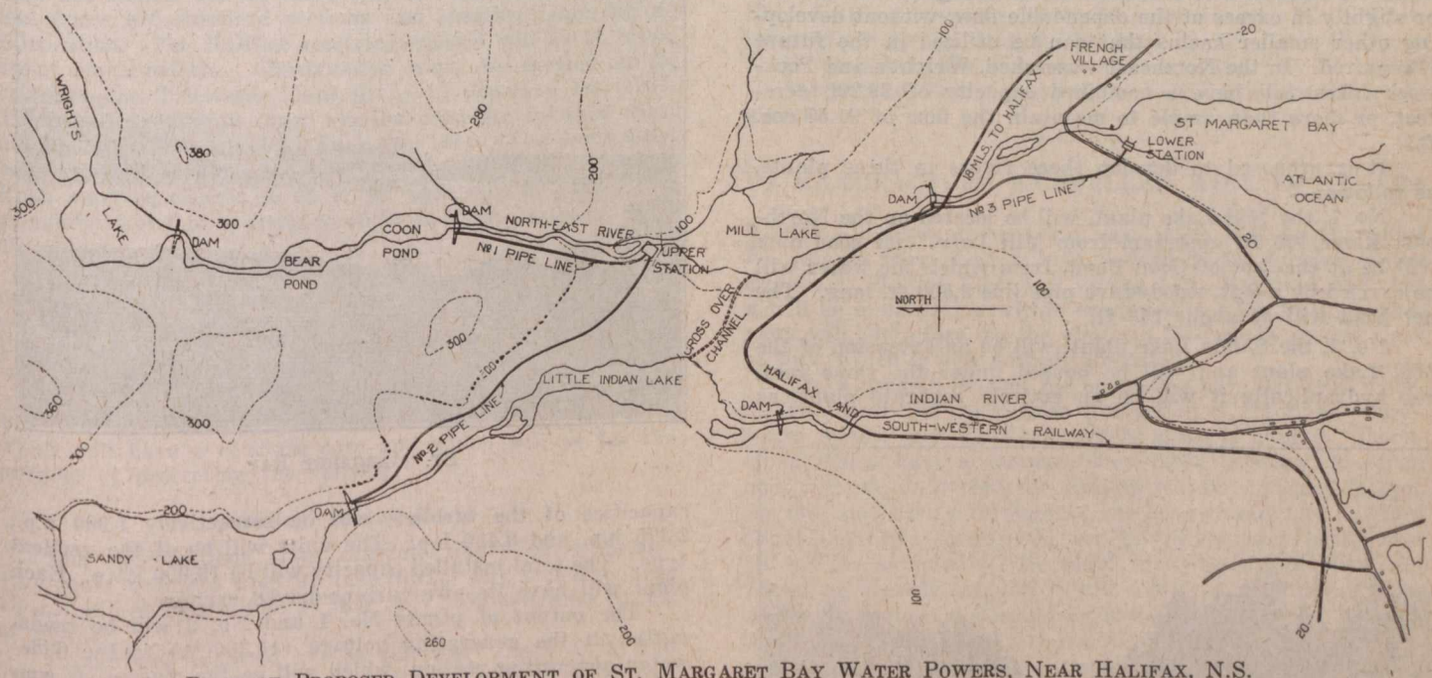
A Weekly Paper for Civil Engineers and Contractors

Proposed Power Developments Near Halifax

Northeast and Indian Rivers to be Developed in Two Stages by Nova Scotia Power Commission—Generating Capacity to Total 13,000 K.V.A.—Three Hydraulically Independent Plants Served by Separate Dams and Wood-Stave Conduits

DEVELOPMENT of the Northeast and Indian rivers, at a cost of approximately $1,050,000, will be started at an early date by the Nova Scotia Power Commission and will provide the city and district of Halifax with about 10,500 h.p., which will likely be sold at about one cent per kilowatt-hour. Tenders are now being received for the hydraulic and electrical machinery and for the construction of the first two of the three parts into which the development is grouped.

About 18 miles due west of Halifax, the Northeast River flows into St. Margaret Bay, an arm of the Atlantic Ocean. Roughly paralleling it, and about a mile farther west, is the Indian River. Both rivers are on the southern slope of the Nova Scotian peninsula and extend northward to a height of land about 500 ft. above sea level.



PLAN OF PROPOSED DEVELOPMENT OF ST. MARGARET BAY WATER POWERS, NEAR HALIFAX, N.S.

The watersheds of the Northeast and Indian rivers adjoin throughout their length and are respectively 35.5 and 68 square miles, measured above the Halifax & Southwestern Railway. Both watersheds are well forested, rough, rocky and but sparsely settled. Northeast River is approximately 17 miles long and the Indian River 19 miles. Both have lakes that are excellent for storage purposes. In the Northeast watershed, Wright's Lake and Pockwock Lake, farther north, are especially adaptable to water conservation. In the Indian watershed, Five-Mile, Big Indian and Island lakes are the principal ones for storage purposes

Run-off data for the past four years have been obtained by the Nova Scotia Water Power Commission in co-operation with the Water Power Branch of the Department of the Interior, and show that the mean discharge of the Indian River for the year ended September 30th, 1916, was 191.7 sec. ft., or 38.29 ins. on the drainage area; for the year 1917, 39.5 ins.; for 1918, 38.88 ins.; for 1919, 41.66 ins.; or 39.58 ins. average for the four years.

The Meteorological Service Station at Halifax has compiled records of precipitation for the past 51 years, over which period the average has been 55.98 ins.; the lowest, 46.11 ins.; the highest, 68.27 ins. The variations from the average have not been great; the lowest was 82.3% of the average. The four-year period, 1914-8, was a cycle of low precipitation. The average for the four years ended September 30th, 1919, was 52.15 ins. Therefore the run-off records above mentioned show that for these four years the run-off was about 76% of the precipitation.

Making allowance for greater evaporation due to the creation of storage lakes of larger area than the natural lakes, it is estimated that the run-off will be 70% of the precipitation. Based upon the records for the past 51 years, it is assumed that a precipitation of 50 ins. is assured, as the average for 51 years was 55.98 ins., and in only 5 years of the 51 was the precipitation less than 50 ins., whereas for 9 years it was over 60 ins. It was less than 50 ins. in 1875, 1881, 1905, 1917 and 1918. In 1919 it was 59.3 ins. A run-off of 35 ins. is therefore assumed as a conservative figure.

As the run-off on the Northeast watershed is difficult to measure owing to several mills and storage lakes which introduce elements affecting the daily flow and for which

allowance cannot properly be made with accuracy, the run-off assumed for the Indian River, 35 ins., is also assumed to be assured for the Northeast River, as the conditions in the two watersheds are practically identical. With a watershed of 35.5 sq. mi. and run-off of 35 ins. over the drainage area, the Northeast River will discharge 91.57 sec. ft. With a watershed area of 68 sq. mi., the Indian River will discharge 175.4 sec. ft.

By the use of three lakes in the Indian watershed, a storage capacity of 45,300 acre-feet can be secured, or sufficient to take care of a continuous discharge of 180 sec. ft., or slightly in excess of the dependable flow, without developing other smaller basins that can be utilized in the future if required. In the Northeast watershed, Wright's and Pockwock lakes will have a combined capacity of 29,200 acre-feet, or more than ample to maintain the flow of 91.57 sec. ft.

NORTHEAST RIVER, FLOW IN JANUARY, 1912

It is proposed to develop these rivers in three plants, as follows:—

No. 1, the Mill Lake plant, will be located on the Northeast River 500 ft. upstream from Mill Lake. Its head dam will be at the foot of Coon Pond, from which the water will be carried by a 6-ft. wood-stave pipe line 3,500 ft. long. The net head will be about 156 ft.

No. 2, the Sandy Lake plant, will be an extension of the Mill Lake plant and will be housed under the same roof, but hydraulically it will be an entirely separate plant, as it will receive its water from a head dam at the foot of Sandy Lake, in the Indian watershed, through a 7-ft. wood-stave pipe line 6,000 ft. long. The net head will be about 97 ft.

INDIAN RIVER AT FOOT OF SANDY LAKE

No. 3, the Tidewater plant, will be built on the shore of St. Margaret Bay and will receive its water from a head dam at the foot of Mill Lake, through a 10-ft. wood-stave pipe line 3,500 ft. long. The net head will be about 91 ft.

At the present only plants No. 1 and No. 3 will be built, although the foundations and tail-race excavation for plant No. 2 will be completed. In order to divert the flow of Indian River to No. 3 plant prior to the construction of No. 2 plant, a dam will be built at the foot of Little Indian Lake and a cross-over channel will be cut from Little Indian Lake to Mill Lake, the latter being at a lower elevation. This dam and channel will be useful even after the construction of plant No. 2, to divert to Mill Lake the drainage of the Indian watershed below the Sandy Lake dam. It will be noted that in the final development, the water of both the Indian and Northeast rivers will pass through two plants, as Mill Lake, which will be head pond for plant No. 3, will also be the tail-water for plants No. 1 and No. 2.

The watersheds above the head dams for plants No. 1 and No. 2 are respectively 33.89 sq. mi. (Northeast watershed) and 66.4 sq. mi. (Indian). Making allowance for this difference as compared with the 35.5 and 68 sq. mi. that the watersheds measure above the points previously assumed (Halifax & Southwestern crossings), the regulated flows are estimated at 85 and 171 sec. ft. respectively. Plant No. 3 receives the combined run-off of the whole of both watersheds or 267 sec. ft. The utilization of these flows at the net heads previously mentioned, which will obtain under average conditions of operation, will warrant the installation of two 1,600 k.v.a. units in plant No. 1, two 2,000 k.v.a. units in No. 2, and two 2,900 k.v.a. units in No. 3. The capacities of the turbines will be respectively 1,900 h.p., 2,375 h.p. and 3,450 h.p. The units will be of the vertical type. The total installed capacity will be 13,000 k.v.a. Each plant will have its own turbine-driven exciter.

ST. MARGARET BAY

The output of plants No. 1 and No. 2 will be transmitted at the generating voltage (13,200 v.) to the Tidewater generating station, which will be the master, or control station, and, from there it will be transmitted, along with the output of plant No. 3, by two lines to a receiving station in Halifax, from which it will distribute at the same voltage. Tenders are now being received for the construction of this receiving station.

The present construction work will include two power dams,—at Coon Pond and Mill Lake. The Coon Pond dam will be 24 ft. high (maximum) and 350 ft. long. It will be mass concrete, with overflow weirs and sluices, and will provide the intake for the wood-stave conduit. The intake will contain trash racks, water control gate, etc., and will be housed. The pipe line to the Mill Lake generating station will be on timber cradles on a graded route, and at the station there will be a differential surge tank.

The Mill Lake power dam will be built a short distance above the railway bridge. It will also be mass concrete, with overflow weirs and sluices and intake for the conduit leading to the Tidewater plant. This dam will be approximately 20 ft. high (maximum) and 450 ft. long.

The main storage dams for No. 1 plant are at Pockwock and Wright's Lake. The Pockwock dam will be about 1,150 ft. long and of height sufficient to effect 12 ft. storage on the lake. This will be a timber dam. The Wright's Lake dam has already been built by the Halifax Power Co., a company which started to develop the Northeast River a few years ago. It consists of concrete weirs and sluiceway and a concrete-cored, earth-filled dam. The small dam at the foot of Little Indian Lake will be of timber construction.

When No. 2 plant is built, the power dam at the foot of Sandy Lake will be a concrete-cored earth dam with concrete overflow weirs, sluiceway and intake. The dam will be 320 ft. long on the crest and the extreme height above river bed will be 27 ft. The pipe line to No. 2 plant will have a surge tank separate from that on No. 1 pipe line.

The main storage dams for No. 2 plant will be at Big Indian, Island and Five-Mile lakes. The latter two will be low timber dams, but the Big Indian dam will be 25 ft. high (maximum) and 1,200 ft. long, of timber construction with earth embankment and a puddled clay core wall.

A surge tank will be built on No. 3 pipe line approximately 400 ft. from the generating station. Where emerging from the dam, the conduit will be protected from flood by a wall in the stream bed and will be carried beneath the railway in a new culvert.

Must Be Completed This Year

The generating stations will have isolated massive foundations for the generating units, and heavy concrete wall construction. The widths of buildings and lengths of bays are similar for all three plants. The beams for roofs and floors are standard sections and lengths, requiring no fabrication. The Halifax receiving station will be of brick, stone and concrete. Construction must be carried on to complete the Tidewater plant first,—by January 1st, 1921. The receiving station must also be complete by that time, and the Mill Lake plant by June 1st, 1921. The dams must be completed in time for handling flood water in season. Bush must be cleared to 25 ft. on each side of centre line of conduits and to a distance of 20 ft. from walls of other structures.

The sea face of the Tidewater station will be approximately on the mean tide shore line. Cofferdams required can be built on dry bottom at low tide. The tail-race excavation beyond low tide line will not exceed 2 ft. below low tide level.

The wing wall for the Mill Lake dam parallels the railway, and train fill may be utilized in constructing the wall, which will have a concrete core and which will be for the purpose of protecting the railway.

Specifications and Costs

The specifications class concrete under three heads: (A) Mass concrete over 27 ins. thick; (B) concrete over 10 ins. and not more than 27 ins.; (C) thin concrete, 10 ins. or thinner.

Proportions required are as follows: Class A, 1:3:5 (broken stone) or 1:7 (gravel); class B, 1:2½:4½ or from 1:6 to 1:5; class C, 1:2:4 or from 1:5 to 1:4.

For use in dam sections, buttresses, piers, heavy walls and foundations, the stone must pass through a 2½-in. ring. For use in walls, etc., 15 ins. thick or less, the stone must pass through a 2-in. ring; for use in floors and slabs, a 1-in. ring.

The power plant roofs are to be of concrete, surfaced with an approved standard roofing, subject to a 20-year bond.

Minor equipment and construction to be supplied by the Nova Scotia Power Commission and not to be included in the general contract for which tenders are now being received, include steel pipe distributors,—that is, two lengths of steel pipe from each conduit to the main turbine valves; steel thimbles for pipe connections (one 72-in. and one 120-in. thimble to be placed at the respective intake houses); electric water heater device to be installed on water service in generating and receiving stations; two 24-in. corrugated iron culverts for pipe line fills; excavation and culvert for pipe crossing under the Halifax & Southwestern Railway, below Mill Lake dam; excavation and culvert for pipe crossing under Coast Road nead Tidewater generating station; cross-over channel from Little Indian Lake to Mill Lake; and the dam at the foot of Little Indian Lake.

Sidings are now in place at French Village station and near Little Indian Lake on the Halifax & Southwestern Railway, and good roads lead from the sidings to Tidewater station, Mill Lake dam and Coon Pond dam. A short road will have to be built to Mill Lake generating station. The pipe line from Coon Pond to Mill Lake has already been graded for nearly the whole distance by the Halifax Power Co.

The estimated cost of the entire development is $1.-050,000; and of plants No. 1 and No. 3, $767,000. The latter figure includes Mill Lake dam, No. 3 pipe line, Tidewater generating station and equipment, storage dams on Indian River, cross-over channel, two transmission lines to Halifax, receiving station in Halifax, operators' houses, Pockwock Lake dam, Coon Pond dam, roads and sidings, No. 1 pipe line, No. 1 generating station and equipment, contingencies, engineering, supervision, inspection and interest during construction. The above figures do not include the acquisition of the rights of the Halifax Power Co. and of other required rights, all of which may cost $250,000 or less. Assuming this figure, the yearly operating charges are estimated at $143,500 for plants No. 1 and No. 3, or $180,955 for all three plants, including interest, sinking fund, depreciation, management, renewals and supplies, operating expenses, insurance, etc. This will be between 0.6 and 0.7c. per k.w.h. if all available power be sold.

The members of the Nova Scotia Power Commission are Hon. E. H. Armstrong, of Halifax, chairman; F. C. Whitman, of Anapolis; and R. H. Mackay, of New Glasgow. K. H. Smith is chief engineer and secretary. C. H. and P. H. Mitchell, of Toronto, are the commission's consulting engineers.

TO MANUFACTURE ENAMELLED WIRE IN CANADA

FORMAL announcement has been made that an enamelled copper wire plant is being added to the factory of the Eugene F. Phillips Electrical Works, Ltd., Montreal, and that it will be in operation within two months. The Phillips company will, therefore, be the pioneers in Canada in this class of wire, which is now entirely imported.

The Canadian market for enamelled wire has been growing on account of the greater production of fractional horsepower motors and other coils where space is limited. Enamelling plants have a comparatively large capacity, however, and it is not likely that the demand will be sufficient to keep the new plant busy throughout the entire year, but Lawford Grant, managing director of the Phillips company, states that he will be satisfied if the plant meets only operating expenses at present, because it will complete their line of wire and will produce in Canada an article that has not hitherto been manufactured in this country.

It is rumored that the Canada Wire & Cable Co., Ltd., of Leaside, Ont., also intend to install an enamelled wire plant. Interviewed by *The Canadian Engineer*, F. J. Bell, president of that company, stated that the matter has been under consideration for some time and that the plant is now on order. Delivery is expected within two months. Questioned as to whether there will be sufficient business in this line to keep two plants busy, Mr. Bell stated that there is not at present, but that the demand is gradually growing.

The American Association of Engineers has 15,000 members and 5,000 applications pending. Although one of the youngest, it is now the largest engineering society on the American continent.

The thirteenth annual convention of the Canadian Gas Association will be held August 27th and 28th in Ottawa, Ont. George W. Allen, of the Consumers' Gas Co., Toronto, is secretary-treasurer of the association.

ENGINEERING LEGISLATION MAKING PROGRESS

British Columbia, Manitoba and Quebec Acts Passed—Bills in Alberta, New Brunswick and Nova Scotia Have Received Second Reading—Outlook Favorable

LEGISLATION providing for the registration and licensing of engineers has been introduced in several provincial parliaments within the past few weeks and has made notable progress. Following is a brief review of the status of this effort to increase the prestige of the profession and to safeguard the public against unqualified engineers:—

British Columbia

The bill incorporating the "Association of Professional Engineers of British Columbia" was introduced and read the first time on February 13th. It was reported by the private bills committee on March 4th, given second reading March 19th, and went into committee of the whole on March 24th. It was given third reading and passed on March 29th. Considerable debate took place on the second reading, and at times it was quite stormy. The premier criticized the bill but agreed that he would not oppose the second reading. Several amendments were made in the private bills committee and in the committee of the whole, some of which have been referred to in previous issues of *The Canadian Engineer*. A more detailed review of the amendments will be published in an early issue. The bill as introduced was very similar to the bill introduced in the Alberta legislature, the text of which was published in full in the March 25th issue of *The Canadian Engineer*.

Following is a classification of the engineers who were behind the bill financially, made up from the list as at February 20th:—

Civil engineers, 175; British Columbia land surveyors, 16; electrical engineers, 17; mechanical engineers, 16; mining engineers, 22; draughtsmen, 1; chemical engineers, 5; naval architects, 1; mining surveyors, 2; forest engineers, 1; total, 256.

Although there was considerable objection from certain mining interests, a very representative body of mining engineers were behind the bill, including many of the best known men in the profession. Practically all of the prominent civil engineers in the province supported the bill.

The bill was in charge of Fred. W. Anderson, M.L.A., who is an engineer, and whose active and unceasing efforts prevented the bill from being thrown out or nullified to an even greater extent by more sweeping amendments.

Alberta

The bill incorporating the "Association of Professional Engineers of Alberta," the text of which was published in full in the March 25th issue of *The Canadian Engineer*, has passed the second reading and is through the committee, but still has to pass the third reading. It was so roughly treated in committee that the engineers who sponsored its introduction seriously considered withdrawing it, but as there had been such great difficulty in getting all the various engineering interests to agree on its provisions, the joint committee of engineers in charge of the bill decided to let it go through with a hope of improving it in future sessions. In fact, a fight is still being made to have some of the amendments modified before the third reading.

Practically all of the professional engineers in Alberta are solidly behind the bill. A satisfactory agreement had been made with the Alberta land surveyors and architects, so there was no opposition from those two sources. Unfortunately, however, the house had been stirred to great activity and independent "thought" by a chiropractor's bill which had been submitted and thrown out on second reading, instead of in the private bills committee, which is unprecedented in connection with private bills. The engineers' bill met with strong opposition during the second reading, and a division was necessary to refer it to the private bills committee.

The engineers had not made any lobby. The bill was submitted on its merits. It became apparent immediately when the private bills committee started to work that there was very strong opposition to anything in the way of forming a close corporation. There had been a good deal of misunderstanding about the bill. The idea had gained ground that if the bill passed, a farmer could not build a ditch or a road on his own farm without hiring an engineer. Some of the labor unions thought that the professional engineer was seeking to trespass on their private grounds.

An endeavor was made during two sittings of the private bills committee to fight the bill through as it had been submitted. Then there seemed to be no question but that the committee themselves would either throw the bill out, or else the house certainly would at the third reading. The bill was then changed so that the association of engineers to be formed will be merely a voluntary one, and anyone can practice in the province whether registered or not. The bill now merely patents the name, "registered professional engineer." With this change there was very little opposition to the bill in the committee, and it was finally passed and reported. It is confidently expected that the bill, as it now stands, will be passed in the house.

"Speaking to a number of my friends who are not engineers, but broad-minded men who take a general interest in things," says a Calgary correspondent of *The Canadian Engineer*, "I find that the general feeling is that the engineers could not expect to go before the house and at the first attempt, in dealing with an entirely new subject such as this, hope to get through such complete and comprehensive legislation as was submitted. The feeling seems to be that if the bill goes through as at present, it is all that the engineers could expect.

"The engineers' representative gave warning to the private bills committee that the engineers expect to make the best use possible of the legislation as it has been permitted to go through; that they expect to be able to show by their actions during the next year or two, that examination and registration of professional engineers is a desirable thing, and fully expect to come back to the house in a year or two and ask for amendments to the bill which would make registration compulsory. The bill as passed by the committee and reported to the house, has not been unnecessarily torn to pieces, which will very greatly facilitate the gaining of amendments in future years.

"The following has nothing to do with the Act, but the ideas may be of interest. The average man on the street has a clear conception of the difference between a lawyer and a lawyer's clerk, although it may be argued that the really smart clerk in a lawyer's office is just as good as the lawyer himself. The public understand the difference between a doctor and a chemist. Most people have some idea of the difference between a Royal Academician and a house painter. But when it comes to the engineering profession, the public seem to absolutely fail to distinguish between what would be called a professional engineer and a locomotive engineer, a stationary engineer or even a plumber or gas-fitter.

"There also seems to be a very great lack of appreciation on the part of the public regarding what they owe to the engineering profession. Anybody who will take the trouble to think for a few minutes, will soon see that practically every public utility has been invented, designed and executed by the engineer. Transportation facilities, the telegraph, the telephone,—all have been worked out by the engineer. Tie them up and you would practically tie up the business of the whole world."

Saskatchewan

The proposed bill incorporating the "Association of Professional Engineers of Saskatchewan" has not yet been introduced in the legislature of that province, owing to the antagonistic attitude of the members of that parliament toward legislation benefitting any profession. A committee of the provincial division of the Engineering Institute of Canada, of which Stewart Young, of Regina, is chairman,

has the bill in hand, but after conference with officials of the provincial government, decided that the time has not yet arrived for its favorable reception.

In order to counteract the general public opinion that the bill is for the sole purpose of benefiting professional men, the Saskatchewan branch of the Engineering Institute has requested its papers committee to have a paper prepared on the necessity for legislation for the protection of the public, to be read at a branch meeting next autumn, just prior to the opening of the legislature, which is usually about November 15th. After the paper is read and discussed, endeavors will be made to have it published in as many newspapers as possible.

The Saskatchewan bill, like the Alberta bill, is based on model draft prepared by the legislation committee of the Engineering Institute, excepting that the examination of candidates for admission has been turned over to the University of Saskatchewan, and the right to hold court for disciplinary purposes and to collect fines has been eliminated from the draft. Otherwise, no changes are contemplated so far as the engineers of Saskatchewan are concerned.

Manitoba

Bill No. 100 of the 1920 session of the Manitoba legislature, incorporating the "Association of Professional Engineers of Manitoba," was passed by the legislature of that province on March 24th and all that remains for the bill to become law is the formality of the lieutenant-governor's signature. The bill passed with only two amendments: One increasing the value of "exempt" work from $500 to $1,000; and the other reducing the length of service as an articled pupil from six to four years. Although the Manitoba bill is very similar to that introduced in the Alberta legislature, some of the clauses being identical, in many respects the Manitoba bill differs materially from the Alberta one. Therefore, owing to the importance of the legislation, which will affect every engineer practising to any extent whatever in the province of Manitoba, the Manitoba bill as passed by the legislature will be published in full in next week's issue of *The Canadian Engineer*. The provisional council of the Manitoba association consists of J. G. Sullivan, W. M. Scott, Guy C. Dunn, J. M. Leamy, W. J. Dick and W. P. Brereton.

Ontario

In Ontario the engineers have not yet been able to agree upon a bill for presentation to the legislature. At the invitation of the provincial division of the Engineering Institute, two members have been appointed by each of six other technical organizations to act with two members of the E. I. C. as a joint committee on legislation. This committee has had two meetings and will hold a third on Saturday of this week, but many points must be thoroughly discussed in order to secure the unanimous support of all engineers in the province; therefore, it is unlikely that any bill will be introduced during the present session of the legislature. The members of this committee are as follows: Civil engineers, Willis Chipman and J. B. Challies; mechanical, Chester Hamilton and Prof. R. W. Angus; electrical, R. R. Stevenson and F. R. Ewart; mining, Jas. McEvoy and C. E. Smith; chemical, Profs. J. W. Bain and E. G. R. Ardagh; architects, J. P. Hynes (second member not yet appointed); surveyors, A. J. Van Nostrand and T. D. LeMay. The committee is considering both the draft bill proposed by the Joint Committee of Technical Organizations and the model legislation proposed by the Engineering Institute. (Also see p. 365.)

Quebec

In Quebec, where the Canadian Society of Civil Engineers obtained very broad legislation many years ago, amendments were passed this year which turn the administration of the Act over to the "Corporation of Professional Engineers of Quebec," which corporation has the right to adopt by-laws, to elect a council of eight members, to levy an annual fee for membership, and to safeguard the honour and dignity of its members. The members of the executive committee of the provincial division of the Engineering Institute are the provisional councillors of the new corporation.

New Brunswick

In New Brunswick the model draft recommended by the Engineering Institute's legislation committee has been adopted practically intact by the "Association of Professional Engineers of the Province of New Brunswick," and has been introduced in the legislature of that province by Mr. Campbell, M.P.P. It is confidently expected that it will be passed with little or no amendment. The provisional council is as follows: President, C. C. Kirby, St. John; vice-president, Geoffrey Stead, Chatham; councillors—R. F. Armstrong, Woodstock; C. B. Brown, Moncton; B. M. Hill, Fredericton; D. F. Maxwell, St. Stephen; R. J. Sandover-Sly, Campbellton; A. R. Dufresne, St. John; C. O. Foss, St. John; J. A. Grant, St. John; G. G. Murdoch, St. John. A delegation of these engineers appeared before the committee of the legislature on April 1st, the bill having previously been read for the second time in the house, and met with a favorable reception. After preliminary work, the committee adjourned, but will meet the engineers again this week to complete the work on the bill. A. R. Crookshank, of St. John, is secretary of the new association.

Nova Scotia

Bill No. 18 now before the House of Assembly of Nova Scotia is an Act incorporating the "Association of Professional Engineers of the Province of Nova Scotia." This Act is virtually the same as the draft prepared by the legislation committee of the Engineering Institute. It was read for the first time on March 11th, and for the second time on March 25th, and was then referred to the law amendments committee, before which a delegation of engineers appeared and explained the objects of the bill. Under the leadership of C. E. W. Dodwell and other prominent engineers of Halifax, committees have had interviews with most of the members of both the House of Assembly and the legislative council, and so far have not met with the slightest objection or opposition. The situation, however, is slightly complicated by the fact that the architects of Nova Scotia also have a bill before the legislature, which had its first reading on March 17th, and there is some opposition to the architects' bill which, it is feared, may spread to the engineers' bill. The third reading will probably be passed within a few days, after which the bill goes to the upper house.

The provisional council of the association is as follows: President, C. E. W. Dodwell, Halifax; vice-president, D. A. MacDougall, New Glasgow; councillors—J. L. Allan, Dartmouth; F. A. Bowman, Halifax; T. J. Brown, Sydney Mines; F. W. W. Doane, Halifax; A. F. Dyer, Halifax; F. R. Faulkner, Halifax; I. P. Macnab, Halifax; W. G. Matheson, New Glasgow; W. P. Morrison, Dartmouth; C. M. Odell, Glace Bay; D. W. Robb, Amherst; J. W. Roland, Halifax; F. H. Sexton, Halifax; K. H. Smith, Halifax; L. H. Wheaton, Halifax.

Prince Edward Island

The comparatively few engineers in Prince Edward Island have not yet formed a provincial association and have proposed no bill for introduction in the legislature of that province.

An engineers' license bill has been passed by the legislature of the State of Virginia, and has been signed by the governor. The Act provides for the issuing of certificates to practise under the title of certified professional engineer, or certified architect, or certified land surveyor. The examining board is composed of three architects, three professional engineers and three land surveyors, with at least ten years' engineering experience. Certificates are granted upon evidence that the applicant has practised engineering or architecture for not less than six years, or land surveying for not less than two years. The fee is $5. In determining the qualifications of applicants, only the engineering members of the board examine engineers, the surveying members examine surveyors, etc.

ASSOCIATION OF C. B. & C. I. EXECUTIVE MEETING

MEMBERS of the executive committee of the Association of Canadian Building and Construction Industries met recently in Montreal to discuss the completion of the National Council and the institution of a campaign for new members.

Several matters arising from the reports of various committees of the recent conference in Ottawa were also considered. It was decided to table the report of the Committee on Business Relations until the meeting of the National Council. In reference to the recommendations of the Committee on Standard Practices, it was decided to appoint four representatives to confer with two to be appointed by the Engineering Institute of Canada and two by the Royal Architectural Institute of Canada, with a view to preparing a uniform standard contract and other standard forms. The following were appointed to represent the association: H. T. Hazleton, Winnipeg; J. B. Carswell, Toronto; K. D. Church, Montreal; and J. K. Thomas, Calgary.

The report of the Committee on Labor was discussed, and it was decided to appoint a standing committee on labor to endeavor to carry out the recommendations of the conference committee and to meet with representatives of the unions. The committee will consist of the following: J. P. Anglin, Montreal, chairman; E. G. M. Cape, Montreal; C. B. Jackson and R. J. Fuller, Toronto; G. A. Crain and H. J. Graham, Ottawa; E. R. Dennis, London; Roy Secord, Brantford; J. W. Pigott, Jr., Hamilton; F. W. Dakin, Sherbrooke; Jos. Gosselin, Jr., Levis; Wm. Wilson, Regina; and one to be appointed from Winnipeg and one from Calgary.

The executive are of the opinion that in addition to the work outlined by the conference committee's report, the standing labor committee should endeavor to encourage the organization of a "Canadian Executive of Organized Labor" in the construction industries of Canada, and the formation of an "Industrial Council" to deal with Dominion-wide labor problems in the building trades. This information has been communicated to the Trades and Labor Congress of Canada and to the Minister of Labor.

The letter received from the Winnipeg Board of Trade, inviting the association to hold its next conference in that city, was favorably received and referred to the National Council for further action.

The association's president, J. P. Anglin, was elected official representative to the Chicago convention of the National Federation of Construction Industries.

PUBLICATIONS RECEIVED

MECHANICAL WORLD YEAR BOOK.—Published by Emmott & Co., Ltd., 65 King St., Manchester, Eng.; 316 pages, 4 by 6⅛ ins., stiff cloth covers. Price 2/-.

PROVINCIAL HIGHWAYS BOARD, NOVA SCOTIA.—Report for the year 1919, published by the King's Printer, Halifax, N. S.; 246 pages and paper cover; 8¼ by 9⅝ ins.; illustrated with several half tones.

CALCULATING DIAGRAMS FOR DESIGN OF REINFORCED CONCRETE SECTIONS.—By James Williamson; published by Constable & Co., Ltd., London, Eng.; 7⅜ by 11 ins.; 20 pages of text and 17 pages of diagrams; price, 12s. net.

ELECTRIC FURNACES IN THE IRON AND STEEL INDUSTRY.—By Rodenhauser, Schoenawa and Von Bauer. Third edition, 1920. Translated from the original by C. H. Von Bauer, formerly chief engineer, American Electric Furnace Co.; 460 pages, 6 by 9 ins., numerous illustrations. Published by Jno. Wiley & Sons, Inc., New York; price, $4.50.

EDUCATIONAL CHART OF LOCOMOTIVE.—Published by "Railway and Locomotive Engineering," 114 Liberty St., New York; 50c. a copy. Single sheet about 16 by 43 ins. Printed in one color on coated paper, showing longitudinal and cross sections of Pacific or 4-6-2 type of locomotive, with every part numbered and the correct names of 676 parts given by numbers.

SUPER-CEMENT NOW ON THE MARKET

REFERENCE was made in *The Canadian Engineer*, issue of January 22nd, 1920, page 151, to a new development in the manufacture of cement. It was there stated that a new form of cement was being produced by the incorporation of a chemical with the clinker before grinding, the product showing very promising results in regard to strength and waterproofing qualities. This cement is new, so far as this continent is concerned, but has been in use in England, to a limited extent, for some years. Its manufacture has been developed in Canada, and at the present time, we understand, some of this cement is being offered for sale under the name "Super-Cement," the term that has been applied to it in England.

About nine years ago J. F. Goddard, an English engineer, discovered that a compound of certain chemicals, when incorporated into portland cement clinker during its manufacture, gave to the cement very useful and desirable properties. Since that discovery Mr. Goddard has continued his investigations with a view to perfecting the process and bringing it into practical use, free from all troublesome features. He had the assistance of well-known chemists and practical cement manufacturers in England, with the result that the new cement was produced commercially. Super-cement has been in successful use for about eight years and has been produced in commercial quantities for five years, although government war restrictions have somewhat retarded the extension of its employment.

Super-cement is made from any ordinary portland cement clinker, which is ground with a chemical ingredient that changes the physical properties of the cement. It is said that the chief difference between the two cements is that in super-cement, particles combine more thoroughly with the mixing water. The chemical action which occurs when water is mixed with the cement is assisted to a considerable degree by the added chemical, it is claimed, more of the cement being hydrated and performing the functions of a binder. This increased hydration assures dense, strong concrete.

An increase in tensile strength from 10 to 50% is claimed for super-cement as compared with portland cement, and an even greater increase in compressive strength. The percentage of increased strength with mortars has been very pronounced, and greater than the percentage increases with neat cement.

Super-cement is said to be especially non-absorbent and impermeable. Mortar composed of one part super-cement and three parts sand, moulded into hollowed cylinders, with walls ⅞-in. thick, and connected to pressure tanks, not only withstood a water pressure of 200 lbs. per sq. in. at the age of 17 days, but dried out and became hard and sound, with no sign of moisture on the outside. Similar mortars have also successfully withstood gasoline under pressure of more than 120 lbs. per sq. in. for over 13 weeks, with no leaks.

In a book entitled, "Cements, Limes and Plasters," by Ernest A. Doncaster, consulting chemist, London, Eng. (published by Crosby, Lockwood & Son, London, 1916), the author remarks that super-cement was originally intended to be only a waterproof portland cement, the waterproofing qualities being obtained by adding a chemical to the clinker. It was found, however, that the treated cement not only made a waterproof mortar, but was also much stronger than ordinary portland cement, thus differing from the usual waterproofing materials, which tend to weaken the cement with which they are used. Mr. Doncaster carried out a number of tests with this material, and found the tensile strength, after 90 days, of a 1:3 mix to be about 50% greater than that of a similar mortar made from similar, but untreated, portland cement.

Joncas, Malouin & Rousseau, Ltd., has been incorporated to carry on business as contractors, engineers and dealers in builders' supplies. The capital is $20,000 and the head office is in Quebec. M. P. Joncas, Paul Malouin and J. E. Rousseau, civil engineers, are interested.

Letter to the Editor

IS THE ENGINEERING PROFESSION RETROGRADING?

Sir,—Civil engineering is a profession in which the relationships, attributes, duties and the remunerations have been appraised principally for the benefit of public bodies and governments.

The secrets to be discovered in the profession act as a stimulus, but enthusiasm is changed to discouragement by the little gratitude shown the engineers for their services. The engineer, at the cost of thousands of sacrifices, has tried to maintain his social position, even though paid half of a bricklayer's wages or about the same as a common laborer. The engineer feels that, even though he is associated with the laboring class during working hours, he should have the privileges of any other liberal profession. The engineer immolated to the god of gold in the recent difficult times, but did expect a readjustment when equilibrium was restored. The result has been that after a long fight for his professional life, he recognizes that he is no more appreciated by his country and his fellow-citizens than before. He is facing three alternatitives: To give up his ideal, to deprive his family or to look for another field of activities where his qualities or his physical strength will be more appreciated.

Living up to Hoover's Definition

Civil engineering demands constant study, because science progresses. The man who gives himself to this profession ought to be disposed to concede a large share of his time to study. Every day brings new discoveries, new experiments and changes which the engineer is compelled to know all about, because he will have to apply them—not as per the data he collected when he was at the university—but according to the developments due to the daily progress of science.

The engineer's ideal is to know and to understand engineering problems. For that he has to pay constant attention to the technical journals, buy new books, etc. His library must be up-to-date, otherwise he cannot be efficient and compete with advantage against confreres who have these privileges.

Those who live in large centres have the public libraries, but in small towns every engineer has to provide his own literature. The minimum sum which he should allow for this is $10 per month. This may be divided as follows: One technical book, $5; four journals, $1; and the remainder for daily papers, magazines, etc. Mr. Arthur Surveyer, consulting engineer, Montreal, in speaking of the importance of reading for intellectual culture, suggested the reading of journals and books pertaining to one's profession, a few daily and weekly papers, two papers published in foreign countries, and some diverting reading to rest the brain. In other words the engineer must be well read in order to live up to the definition given by Mr. Hoover, food controller of the United States: "The engineer is the man who can produce with a dollar that which anyone else can secure only with two."

Must Make Sacrifices

Civil engineering is a liberal profession. Up to the present, it has been considered one of the select branches of Canadian society. When he was at the university, the engineer naturally expected to earn enough to be able to marry and support a family, but as things are going now, he will have to sacrifice this.

It is easy to prove by comparing the remuneration offered to the engineer with the high cost of living that the engineer is not paid in proportion to the value of his services. Inasmuch as I have had experience myself, I will try to prove what the domestic expenses are for a family of five persons in Three Rivers, Que.:—

Rent, $40; taxes, $7; light, $2.50; heating, $10.50; fuel for the kitchen, $4; depreciation on furniture, $8; total, $72 a month, or $864 a year.

Clothes for the man will require an annual expenditure of $210; for the wife, $160; for the children, $235; or a total of $605.

With butter at 75c. a pound, eggs at $1 a dozen, sugar at 18c. a pound, bread at 26c., beef at 30c., etc., it is not too much to allow $780 a year for food.

Adding these sums gives a total of $2,249 a year. This is a very conservative estimate of expenses excluding any provision for the children's education, sickness, emergencies, insurance, savings, etc.

Death of Legitimate Ambitions

This is what the engineer has to face. He has to fight for his daily bread and on his return home has not the satisfaction of an accomplished duty but fears to see his credit compromised at any moment. He has to desert his social life, to request from his wife sacrifices which she never knew in her own family. His fellow-citizens consider him in the miser's class. He is a witness to the death of his legitimate ambitions.

Probably, unless the future quickly brightens, many civil engineers will have to give up their profession. They will have to use their brains or muscles in other activities. The bricklayer receives $1.25 an hour; the carpenter $1 an hour, and the day laborer 45c. This is for the first eight hours. For overtime they are paid extra. This means $3.50 to $10 per day. The engineer who has charge of a party of laborers, works more than eight hours. Will the engineer become a bricklayer or a laborer?

One of my acquaintances, who was at a commercial academy with me some 15 years ago, is now a commercial traveller in dry goods. He is 35 years of age and has a fixed salary of $3,500 a year plus a bonus. Last year he drew $4,700. A younger man earned a little over $3,000. Should the engineer become a traveller?

A brakeman employed by a railroad company received for the last month $288. The freight conductor received $375. Perhaps the engineer will become a trainman?

Must Educate the Public

Engineers have a duty before them if they wish to be understood. It is to educate people to the importance of their profession. The small percentage of the engineers who come in constant touch with officials must impress upon the minds of company directors and public officials the personality and character of the engineer as a professional man. During this dark period, close co-operation between chiefs and assistants is necessary in educating the public to a realization of the fact that no body of men are so vital to the public's welfare as are the engineers.

ROMEO MORRISSETTE.

Three Rivers, Que., March 20th, 1920.

W. C. K. & CO., INC., CHANGES NAME

ANNOUNCEMENT has been made of a merger of construction companies in the United States, which will be of interest to many Canadians, as one of the companies, Westinghouse-Church-Kerr & Co., Inc., maintains a Canadian office and has done a large amount of work in this country. This company has been merged with Dwight P. Robinson & Co., Inc., of New York City, and the new company will be called Dwight P. Robinson & Co., Inc., with executive offices at 61 Broadway, and engineering offices at 125 East 46th St., New York. Dwight P. Robinson, who will be president of the company, was for many years president of the Stone & Webster Engineering Corporation. He formed his own company in 1918 and has specialized in large central power stations and hydro-electric plants. "W. C. K.," as Westinghouse-Church-Kerr & Co., Inc., was generally called throughout the construction field, was established 36 years ago and has specialized in the construction of industrial and power plants and railroad shops and terminals.

A CITY'S PAVING PROBLEMS*

By Charles A. Mullen
Director of Paving Dept., Milton Hersey Co., Ltd., Montreal

WHAT are a city's paving problems? A wag once defined them as raising and spending money, more money and still more money, principally for the personal benefit of the spenders, meaning the politicians, and the spendees, meaning their politico-contracting friends. Many true words are spoken in jest; for several exposures have proven that the politician spenders and the contracting spendees were both the agents of the same selfish and corrupt interests. In most North American cities, at least until recently, the situation could very well be summed up in the words of Mr. Wag.

Even in my own day, and I am not yet an old man, most paving was laid primarily for the graft there was in it and only secondarily as a roadway covering intended to resist wear and render community service. Thank our lucky stars, municipal affairs on this continent are steadily improving, and we now quite frequently lay pavements primarily for use, both with municipal paving plants and through agreements with legitimate contractors working on a business basis.

Behold an Optimist!

Do not think, from the few preceding words, that the writer is a confirmed pessimist. My years of experience as a roustabout in the paving industry would not justify my being such. I declare myself an optimist; for, as I have just said, paving is now sometimes laid on our streets for the purpose of being travelled upon.

I wish first to give a vivid cross-section view of the paving business as I knew it but a few years ago, in order that the progress which has been made since may be fully appreciated. Present city administrators not only have to shoulder their own paving burdens, but the children must still suffer for the sins of their fathers, especially their "city fathers."

The Paving Promoter

I have been in Montreal, connected with the firm of engineers and chemists of which I am now a member, and acting professionally for both the city of Montreal and the province of Quebec, and others, since 1916. In that period, I have seen various promoters attempt to put paving deals over in Montreal, but I have not seen one succeed. At the same time, it is necessary to say that when first I became familiar with the situation in that city, there were still some very strong odors from deals that had gone before; but these odors are gradually becoming fainter and fainter, and soon, I believe, the paving promoter who makes a business of putting something over on cities will be unknown in those parts.

These gentry seek fields where returns are both easy and safe. Yet what would we have done without the self-same paving promoters in earlier days? It is safe to say that, at least prior to the beginning of the twentieth century, no new pavement could have been extensively introduced without them. They did business as we, in our ignorant carelessness, made it necessary for them to do business. Why blame the Romans for being Romans in Rome?

Paved With Politics

If the citizens have neglected their duties as such in the past, and have permitted their municipal affairs to be handled by a few professional politicians of the self-seeking class, what right have they now to object if they find that there was more politics put into their pavements than wear value for the money spent?

Why should they complain, for instance, if told that the money wasted in paving some of their streets, if saved and put at compound interest, would have created a fund that would keep a proper pavement repaired and renewed until doomsday? Yet, this is a fact; and now they face the unpleasant necessity of raising money to pay for new pavements on streets where they have not yet finished paying the bonds issued to build the old ones that have prematurely passed away.

Montreal's Reputation

Some years ago I was in Albany waiting for a train to Montreal for my first visit, and at the club I happened to meet a paving man who was accustomed to do business there. To my inquiry as to conditions in Montreal, he said: "Oh, you don't need to go to the city hall at all. Business is done over the bar of the Blank hotel. If you have the price, the contract is yours." Now this was probably a case of illustration by exaggeration; but everyone knows that in years gone by some of the conditions in Montreal were pretty bad. It is against the results of those conditions, coming to light on the streets to-day, that the present city administration must provide, and for which provision the citizens must now pay.

An Engineer's Business

I might be asked, as a member of the engineering profession, why the former city engineers permitted such paving work to be done. I would reply that it was because they could not prevent it, and the citizens would not help them prevent it. In those days, an engineer holding public office in the gift of politicians was supposed to draw his salary and mind his knitting; in other words, to speak only when he was spoken to. If he did not adhere strictly to professional matters in the narrow sense in which the term was then too often interpreted, and leave civic or political or business matters alone, he was apt soon to be seeking another job; and little the careless citizens of those days would have worried about whether he got it or not.

To the credit of the profession in the city of Montreal, be it said that some of the former city engineers insisted upon a broader definition of their professional duties, and the struggle for honest paving was well under way when I first came to know the facts concerning Montreal.

Municipal Junketing

Paving is a very dry subject. It is dry even in the province of Quebec, where we have a reasonably moist law. Therefore, a little humor may not be amiss before venturing upon the waste of the paving Sahara. I will not say this story is true, nor name the man, nor even tell the cities concerned, for the story is quite as good without.

Many know that in the past, when a city was contemplating a large amount of new paving work, it has been customary for the city fathers to make it the occasion for appointing a not too small committee of themselves and friends to visit several other cities in quest of knowledge concerning the latest fads and fancies in pavements, at the expense of the city treasury.

Very frequently such junketing parties originating near the Pacific Ocean will find their way to the Atlantic seaboard, and take in or be taken in by Washington, Philadelphia, New York and Boston. In some one of these cities, most of the large paving interests that maintain promoters throughout the country will have a main office, attached to which is an experienced guide who knows the ways and vagaries of of municipal junketeers.

Notifies Home Office

The Pacific coast promoter, of course, notifies his home office of what is coming its way, and when; also what the deal will be worth if it can be put over. He will mention such details as whether Deacon John Doe, who is an eminently respectable member of society and a Sunday school superintendent in his home town, most enjoys prize fights, horse races or poker.

He is also apt to mention the particular competitor whose pavements should come in for some scientific knocking; for every paving man knows that an experienced guide can pilot a party around for a week without ever taking them over a bad

*Article based on notes of a recent after-dinner talk at the Kiwanis Club, Montreal.

pavement laid by his own company, or a good one laid by a competitor.

After properly priming the home office, the promoter then supplies the chairman of the visiting committee with a letter of introduction to the president of his company. When this letter is presented, the president graciously receives the committee, and, unless they have a million dollars to spend, turns them over to his assistants for their further good treatment.

Inspecting Pavements

Some engineers have a notion how such a municipal junketing party as I have just described inspects pavements when it reaches, say, New York. The committee puts up at some hotel like the Belmont, and the guide picks them up there in the morning right after breakfast, which is at about eleven o'clock. He then charters automobiles and starts out to show them some of his company's good pavements.

He does not say that he is showing his company's good pavements, for he knows that as soon as the cars begin to ride smoothly some alderman is sure to remark: "Why, this is a good pavement; who laid it?" And the guide knows that he will have an opportunity to answer, sort of off-hand like, "Oh yes, we laid this one in Nineteen Blankety-Blank." He puts the date back just as far as he thinks the credulity of the committee will stand, but he always makes the remark in such an off-handed manner that he can gracefully correct himself if challenged.

Competitor's Bad Ones

Then the guide swings the party over some bad streets, quite accidentally, of course, knowing that the same alderman who put the former query will pipe up and ask: "Who laid this rotten piece of work?" Of course the competitor did; that is why the committee is riding over it. All paving companies make some mistakes, and each knows where all of the other's mistakes are located.

By this time, the committee gets interested in picking its own streets, and mentions Broadway, Wall, and other world-famous thoroughfares; but the guide does not have to answer questions relating to the pavements on these roadways. The committee is enquiring about tall buildings, prohibition enforcement, and many other things that their home people did not send them out especially to investigate.

In the afternoon, they are interested in knowing the kind of roads in Central Park and on Riverside Drive; then it is dinner and the theatre, etc., and the next morning the chairman of the committee asks the guide for a memorandum of the streets they have seen, and is handed a nicely typewritten report suitable for use by the committee as its own,—prepared just by way of suggestion, of course.

The Same Punctuation

On one occasion two committees visited New York at about the same time, and the guide, not having time to write a special report for the second committee, made a few necessary changes in the carbon copy of the report given the first committee and had it rewritten for the second.

Both committees arrived home somewhat the worse for wear, and, thinking the reports they had received from the guide would do very well as they were, had them re-copied and submitted to their city council as their own, and the local paper in each little city printed the report of its own committee in full.

The two towns were only about fifteen miles apart, and the local pro-bono-publicos noticed a strange likeness between the two documents. Upon close comparison, it was found that even the punctuation was identical, errors and all.

Had the guide known his geography better, he would not have made such a serious blunder. As it was, his firm lost the contracts and some aldermen in both cities lost their jobs at the next election.

The First Problem

The above probably tells quite clearly, in a back-handed way, what I think is the first part of a city's paving problem: Honest, efficient city government.

Lacking this starting point, the solution of the remainder of the problems is practically hopeless; if people want better streets and roads to drive and truck over during the next few years, it behooves them now to give very careful attention to their civic government.

Good government makes good paving possible; I have never known bad government to produce anything better than Montreal has in its down-town district to-day as a heritage from its former careless citizenship.

City Government

The general development of good city government from bad has brought forth certain definite principles that are now embodied in a model city charter published by the National Municipal League, as a guide, to be altered for local application. This document may be secured by writing to the league's headquarters in Philadelphia. Many Canadians are numbered amongst the membership of this league, and its work applies to the cities of both the United States and Canada.

This model city charter provides what may be briefly described as the commission-manager form of government, with proportional representation. Westmount already has the commission-manager form, as have some other Canadian municipalities; and possibly some of them have already adopted the proportional representation feature. This new type of charter has given satisfaction to the cities which are working under it. Ashtabula, O., adopted it first, and Kalamazoo, Mich., and others followed.

The Second Problem

The second part of a city's paving problems is raising money. And right here I want to disabuse the mind of any man who thinks that good city government can be supported and well-paved streets constructed and maintained on a system of too low taxes supplemented by municipal hot air.

The question should not be so much, "What is the tax rate?" as "How is the municipal dollar being spent?" If it is being economically and justly handled, we can possibly get more value from a Canadian dollar by municipalizing it through the tax-roll than in any other way; certainly better value than they give us in the United States these days.

Our Municipal Bonds

I do not see anything wrong in practice with the principle of issuing municipal bonds to pay for paving city streets; but the less it is necessary to resort to this practice, the better. The matter should be governed by strictly business practice. Sometimes it is good tactics for a man to mortgage his house; sometimes not.

The greatest difficulty is the temptation which municipal bonds offer to the crafty politician to spend money in this generation, have paved streets and both the political credit and graft that may be had by paving them, and at the same time maintain a low tax rate to show the people at election time so they will keep his party in office. Nearly all of this type of politicians work to the motto, "After us, the deluge."

Most of our cities have been through just this experience; but they do not wake up to the true condition of their municipal affairs until it is too late and the city credit has been pledged to such an alarming extent that the evidence of it cannot longer be kept out of the tax rate. By the time they realize that they have been trusting their affairs to men who are either dishonest or incompetent, but more probably both, the political boss can well afford to retire and go to live as a country squire in some foreign country.

The Third Problem

The third part of a city's problem is spending the money; not for the benefit of the spendee, but for the good of the city.

That is where we engineers and public works men are supposed to come in. Had we more to do with this spending in the past, and the politicians less, there would not now be a necessity for raising so much money either for present needs

or for defraying the funeral expenses and liquidating the unpaid debts of "dead horses" in the form of pavements which can no longer render an equivalent and must be replaced.

When I was first consulted by the city of Milwaukee, which was in 1910, they told me that some of the streets of that city were carrying three issues of bonds, each for a different pavement that had been constructed and failed on the same street area, and that it would be necessary to provide a fourth bond issue if the last failure was to be replaced.

Pavement Construction

Pavement construction should begin with a careful engineering survey of a city's natural advantages from a paving point of view; not for each individual street at first, but with the entire city in mind. Then a general paving plan should be prepared, on which would be designated main thoroughfares for light, medium and heavy traffic,—not for the purposes of making restrictions but for taking care of the bulk of each type of traffic in the most natural way.

In Montreal, Sherbrooke Street is used by most of the light-weight traffic moving parallel to the St. Lawrence River; St. Catherine Street accommodates much of the medium weight traffic; and Notre Dame Street takes care of most of the heavy-weight traffic moving up and down the harbor front.

These three streets should be kept in particularly good condition, even at the neglect of side streets. This is the line on which the present city administration of Montreal is working, though it may be said to have made only a start.

Selecting the Paving

The types of paving to be used on different streets should be determined by engineers, not politicians; and the engineering department should always be ready and willing to give citizens definite reasons for its every action, to which a citizen is entitled.

The politicians made these selections oftener than the engineers in past days, and as a result a paving map of almost any one of our large cities, upon which the several types of paving are platted in different colors, closely resembles great-grandmother's crazy work quilt.

The engineer should also decide when and where paving work is to be done, so that the presence of a few blocks of good paving on a street will not necessarily mean that the owners of the abutting property are politically "in right;" or a few blocks of bad paving, that the property is owned by someone "in wrong" with the majority of the city council.

Pavement Maintenance

We construct a pavement once, but we maintain it forever; that is, we rather expect to maintain it that long. Therefore, the maintenance problem is really a larger one than that of construction, and construction may truly be said to be merely incident to the beginning of maintenance and a part thereof. There is really no definite line of demarcation between the two.

Many items enter into this maintenance problem; not the least of which is the current rate of four to six per cent. on the municipal dollar. Whether that municipal dollar is a borrowed one or the city's own dollar makes no difference. It is worth so much rental per year either way.

This means that if a city can lay one pavement one dollar per square yard cheaper than another, and can maintain it for not more than the annual current interest rate above the amount for which it can maintain another pavement, these pavements are equally economical.

This fact should cut out the laying of some of the higher priced pavements such as vitrified brick, and limit the use of granite block to where it is most needed on very heavy traffic streets and steep grades which carry heavy weight traffic.

The Real Pavement

The real pavement is the artificial foundation which is laid upon the properly graded, drained and rolled subgrade or natural foundation. Just as the real floor in one's house is the floor-boards and not the carpets, so is the real pavement the artificial foundation and not the wearing surface.

The carpets and the pavement wearing surface both wear out after a time and must be renewed; but we expect something reasonably approximating permanence in our floorings and in our pavement foundations.

In paying for the real pavement, the artificial foundation, depreciation may be charged off very slowly, and bonds logically issued for a long term of years; but in paying for the pavement carpet or wearing surface, depreciation is much quicker and bonds issued for the purpose of paying for them should be short-term securities.

Types of Foundation

When it comes to artificial foundations, I am rather a strong advocate of portland cement concrete of standard construction, no fads and fancies allowed; but in some cases bituminous concrete may be used to great advantage. In other cases, where the traffic is very destructive, a combination of both types has been suggested,—a slab of hydraulic concrete on the bottom to supply the rigidity, and a covering of bituminous concrete above that to take the shock, and then the pavement wearing surface to take the wear.

Old macadam, old granite or slag block, and other types of pavements are sometimes used as foundations for bituminous surfaces; and broken stone alone, properly placed and compressed, is frequently used as a foundation where the traffic is not too heavy.

A Mecca for Autoists

I hope to, and I believe I shall, live to see that day, not in the very dim future, when the province of Quebec will be noted for its good roads, and tourists will come from far and near to spend their summers motoring through that section of Canada; and when Montreal Island will all be one large city, with a beautifully laid out and maintained motor driveway all around its wonderful waterfront, and its hub, the old city of Montreal, the best-paved port in the world.

Montreal has good city equipment already on hand, a good organization, and this is augmented by further equipment and organization in the hands of legitimate and responsible paving contractors. It has the means. The only other thing necessary is to have the will, and I believe that it is fast developing that.

MONTREAL AQUEDUCT BOARD

FOLLOWING is the personnel of the board of engineers that has been appointed by the Administrative Commission of the city of Montreal to supervise the completion of the aqueduct: A. E. Doucet, director of public works of the city of Montreal, chairman; W. J. Francis, consulting engineer, Montreal; and R. S. Lea, of the firm of R. S. & W. S. Lea, consulting engineers, Montreal. The plans for the work and the report advocating that it be undertaken were prepared by Mr. Lea.

James Ewing, of the firm of Ewing, Lovelace & Tremblay, consulting engineers, Montreal, addressed the Montreal branch of the Engineering Institute of Canada last week on the need of a general plan for that city. He pointed out that the improved thoroughfares of Montreal are too narrow, but that widening them is generally too expensive, and that it will be cheaper to open parallel routes through less valuable property and diagonal main thoroughfares which will reduce the distance and grades between the uptown and downtown districts. City Commissioner R. A. Ross approved of Mr. Ewing's statements and urged the engineers to get behind the movement, stating that if Montreal is to be improved along the lines suggested by Mr. Ewing, that it will have to be upon a very large scale and with the co-operation of all architects and engineers.

STRUCTURAL ADVANTAGES OF "GUNITE" TYPE OF HOUSE CONSTRUCTION*

AMONG the many plans devised by the inventive skill of American engineers and constructors, stimulated to unusual activity by the demand for more and better houses, there are a number which, departing from the conventional and differing in detail, have certain fundamental ideas in common. These common ideas, in accordance with which this committee has been asked to gather this group of designs, appear to be briefly:—

1. Insulation against heat conductivity by the use of dead air spaces of greater or lesser extent, but positively isolated and non-communicating.

2. Fulfillment of structural requirements to produce strength, fire-safeness and permanence.

3. The development of such methods as will allow versatility in design, both as to size and architectural treatment. (See Conclusion No. 6.)

Designer Has Wide Latitude

In the working out of the details of construction to meet these fundamental propositions, the designer has had wide latitude, and his predilection as influenced by his daily vocation is clearly shown in the manner in which he has approached the proposition. One is accustomed to building structures with cement-guns, another is familiar with plaster contract work, another is an architect and another is a structural engineer. Each applies technical skill and practical experience in his own way to the solution of the common problem, with results that are interesting and valuable, but the knowledge and skill of all these has been utilized in the development of the plastered or gunited type of house, which may be defined as follows:—

The plastered or gunite concrete house is one having a reinforced concrete structural framework, either cast in place or shot with a cement-gun, and having comparatively thin exterior double walls of concrete formed by plastering or shooting concrete on expanded metal or mesh reinforcement. This type may or may not have concrete floors and roof. If not of concrete, metal lumber makes the best substitute. Wood floor joists and wood stud partitions can be used when economy in first cost is demanded.

One of the greatest, if indeed not the greatest, objection to monolithic concrete construction is the bother and expense of forms. This is particularly true of dwelling house construction because of its endless variety, with complications of openings, angles, etc. There can be no question but that the ultimate to be desired in concrete house construction is a design in which every piece that is erected remains put and forms a permanent, integral, necessary part of the structure.

The first fundamental idea of this group of designs is the matter of insulation against heat conduction. Insulation is a matter which vitally affects the comfort of a house, as well as the cost of heating it. Control of heat loss and ventilation is fundamental to success in the design of a heating plant, and such control cannot be obtained with exterior walls having poor insulating qualities.

Dead Air Space

Insulation of exterior walls of houses is also required to prevent condensation of moisture on the interior surface of these walls, regardless of the type of construction. Masonry walled houses are always furred, lathed and plastered on the inside, thus producing an air space between the masonry wall and the interior of the house, which furnishes the required insulation to prevent a sufficient difference in temperature being established between the wall surface and the air within the house to cause condensation.

Concrete houses, of whatever type, are no exception to this requirement for insulation, and the designers of this group make it possible to supply the requirements of insulation by including a dead air space in the wall proper. The plastered and gunite types have a concrete exterior wall about 2 ins. thick, separated from the interior finish by a dead air space.

Any air space in a wall to be effective must be "dead;" that is, have no connection with the outside of the building, and should be limited to such width and arrangement as to prevent convectional currents of air being set up within the dead air space itself. The outside wall of the plastered or gunite house is usually only from 1½ to 2 ins. thick, but this wall is reinforced in all directions by expanded metal or mesh reinforcement which is completely imbedded in the wall. The wall is moreover supported on all four sides by the reinforced concrete framework so that it is required to act merely as a "curtain" wall.

Strong and Fire-Resistive

Good workmanship will insure a very dense wall 1½ to 2 ins. thick which is not only impervious to moisture under the most severe weather conditions but also prevents any appreciable transfer of air between the dead air space and the exterior. While the wall itself possesses some insulating value, it is to be remembered that the entrapped air within the dead air space is depended on for insulation.

If a very high degree of insulation is desired, this type of construction allows the use of various insulating mediums, such as heavy waterproof building paper, corkboard, linofelt, Cabot's quilt, insulite or flax-linum, etc., which can be applied in sheets directly to the inside surface of the outside wall.

Especial attention is called to the table of relative heat conductivity, as given under the description of the cellular gunite house. This table was worked out by using formulae given in a bulletin issued by the University of Illinois, entitled "Heat Transmission of Building Materials."

The second fundamental requirement is fully met by this method of construction, but an examination of building codes in various cities reveals the fact that the requirements of the construction of ordinary dwelling-houses are based on familiar practice in the construction of masonry walls comprised of small units set in mortar, or on frame construction. The plastered or gunite type of house, as above defined, may truly be said to be a new type of construction to most building commissioners and inspectors. It is not to be expected, therefore, that present building codes provide directly for the use of such construction. However, this type does fulfill the fundamental requirements of strength and fire-resistive qualities.

Building Code Requirements Fulfilled

The structural framework is of reinforced concrete cast in place or shot into place with a cement-gun. The sizes and reinforcing of the various structural parts are easily varied to meet all specified load conditions and are matters of simple engineering design. The exterior walls are, of course, thin as compared with those specified for ordinary masonry bearing walls, but it should be borne in mind that this is an entirely different type of construction.

The exterior walls of the plastered or gunite type of house have a reinforced concrete frame which, in conjunction with the reinforced thin slabs, make strong and rigid bearing walls and have the elements of strength of the well known reinforced concrete floor. Lack of familiarity is, therefore, the only excuse for hesitation in allowing this type of dwelling-house to be constructed within the fire limits of cities or in any other localities.

The results of such tests as are available on the fire-resistive ability of a concrete wall 2 ins. thick, reinforced with mesh or expanded metal, indicate its ability to withstand the 2-hr. fire test without serious injury. It will be recalled that the usual building code requirement for the thickness of concrete covering over reinforcing for flat surfaces, such as in floors, is from ¾ in. to 1½ ins., with an average of about 1 in. This indicates at once that the exterior reinforced concrete wall, 2 ins. thick, practically fulfils the usual building code requirement for fireproofing even the large fireproof buildings.

For usual dwelling-houses there is not sufficient combustible material to produce a fire of sufficient intensity and

*Report of committee on Cement-Gun type of concrete houses, presented at the National Conference on Concrete House Construction, February 17th-19th, 1920, Chicago, Ill.

duration to affect in any serious way the reinforced concrete framework of this type of building. A favorable insurance rate is, therefore, justified for this type of construction.

Another point that occurs to the committee in examining this group of designs is the fact that there has been introduced here an entirely new element of safety, elsewhere non-existent.

It will be noted that in all these designs there is a form of wall construction consisting of relatively thin walls with relatively a very high degree of steel reinforcement, all thoroughly knit together into a strong unit. The effect is the same as that of wire glass. It may be cracked and broken, but it will not go to pieces. Not only should it be in a high degree cyclone and earthquake-proof, but it should be like wire glass, flame resisting.

Conclusions

The conclusions which the committee reached after examining the designs available in this group are as follows:

1. All structural requirements are fully met in the plastered or gunite type of house herein defined.

2. The framework and walls of this type are of fireproof material and are sufficient to withstand without serious injury any conceivable dwelling-house fire.

3. It follows from conclusions 1 and 2 that building codes should allow this type of construction within the fire limit of cities, and that insurance rates should credit in full this type as fireproof construction in all portions where concrete is used.

4. The insulating qualities of the double wall produced by this type (or method) is sufficient to prevent condensation of moisture on the interior on exterior walls and insulating mediums can easily be applied to obtain any desired degree of insulation.

5. Concrete floors produce a thoroughly fireproof and sanitary structure. Concrete floors should preferably have embedded nailing strips or be covered with a layer of nail-coat to which a wood floor may be nailed or be covered by rugs, carpets, or special, easily removed floor coverings.

6. The use of plastered or gunite concrete houses lends itself to flexibility of design so that the architect is not hampered by any predetermined unit in working out the design of his building. Furthermore, he can have different texture finishes for the exterior walls and trim the building with wood porches, cornices and the like as is customary in the standard wood frame covered with stucco, while at the same time securing the fireproof qualities in the exterior of the wall construction with a minimum expenditure of material, which is about one-third of what a monolithic 7-in. wall would be, thus conserving materials and operating to keep the cost of construction at a point that more houses can be built for a given amount of money than would be the case where heavy masonry walls are used.

7. The particular type which a builder should select out of this group will depend on the availability and relative cost of materials, power, skilled artisens and common labor.

8. All types are good in design and will make superior houses if the work is properly executed.

9. A concerted effort should be made by the parties in this group to get tests made by the underwriters' laboratories so as to get definite and favorable rulings on city building codes and insurance rates.

The Sarnia Bridge Co., Ltd., of Sarnia, Ont., has been reorganized under a Dominion charter. The company does not intend to enlarge its plant immediately, but preparations are being made for the future. The officers of the reorganized company are: Roy M. Norton, president; H. B. Fenton, vice-president; and H. F. Howland, secretary-treasurer. Directors: W. H. Kenny, H. W. Stewart, H. M. Pardee and F. J. Scupholm. Mr. Scupholm is in charge of the engineering staff. The other three directors are prominent Sarnia business men. The new company is capitalized at $500,000.

THE ENGINEER AS AN ARBITRATOR*

By William S. Wollner

RECENTLY a contractor performed construction work amounting to several millions of dollars. The engineer in charge of the work assumed that by virtue of his position he must see that the terms of the contract between this man and his principal were rigidly adhered to. No allowance was made by the engineer for changed conditions owing to the advent of the world war, nor for unforeseen difficulties encountered by the contractor in conducting the work. This attitude of the engineer created friction between the engineering force and the forces of the contractor, and the men on the work assumed the attitude of completely separated factions, the principal function of each being to first and foremostly protect the interest of his principal. This attitude resulted in making the work of the engineer, as well as that of the contractor, far more difficult to perform than it would have been if the proper spirit of co-operation had prevailed.

Needless to say, it cost the contractor many hundreds of thousands of dollars more to do the work than if a spirit of "give and take" had prevailed.

Large Amount Due Contractor

Upon completion of this job, the attorneys for the contractor opened negotiations with the attorneys for the principal, it being openly stated by them that unless the principal made proper restitution to the contractor for his losses occasioned by the arbitrary attitude of the engineer, the contractor would take the case to court. There seemed no way of settling the matter other than by a law suit. At this stage it occurred to the attorney for the contractor that the matter was properly one to be settled by engineers rather than lawyers and laymen, and he prevailed upon his principal to permit him to employ the services of an engineer in whose judgment he had full faith. The engineer, upon being approached, stated that he was willing to accept the case provided that he might view it as an arbitrator even though he was employed by only one side, it of course being understood that his decision should not be binding on either principal.

This was agreed to and he proceeded to make a thorough engineering study of the project and the manner in which the work had been performed and completed. His report to the contractor was that he was entitled to several hundreds of thousands of dollars in addition to the amount paid him for the work. This report was placed before the representatives of the owners of the project who, of course, said that it was natural that an engineer employed by the contractor should come to a decision of this kind.

Owner's Engineer Confirmed Award

The engineer insisted that he had approached the case in the same manner as he would have had he been employed by the owner alone or by the two factions jointly, and suggested as a check upon his findings that the owner select an engineer of known probity to proceed along the same lines as he had followed. The owner agreed to this and employed an engineer under the same arrangement that the first engineer had been employed; that is, that he was to proceed in the same manner as if he were employed by both parties at issue. The project owner was greatly surprised upon receiving the report of this engineer to find that in all essential features he had agreed with the contractor's engineer. After discussing his report with his engineer, the owner offered to pay to the contractor the additional amount which his engineer had found was due him, which was, as stated before, several hundreds of thousands of dollars. The foregoing is an excellent illustration of the attitude taken by the high-class engineer toward his duty as an arbitrator.

In most professions ethical standards demand that a professional man's first duty should be to his employer. This is most marked in the legal profession, and, of course, is a

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*From the "Monad," the bulletin of the American Association of Engineers.

fact in the medical and allied professions as well. It is generally understood by architects and engineers who have practised their profession for some time that although they usually draw their entire compensation from one party at interest, it is a term of their employment that they must see that justice is done to all parties. Of course, it is not unusual for an engineer to be employed as an arbitrator by both parties to a dispute, and his duty is so clear cut in a case of this kind that there can be no deviation from proper procedure. The young engineer who has just been placed in responsible charge, however, finds it difficult at times to realize that his duty does not require that he devote his energies solely to protecting his principal's interest.

One of the complaints that contractors most often make is that the young engineer is not properly trained to a realization that a contractor's interests are so closely bound to those of the principal that any injustice done by the engineer to the contractor is certain to affect the interest of the principal. Contractors often state in confidence that they add a percentage to their bids for work upon which certain engineers are employed, as they know that these engineers will not take a position of arbitrator between the principal and themselves, but will consider it their duty to see that the terms of contracts are literally complied with regardless of changed conditions and difficulties that may be encountered.

Some engineering schools have as a part of their curriculum a course in engineering ethics, and the graduates from these schools seem to be more successful in their dealings with contractors and other parties at interest than do graduates from colleges where the question of ethics is not made part of the course of study.

The question of temperament also enters into this matter, as some men are naturally arbitrary while others are natural arbitrators.

This is a matter that is of interest to all engineers regardless of whether they are just entering the practice of their profession or whether they have been practising engineers for some time. Nothing will profit the interest of his employer nor add to his own prestige more than an engineer's assuming the attitude of arbitrator in all his professional relations.

CODE OF PRACTICE FOR THE CONTRACTOR

Statement Submitted to the Committee on Ethics of the Associated General Contractors of America

IN all dealings with fellow contractors, with sub-contractors and supply houses, with owners and their representatives, with labor and with the public, the general contractor should ever be guided by the principles of fair practice that are generally accepted as just in the business world. In addition, the reputable contractor will observe and be bound by all rules of practice established for the good of contractors and generally recognized as beneficial, and will lend his willing support to their enforcement, so long as the interests of the public are not thereby endangered.

Skill, Honesty and Responsibility

Those qualities of honesty, skill and responsibility required for membership in the Associated General Contractors of America should become the guiding factors in determining the general contractor's relations with others. Honesty of purpose should be the basis of all his business transactions. This pre-supposes a reasonable degree of skill in performing whatever work he may undertake, and the possession of sufficient resources, including organization, equipment and finances, to enable him to carry the work to a successful conclusion, and he should be willing to prove the existence of these resources upon demand.

No reputable contractor will enter into a contract for the execution of any project for which his training and experience have not fitted him, nor will he embark upon an enterprise for the execution of which his resources, including assistance that he can reasonably expect, are not sufficient to carry out the undertaking. This is not to be interpreted that personal experience in any particular field of construction is a prerequisite to entrance into that field, but the contractor or his representatives should have demonstrated their ability to handle construction work on a scale similar to that proposed, and preferably work of a similar nature.

Bidding

No contractor should be a party to any method of letting a public contract not in accordance with the recognized legal procedure and established fair practice.

On private work, a fair code of bidding practice should be adhered to strictly for the joint protection of the contractor and the owner or his representatives.

When a contractor is invited to submit a proposal on work for which he is unable or unwilling to compete, he should immediately notify the architect or engineer to that effect.

No general contractor should submit a borrowed or accommodation bid.

Where plans for securing payment for estimating are in force, no contractor should collect payment for an estimate without the knowledge of the owner or his representative.

After bids have been opened and rejected, no contractor should be a party to the award of the contract until new proposals have been taken in due form.

Recognition of Existing Agreements

In undertaking work in a locality where there are generally recognized agreements in force between contractors and labor, between contractors and architects and engineers, or between contractors and any other group, a contractor should respect these agreements, if possible; or he should confer with those responsible for such agreements regarding them; or he should publicly announce his intentions not to abide by the terms of such agreements, giving his reasons for so doing. Changes in an agreement should be brought about, as far as possible, through joint consent of accredited representatives and not through infraction of its provisions. Much of the stability and prosperity of the construction industry is entirely dependent upon the strict adherence to agreements and codes of practice not always enforceable by law.

Loyalty to Other Contractors

Upon each general contractor falls the responsibility of maintaining and building up the reputation of contractors as a group. His duty to his fellows and to himself demands that by energetic application and keen attention to the enterprise in hand, he keep the standards of contracting high and add to its good reputation. Where not opposed to public interest, he should work loyally for the success of measures brought forward to benefit contractors as a whole, regardless of his present interest or lack of interest in the plan.

Work for Public Welfare

Since it is part of every man's duty to participate in movements to protect and advance the public welfare, the general contractor should exert his influence toward furthering the interests of the public. Particularly in matters in which his experience makes him unusually well qualified to act, he should give freely of his thought and support, and hold himself in readiness to assume responsibilities should that be requested of him. He should co-operate with public officials in the discharge of their duties in matters where such co-operation is proper, and should watch carefully to see that none of the laws pertaining to construction are violated on his operations.

By sincerely following these general principles as a basis, with the further guidance of a series of decisions from the Committee on Ethics concerning representative cases, members of this association will continually offer proof of their integrity and responsibility, and will safeguard the good name of contracting.

HORIZONTAL PRESSURE OF SAND*

By Ponsonby Moore Crosthwaite

RECENTLY the author made a series of experiments to ascertain the angle of internal friction in sand, clay and other materials by loading a plunger of known diameter and measuring the penetration caused by known weights. The value of ϕ, the internal angle of friction, was calculated from Rankine's formula:—

$$d=(P/W)[(1-\sin\phi)/(1+\sin\phi)]^2$$

when d is the penetration in feet, P equals the pressure per square foot, W equals the weight of the material per cubic foot.

The angle of internal friction from these experiments was much less than the angle of repose, and was not constant for any one material, but depended on its state of aggregation, whether it is put loosely together, shaken or consolidated by tamping.

The conclusion he arrived at was that walls calculated by Rankine's theory, which assumes the "angles of internal friction" and the "angle of repose" to be the same, would have a factor of safety of from 2½ to 4. In order to test this conclusion, a number of experiments were made in which the pressure of dried sand against a model wall was measured. The first experiments were made with a vertical door backed with sand and hinged at its lower edge, the tension in a string necessary to keep it in position being measured. Experiments mere made: (1) with the sand lightly poured into the box of which the hinged door formed one end; (2) with the sand thoroughly stirred together; (3) with the door surcharged to an angle of 30 degs., the angle of repose of the sand being 35 degs.; (4) with the door surcharged to different angles.

These experiments proved that the pressures calculated by Rankine and Colomb were much too high, especially for the surcharged wall.

The Wedge Theory

At the same time experiments were made to test the wedge theory. A false bottom, coated with glued-on sand, was provided that could be set at any angle with the back of the wall, so that the pressure produced by any wedge could be measured. These experiments proved that the wedge theories of Darwin, Boussinesq, Brightmore and others, that take into account the friction between the back of the wall and its backing, give correct results for the wedge of maximum thrust so long as the wall is not surcharged, but that it breaks down altogether when applied to a surcharged wall, the calculated pressures being 30% too great; also that wedges making a small angle with the back of the wall produce a greater pressure than calculation by the theory gives.

These results made the author think that something was wrong with the theory, and it occurred to him that it might not be right to take into account the friction between the wall and backing. He therefore modified the equation by which the pressures had been calculated, neglecting the friction between the wall and backing, and introduced into it an angle of internal friction instead of the angle of repose.

The angle of internal friction was arrived at by calculating what angle would satisfy the maximum pressures observed for the unsurcharged wall for the sand lightly put together and well stirred together. These angles, instead of being 35 degs., the angle of repose, were 42 degs. 20 mins. and 49 degs. These angles were then used for calculating the undivided wedges, the results coming out in marked agreement with the experiments. The angle 42 degs. 20 mins. was then used to calculate what should be the pressures for the surcharged wall, with the result that there was the same agreement, the maximum calculated pressure being practically identical with the observed.

The author then carried out experiments to definitely test whether wall friction did actually affect the horizontal pressure or not. For this investigation new apparatus was used.

A long box was cut into two compartments by a vertical saw cut transverse to its length. One half was fixed to solid supports, the other being carried on live rollers. When the box is full of sand the two compartments are urged asunder by the pressure of the sand on the plane passing through the saw cuts. This is the pressure on Rankine's ideal plane, and it was determined by measuring the tension on a string that prevented the rolling half of the box from being pushed forward. The rolling box was then turned end for end, so that the sand in the fixed compartment was held in position by the solid end of the box, the face of which was coated with glued-on sand. This is the same as if it had been retained by a rough wall, and if friction between the wall and backing affects the amount of the horizontal thrust the amount of the tension now required to keep the rolling box in position should have been less than before. A large number of experiments were made, and it was found that there was practically no difference, and proved, so far as laboratory can, that it is not correct to assume that friction between the wall and backing can affect the amount of the horizontal thrust.

The results of all the author's experiments prove that the angle of internal friction is considerably greater than the angle of repose, and that it varies with the state of aggregation of the material. Also that the latter is a physical constant that relates only to the surface where the particles are free to rotate, but that at the interior of the mass it is the angle of internal friction that determines the stability. It is therefore unlikely that any theory can give correct results which only takes into account the angle of repose. In Darwin's paper on the "Horizontal Thrust of Sand," he says that "the maximum internal friction in various parts of a mass of sand is not constant at all"; but, nevertheless, he uses the "angle of repose" as the "angle of internal friction," and tries to make his theory fit in with his experiments by introducing wall friction.

With regard to his apparatus used in his experiments, the author found that the wall on live rollers worked extremely well, and believes that it could be designed to measure the pressures against a wall 10 ft. high and 10 ft. wide. With such apparatus it is suggested that it would be possible to investigate clay backings, which are not likely to be amenable to treatment in such small apparatus as was used in the present experiments.

Conclusions

The conclusions the author would draw from his investigations are:—

(1) That the plane of rupture may be a convenient mathematical fiction, but has no existence in the granular material dealt with—at least, he was unable to trace any evidence of it in his experiments.

(2) That the angle of repose is a physical constant that relates only to the surface, and is represented in the interior of a mass of sand by the angle of internal friction.

(3) That the angle of internal friction is not a physical characteristic constant for any one material, but varies with the state of its aggregation.

(4) That friction between the back of a wall and its backing does not affect the amount of the resultant thrust.

(5) That the wedge theory which takes into account wall friction and the angle of repose, though giving correct results when applied to a wall without surcharge, or with a negative surcharge, breaks down completely when applied to a surcharged wall.

(6) That the wedge theory when modified by leaving out wall friction and introducing, instead of the angle of repose, the angle of internal friction, gives correct results in all cases, whether for the maximum thrust or that produced by individual wedges.

Finally, the author draws attention to the agreement of his experimental results with the conclusions of Sir Benjamin Baker, who states from his experience, derived from consideration of works of the largest size, that to retain loose earth, walls designed to withstand liquid pressures of 10 to 20 lbs. per cubic foot are sufficiently strong. The author's measured pressures for loose earth correspond to a liquid pressure of 18.4 lbs. per cubic foot, and for well-stirred sand 14 lbs. per cubic foot.

*Abstract of paper read at the last meeting of the Institution of Civil Engineers of Great Britain.

ADVISORY CONFERENCE COMMITTEE ON ENGINEERING LEGISLATION FOR PROVINCE OF ONTARIO

FOLLOWING is an official statement on the work of the advisory conference committee on engineering legislation for the province of Ontario, issued by the secretary of the committee:—

In common with their fellows of other provinces, the engineers of Ontario are keenly interested in obtaining suitable legislation to establish their status and to regulate their practice. To accomplish any real results, it was realized that all branches of engineering should be consulted, and that all kinds of divergent opinions must be brought together on common ground.

The advisory conference committee has been formed with this end in view. The committee consists of two representatives of each of the following organizations: Canadian Mining Institute, Engineering Institute of Canada (Ontario division), American Society of Mechanical Engineers (Ontario section), American Institute of Electrical Engineers (Toronto section), Canadian Institute of Chemistry, Association of Ontario Land Surveyors and Ontario Association of Architects.

The above organizations have been chosen as most representative of their respective branches of engineering in Ontario.

Two lengthy sessions have already been held, and much progress has been made towards the establishment of broad general principles upon which legislation should be based. Now that the work is well organized, it is the intention of the committee to pursue the matter vigorously until a conclusion has been reached. The task is not an easy one, and if some considerable span of time should be found necessary to its fulfilment, it will be because the committee wish to be thorough, and to bring in a report which can be freely endorsed by both parties.

The matter is being considered by the committee with a view to meeting the requirements of the different branches of the profession as well as eliminating grounds for objection on the part of any branch, while retaining one general organization of the whole profession.

It is perhaps not going too far to say that the result of the conferences already gives reason to expect a satisfactory conclusion.

The views of all engineers of Ontario are sought, and any of them may feel free to communicate with the committee to this end. Clifford E. Smith is chairman; Willis Chipman, vice-chairman; and F. R. Ewart, secretary. Communications may be addressed to the latter at 207 Excelsior Life Bldg., Toronto.

NEW BRUNSWICK WATER POWERS COMMISSION

PREMIER FOSTER, of New Brunswick, has introduced a bill in the legislature of that province, providing for the appointment of a provincial water power commission, following the example of Ontario in principle if not in detail.

"Data on hand," he says, "is sufficient to show us that the North Shore district, which would embrace Campbellton, Newcastle and Chatham, could be well taken care of from the Tetagouche River, supplemented by the purchase of some power from the Grand Falls plant now being built on the Nepisiguit River.

"The city of Fredericton and valley of the St. John River district could be well looked after by the Pokiok and Shogomoc Rivers, about thirty miles above Fredericton. The city of Fredericton, by reason of its geographical location and railway connection, should be an industrial centre, and an adequate supply of power is available. To this could be added a transmission line, extending up the St. John valley, tapping the important towns, such as Bath, Hartland and Bristol, and linked up with the transmission system of the Maine & New Brunswick Power Co.'s line, which now extends south to Andover.

"When the bill comes before the house in its committee stage, I purpose submitting some amendments. One will be to limit the authorized expenditure this year to one million dollars. Now, I have no doubt that some of our critics will immediately say, 'He is going to develop the water powers of New Brunswick with a million dollars.' Far from it. But I never think it desirable to grant too great powers in any legislation, and when a year goes by and the commission comes to us with a well-defined plan, the power of either approving of it or rejecting it will again be in the hands of the people's representatives."

MORE WATER NEEDED BY THE "HYDRO"

IN a special report on the Hydro-Electric Power Commission, presented recently to the Ontario legislature by G. T. Clarkson, auditor, of Toronto, Mr. Clarkson urges that the treaty with the United States specifying the amount of water that can be diverted from Niagara Falls, should be amended. He claims that unless this is done the Ontario Power Co. plant must curtail its operation so as to permit the Chippawa power canal to be used to its fullest capacity.

The Ontario Power Co., he points out, is diverting 13,500 sec. ft. at present, while the Electric Development Co., and the Canadian Niagara Power Co. are using approximately 20,000 sec. ft., leaving a surplus of only about 2,500 sec. ft., and at present the Electrical Development Co. is seeking to divert this surplus to its own plant.

"It would be of advantage," says Mr. Clarkson, "if an amendment can be obtained so that an additional supply of water may become available for such works (Chippawa-Queenston project). The commission states that of the 13,500 sec. ft. now used by the Ontario Power Co., it intends to divert 3,500 to the Chippawa canal, and that such water, with the surplus above mentioned, and 1,000 to 1,400 sec. ft. to be obtained from the spillway of the Welland Canal, will be available to produce upwards of 250,000 h.p. from the initial development at Queenston and leave water sufficient to permit the Ontario Power Co. to produce 150,000 h.p."

Among the Ontario companies that have been recently incorporated is the Ontario National Pavements, Ltd., with head office in Toronto and an authorized capital of $1,000,000. Edward N. Martin, engineer, is a director.

Employees of the Works Department of Port Arthur met last week and presented City Engineer L. M. Jones with a handsome diamond ring. Mr. Jones recently resigned in order to accept a position with the Warren Bituminous Paving Co. of Ontario.

E. M. Proctor, of the E. A. James Co., Ltd., consulting engineers, Toronto, has advised the city council of Windsor, Ont., that $200,000 will be required to put that city's water works in first class condition. Of this sum $65,000 is needed for extensions in new districts, $20,000 for two booster pumps, $40,000 to pay outstanding accounts and for work now under way, and $2,000 for a new chlorinating plant.

Prof. Robert W. Angus, of the University of Toronto, has submitted a report to the Board of Water Commissioners of Oshawa, Ont., strongly advising the board in favor of obtaining its whole supply from Lake Ontario instead of endeavoring to develop an auxiliary supply from springs. The town council has authorized Prof. Angus to go ahead with the preparation of the plans and estimates for an extension of the water works system, based upon Lake Ontario as the source of supply.

The Ontario Railway and Municipal Board have approved of the by-law authorizing the construction of water works plant by the township of Scarborough, which is adjacent to the city of Toronto. The by-law provides for the expenditure of $130,000 for the construction of a pumping and filtration plant and one water main from the pumping plant to the distributing reservoir, but does not provide for distribution mains. The E. A. James Co., Ltd., Toronto are the consulting engineers for the township.

PROPOSES $6,500,000 WATER WORKS PLANT TO SERVE NIAGARA METROPOLITAN AREA

PROVINCIAL Sanitary Engineer Frederick A. Dallyn, of the Ontario Board of Health, has recommended to the Welland Water Commission and to the city council of Welland, Ont., that a water purification plant and reservoir be built at Fonthill at a cost of $6,500,000, to serve a present population of 52,000 and an estimated population in 1930 of 110,000.

The municipalities included in the scheme are Port Dalhousie, St. Catharines, Merriton, Thorold, Allanburg, Port Robinson, Fonthill, Welland, Humberstone, Port Colborne, Niagara Falls and Stamford.

At the present time the raw water supply for these towns and cities is heavily polluted. Approximately 35 intakes in the Welland Canal are in operation. Some of these are factory intakes upon which eight or nine thousand employees depend. Some of these intakes have treatment systems, but are under no supervision. Tht typhoid death rate for the community is very high, although chlorination has cut it in half. Some of the intakes are very badly located. At Port Colborne boats discharge within a few feet of the intake.

In 1914 a plan was prepared for the construction of a concrete pipe paralleling the canal, with an intake outside the breakwater at Port Colborne, and continuing north to Allanburg, with separate pipes to Thorold and Merriton in one direction, and to St. Catharines in the other direction. The Dominion government is not committed to this plan, says Mr. Dallyn. Only two sources of supply are available,—at Port Colborne, or on the Niagara River at Chippawa. Within the next few years, says Mr. Dallyn, Niagara Falls will be compelled to go to Chippawa for water.

Mr. Dallyn says that the cost of the scheme is heavy, but no more than if each municipality were to be required to establish its own chlorinating and filtration works. If his metropolitan scheme is adopted, the use of canal water will be prohibited except for cooling purposes. Forty miles of large distributing mains will be required. The annual cost of the system is estimated by Mr. Dallyn at $542,000, which he divides as follows: Municipalities, $176,000; services in the townships, $78,000; industries, $120,000; Dominion government, $200,000.

ONTARIO HYDRO'S PROPOSED EXPENDITURES

Present Plans Will Require $55,000,000 Within the Next Two Years if Radial Railways Are Constructed—Hydro Represents Large Share of Provincial Debt

IN a special report to the Ontario legislature, G. T. Clarkson, chartered accountant, of Toronto, states that of the $100,000,000 debt of the province of Ontario, $40,000,000 is represented by advances to the Hydro-Electric Power Commission, and $10,000,000 by the Central Ontario System, which is owned directly by the government but operated by the commission. The province has also guaranteed other securities for the commission to the amount of about $8,300,000, to facilitate the purchase of the Ontario Power Co. and other properties.

To complete the Chippawa, Nipigon and Rideau developments and to make needed extensions during the next two years will require approximately $27,000,000 further expenditure, says Mr. Clarkson. He bases this estimate on the following figures, which have been submitted by the commission's engineers:—

For the Chippawa scheme $21,500,000 will be required in addition to $18,500,000 that has already been expended: for Nipigon $4,000,000 will be required in addition to $1,000,000 already spent; for the Rideau system there will be required a further expenditure of $350,000; and for the other systems $150,000. Other extensions to take care of the commission's growing business will require an expenditure of an additional $1,000,000 on capital account within the next two years. The commission is also indebted to its bankers for $1,000,000 for money advanced to the Ontario Power Co.; and the second mortgage bonds of that company, amounting to $2,700,000, mature next year and must be provided for.

In the event of the commission deciding to proceed with the construction and purchase of hydro-electric railway lines, approximately another $25,000,000 will be required in that connection. The total amount to be expended within the next two years, according to the present plans of the commission, says Mr. Clarkson, is approximately $55,000,000. Owing to the present condition of the money markets Mr. Clarkson advises the province and the commission not to proceed too rapidly with construction work on the radial railways unless convinced that construction costs will not decrease within the next few years and unless satisfied that each railway is a conservative business undertaking. He advises the legislature that it has every reason to have confidence in the Hydro-Electric Power Commission and its projects and that the legislature should support the "Hydro" in all proposed undertakings, with the possible exception of the immediate construction of radial railways upon a large scale. The chief reason for caution in the construction of these railways, says Mr. Clarkson, is the large amount of money that the province will have to raise within the next two years in order to finance the commission's other undertakings.

WATER POWERS OF NEW BRUNSWICK

IN the New Brunswick legislature last week there was presented a progress report of the provincial water power commission indicating that three developments on the Lepreaux River are possible. A head of 67 ft. can be secured at Lower Falls, 100 ft. at Big Falls; and 90 ft. at Ragged Falls, giving a total power at least three times as great as the present requirements of the New Brunswick Power Co., and yielding a revenue, at one cent per k.w.h., of $351,889. The horse-power estimates of the three developments are: Lower Falls, 1,563 continuous h.p.; Big Falls, 2,310 continuous h.p.; Ragged Falls, 2.078 continuous h.p.; total, 5,951 continuous h.p.

The commission recommends present development at Big Falls at an estimated cost of $550,000.

For the Fredericton district the commission recommends a $550,000 expenditure on the Shogomoc River, giving 3,132 continuous h.p.

The Tetagouche development for the North Shore, at an estimated expenditure of $595,000 will produce 1,241 continuous h.p.

Sir Adam Beck was interviewed this week by a delegation from towns in Northern Ontario, including North Bay, Sturgeon Falls and Sudbury, with a request that power be developed on the French River. Sir Adam requested a memorandum setting forth the exact requirements for power in that district and promised that upon its receipt the commission would submit figures regarding the approximate cost per horse-power for the quantity required. It is estimated that from 25,000 to 40,000 h.p. is available. The delegation stated that they believed that the river would be canalized following its development for power purposes.

The Isle Perrot Bridges Commission met in Ottawa on March 25th and were granted a hearing by Sir George Foster, acting premier, and the Hon. Messrs. Ballantyne, Reid and Doherty. The commission was supported by delegations from Cornwall, Belleville and several county councils. In replying, Sir George Foster made no promise, but stated that the commission's request for a grant for the construction of the two bridges upon the plan suggested by Sir Lomer Gouin would be taken into serious consideration, and that an answer would be forwarded to the commission at an early date.

OPERATING EXPERIENCES WITH ACTIVATED SLUDGE PROCESS FOR FACTORY WASTES*

By George W. Fuller
Consulting Engineer, New York City

On the outskirts of Boonton, N.J., the E. A. Stevenson & Co., Inc., have a plant for refining crude cocoanut oil and the manufacture of cooking oil, soap bases and butter from cocoanut oil and milk products. The refined product is marketed for the most part as an edible oil of a melting point of 76 to 92 degs. F. under the trade name of "Cobee," and as nut margarine under the trade name of "Spredit."

Character of Wastes

The average amount of combined wastes to be dealt with from the factory is about 150,000 gals. daily at rates ranging from about 30,000 to 300,000 gals. daily, and at an average temperature of 40 degs. C. Some 100,000 gals. of clean, hot, condensing water was diverted to a nearby brook as part of the treatment program.

Refinery wastes, about 70,000 gals. daily, and discharged at rates varying from 20,000 to 100,000 gals. daily consist for the most part of condensing water with which is discharged some 450 gals. of volatile oil. Some of this oil combines with caustic soda used in the process and forms a liquid soap. Probably 70%, or some 315 gallons of this oil is recovered in the grease traps. These wastes are discharged every day of the year, 24 hours a day.

Charcoal is often and Fuller's Earth always present in these wastes.

The average temperature of the refinery wastes is about 50 degs. C., but are often as high as 70 degs. or more.

The dairy wastes discharged during 8 hours of 6 days in the week consist on an average of about 50,000 gals. of milk and churn wastes, containing some 1,000 gals. of buttermilk, 20,000 gals. of floor and apparatus washings and 1,400 gals. of acid wastes daily. Maximum rates are about double the average rates, although milk and churn flows are often three times the average. Dilute sulphuric acid from the digestors is discharged with these wastes intermittently in amounts varying from 700 to 2,000 gals. daily, the strength ranging from 100 to 3,000 parts per million. The actual rate of discharge is about 100 gals. per minute, the operator at the plant being notified in advance to allow him to by-pass them to the re-aerating tank for treatment.

Toilet and wash room discharges from the 200 employees at the factory amount to about 10,000 gals. daily.

Dairy wastes are conducted to the plant through a separate pipe and discharge into the inlet trough to the aerating tanks without preliminary treatment.

Former Disposal Experiences

Previous to the installation of the present treatment works, waste matters from the refinery and dairy and condensing water were discharged together into a grease trap of about 20 minutes' capacity at average rates. From this trap they were conducted to lagoons roughly formed with cinder banks, the discharge from which was over weirs protected by scum boards to hold back the grease and oils to a small brook leading to a mill pond and ultimately into the Passaic River. There was more or less sedimentation of the heavier matters, charcoal and Fuller's Earth, by this process and a large proportion of the floating oil was removed by skimming.

Toilet and wash room wastes were discharged to two cesspools which satisfactorily disposed of them.

Pollution of the brook resulted in complaints from property and mill owners and ultimately required improvements in the method of disposing of these wastes. The writer's firm was called upon late in the autumn of 1918 to advise as to remedial measures.

The desirability of minimizing the investment for obtaining the necessary treatment of the wastes sufficient to avoid difficulty from a suit brought by riparian owners below as well as the restricted area of available land and the oily nature of the wastes brought about a decision against filtration as a finishing process and a resort to the activated sludge process with such operating procedures as the local conditions demanded.

*From "Municipal and County Engineering."

New Treatment Works

The plant as constructed consists of preliminary grease traps, aerating tanks, re-aerating tank, final settling tank and necesary operating appurtenances.

During the construction of the plant the jet condensers used in the refinery were replaced with surface condensers and this hot condensing water diverted through a new pipe line directly to the brook. This eliminated some 100,000 gals. of hot water which would have required cooling to prevent destruction of bacterial growths in the aerating tanks.

An attempt was also made to store and neutralize the acid discharge, but this was later abandoned for the procedure described beyond.

The new grease traps supplementing the old one are in three units of a total capacity of about one hour's flow at normal rates or about 5,000 gals. They are each 10 ft. in length, 6½ ft. in width with a sloping bottom to flow-off drains allowing for an average depth of 3½ ft. wide.

The aerating tanks are in two units of a combined capacity of about 45,000 gals., each of them being 30 ft. long, 10 ft. deep and 10 ft. wide.

To insure thorough mixing of the activated sludge with the wastes treated, vertical baffles were placed across the aerating tank. The baffles are 3 ft. apart longitudinally, with a waterway 2 ft. deep, alternately above and below them.

The re-aerating tank is 30 ft. long, 5 ft. wide and 10 ft. deep and contains about 11,000 gals.

The final settling tank is of the Dortmond type to provide for a vertical upward flow. It is circular, 11.2 ft. in diameter, 10 ft. deep to the bottom of the cone and with capacity of about 6,000 gals. The sewage enters the tank through a 12-in. vertical trough enlarged at the lower end to about 2 ft. square; the discharge is 6 ft. below the water level; the outlet is over weirs to troughs placed near the side of the tank.

Provision is made for the introduction of milk of lime at the inlet to the aerating chambers and also to the final settling tank. The former is to correct acidity and the latter to facilitate clarification.

Air Supply and Piping

Air is supplied from two motor driven No. ½ Root blowers, each of a normal capacity of 150 cu. ft. per minute at 5 lbs. pressure. Main air piping to the tanks is 4-in. wrought iron pipe with 2-in. drop pipes in duplicate to 1-in. air distribution grids. These distribution pipes are spaced 12 ins. apart, with 1/16-in. circular openings spaced 3 ins. apart and staggered on the lower quadrant of the pipe. Sludge is pumped by a 4-in. air lift discharging to a trough from which the sludge can be delivered either to the re-aerating or aerating tanks as desired. The blowers after operation for three months showed a serious reduction in capacity and arrangements are now being made for furnishing air from the main compressors at the factory and which with regulating valves will provide for an available pressure up to 100 lbs. if desired. This change will overcome irregularities in blower performance and assist in maintaining the air pipes free of clogging.

Clogging of the air pipes has been caused more by the settlement of heavy suspended matters around them during the early period of operation when experiments with humus, peat, etc., were being conducted, than by solid matters entering the openings in the pipe. Filtros plates and other similar devices were considered for air distribution but rejected because of the unusual quantity of grease and oil in the waste to be treated and which it was feared would clog the pores of the plates. While the comparatively large openings in the distributing piping compel the use of a greater amount of air than would have been the case with filtros plates, it also provides for ease in cleaning out these openings by the use of air under pressure. Experience has shown that it is

always possible to remove any clogging matters by air pressures of 10 lbs. or over.

On May 16, 1919, the plant was first started in a preliminary way with the intention of obtaining activated sludge from the contents of two cesspools which were emptied into one of the aerating tanks. The cesspool material amounted to about 11,000 gals. and represented the accumulation of some months, coming from the water-closets used by the 200 employees. There was some interruption in getting the mechanical equipment in smooth working order and very little was obtained as a result of the first month's operation. The cesspool wastes appeared to have been septicized to a point where it was difficult to activate the suspended matter.

Activation of Outside Material

Failure to obtain proper sludge from the cesspools resulted in a systematic effort being made to obtain activated sludge by using organic substances other than the factory wastes. Use was made of peat, humus, sawdust, horse manure and cow manure. Barrel experiments were made with these different substances alone and with the addition of washings from rich garden soil inoculated the organic material with nitrifying bacteria.

It was found that the use of peat presented difficulties caused by mineral matter which clogged the openings of the distributing pipes. In a measure the same was true of the straw mixed with the horse manure. Humus was tried but the expense was greater than for other materials and it was of such a texture that it was impossible to suspend in the liquid treated more than about 5 per cent. as measured by the volume of the sludge after 10 minutes' sedimentation.

Inoculation with washings from garden soil allowed a satisfactory sludge to be obtained in from 3 to 5 days with either peat or humus, and in not to exceed 12 days with cow manure or horse manure. Apparently these latter two materials require a longer period for activation on account of their anaerobic condition initially as compared with the aerobic condition of the peat and humus; without inoculation the sludge was ripened in 18 to 24 days, thus showing that inoculation with nitrifying bacteria materially hastened the activation process.

Combustion of Organic Matter

One of the interesting results obtained was the extent to which organic matter disappeared through wet combustion resulting from the oxidizing and nitrifying nature of the process. Studies were carefully made of available sources of organic matter which could be obtained cheaply and readily and which would be satisfactory as regards grit and fibrous products which would tend to clog the air distributing lines. It was finally decided that everything considered, the best material to use is cow manure obtained from neighboring dairies. The volume required is about 8 cu. ft. per 24 hours for a flow of about 150,000 gals. of wastes. The water content of this material varies somewhat but probably averages about 70 per cent. This indicates a needed addition of dry organic matter of about 130 parts per million. The material is mixed with water in a wheel-barrow until in a liquid condition and then applied to the inlet section of the aerating tank. This is done about four times during eight hours of the day or at the rate of about 1 cu. ft. of cow manure per hour during that period. No cow manure is added during the remaining 16 hours when no creamery wastes reach the plant.

Operating Program

Under normal conditions the flow is directed to one aerating tank to the amount of about 100,000 gals. daily; quantities in excess of this flow to the second tank. Acid discharges occurring from one to five times per day are bypassed to the re-aerating tank and from there applied with the pumped discharge of limed sludge from the final tank.

The amount of air used is about 0.5 cu. ft. per square foot of tank surface per minute or about 1.5 cu. ft. per gallon of liquid treated. An aeration period of about 3 hours ordinarily seems to suffice and with peat a two-hour period of aeration seems reasonably sufficient for short intervals. The amount of sludge is kept as nearly as possible to 20 per cent. as a smaller amount does not satisfactorily clarify the wastes and a greater amount requires additional expense for cow manure.

Final Sedimentation

After the wastes have been aerated and discharged to the final tank the supernated liquid is drawn off at the top and the sludge collecting in the hopper bottom is removed continuously by the air lift to the inlet distributing trough as previously explained.

It was found that plain sedimentation for the period available did not produce complete clarification and lime was added at the inlet to the final sedimentation tank at the rate of about 3 grains per gallon. This produces a clear effluent and the lime pumped with the sludge serves a double purpose in that it not only aids in precipitating suspended matters, but it also serves to correct the acidity which appears in the mixed wastes and which are by-passed to the re-aerating tank.

The final effluent is not only well clarified and substantially free of fatty products, but is stable without dilution for a period of more than 14 days in stoppered bottles, subject to the methylene blue test at ordinary temperature.

General Considerations

The novelty of this process as applied under local conditions, will be appreciated when it is stated that the problem consists essentially of finding a material with which to build up sludge rather than that of encountering the expense of disposing of sludge as is usually the case; in fact, the sludge beds on an adjoining cinder dump have not been used at all during the first three months of operation of this plant.

The average temperature of the mixed wastes, about 40 degs. C., does not seem to be a handicap to this process, but on the contrary is probably a material factor in intensifying operations as indicated by the relatively short aerating period required as well as by the weight of organic matter which is actually burned out in the aerating tanks. An occasionally influent temperature of about 60 degs. C. for a few minutes is of course not helpful, but the plant seems to recover during the interval between such occasions.

The process is also much less sensitive to acids than one might suppose, although it is a fact that it is somewhat interfered with at times, due apparently to acidity.

The process is greatly dependent on freedom from interruption of the air supply. This was demonstrated when on July 23rd an extraordinarily heavy rain produced local floods which resulted in a suspension of the air supply on two occasions during the same day, one of them being for 8½ hours. This was sufficient for the sludge to lose its activation and become putrescible. It required aeration of about 7 days following this mishap to place the plant on a normal working basis again.

In spite of adverse local conditions this activated sludge plant shows that plants of this type will satisfactorily treat even so difficult a waste as this, and its operation shows that a satisfactory substitute for the suspended matters usually met with and utilized in municipal sewage treatment works of this type may be obtained from various materials outside of those contained in the sewage, the selection of the best material depending on local conditions as to availability and cost.

The plant has not been controlled with the aid of extensive laboratory tests, although at the factory there are reasonably satisfactory laboratory facilities. Working procedures have been developed on the basis of listing one after another the difficulties which arose with a description of remedial steps to be taken in each respective event. During the tuning up operations an experienced operator of sewage disposal plants has been sent to this factory several times each week in order to study its behaviour and the effect on aeration of seeding with garden soil, the correction of acidity and use of lime, as well as the mechanical manipulation of the plant, and steps needed to control the wastes more effectively prior to their entrance into the aerating tank. This tuning up occupied a period of about 10 weeks.

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PRINCIPAL CONTENTS

NOVA SCOTIA POWER COMMISSION

ALTHOUGH the sources of water power in the province of Nova Scotia are not large individually, the data collected by the Nova Scotia Power Commission and its consulting engineer show that they are of great capacity collectively. The topography of the province is particularly suitable to water power development. The interior is rocky and well forested, the lakes are numerous, and short rivers lead with rapid descents directly to the sea. Perhaps the greatest assets, however, are the very high precipitation—greater than anywhere else in Canada except at the Pacific coast—and the climate, which provides an exceptionally large part of the precipitation in rainfall and not snow.

In a very clear, complete and most valuable report recently presented to the commssion by Brig.-Gen. Charles H. Mitchell, of Toronto, it is stated that the powers of Nova Scotia can be combined into groups and arranged to serve various parts of that province, and that a study of the possibilities of such grouping leads to a surprisingly gratifying conclusion as to the asset that the province has in its water powers.

The Nova Scotia Power Commission will undoubtedly become an immense factor in the industrial and economic welfare of Eastern Canada. It intends to develop its powers in isolated groups beginning with the St. Margaret Bay powers, which have been ingeniously grouped to supply Halifax with approximately 10,000 h.p., but foresight has been shown in planning these groups in such manner that they can later be joined electrically into one large system, covering a large part of the province. Several of these powers will be more or less developed, and probably interconnected, within a very few years. In the plans of the commission, no consideration is given to the distribution of the power after its delivery in Halifax on any other city, as it is wisely assumed that the function of the provincial government enterprise ceases at the "low tension side" of the municipal receiving station, and that the delivery of the power to the consumers is a function of a municipal or private power corporation.

STRIKES IN CIVIC UTILITIES

IN view of the experiences that Montreal, Toronto and other Canadian cities have had with regard to strikes by employees of water works and other civic departments, there appears to be urgent necessity for provincial or Dominion legislation regulating the extent to which any union or other organization can be allowed to imperil the property, health and life of whole communities. In order to ascertain what, if any, legislation there may now be on the statute books that would tend to prevent unexpected and unjustified strikes of employees who are indispensable in the operation of civic utilities, *The Canadian Engineer* requested its solicitors to make a search and prepare a resumé of any existing laws that could be utilized in the interest of public safety should there be recurrences of such strikes. The solicitors' reply follows and shows how inapplicable and inadequate is the existing legislation and how necessary is the enactment of new statutes to deal with such affairs:—

"Referring further to your letter requesting information in regard to statutory prohibitions of strikes by municipal employees engaged in services which have a bearing on the health or safety of the community.

"With the exception of the Criminal Code, we have not been able to discover any statutes dealing with strikes by municipal employees as such, for the legislation of this sort and the orders-in-council during the war deal only with industrial strikes.

"In the Criminal Code there are some sections dealing more or less with the matters you mention. Section 499 of the Code is as follows:—

"'Everyone is guilty of an offence punishable on indictment on summary conviction before two justices, and liable, on conviction, to a penalty not exceeding one hundred dollars or to three months' imprisonment, with or without hard labor, who—

"'(a) Wilfully breaks any contract made by him, knowing, or having reasonable cause to believe, that the probable consequences of his so doing, either alone or in combination with others, will be to endanger human life, or to cause serious bodily injury, or to expose valuable property, whether real or personal, to destruction or serious injury; or

"'(b) Being bound, agreeing or assuming, under any contract made by him with any municipal corporation or authority, or with any company, to supply any city or any other place, or any part thereof, with electric light or power, gas or water, wilfully breaks such contract, knowing, or having reasonable cause to believe, that the probable consequences of his so doing, either alone or in combination with others, will be to deprive the inhabitants of that city or place, or part thereof, wholly or to a great extent, of their supply of power, light, gas or water. . . .

"'It is not material whether any offence defined in this section is committed from malice conceived against the person, corporation, authority or company with which the contract is made or otherwise.'

"The question here, of course, is whether the terms, power, light, gas or water, taken either singly or together, could be interpreted to extend to all public utilities. To get the exact interpretation of these words and the full extent of their application would require a detailed reading of case law on this section.

"In the Municipal Act, R.S.O. (1914), Cap. 192, Section 250, power is given to municipal councils to make such by-laws and regulations for the health, safety, morality and welfare of the inhabitants of the municipality as may be deemed expedient and are not contrary to law. Section 249 provides that the jurisdiction of the council shall be confined to the municipality which it represents. The penalties for violation of by-laws of a municipality as provided in Sec-

tion 497 (supra) are not to exceed $50, exclusive of costs, and for the recovery of such penalities all the provisions of the Ontario Summary Convictions Act shall apply.

"Consequently, there might be regulations in the matters in question, but since you ask for provincial and Dominion legislation, we have not looked over the city by-laws, the by-laws being different for different cities.

"Under the provisions of the Criminal Code there is the offence of conspiracy, which might be made to apply in the case of strikes by municipal employees, endangering public health. Section 573 of the Code gives as the maximum penalty seven years' imprisonment for conspiracy to commit any indictable offence 'not hereinbefore provided for,'—those provided for being, in restraint of trade, to defile and to bring false accusation. With regard to conspiracy, to succeed in a civil action some damage must be proved, but in a criminal action the mere agreement is sufficient, although ordinarily, some overt act must have been performed to provide evidence.

"The case law relating to unions depends to a great extent on the fact of their being incorporated or not, the acts of officials of unincorporated trade unions, acting as officials, being difficult to distinguish from acts having a merely personal liability."

From the legal opinion above quoted, it appears that the incorporation of unions is really an important subject. The members of the Association of Canadian Building and Construction Industries discussed this phase of relations between employers and unions at length at the last annual convention, and opinions at that time differed widely regarding the advisability of demanding that all unions be legally incorporated.

PERSONALS

THOMAS DOUGLAS MYLREA has resigned as designing engineer of the Trussed Concrete Steel Co., Ltd., Toronto, to become a member of the firm of F. G. Engholm & Partners, reinforced concrete engineers, Toronto. Mr. Mylrea will assume the managership of the Toronto office, Mr. Engholm going to Montreal in charge of the firm's office in that city.

Mr. Mylrea was born January 17th, 1886, in Liverpool, Eng. He was educated in the public schools of Chicago, Ill., the R. T. Crane Technical School and the University of Illinois, where he obtained the B.Sc. degree in 1909. After three years with the American Bridge Co. as clerk of works, draughtsman and checker, he came to Canada as chief draughtsman of the Dominion Bridge Co.'s Winnipeg office. In 1913 he moved to Toronto and joined the staff of Harkness & Oxley, consulting engineers, as a designer, and was engaged in the preparation of plans for the Dominion Bank Building. After a term as science master at the Ingersoll Collegiate Institute, he returned to Toronto and became engineer of tests in the city architect's department, which position he resigned three years later to join the Trussed Concrete Steel Co. While with the city architect's department he conducted a large number of extensometer tests of flat-slab construction, and also prepared an exhaustive report upon the Quaker Oats fire in Peterborough. Mr. Mylrea is an associate member of the Engineering Institute of Canada, and was appointed by the Toronto branch of the institute as a member of its committee for the examination of the city's new building by-law.

J. W. PEART has been appointed general supervisor for the Public Utilities Commission of London, Ont.

ERNEST DEYELL, of Otonabee, has been appointed county commissioner of roads in the suburban area of Peterborough, Ont.

R. O. WYNNE-ROBERTS, consulting engineer, Toronto, has been retained by the town of Port Colborne, Ont., to prepare plans for a water works system, sewers, sewage disposal works and grades for pavements.

ALAN K. HAY has been appointed engineer and secretary of the Ottawa Suburban Road Commission.

W. L. MACFARLANE, formerly superintendent of the St. Lawrence Power Co., has been appointed manager of the street railway at Cornwall, Ont.

MAJ.-GEN. SIR DAVID WATSON has been appointed chairman of the Quebec Harbor Commission, succeeding Senator L'Esperance, who has resigned owing to ill-health.

HENRY HARVIE has resigned as assistant to the hydraulic engineer of design, Hydro-Electric Power Commission of Ontario, to accept a position as hydraulic engineer of the Canadian Ingersoll-Rand Co., Ltd., Montreal.

R. S. LEA, of R. S. & W. S. Lea, consulting engineers, Montreal, has sailed for Europe, via the Mediterranean. Mr. Lea will first visit Italy, where he will inspect the latest Italian hydro-electric power developments.

DAVID L. WEBSTER, formerly superintendent of the pumping plant of the Brantford water works, has organized the Brantford Brass Foundry Co. and will engage in the manufacture of water works and other brass castings.

F. W. THOROLD, consulting engineer, Toronto, has been appointed by the city council of Walkerville, Ont., to represent that municipality on the board of engineers who will investigate the proposed metropolitan water supply for the Essex Border municipalities.

J. E. PRINGLE, of Hamilton, has been appointed assistant engineer on the staff of the Kipawa Co., Timiskaming, Que., where extensions to the sulphite mill are being undertaken. Mr. Pringle served during the war as a lieutenant with the Royal Engineers in India, Palestine and Mesopotamia.

JOHN F. REAGAN, JR., has been appointed eastern sales manager of the Neptune Meter Co., succeeding the late D. B. McCarthy. Mr. Reagan was formerly general manager of the Consolidated Water Co., of Utica, N.Y. He joined the sales-engineering staff of the Neptune Meter Co. in July, 1910.

W. A. SLATER, engineering physicist of the Bureau of Standards, who was in charge of tests for the Concrete Ship Section, U.S. Emergency Fleet Corporation, has accepted an invitation to address the Toronto Branch, Engineering Institute of Canada, at 8 p.m., May 13th, on "Concrete Tests for the Emergency Fleet Corporation."

J. W. BLACKMAN who was city engineer of New Westminster, B.C., before enlisting for military service early in the war, has been appointed city engineer of North Vancouver, succeeding A. M. West, who resigned last week. Mr. Blackman has been engaged recently on work for the city of Chilliwack and for the Vancouver Sewerage Commission.

W. E. DONCASTER has been appointed acting district engineer for the Department of Public Works of Canada at Prince Rupert in place of Major R. Hull, who has been granted leave of absence on account of ill-health. Mr. Doncaster will supervise the construction of the new government dock at Prince Rupert, of the dock at Stewart and the clearing of the Naas and Stikine channels.