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The Canadian Engineer

ESTABLISHED 1893

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A reader is anxious to secure copies of the Canadian Engineer for May 3rd, 1907, and is willing to pay 25 cents a piece for these. Perhaps some of our subscribers can accommodate him.

TORONTO, CANADA, FEBRUARY 7th, 1908.

CONTENTS OF THIS ISSUE.

A SUCCESSFUL MEETING.

The twenty-second annual meeting of the Canadian Society of Civil Engineers was the most successful yet held. This was as it should be. Each year the attendance should increase, the interest should grow, the discussions should become more valuable anything different would indicate a dead institution. The Canadian Society is not dead, but very much alive—alive to the necessities of the profession, alive to the possibilities of the profession in Canada, alive to the advantages to be gained by the interchange of ideas.

If one were to ask the members who attended what they considered the predominant note of the meeting they would with one accord reply—Progress. Every discussion was on a high plane. Personal feelings and petty differences never appeared; everything was for the good of the order. Men differed as to methods—strong men often differ—but all had the same object, the improvement of the standing of the profession.

A number thought this would be secured if more members furnished papers describing completed works or explaining away the difficulties of engineering problems; others suggested that efforts should be made to secure a close corporation for engineers, while others maintained that such mechanical means as suggested were but poor makeshifts. What was required was the cultivation of a professional spirit, a kindly feeling for fellow-members, a willingness to lend a helping hand.

It was not decided which method would best strengthen the profession. We do not imagine men will ever agree on this, but we do believe that the spirit of the meeting just closed, if carried through the year, will do much to improve the engineering profession in the eyes of our fellow-citizens.

TESTING LABORATORIES.

The day has come—indeed, is long past—when the Government should aid in the establishing and equipping of large testing laboratories. It is not necessary that a new department should be organized, nor new buildings erected, but rather that the testing laboratories in our Canadian Universities should be voted appropriations to assist in making more complete the present equipment, to provide suitable directors, to prepare material for tests, and to arrange for the publication of the results secured.

The laboratories in the Applied Science Departments of our universities have now some equipment, which could at once be made use of in carrying on such work. In a small way they have been carrying on tests with very satisfactory results, but even yet our technical schools are lamentably weak in scientific research work. This is not a reflection upon the science faculties. Those familiar with the conditions know that the deficiency along this line has not been for want of men, but for want of money.

To-day the great weakness of our schools of Applied Science is their failure to actually apply science, is their failure to make mathematics, mechanics, physics and chemistry lend themselves, in the hands of the engineer, for the working out of the problems of the every day. Too wide a gap exists between the problems of the college hall and the practical problems of the world. So much time is devoted to pure science and so little to its practical application that the young student acquires a wrong conception of the value of what he has learned and begins to minimize what he has to learn. No better institution than a well-equipped testing laboratory could be suggested to assist in familiarizing the student with some of the practical work of the engineer, to encourage research work in the technical colleges, and to aid the engineer in securing reliable information of action of his materials of construction under various conditions. The present seems to be a most convenient time to impress the necessity of such laboratories. New building materials are being introduced, materials that have not been tested. New designs are being employed, designs that have not been tried by long use nor developed after repeated experiments in the testing-room. The engineering societies and engineers' clubs could not do better than at once make arrangements to memoralize the Government or Governments on this matter.

LABOR.

Along with the scarcity of capital which has recently affected a large part of the commercial world is a shortage in the supply of labor. This shortage of labor is a result of great industrial activity almost everywhere; but it is also due in part to the fact that more large projects than usual are also upon the carpet. For example, to begin close at home, the construction of the Grand Trunk Pacific and the Canadian Northern, together with the extensions of the Canadian Pacific and the Great Northern, mean the addition of 6,000 to 8,000 miles to the railway mileage of this continent. These various railway enterprises would probably employ 50,000 men, if that many could be got.

In the United States extensive additions are planned to many railway systems; and in New York State especially heavy industrial work is planned, such as tunnels and subways. There is the great barge canal through the State, to cost $100,000,000, and the conduit already begun to bring water into the city of New York from the Catskill Mountains at a cost of $150,000,000. These of themselves will employ many thousands, perhaps tens of thousands, of workpeople. The Panama Canal, too, is said to require 40,000 men as a steady working force.

Outside of America, the rebuilding of the Siberian railway causes demand for Asiatic labor, and in Africa the Cape-to-Cairo railway will for years make drafts on labor for construction purposes. And in the mines of the Transvaal, whence the coolies are now being taken, other laborers in large numbers, will have to be substituted.

Never before, says the Outlook, has the premium on muscle been so great as it is to-day in the labor marts of the world, with the result that labor has found that it can to a great extent dictate terms as to hours and remuneration. Besides, there lately appeared in a Government report an estimate that labor, in some instances at any rate, is to-day only about three-fourths as efficient as it was a few years ago. This, of course, is a considerable factor in estimating numbers of laborers required. An editorial in the Iron Age of October last said: "There is an increasing lack of efficiency in labor, marked by a lessened output and by lowered quality." And, it is added, the great increase in the volume of business is to blame for this by increasing the disposition towards slip-shod work. Indeed, as has been said, "the increasing cost of unskilled labor and its decreasing effectiveness present the economic problem of the times." It is not easy to say how far this lessened efficiency of the average laborer is at the present time keeping back industrial and transportation enterprise.

UNIVERSITY OF MANITOBA ENGINEERING DEPARTMENT.

We have just received a syllabus of the course in Civil Engineering and the preliminary course in Electrical Engineering given by the University of Manitoba.

The University of Manitoba was established in 1877, and has the sole power to confer Degrees in Arts, Law, and Medicine, and it is fair to presume that it will be the sole power conferring degrees in Engineering.

During the last few years the Canadian universities have found this department of Applied Science the most popular, and it is not to be wondered at that Manitoba should add such a department to their university. The engineering problems of the West demand scientifically trained engineers. During the past couple of years the demand for university trained men has been great. Manitoba is preparing to do her part in meeting the demand.

Those interested in the educational training of embryo engineers and those interested in educational methods would do well to become familiar with the syllabus of courses offered by Manitoba. A new college would not be expected to offer many courses nor a large variety of options, but one would expect to see in courses outlined the trend of modern ideas and methods along educational lines. The courses have no doubt been prepared after much discussion, and it is, indeed, refreshing to find several departures from the path outlined by the older colleges.

In the first year two hours a week are devoted to English. This is as it should be. The successful engineer must have a ready command of pure English, and must be able to express himself in clear, forceful English. In other Canadian universities the students in Applied Science have not an opportunity to devote any time to the study of our national language.

In the second year a course of lectures in Logic is contemplated. Logic, the science of correct thinking. Is there any reason why logic should not receive a large place in such a course?

In the third year two hours a week are given to Economics and Political Economy. Of all the professions, none are more intimately connected with the industrial progress of the country than engineering. The engineer, to make the most of his opportunities, must study carefully the relation of supply and demand. Taxation and transportation are subjects he must be familiar with: the one he cannot escape; the other is his to solve. Finance and labor go hand in hand with constructive engineering.

In the fourth year one hour a week is given to Engineering Law. The engineer is not a lawyer, nor does he care to be; yet he is a fortunate engineer who knows something of law as it relates to the engineer's powers and responsibilities.

The four additions to the usual college course in Engineering are wise and necessary. Manitobans are to be congratulated that, in addition to the usual studies in pure and applied mathematics, mechanics, physics, and chemistry they have a University Board with courage enough to venture into new fields.

Q. E. D.

Confidence + Economy = Prosperity.
Speculation—Common sense = Poverty.
Optimism × Speculation = Panic.
Extravagance ÷ Need = Sense.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The twenty-second annual meeting of the Canadian Society of Civil Engineers was held in the rooms of the Society, Montreal, on Tuesday, Wednesday, and Thursday, the 28th, 29th, and 30th of January, 1908.

Tuesday morning and afternoon were taken up with receiving reports.

The president's report shows that the Society is in a flourishing state, both as regards the number of members and its financial condition. During the year the membership has been increased by some four hundred, and the membership, including the honorary, associate and student classes, now numbers nearly two thousand.

The treasurer's report was very satisfactory. The receipts for the year were $10,868.89, and this, with last year's balance, make a total of $13,005.76. The expenditure for the year was $9,551.81, leaving a balance of $3,453.95 to be carried over to 1908.

A resolution, moved by C. E. W. Dodwell and seconded by L. A. Vallee, was unanimously passed congratulating the Governor-General on his wise and public-spirited patriotism in inaugurating the proposal to secure and dedicate the Plains of Abraham as a national park. It was further resolved to vote a contribution to the object, probably $500, but this amount will have to be fixed at a special meeting, to be held on March 12th.

W. McLea, Walbank, B.A., Sc., Past President of the Canadian Society of Civil Engineers.

There was an important discussion on the desirability of establishing departments for the testing of engineering materials and structural members. It seemed to be the general opinion that this might be taken up first in conjunction with the universities, and, as it is developed, established as a department of the Federal Government.

The committee appointed to report on uniform specifications for cement testing recommended that cement be packed in bags, a bag to consist of one hundred pounds net. Barrels to be entirely discarded. It is understood cement manufacturers favor this change just as soon as the present stock of bags is exhausted.

The Gzowski medal was awarded to Messrs. Holgate & Ross for their paper on The Huronian Company's Power Development.

The following prizes were awarded for student papers:

In the General Section Mr. C. F. Bristol secured the prize for his paper on the New Shop of the Intercolonial Railway of Canada, at Moncton, N.B.

In the Electrical Section the prize was awarded Mr J. A.. Parham for a paper on Straight Air Brake Equipment.

The Mining Section prize was awarded Mr. C. L. Cantley for his paper on Coal Washing at the United States Steel Company's mine.

In a discussion regarding the engineering status there was a general consensus of opinion that the time is approaching when, in regard to the educational standing of members seeking admission, who are not graduates of engineering universities, they shall be required to undergo an examination similar to that demanded by the Institute of Civil Engineers of Great Britain, i.e., in a modified form an examination approaching the standing of the college graduate.

Tuesday evening the retiring president, Mr. W. McLea Walbank, delivered his address, and the assembly was such as to tax the capacity of the Society's rooms in Dorchester Street.

The address of the retiring president was notable in its criticism of municpal ownership, and in the facts and figures commended to the attention of those who instance Glasgow as a successful exponent of the theory in practice.

Following Mr. Walbank's address, Mr. H. Holgate showed a number of lantern slides of the Quebec Bridge. The views shown represented the bridge in various stages of construction; also its condition after the collapse. As the Commission have not as yet reported to the Government, Mr. Holgate did not pass any remarks on the probable cause of the failure.

Wednesday was given over to sight-seeing and the annual dinner.

In the morning the Montreal Street Railway provided cars for the members who wished to visit the works of the Lakefield Portland Cement Company at Pointe aux Trembles, the new power house of the Montreal Street Railway, and the foundry of Warden King, Maisonneuve.

The Lakefield Portland Cement Company have just opened these works. The plant at present is equipped for an output of two thousand barrels per day. This factory is very fortunate in its location. The limestone, which is quarried within five hundred feet of the factory, does not need to be corrected by the addition of clay, and the Montreal Terminal Railway tracks run into the factory, thus giving direct connections with the steam roads of Montreal, and in summer the wharves on the river.

In the evening the annual dinner was held at the Windsor Hotel. About 150 members and guests were present, and some eloquent speeches were listened to. Mr. W. McLea Walbank, the retiring president of the Society, was in the chair. Those supporting him included Mr. Charles MacDonald, president of the American Society of Civil Engineers; Mr. Kilburn, Mr. Frost, Mr. W. G. Ross, while on his left were Principal Peterson, Mr. R. S. Logan, Mr. E. A. James, the editor of the Canadian Engineer; Dr. Adams, Mr. F. P. Gutchins, chief engineer of the C.P.R.; Mr. C. H. Catelli, president of the Chamber of Commerce, and Mr. Dubee, secretary of the Montreal Street Railway.

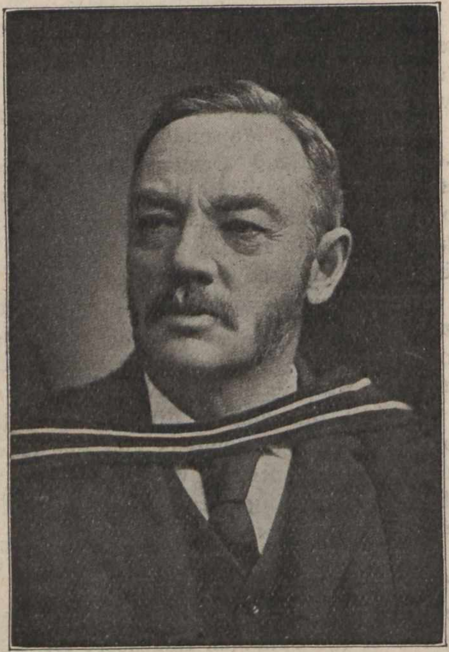
Mr. C. MacDonald, president of the American Society of Civil Engineers, was the first to respond to the toast of "Our Guests," proposed by Mr. Wm. McNab. Mr. MacDonald extended the congratulations of the older Society to its younger sister. Nearly fifteen years ago, he said, he had represented the Society in Montreal on the occasion of the establishment of the McGill Engineering School, the gift of Sir W. Macdonald. It had done much for the advancement of the standard of the engineering curriculum. "To-day," said Mr. MacDonald, "the engineering profession stood far higher than in those days, and it required no prophet to see that there was a glorious future before the engineering profession in Canada. Railways were being extended, and there were canals to be built. The twentieth century belonged to Canada, and when the century closed the engineer would be found to have been a momentous factor in the nation's development."

Mr. Kilburn, in a short speech, touched upon the results to accrue from the Trent Canal from Georgian Bay to Quinte. Of this canal 160 miles had already been constructed, and it possessed two of the finest lift locks in the world. These were situated at Kirkwell and Peterboro'. The canal was the work of Canadian engineers. It would shorten the journey for grain to Liverpool by about 500 miles. "The importance of such a canal," said Mr. Kilburn, "had been seen long ago. As far back as 1837 money had been voted by the British Government for its construction. But the Rebellion had broken out, and the money went to pay for it. The matter then lay in abeyance till recently. The canal would bring a great influx of trade to Montreal. The Government was alive to the importance of the work. The contracts were let, and it was on the way to completion. It would be a great boon to the St. Lawrence route." Mr. Kilburn remarked upon Canada's possession of practically boundless horse-power waiting to be developed, and then referred with gratification to the way in which Canada had sustained the stress of the recent financial crisis.

Mr. R. S. Logan, of the G.T.R., spoke of the obligations of the railways to the Engineers' Society, and said the G.T.R. was one of the great monuments to the skill of Canadian engineers.

Mr. Dubee, secretary of the Montreal Street Railway, extended the invitation of his Company to the rest of the members to visit the new power house. The power house about to be completed, he said, was one of the largest in Canada, and one of the completest on the continent, if not in the world.

Mr. C. H. Catelli, president of the Chambre de Commerce, referred to the value of McGill and Laval to the en-



John Galbraith, LL.D., President of the Canadian Society of Civil Engineers.

gineering profession. A training in these universities was a passport to the profession in any country in the world.

Dr. Adams, on behalf of the Canadian Mining Institute, also responded, and spoke of the importance of the mineral wealth of Canada, the annual product from Canadian mines totalling $83,000,000 yearly.

Principal Peterson, in proposing the toast of "The Society," spoke particularly of the work being done by the universities, and in regard to technical education said: "You will have no technical education worthy of the name until you have improved the education by which it should be preceded. This had been the case in Germany. It is illusory to be talking of technical education at a time when more attention should be concentrated on the improvement of common school education.

Mr. M. J. Butler, Deputy Minister of Railways, remarked that up to about a dozen years ago the engineer had been regarded as a superior kind of tradesman. Now, they had risen to the rank of a profession. Mr. Butler also remarked upon the fact that Canada, with a population of six millions, had an engineering society with a membership of 2,000, whereas he remembered the day when the States, with a population of sixty millions, had a similar society of only 1,000 members.

Thursday was taken up with the introducing of the newly-elected officers and the completing of unfinished business.

There was a long general discussion, as the result of which various recommendations were referred to the council for consideration, such as giving legal protection to members, publishing complete reports of the proceedings of the annual meetings, and getting from members more papers on technical subjects.

Toronto, Ottawa, and Quebec were suggested in turn as the place for the next annual meeting. The decision was left to the council.

The election of officers for 1908 resulted as follows: President, John Galbraith, Toronto; vice-presidents, W. F. Tye, Montreal; M. H. McLeod, Winnipeg; G. H. Duggan, Sydney. Members of the Council (General Section)—W. H. Breithaupt, Berlin; W. R. Butler, Kingston; F. F. Busteed, Vancouver; A. E. Doucet, Quebec; F. P. Gutelius, Montreal; H. Holgate, Montreal; N. J. Ker, Ottawa; J. G. G. Kerry, Toronto; R. W. Leonard, St. Catharines; R. McColl, Halifax; C. H. Mitchell, Toronto; J. E. Schwitzer, Winnipeg, and Wm. Kennedy, Montreal. Mechanical Section—R. J. Darley, Montreal; D. W. Robb, Amherst, N.S. Electrical Section—A. A. Dion, Ottawa; R. S. Kelsch, Montreal. Mining Section—C. M. Odell, Glace Bay; J. B. Porter, Montreal. Nominating Committee—C. E. W. Dodwell, W. McLea Walbank, R. A. Ross, J. N. Ker, C. W. Dill, C. H. Rust, J. E. Switzer, J. Kennedy, E. Marceau, H. D. Lumsden, W. McLea Walbank.

Fully three hundred members were present, and among the number were, from Montreal: W. McLea Walbank, J. W. Heckman, M. Neilson, Wm. McNab, R. S. Lea, W. F. Tye, H. Holgate, F. C. Jewett, R. M. Hannaford, R. A. Ross, H. E. Vautelet, H. R. Lordley, L. G. Papineau, F. P. Shearwood, S. S. Oliver. A. E. Doucet, A. W. Robinson, W. Elliott, L. A. Amos, W. J. Francis, J. A. Jamieson, O. Stitt, J. J. McNab, J. B. Porter, M. J. Taylor, C. N. Monsarrat, V. H. Dupont, A. E. Dubuc, O. H. Cote, W. A. Kennedy, M. Stansfield, G. R. McLeod, C. H. McLeod, H. B. Whyte, J. M. R. Fairbairn, H. A. Lumsden, H. Daw, and others.

Toronto.—Willis Chipman, E. R. Clarke, C. W. Dill, J. Galbraith, R. T. Gough, T. C. Irving, Jr., secretary-treasurer Toronto Branch; E. A. James, J. G. G. Kerry, C. H. Rust, D. C. Raymond, W. R. W. Parsons, J. G. Sullivan, C. B. Smith.

Ottawa.—A. Amos, R. Bickerdike, Jr., R. W. Bishop, A. Gordon Grant, H. W. Jones, C. H. Keefer, T. C. Keefer, Jr., D. Macpherson, G. A. Mountain, L. M. Rheaume, A. Stewart, E. L. Walsh, Alex. Gray, B. H. Fraser, B. F. Bruce, M. J. Butler, J. B. McRae.

Quebec City.—T. Breen, A. E. Doucet, A. Leofred, S. S. Oliver, L. A. Valler.

Kingston.—H. B. R. Craig, C. Russell-Brown, L. W. Gill, A. Macphail.

Ontario.—S. B. Clement, North Bay; D. N. Sharpe, Lindsay; T. C. McConkey, St. Mary's; R. F. Latham, Hamilton; G. C. Carmen, Cornwall; W. H. Logan, Prescott; W. R. Maher, Eganville; A. L. Killaly, Cardinal; R. W. Leonard, St. Catharines; W. J. Moore, Pembroke; J. D. Barnett, Stratford; W. W. Benny, White River; G. H. Garden, Rockland; H. A. McCarthy, North Bay; W. H. Breithaupt, Berlin.

Quebec.—D. S. Barton, Levis; J. A. Tremblay, Montmagny; J. P. Todd, St. Casimir; H. B. Alymer, Melbourne; L. A. Dufresne, Sherbrooke; G. W. Smith, Thetford, P.Q.; G. J. Desbaratas, Sorel; H. Dessaulles, St. Hyacinthe.

Other Provinces.—W. B. Mackenzie, Moncton, N.B.; C. E. W. Dodwell, Halifax, N.S.; J. E. Switzer, Winnipeg; C. B. Brown, St. John, N.B.; G. N. Otty, Hampton, N.B.; J. G. Campbell, Sydney Mines; W. B. Cole, St. John, N.B.; G. Stead, Chatham, N.B.

United States.—E. S. Fraser, Bristol, Tenn.; T. K. Thomson, New York; G. H. Frost, New York; M. Burpee, Houlton, Me.; S. H. Thomdike, Boston, Mass.; D. Williams, St. Johnsbury, Vt.; G. C. Bartram, Boston, Mass.

CORRESPONDENCE.

[This department is a meeting-place for ideas. If you have any suggestions as to new methods or successful methods, let us hear from you. You may not be accustomed to write for publication, but do not hesitate. It is ideas we want. Your suggestion will help another. Sketches accompanying letters should be made separate, on white paper or tracing linen, in India ink lines. Letters or figures should be plain.—Ed.]

CURVATURE OF WYES.

Sir,—It was found necessary last spring to put in a Y at Bala, a point on the Muskoka Section of the C.P.R. Owing to the existing tracks and want of tail room the curves that could be used were limited to a 15° leading off the main line and 16° 48′ leading on to a siding. There was some discussion regarding the advisability of using any curves sharper than 10° so a short sketch of the result will be interesting.

The track was laid with 60 lb. steel without tie-plates, a gauge of 4′-9¼″, and 3″ super elevation to the outer rail, this latter was taken out by the section-men soon after, leaving the rails level.

It was then found that while engines passed around the sharper curve, they all dropped off at a certain place on the other leg. I checked in the curves with a transit and found that owing to the switches, the 16°-48′ curve was sharpened to an 18°, and the 15° to a 16°-30′; and at a particular place on the latter curve the track was six feet out of line, the track gang having swung in to avoid a shallow piece of rock and had not relined after surfacing. After the track was lined to centre no difficulty was experienced, and since then besides watching it carefully, the section-men have had no trouble with it.

At Footes Bay Ballast Pit the Y has one leg of 10° and one of 7°-30′, the former has been in constant use since April The track was laid with 80-lb. steel on hemlock ties without plates, ½″ extra gauge and seven inches super elevation to the outer rail. This was much too high and caused the inside rail to cant, the trains travelled at a rate from 25 to 30 miles per hour, owing to a heavy grade in the pit. When resurfaced this summer the elevation was cut down to 4″ and even this proved too much as a compound consolidation was then put in the pit which seldom travelled faster than 5 or 6 miles per hour and the inside rail still continued to cant causing endless trouble to the section-men.

The engines used both on construction work and on passenger trains are Moguls and Compound Consolidations; the former having an average wheel base of 15′-9″, and the latter 15′-0″, some having blind driving wheels, but the majority being flanged.

I believe that the correct gauging, surfacing and lining to be of more importance than the degree of curvature, this, of course, within reasonable limits, and that tie-plates should be considered indispensable.

I would like to see some one else's views on the subject.

Yours truly,

Chas. D. Norton.

Footes Bay, January 13th, 1908.

CONCRETE.

Sir,—With respect to mixture for concrete, I have pleasure in submitting the following:—

Evidently the writer who quotes the specification contained in your letter to me was endeavouring to adopt a very concise wording, and if it were to be broken stone concrete, probably this short form would be sufficient, although I would suggest that some size of broken stone be included, as for instance, "broken stone to be of size capable of passing through a 2½-inch ring."

The introduction, however, of gravel, complicates the specification considerably, and in order to obviate this I would suggest that the following be added to the wording already submitted viz.: "Gravel, if used, to be of general uniform size. Sand and gravel may be combined to form eight parts of the aggregate, in which case sizes shall be graded so as to fill voids; sizes to be approved from time to time by engineer according to nature of work to be done."

In any case in such a specification it should certainly be required that all materials be approved as to quality by the engineer. In the case of gravel this introduces a difficulty of inspection due to possible lack of uniformity as the material comes from the gravel pit, consequenttly I have suggested that the gravel be "approved from time to time" and according to nature of work to be done." Yours very truly,

C. H. Mitchell.

Toronto, January 28th, 1908.

RAILWAY CROSSOVER.

Sir,—I herewith attach particulars of a solution to "Rodman's" query, your issue of January 17th last:—

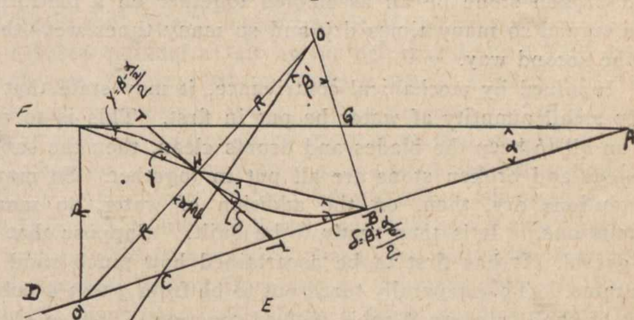
The angle B is required—

OH = O′H = radius of curve = R.

DE is drawn parallel to FG at distance = R.

With a radius = 2R and centre O, cut DE in O′.

$$\text{Cut off } O'OC = \frac{A}{2}\text{; then } COB = B'.$$



It will be most convenient to plot to scale the diagram and measure the angle B′; then

$$\text{Tan } B' = \frac{BC}{BO}\text{, and thus } B' \text{ can be found from tables.}$$

TT_1 is a common tangent to the two branches of the curve.

It will be noticed that y + d = B′.

W. H. PRETTY.

Peterboro', Jan. 27th, 1908.

RE CONCRETE.

Sir,—In reference to specifications for concrete, referring senger trains are Moguls and Compound Consolidations; the five of broken stone, I beg to say, that according to my judgment there should be one part less of sand in order to give the best, and most economical mixture.

The following proportions are recommended by Mr. John Watt Sandeman, M. Inst. C.E., for the construction of economic concrete:—

Cement.	Sand.	Broken Stone.
1	1	3½
1	1½	4¼
1	2	5
1	2½	6
1	3	7

You will find an article in the Paving Journal of April, 1896, with reference to these proportions, and his investigations.

In Toronto, excellent concrete for roadway foundations is made by using the proportions of one, three and seven, but in Vancouver, I am using one, two and one-half and six, as I have found it advisable to reduce the quantity of sand as much as possible, owing to its being of inferior quality.

Yours truly, W. A. Clement,
City Engineer.

Vancouver, January 24, 1908.

CONCRETE SPECIFICATION.

Sir,—"Associate" is under the impression that the wording of his specification is loose. And it would appear in the same light to many others. It is clear and precise. There is no ambiguity about it. The term "1 : 3 : 5" is only used in journalism or letter writing, and the "initiated" only understand its true meaning. The specification reads in this manner: "One measure of Portland cement, three measures of sand and five measures of broken stone." Then they go on to define the above ingredient in this way: "The cement shall be of such a brand as to stand a tensile strain of so many pounds per square inch after so many days of immersion in water, so many hours to dry before being broken. The sand shall be clean, sharp sand. It may be bank, pit, river, or sea-shore sand. The stone shall be of sound, hard, durable rock, broken to pass through a 2 or 2½-in. ring." Then it specified how to assemble all this material on a strong platform of such a length and breadth and thoroughly water-tight; that the sand be spread evenly on the platform, then the mixture turned so many times when dry and so many times when wet; that this mortar be spread out evenly, the crushed stone sprinkled with water, then thrown on the mortar and turned so many times before being deposited—that is the first way. Another way is that the sand, cement and broken stone be all assembled together on a platform, and turned so many times dry and so many times wet—that is the second way.

If mixed by mechanical contrivance, it may state that a very small quantity of water be put in first. This is to act as an oil to keep the blades and drums clean, then the sand, cement and broken stone are all put in together. So many revolutions dry, then, on the addition of water, so many revolutions. It is then ready to be built. Suppose that it is gravel. It has first to be ascertained how much sand it contains. This generally turns out to be from 3 to 3½ cubic feet of sand in every 8 cubic feet of concrete. Those eight cubic feet just suit the bags for all practical and general purposes.

Now that the specification is defined the next process is to work by measure. All cements are parcelled in cotton bags, which contain almost a cubic foot, that being so if it is gravel cement. Then the measure for one bag will be 4 feet by 4 feet by 6 inches. If sand and broken stone, and the true measure is required, it will be sand 3 cubic feet; broken stone 5 cubic feet. That is your specification, and that is how the engineer speaks in his specification. The engineer never made this one. He had nothing at all to do with it. His specification is this: "For Portland cement concrete, one measure of cement, two measures of sand and three measures of broken stone, as already defined." When he does alter this it is always to enrich it by taking one part of the broken stone off, which would be 1 : 2 :2. The enquirer takes no chances—leaves nothing to Bumbleton to lay his claims or clutches upon. It took a cleverer character than Bumbleton to scheme and devise that 1 : 3 : 5 affair. Personally, I do not know the copyist nor his ways. I have met this tribe. They are numerous in all nations.

The engineers are using this specification without question. Why do they use it? That reason is not far to seek. This is a comparatively new building agent that has crept into the building world. Engineering is a very conservative profession, and rightly so. There were only a few in the earlier days that had courage to venture upon the unknown substance. The majority held back and conducted this work with the older and tried methods. Then another tribe stepped in, got hold of the original specification, and to make it appear as their discovery they clapped on two to the broken stone and two to the sand, which made it appear thus: 1 : 3 : 5. They then sounded their horn that this was the cheaper and best, and got many companies and corporations to swallow this dose. That they got in is certain, cr there would be no occasion to write this letter. Whenever this specification has been carried out to the letter, it has proved disastrous to the undertaking and to the reputation of good men. Engineers did their very best to carry out the 1 : 3 : 5, and said that it was only a pure mass of stones, but porous for certain mentioned works, and to obviate this a three-inch facing of the three parts sand and one part cement made into mortar, this mortar facing was built simultaneously with the 1 : 3 : 5 concrete. To make the concrete water-tight was the honourable object the engineers had in view. The object of this three-inch mortar facing was not to make walls water-tight. The object was to have a smooth face and not rob any mortar from 1 : 2 : 3, and not to disturb the form or destroy the polish by facing up with a trowel and sometimes a shovel. That was the threefold object of this mortar facing. The engineer's water-tight facing is as follows: "One measure of cement, two measures of sand, and two measures of broken stone to pass through an one-inch ring. When this 1 : 2 : 2 was made into concrete, it was built as a six-inch face lining and built simultaneously with the 1 : 2 : 3 by using dividing boards, the mortar of the 1 :2 : 2 and the 1 : 2 : 3 was the same so that they comingled and cohered together. That engineers now recognize that cement concrete is to be greatly used is indicated by the fact that they give it what they did not give it in the early days—a more hearty recognition. And I am in the hopes that I may live to see this 1 : 3 : 5 rejected as unfit for any work but street bottoming, and not too good for that either. Engineers or the Government will yet by a Royal Commission look into this, and when they do so, it will be found that three cubic feet of mortar will not envelope five cubic feet of angular cubes. Showing that if it cannot envelope every cube, then it cannot be solid, and, if not solid, then it can be neither wind nor water-tight. And thus this original 1 : 2 : 3 will become the standard specification by statute. It would require to be so for public safety. 1 : 3 : 5 is much more costly, as there is two cubic feet always to be broken and paid for when there is no necessity. The 1 : 2 : 3 was ordained to carry a far greater burden than the "2." Some say 35 per cent, some say 40 per cent. I had to burden it to 60 per cent., and made splendid, sound and solid work by rubble displacers on an extension sea wall. Not one discovery that can be mentioned, but had its origin, lowly and simply be it, in any of the sciences. But the sharks are on the prowl. They scourge mankind with their ferocity and voraciousness. They must have their snouts plunged in, and as they cannot do it by honourable means, then by any means—by robbing other men of their labourers.

Let "Associate" stick to his specification, carry it out to the best of his ability. He is just on the same road as a great many others, but if he does his best that is all the best can do.

So long as the 1 : 3 : 5 specification is maintained, so long will there be eternal warfare between those who are in charge of works and the execution. Were I writing for the remaining days of my existence, this 1 : 3 : 5 would keep me going to explain and expose the low, mean products that I have witnessed. O. Fraser.

Port Colborne, Ont.

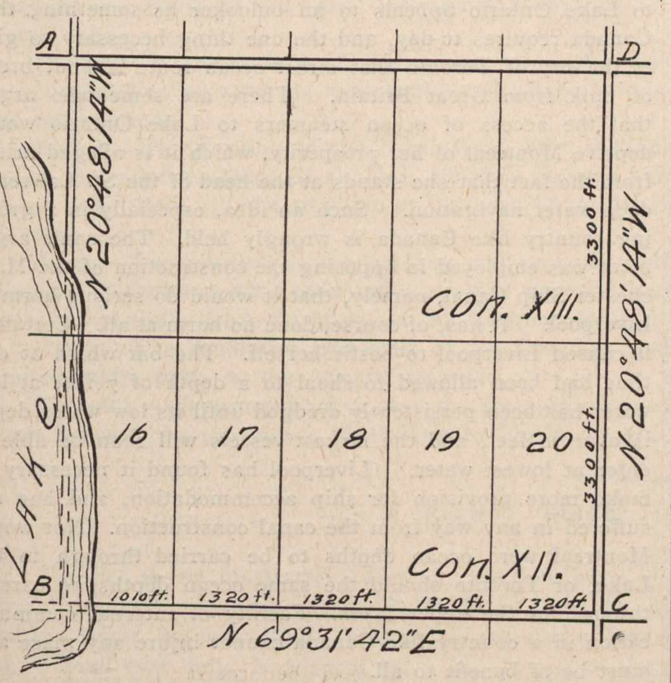
VERTICAL CURVES.

Sir,—I would be pleased if some of your readers would tell of their experience with vertical curves. I have not as yet been able to secure a suitable method of running in vertical curves. A method both accurate in mathematics and yet simple enough to be used in the field. Yours,

Niagara, February 1908.

RUNNING A LOT LINE.

Sir,—A. B. C. in his question as to running the lot line between lots 16 and 17 does not give enough information. If the township in which this lot is located is in certain dis-



tricts mentioned in the Survey Act, and if none of the other lot lines are run then he should take the astronomical bearing for running new lines irrespective of the bearing of the blazed line he mentions. Yours.

Toronto, January 17th, 1908.

FOLKESTONE PIER WORKS.

(From our Own Correspondent.)

Important harbour and pier works have been carried out by the South Eastern Railway Company at Folkestone since 1897. New works, designed to meet the increased traffic requirements comprise the extension of the old pier by 900 feet of solid work, with the provision of four new berths available at all tides and in all weather; the protection of the west face of the old pier by a solid wall carried down to a secure foundation, the strengthening of the root of the pier by a wall founded on cylinders and protected by a wave breaker of 20-ton blocks deposited pell-mell; the renewal of the east face of the old pier in greenheart piling and the provision of a new dock throughout its length. The pier terminates in a round head 65 feet in diameter upon which stands a granite lighthouse exhibiting a fourth order double flashing light, and a fog-horn house with air compressing machinery. The new works are composed of 20-ton concrete blocks, of which 133,500 cubic yards were used. Among the methods adopted for testing the cement was a boiling test used as a measure of the aeration necessary. Experiments were made with 100-ton lots to ascertain the increase of volume due to aeration, and one of the consignments tested in this manner continued to increase at a rate sufficient to pay the cost of turning the cement up to the twenty-second turn. Tests extending to three years were also made of cement which had been adulterated with gypsum to control its setting properties, and the results showed a serious diminution of strength in the last year of the test with neat cement, but a steady increase with the mortar test. The staging from which the actual building was carried on was 101 feet wide, and 400 feet long, with a rail level 21 feet above high water. It was formed of Oregon pine piles 18 inches square carrying lattice girders of 40 feet span. There were two 20-ton and two 30-ton goliath cranes, the latter being used for handling the diving bells of which there were two, each 13 feet by 10 feet by 6 feet, weighing 26 tons. The 20-ton goliaths were used mainly for block setting. In connection with the strengthening works at the root of the pier, owing to the proximity of the old work and the amount of cover to be removed before obtaining a good foundation, it was necessary to resort to cylinders to obtain a secure footing in the lower greensand beds. These cylinders, which were 11 feet in diameter were placed in two rows. Those in the front row were built up of steel rings 5 feet deep, whilst in the back row the cylinders were made of concrete in sections each weighing nearly 20 tons. The steel cylinders were sunk by means of compressed air, and the concrete cylinders by grabbing in the usual way. The block work wall, built on the top of the cylinders, was backed with chalk filling upon which the main pier station was built.

EXPERIMENTS ON WIND PRESSURE.

Dr. T. E. Stanton, of the National Physical Laboratory, has just completed the second part of the research on the distribution and intensity of the pressure of the wind on structures, which was proposed by the Committee of the National Physical Laboratory as the first investigation to be underaken in the Engineering Department. For the purpose of the work a steel windmill tower was erected in the grounds of the National Physical Laboratory at Teddington. Experimental boards and models of structures were attached to a light framework carried by the cap of the tower, the height of the centre of the boards from the ground being 50 feet. In these observations, the velocity of the wind was estimated from a pair of pressure tubes, placed about 15 feet above the centre of the board. These tubes were connected by lead pipes to a sensitive water gauge placed at the foot of the tower. The resultant pressure of the wind on the board was estimated from a measurement of the pressure produced in a closed cylinder of air by the deformation of a thin steel diaphragm forming its cover which was in contact with the centre of the pressure board. This pressure was also transmitted through lead pipes to the foot of the tower and there measured by a similar tilting gauge to the one used for the velocity estimations. The simultaneous observations of pressure and velocity were only possible in the short periods of time in which the velocity of the wind was fairly constant. Such periods, lasting from two to five seconds, were found to occur about once a minute in a fairly steady breeze. The results of these observations on three pressure boards, one 5 feet by 5 feet, one 5 feet by 10 feet, and one 10 feet by 10 feet gave practically identical values of the constant in the pressure velocity relation. In units of pounds per square foot, and miles per hour, the mean value of this constant for the three boards was 0.0032. As this value agreed so well with the average of those obtained by previous experimenters when using plates of the order of one square foot in area, experiments were not made on smaller plates. Experiments were also made on a model of a braced girder 29 feet long by 3 feet 7 inches deep, and on a roof model whose sides were 8 feet by 7 feet. The ratio of the resistance per unit of area of the model girder to that of a square board in the wind was found to be precisely the same as the ratio of the resistance per unit of area of a small model of the girder made to a linear scale of 1 in 42 to a square plate in the experimental channel and uniform current used in the previous experiments. The resultant pressures on the roof were obtained, for both windward and leeward sides, at angles of 30, 45 and 60 degrees inclination to the horizontal, and indicated the considerable suction effects on the leeward side of a roof when the pressure inside the building is augmented from the windward side by open doors or windows. These results lead to the conclusion that the resistance of a complicated structure in the wind can be accurately predicted from a determination of the resistance of a small model of the structure in an experimental channel.

CANALS AND TRANSPORTATION.

W. H. Booth, M. Am. Soc. C.E.

The canal question has been somewhat acute recently in England where the one-time fine system of artificial navigation has been suffered to fall into decay or has as some say, been specially destroyed by the railroads who obtained control over so many of the canals. The railroads controlled parts here and there and were thus enabled to cripple the complete system. On the continent of Europe a different state of affairs has prevailed. France, Holland, Belgium, and Germany have all kept their canals in order and have enlarged them to fill modern conditions.

Except the Caledonian Canal there are few really great canals in all Great Britain. The Beaver Navigation in Cheshire is a fairly large undertaking that has been well maintained. The Thames navigation admits of mere small barges beyond the lowest lock at Richmond, and then there is that great undertaking the Manchester Ship Canal, the making of which has at least coincided with the emergence of the great city of Manchester from a state of actually falling population into one of active and fresh expansion only paralled by a few large cities in the world. One of the later European canals is that from the sea to the ancient mediaeval city of Bruges in Flanders. This canal was commenced in the year 1896, and in ten years time, an English steamship the s.s. Mellifont of the Lancashire and Yorkshire Railway Company traversed the canal and entered the new port of Bruges, which is now six hours nearer to the port of Goole than it was by the old route via Ostend.

Six and a quarter miles long, the new canal is 71 feet wide at the bottom and 227½ feet wide at the water line. The present depth is 26 feet. It has been, of course, a simple matter to make this canal through a flat country, and one marvels it was not made sooner, for, in the middle ages, Bruges was the commercial capital of northern Europe and a place of great wealth and importance as far back as A.D. 1301. There is a regular service by the L. & Y. Railway boats to England, and this company has secured good terms from the Belgian Government. In 25 years there has been spent on the ports and canals of Belgium no less than sixteen million pounds sterling, a sum which is large considering the small area of Belgium. The total area of Belgium is only a little over 11,000 square miles, and there are 1,360 miles of canal, or one mile to each 8⅓ square miles of area. That is to say, it is as though the country were cut up into areas of about 17 miles square with a canal round about each square so that there would be no point more than 8½ miles distant from water. What is more, the sea end of the new canal at Zeebrugge is protected by a mole, and this has a length of 2,423 yards, will carry a triple line of railway and generally provide such a port as the Hook supplies to Holland. Meanwhile what is being done to furnish similar facilities for Great Britain, once famous for her excellent canal system? The answer is nothing further than the Manchester Ship Canal, the traffic on which is growing at a rapid rate. When the effect on Manchester of that canal is considered the wonder is that the people of England are content to sit down and watch foreigners take all the advantages which a good system of canals affords. Everyone should know that the English canals were killed. They did not die from competition, for the railways never really competed with them. Traffic was often sent by the canals at railway rates, but it never seemed to the railways that they could afford to allow canals to live. But there is no reason based on experience for railway directors to place much reliance upon their judgment as to what is or is not good for their own interests or for the interests of the country on whose prosperity depends that of the railways did they but know it.

It is said that since the Manchester Ship Canal was opened for traffic the railway traffic between Manchester and Liverpool has doubled itself. Any man travelling in Canada cannot fail to be struck with the fine methods of canal engineering on the line of the St. Lawrence navigation, but this canal system only permits of a draft of something like 15 feet. Doubtless such a draft was considerable at the time the canals were made, and the canals were a great undertaking for Canada at the time. But their enlargement to thirty feet depth would be a smaller undertaking for the Canada of to-day than was the fifteen feet depth of the present canals when they were undertaken. A real ship canal to Lake Ontario appeals to an onlooker as something that Canada requires to-day, and the one thing necessary to give to the city of Toronto that direct ocean route without break of bulk from Great Britain. There are some who argue that the access of ocean steamers to Lake Ontario would deprive Montreal of her prosperity, which it is alleged arises from the fact that she stands at the head of the St. Lawrence deep water navigation. Such an idea, especially in a growing country like Canada is wrongly held. The same argument was employed in opposing the construction of the Manchester Ship Canal, namely, that it would do serious harm to Liverpool. It has, of course, done no harm at all. Certainly it caused Liverpool to bestir herself. The bar which at one time had been allowed to shoal to a depth of 7 feet at low water has been persistently dredged until its low water depth is over 30 feet, and the largest vessels will soon be able to enter at lowest water. Liverpool has found it necessary to make more provision for ship accommodation, and has not suffered in any way from the canal construction. Nor would Montreal were ocean depths to be carried through to the Lake, or Toronto should the same ocean depths be carried through to the upper lakes. Facility of internal communication in a country like Canada cannot injure any place and must be of benefit to all.

THE GEORGIAN BAY CANAL SURVEY.

A Government survey of the route, which is said to be quite practicable from an engineering standpoint, is almost completed. The general consensus of opinion seems to be that when the canal is built it will be a free canal, constructed, owned and operated by the Federal Government.

The route is as follows: The French River is entered at Georgian Bay and followed for sixty-three miles to Lake Nipissing; then across this lake, 19½ miles to North Bay. This has been surveyed by the C.P.R. It would make a continuous waterway from Fort William to North Bay and also to Callander, which has a fine harbor on Lake Nipissing, where the G.T.R. could handle the grain. The cost of this section has been variously estimated, but the last report puts it at $13,700,000.

From North Bay, the canal is projected over a height of land, through a chain of lakes 25 miles to the Mattawa River, and thence 15 miles with the Mattawa to the Ottawa River. The Ottawa River is the backbone of the canal, although the St. Lawrence is also used for 25 miles, from St. Anne to Montreal. The total length of the waterway is 440 miles, and it is designed to accommodate vessels 650 feet long, 60 feet beam, and 21 foot draft. A vessel of this class would have a capacity of 10,000 tons.

The annual report of the Department of Public Works for the nine months ending March 31 has been presented to the House of Commons. It contains an interim report from Mr. A. St. Laurent, engineer in charge of the Georgian Bay Canal survey. Mr. St. Laurent makes a recommendation in favor of the appointment of a commission to investigate the industrial, commercial and natural aspect of the proposed undertaking. He suggests that they be asked to consider these points:—

First.—A study of the transportation problem in relation to the proposed waterway and to what extent can it help developing the immense resources of the country.

Second.—The advantages of a large waterway from the lakes to the seaboard, open to all carriers, and its influence in regulating the rate of transport, especially upon the cheaper commodities which the country produces.

Third.—The competition of the all-water route with the railways, probable beneficial effect on railways by creating new industries, on account of the cheap transportation of low grade freight that cannot be hauled properly by rail.

Fourth.—The volume of traffic available on account of the natural advantages of the waterway.

Fifth.—The traffic of the Great Lakes; how it reaches the seaboard; the percentage of Canadian traffic handled through United States ports, and causes therefor.

Sixth.—Lake transportation; rates that prevail on lake and rail as against all rail; also a comparison with an all-water route.

Seventh.—A comparison of the volume of traffic that may be handled by water as against the rail routes, within the same period.

Eighth.—The position of the North-West, Fort William being the objective point of all lines running through the wheat belt. How will the situation at the head of the lakes be met?

Ninth.—The position of the existing and proposal gulf lines via Galveston; what their influence may be regarding diversion of traffic from the lakes and St. Lawrence routes.

Tenth.—The conditions that exist at the Canadian and United States ports on the Atlantic seaboard.

Eleventh. — Interprovincial trade; the strengthening of trade between the provinces; North-West to supply Ontario, and Quebec to supply in return the product of their manufacturers, whilst it will perhaps be possible for Nova Scotia to supply coal to Ontario at a cheaper rate than it now costs to bring it from the United States, effecting a great saving to the country.

Twelfth.—The iron industry and other mineral resources.

Thirteenth.—Pulp industry and the possibilities of development.

Fourteenth.—The tendency to manufacture at the base of supply; the possibilities along the route of the waterway, where raw material which cannot be transported by rail at a low rate is available. The easy development of large water powers at dams for manufacturing purposes.

Fifteenth.—Comparative cost of transportation per ton per mile, lake, and rail, and all water.

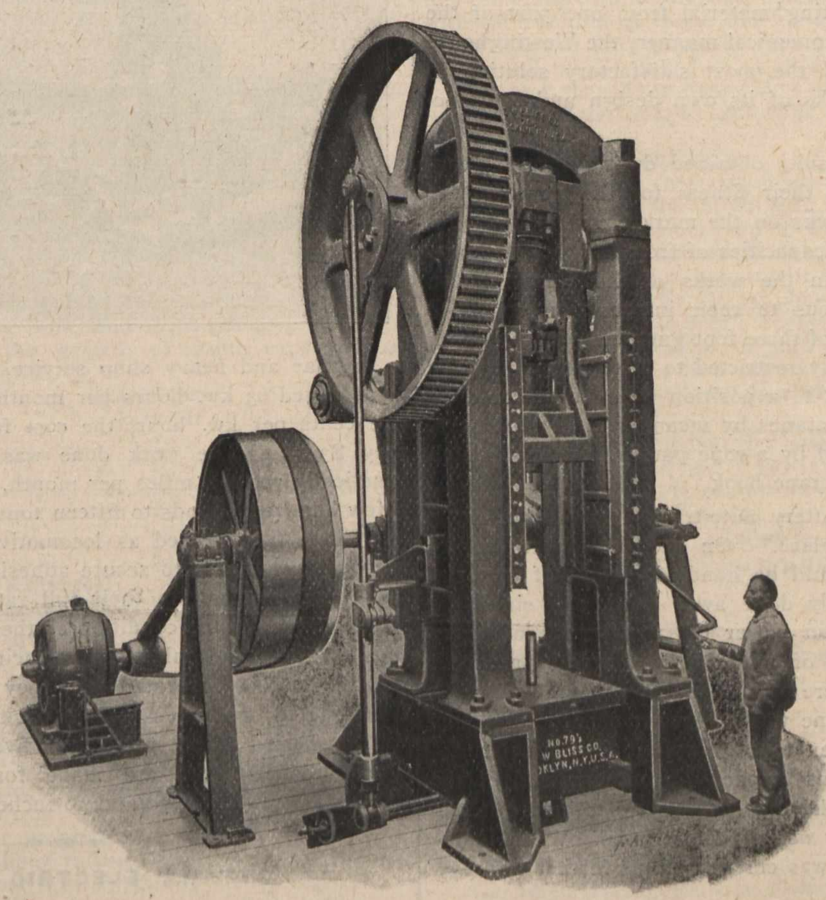
Sixteenth.—New territory opened in the North-West and the requirements to move the grain crop ten years hence.

Seventeenth.—Storage at the head of the lakes and the seaboard; extent of the terminals required.

Eighteenth. — Markets; general statistics; synopsis of history of deep canals, their trade development.

A GIANT "BLISS" SINGLE CRANK PRESS.

The cut shown illustrates a new single crank press recently designed and built by the E. W. Bliss Company, 21 Adams Street, Brooklyn, N.Y. This press, one of the largest of its kind ever built, is adapted for a wide range of work such as heavy blanking, trimming, and shearing, also drawing cold from heavy sheet steel such articles as automobile hubs, cream separator bowls and deep drawn seamless shells. This type of press is adapted for the manufacture of that



class of articles that do not require the blank-holder essential in the manufacture of utensils that are drawn from thin sheet metal, consequently no blankholder with attendant toggle or cam action is provided in this press.

This press is capable of exerting a working pressure of 500 tons. Some interesting details of construction are as follows:—The press is double-geared and provided with extra large flywheel which also serves as a driving pulley; the proportions of the machine are unusually strong and massive throughout; the bed, frame columns and crown piece are all of special cast iron and are bound together by four vertical tie rods each 6 inches in diameter; these tie rods receive all the stress due to the pressure exerted by the machine, thus relieving the frame columns of all working tension; the frame columns themselves are of cored boxing section of ample dimensions to impart rigidity to the entire structure and to support the bearings of the back gearing and driving shaft; the bed of the machine is also of cored section with wide extending feet, giving an area of base amply suitable to the general dimensions and the height of the machine. The bed is provided with a circular opening 12 inches in diameter and with a bored recess 16 inches in diameter into which a heavy plate is inserted on occasions when it is preferable to dispense with the opening in the bed. The crown piece of the machine is solid and serves as a bearing for the crank shaft as well as joining the tops of the frame columns; the main shaft is of high carbon open hearth steel, and can be removed or placed in its working position without disturbing the crown piece of the press; the pitman is of cast steel provided with a 6-inch diameter forged steel adjusting screw, the adjustment being effected by means of a ratchet motion.

The driving and intermediate gears and pinions are made of steel, the main gear and pinions having specially designed short teeth, shrouded, attaining unusual strength without any undesirable enlargement of the pitch. The press is started and stopped by a single hand lever working in conjunction with an unusually powerful friction clutch and brake; the press can be readily stopped at any position of its stroke up or down; a powerful knockout is provided, easily capable of adjustment for various lifts or being rendered inoperative on occasions when its use is not required. The part of the knockout beneath the bed may be readily removed to make way for shells that it may be more desirable to pass through the bed instead of being extracted from above.

Some of the general dimensions of this machine are as follows:—

Distance between housings .... 37″
Stroke of slide .... 24″
Adjustment of slide .... 8″
Ratio of gearing 58:1
Depth below floor line .... 30″
Total height above floor line .... 16′ 7″
Floor space over all .... 10′ 2″ × 14′ 8½″
The flywheel is 62″ diameter, 10½″ face, weighing 2,500 lbs.

The total weight of the machine is 75,000 lbs.

THE WESTINGHOUSE STORAGE BATTERY AUTO-TRUCK FOR INDUSTRIAL RAILWAYS.

Beset by the problem common to all large industrial establishments of transporting material from one part of the works to another in an economical manner, the Westinghouse Machine Company found the most satisfactory solution in storage battery auto-trucks of its own design and construction.

Convinced by the results obtained during several years of continuous service of their fitness for the purpose, the company has put the trucks on the market and is now prepared to furnish them in capacities of from ten to forty tons.

The system in use in the works of the Westinghouse Machine Company previous to their introduction consisted of small cast iron trucks of three foot gauge, moved by hand, whose load was necessarily restricted to a few tons. Heavy castings were transported to a position where they could be handled by the overhead cranes by means of fifty-ton trucks, which were usually moved by a rope passing under a snatch block and attached to a crane hook.

When the storage battery auto-trucks were installed, a surprising change took place. On account of the facility with which the trucks could be handled, delays of material in transit were practically done away with, and since the trucks furnished their own power the number of labourers required for the moving of material was greatly reduced. More important still, there was a marked improvement in crane service, since a crane was no longer needed for transporting castings below ten tons in weight (the first trucks installed being of ten tons' capacity) from one end of the long shops to the other, driving several cranes before it and putting them temporarily out of commission. When larger trucks were added, there was corresponding further improvement in crane service.

The trucks, though of extremely simple construction, are very substantially made of the best materials. A steel frame, thoroughly braced, is carried on four wheels, the journal of which run in roller bearings. The driving axle or axles, as the case may be, carry the motor, or motors, as in street railway practice. The motor is spring suspended from the frame at one end, and connected to driving axle by suitable reduction gearing. A spring suspended cradle or angle iron carries the battery trays.

At the operating end of the truck are mounted the controller, brake, charging receptacle, cut-out switch and voltammeter. A convenient step and draw bar head are provided at each end.

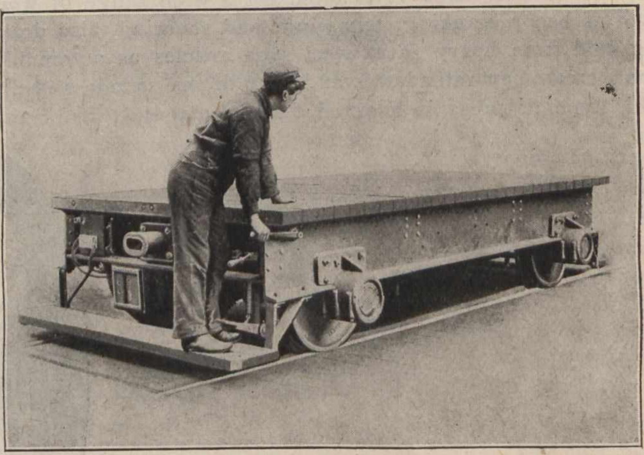
All the machinery is below the top of the frame and is covered by a heavy wooden deck for carrying the load. This deck is made in sections, so that one part of the mechanism is readily accessible.

The motor is of the well-konwn Westinghouse vehicle type, capable of standing heavy overloads, is dust proof and self-oiling.

The controller is also of the Westinghouse vehicle type, giving four speeds in either direction. It is provided with operating and reverse levers, which are interlocking to prevent premature reversal, thus protecting the motor and the batteries.

The battery is contained in two or more trays or cells, and is of ample capacity for the particular service. It is especially designed to operate at high rates of charge and discharge, and, therefore, a battery of four or five times the capacity, as is usually the practice in similar service, is not needed, since the plates in this battery are capable of discharging at a very high rate for three or four minutes at a time without injury. Another reason for adopting a battery of smaller ampere hour capacity than is customary in similar work is that the time available for charging during the working hours is usually thrice the period of time that the truck is actually running. Charging is made so simple that the truck can easily be charged during these idle periods.

During a six months's test of the standard ten-ton truck herein illustrated, the power required to charge the battery



in regular and heavy shop service was accurately metered. It averaged 63 kw. hours per month. At the high figure of five cents per kw. hour, the cost for the current would be only $3.15. The work done was recorded and averaged practically 700 ton miles per month, the loads running from a few hundred pounds to fifteen tons.

These trucks used as locomotives on a level track and without any weight to secure adhesion can haul, on suitable cars, from one-half to their full rated capacity as a truck, depending upon the condition of the track and kind of bearings on the cars hauled. By placing sufficient weight over the drivers to secure adhesion, they are capable of handling from one to two times their capacity as a truck for a continuous period of not more than five minutes.

Standard trucks are made for six different gauges, namely, 18, 21½, 24, 30 and 36 inches, and 4 ft. 8½ inches.

OTTAWA ELECTRIC RAILWAY.

The best in the history of the company is the general opinion of the annual report of the Ottawa Electric Railway Company for 1907, presented at the shareholders' meeting on Monday. The receipts for the year were $574,278, an increase over 1906 of $48,531. Net earnings were $224,349. Net profits were over 18 per cent., after paying fixed charges. Dividends of 12 per cent. were paid. The number of passengers carried was 12,623,440, an increase of 1,215,218 over the previous year. Eleven million more passengers were carried last year than in 1902, the first year of the Company's operation. The old board of directors was re-elected.

CANADA'S RAILWAYS.

Dominion Has Highest Mileage, Measured Against Population.

Few sets of figures issued in the Government Blue Books are so interesting as those emanating from the Department of Railways and Canals. The figures for last year are particularly so, apart from the progress which they record in all branches of the transportation business, for they are based upon a new form of schedule—identical in all essentials with that adopted by the Interstate Commerce Commission at Washington—and give statistical information never previously afforded. The introduction of the new schedule involved a uniform system of accounting on the part of the railways. This in itself was a reform urgently needed, and was one in which the railways heartily co-operated.

Mileage—And a Comparison.

Transportation facilities increased during 1907 to the extent of 1,099 miles of new track. The mileage of double track was increased from 743 to 1,067 miles. This gain of 324 miles was almost wholly applicable to main lines. The total mileage in operation was 22,452 miles, or 5 per cent. more than in 1906. It is estimated that 3,000 miles were under construction.

The following table compared Canada's railway mileage with that of other countries with respect to population and territorial area:

	Population to each mile of railway.	Square miles to each mile of railway
United States	381	13.61
United Kingdom	1,821	5.29
France	1,590	8.46
New South Wales	686	146.09
New Zealand	358	43.42
Victoria	360	25.89
Canada	289	161.80
India	10,119	61.09

From this it is seen that Canada has the highest mileage measured against population, and the lowest measured against territory among the countries indicated. In other words, Canada stands foremost among them in transportation facilities in proportion to her population.

Aid and Capitalization.

The total aid to railways now amounts to $181,298,412 in money and 52,183,063 acres in land. Further, the Dominion Government have guaranteed the bonds of the companies to the extent of many millions of dollars. Capital aggregating $1,171,937,808 is invested in the railways of the Dominion. On this sum, net earnings, amounting to $42,989,537, represent a rate of 3.66 per cent. Per mile, the capitalization, excluding Government lines, is $56,995. In the United States, it is $67,936 per mile, and in the United Kingdom, $273,437.

Traffic during the year gained substantially. In freight the increase was 5,899,422 tons, and in passengers 4,147,537 in numbers. Since 1875 the growth of traffic, expressed in millions, has been as follows:

	Passengers carried.	Tons of freight.
1875	5	6
1885	10	15
1895	14	22
1905	25	51
1906	28	58
1906	32	64

Earnings and Operating Expenses.

Earnings and operating expenses last year figured thus:

	1907.	Increase over 1906.
Total earnings	$146,738,214	17.09 per cent.
Operating expenses	103,748,672	19.07 per cent.
Freight earnings	95,738,079	14.9 per cent.
Passenger earnings	45,730,652	17. per cent.
Net earnings	42,989,537	12.55 (in volume)

Proportion of operating expenses to earnings	70.70
Average earnings per ton	$1,472
Average earnings per passenger	1,219
Total earnings per mile of railway	6,536
Operating expenses per mile of railway	4,621
Earnings per train mile	1,953
Operating expenses per train mile	1,381

The total train mileage was 75,115,765—an increase of 2,392,283 miles, or 3 per cent. This applies almost entirely to passenger service. In the mileage of freight trains, there was a reduction of 221,278 miles, despite the fact that 5,899,422 additional tons were hauled. This indicates that heavier units and higher traction power were employed.

In this report for the first time figures are given relating to the average earnings per passenger per mile and the average earnings per ton per mile. These are basic factors in the railway problem. On 68 out of 80 operating lines, the average revenue per passenger per mile was 2.863 cents and the average rate per ton per mile 3.655 cents. On 28 lines having passenger earnings of more than $25,000 per annum, the average revenue was 2.232 cents. Freight earnings on the five principal railways was .702 cents per ton per mile.

Equipment and Rolling Stock.

Large additions were made to the rolling stock of the railways. There were:

	1906.	1907.	Increase.
Locomotives	2,931	3,504	573
Freight cars	96,565	113,514	16,949
Passenger cars	3,319	3,642	323

Persistent complaints of car shortage led to special inquiries by the Department. Only one road admitted a shortage. Yet it is assumed that a considerable deficiency exists. Allowing for the cars worn out and destroyed, the 1,099 miles of new track operated, and the additional freight handled, 18,317 extra freight cars were required last year to maintain normal conditions; that is, 1,368 more than were actually brought into use. The total supply of cars was 5,218 for every 1,000 miles of railway. In the United States it was 8,810. It is noted that causes other than car shortage helped to congest traffic. The Manitoba Grain Act is one; the Lord's Day Act another. The effect of the latter is reported to have meant a loss of 21 per cent. of the handling capacity of one company. Shippers are blamed for not increasing their warehouse accommodation in keeping with the large expansion of the past decade. Delays in loading and unloading also contributed to the congestion.

Heavy Casualty Returns.

More persons were killed and injured on Canadian railways in 1907 than in any previous year. The total killed was 587; the injured numbered 1,698. A large proportion of the casualties related to employees, of whom 249 were killed and 1,126 injured. So far as passengers are concerned, one person in every 459,104 was killed and one in every 91,299 injured. In 1906, the figures were one in every 1,749,361 killed, and one in every 121,168 injured.

Thus, whatever their advance in other directions, Canadian railways are apparently not increasing in safety. Some space is devoted in the report to this question, and it is asked: Can comparative safety in railway travel be brought about? The answer is in the affirmative. The matter is largely one of cost and integrity. "If proper provisions against casualties are made by the railways, and every individual associated with the running of trains did his duty, this frightful annual toll of life and limb would be very much reduced." The first step would be the introduction of a thoroughly tested block system and the closer inspection of new rails, roadbed and equipment. Last year's accidents cost the railways nearly $2,000,000.

Growth of Electric Railways.

Electric railway interests made modest headway during the year. The paid-up capital was increased by $11,337,505, bringing the total amount up to $75,195,475. The mileage remained almost stationary at 814.52. Gross earnings were $12,630,430, showing a betterment of $1,663,559. Operating expenses aggregated $7,737,251, being an increase of $1,062,214. The result of the year's operations was a credit balance of $4,971,624. Operating expenses proportioned 61.25 of gross earnings. This is a highly encouraging figure. The total number of passengers carried was 273,999,404—a gain over 1906 of 36,344,330.

Here again the accident list is a heavy one. No less than 71 persons were killed and 1,736 injured. The fact is worth noting that not a single person was killed in Montreal, while nine lives were lost in Toronto.

RAILWAY EARNINGS.

Canadian Pacific Railway.

Canadian Pacific Railway Company's return of traffic earnings from January 14th to January 21st:

1908	$1,055,000
1907	923,000
Increase	$132,000

Canadian Pacific Railway.

Canadian Pacific Railway Company's statement of earnings and expenses:

	Dec., 1907.	Jan. 1st to Dec. 31st, 1907.
Gross earnings	$6,418,596 38	$40,885,496 07
Working expenses	4,341,386 80	26,454,473 48
Net profit	$2,077,189 58	$14,431,022 59

In December, 1906, the net profits were $2,265,504.34; and from July 1st to December 31st, 1906, there was a net profit of $14,585,866.70. The decrease in net profits over the same period last year is, therefore, for December, $188,040.76; and from July 1st to December 31st, $154,844.11.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.*

Canada Northern must move its Fort William Station.

Grand Trunk Railway apply for permission to build a spur at Port Colborne, Ont.

4269—Jan. 25—Application of the Canadian Pacific Railway for authority to open for carriage of traffic that portion of the main line of its railway between Markstay and Stinson, Lake Superior Division, a distance of seven miles.

4270—Jan. 27—Varying Order No. 3499 of August 7, 1907, in connection with two branch lines, or spurs, of the Vancouver, Westminster and Yukon Railway Company, in the city of Vancouver, one near Clark Drive and the other east of Westminster Avenue to a point on Burrard Inlet.

4271—Jan. 27—Extending the time of the Vancouver and Yukon Electric Railway Company of British Columbia for an order for the use of a crossing at rail level on Park Avenue, in the city of Vancouver, for one year and six months.

4272—Jan. 22—Requiring the Canadian Northern Railway to remove its railway station in the city of Fort William, Ont., from its existing location to a location clear of the intersection of Victoria Avenue with Vicker Street, and to complete the work on or before January 31st, 1908.

4273—Jan. 29—Application of the Grand Trunk Railway Company to construct, maintain, and operate certain branch lines of railway or siding upon and across Lots 28, 29, 30, 31, 32, and 33 in the First Concession of the Township of Humberstone, in the village of Port Colborne, Ont., and Lots Nos. 1, 2, 3, 4, 5, and 6 in the Township of Wainfleet, county of Welland, in the Province of Ontario.

4274—Jan. 29—Application of the Canadian Pacific Railway Company for authority to construct, maintain, and operate a branch line of railway, or spur from its main line, at a point near Bordeaux, Que., to the site of the new gaol.

4275—Jan. 30—Extending time for the use of Grand Trunk Pacific Railway freight standard Mileage tariff from January 31, 1908, until such time as the Board shall otherwise order or direct.

4276—Jan. 31—Application of the Toronto and Niagara Power Company for authority to erect, place and maintain its aerial wires for the transmission of electrical power, viz., 12,000 volts, over the track of the Michigan Central Railway, in the Township of Stamford, near Falls View Station, in the county of Welland, in the Province of Ontario.

* Full text of these orders may be secured from the Canadian Engineer for a small fee.

NEW INCORPORATIONS.

Ontario.

Collingwood Hardware, Limited, Collingwood, Ont., $40,000. W. D. White, F. Wright, R. H. Breeze, Ella M. White, Francis White, all of Collingwood.

The Great West Coal Company, Limited, Port Arthur, Ont., $250,000. J. J. Carrick, J. A. Crozier, J. A. Crozier, P. D. Munro, G. W. Brown, T. Tretheway.

Canada Southern Oil and Gas Company, Limited, Tilbury, $100,000. J. A. Tremblay, B. Ballard, J. D. Wesner, E. Giroux, H. Callwood.

Standard Brass Manufacturing Company, Limited, Sarnia, Ont., $20,000. W. Brabant, Leo. Brabant, F. X. Brabant.

The Time Saving Coupler Company, Limited, Toronto, $50,000. A. Uvedale, R. Musgrave, H. E. Johnston.

Alexander Land Company, Limited, Toronto, Ont., $75,000. A. W. Holmstead, F. H. Potts, T. A. Silverthorn, M. G. Carroll, Edith M. Carruthers.

Canadian Northern System Terminals. A Dominion Incorporation appoints an attorney in Toronto.

Manitoba.

The Babb Hardware Company, Limited, Portage la Prairie, $60,000. A. Babb, G. K. Kirkland, J. A. Lindsay, J. Brandon, E. A. McPherson.

The Fusee McFeetors Company, Limited, Neepawa, $75,000. R. H. Fusee, J. McFeetors, J. McIntosh, J. Crawford, J. Wemyss, J. H. Howden, J. Simpson, J. Brown, J. Kerr.

Foley, Lock & Larson are applying to have their capital stock increased from $300,000 to $1,000,000.

ENGINEERING SOCIETIES.

CANADIAN RAILWAY CLUB.—President, W. D. Robb, G.T.R.; secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, E. A. Evans, Quebec; secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, J. F. Demers, M.D., Levis, Que.; secretary, F. Page Wilson, Toronto.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. Galbraith; secretary, Prof. C. H. McLeod. Meetings will be held at Society Rooms each Thursday until May 1st, 1908.

TORONTO BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—96 King Street West, Toronto. President, C. H. Mitchell, C.E.; Secretary, T. C. Irving, Jr., Traders Bank Building.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, J. G. Sing; secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months. February 6th, 1908, monthly business meeting.

CANADIAN ELECTRICAL ASSOCIATION.—President, R. S. Kelsch, Montreal; secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN MINING INSTITUTE.—413 Dorchester Street West, Montreal. President, Frederick Keffer, Greenwood, B.C.; secretary, H. Mortimer-Lamb.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, R. McColl.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, TORONTO BRANCH.—W. G. Chase, secretary, Confederation Life Building, Toronto.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, H. L. Holman; secretary, Calvin W. Rice.

SOCIETY NOTES.

American Society of Mechanical Engineers.

The first meeting of the Gas Power Section of The American Society of Mechanical Engineers will be held Tuesday evening, February 11, in the Engineering Societies Building at 29 West 39th Street, New York.

The subjects under discussion will be "Experimental Gas Turbines in France" (with lantern slides), "A Simple Continuous Gas Calorimeter," "A Gas Engine and Producer Guarantee." Other subjects relating to the question of Gas Power will also be discussed.

Toronto Branch A. I. Electrical Engineers.

On the twentieth of February, 1908, the society will hold their regular meeting at the Engineers' Club, 92 King Street West. One of the most important matters to be discussed will be a resolution to petition the Board of Directors of the Institute, praying them to arrange for the subdivision of the class of Associates into Associate Members and Associates.

DRAINAGE OF ROADBEDS.

H. B. Kippen, A.M., Can. Soc. C.E.

It is generally allowed that good drainage is the most essential element in the building of a thorough first-class roadbed, and yet railroads are built, even now, with insufficient drainage, which later will increase the cost of maintaining the road in an A1 condition.

Economy in railroad construction is as necessary as in anything else, in the present age, but to distinguish, during the process of construction, which is a true economy as regards drainage, and what an unnecessary expenditure, is a most difficult problem.

This applies more directly to drainage of embankments, when these have to be constructed on muskeg or bog. In many parts of Ontario, especially the northern portions, the formation of the country is such, that in building a railroad it often occurs, that the line will pass from one ridge of rock to another, leaving an intervening space of embankment, to be built on bog or muskeg, which may vary in depth from 10 to 75 feet or more.

If the line is being built on a low grade a low fill may be called for, crossing the swamps, or on the contrary a heavy embankment may be necessary.

What provision is to be made to prevent this bank from becoming a sink-hole? Drainage, and frequently crosswaying is laid, and on it the embankment is built. The sounding rod may show that this swamp is 35 or 40 feet deep, before rock is reached, and this bog has been kept in a soft, spongy state, for generations, as the ground is usually so nearly level that nothing more than some excessive surface water, flows off by a natural outlet.

It is not uncommon to find a heavy growth of timber on many of these swamps, the interlocked roots of which are a factor, in sustaining the weight of embankment, until the load becomes too great, when the ground will break on either side and the dump go down 10 or 15 feet.

Crosswaying, if properly placed, may be satisfactory in some cases, but it often happens, from one cause or another, that it proves itself quite inadequate. The placing of ditches on either side of embankment, at a reasonable distance from centre line, will be found, in many ways, more satisfactory. These ditches, to be useful, should be at least 6 feet deep, paralleling the dump across the swamp, the water being passed under dump by culvert or pipe. A sufficiently deep offtake ditch is provided, on one side or the other, to draw the water off, so the right-of-way between these parallel ditches, becomes thoroughly drained, to a depth of say 6 feet. Time, however, must be allowed before the best results are obtained, as percolation is slow, and the sustaining power of the ground only increases as the water is drawn off. Although not customary, advantages would follow, in many instances, if these ditches were cut, before the grading of embankment was begun, thus affording the saturated ground, on which the fill will rest, more time to drain and harden, before it will be called upon to support the weight of dump. When this is not done it frequently occurs that the swamp crust is broken for a considerable distance, on either side, beyond the slope line of fill under construction. In cases of this sort, it is doubtful if drainage would be of any assistance in sustaining the embankment.

Through a country where swamps are numerous, this method of ditching would be costly, the more so as an offtake ditch has, sometimes, to be carried half a mile or more, before the necessary fall can be obtained, and rock is almost invariably encountered at the outlet.

If, however, by drainage of this sort the embankment be kept in place, and greater safety secured for the travelling public, then the cost would be justified, and the railway more than compensated by the saving in maintenance.

BUILDING MATERIALS IN ONTARIO.

The sixteenth annual report of the Bureau of Mines for Ontario, which is being distributed, contains a very interesting report of interest to builders and cement workers, showing as it does the growth of these trades, and comparing prices and output with previous years.

That building operations were actively carried on during the past year is clear from the returns made of the production of materials used for construction purposes. The larger cities and towns have nearly all experienced a shortage of dwelling houses, and the higher scale of rentals has had the natural result of bringing about the erection of a very large number of new houses; this, too, in the face of the steadily increasing cost of building. The demand for building materials for railway construction and other public improvements has also been very considerable.

The output of common brick, according to returns to the Bureau, was 300 million worth $2,157,000, as compared with 250 million valued at $1,937,500 in 1905. Pressed brick rose from 26,000,000 worth $234,000 in 1905 to 39,860,000 worth $337,795 in 1906. The brick yards in and around Toronto have for several years had difficulty in meeting the demand, and prices in that market have increased in consequence Taking the Province as a whole, however, there has been a slight fall in the average price of bricks as compared with 1905, the value having gone back practically to the level of 1904. The tendency to higher prices for bricks has been manifest for a series of years, as the following figures show, 1906 being the first year in which this tendency has been suspended.

Year.	Price per M.
1901	$5 73
1902	6 41
1903	6 78
1904	7 15
1905	7 75
1906	7 19

The advancing prices have beyond doubt been due to the increasing cost of labor, fuel and plant, as the raw material is of comparatively little monetary value, and exists in enormous—it may be said, inexhaustible—quantities distributed over the whole of the Province.

Other clay products were pressed and paving brick, pottery and sewer pipe, which were made in about the usual quantity. An exception ought perhaps to be made in the case of pottery, the domestic manufacture of which does not seem to be flourishing. The causes for this lack of progress appear to be severe competition from imported goods, and the scarcity of suitable clay for the finer articles. The glacial deposits in Ontario are rarely pure enough or sufficiently uniform in composition to furnish clay of the requisite composition for any but the common varieties of pottery. There are three factories for the production of sewer pipe, namely, those of the Toronto and Hamilton Sewer Pipe Company at Hamilton, the Ontario Sewer Pipe Company at Mimico, and the Dominion Sewer Pipe Company at Swansea. The first named was burned down in April, 1906, but new buildings were erected and the works again put in operation about the beginning of December.

The output of stone for builders' use remained at about the same level as in former years, and was supplemented by a very considerable production of crushed stone for roadmaking and fluxing purposes. The rapidly growing use of Portland cement which is now employed so extensively for foundations, bridges and even whole structures, has undoubtedly interfered with the development of the quarrying industry in Ontario, as well as in other places. The Province is well supplied with the raw material for this industry, and admirably situated for carrying it on to advantage, especially with our neighbors to the south, by reason of cheap water transportation. Nevertheless, it is a fact that " limestones, granites and marbles of eastern Ontario, the dolomites, sandstones and limestones of southeastern Ontario, and the traps, granites and sandstones of the north, have not yet begun to play that part in the economic life of the Province of which they are capable. In part this may be due to adverse tariffs, but perhaps also in part to other causes of a nature likely to disappear before skill, enterprise and capital.

The quantity of lime turned out by the kilns of Ontario in 1906 was 2,885,000 bushels, as against 3,100,000 bushels in 1905. Returns show a decided advance in price, the average value per bushel in 1906 being 17.2 cents, as compared with 13.7 cents in 1905.

Cement.

Very few departments of the mineral industry can exhibit so remarkable a record of steady and rapid growth as the manufacture of Portland cement. Beginning in 1891, the production has increased from 2,033 barrels valued at $5,082, to 1,598,815 barrels in 1906 worth $2,381,014, and the number of manufactories has risen from one to twelve. The raw materials, marl and clay, are abundant, and the demand for cement has been, and still is, very active. In consequence of this demand, the increase in production has been accompanied by an advance in price, the average cost per barrel at the factory having risen from $1.42 in 1905 to $1.48 in 1906 It seems in every way likely that the production and sale of cement will show a corresponding increase in 1907.

The cement plants which were in operation during 1906 were the following:—Raven Lake Portland Cement Company, Raven Lake; Imperial Cement Company, Owen Sound; Belleville Portland Cement Company, Point Ann; Lakefield Portland Cement Company, Lakefield; Canadian Portland Cement Company, Marlbank; National Portland Cement Company, Durham; Grey and Bruce Portland Cement Company, Brookholm; Owen Sound Portland Cement Company, Shallow Lake; Ontario Portland Cement Company, Blue Lake; Sun Portland Cement Company, Owen Sound; Western Ontario Portland Cement Company, Atwood; Hanover Portland Cement Company, Hanover. Two plants, those of the Colonial Portland Cement Company, Wiarton, and the Superior Portland Cement Company, Orangeville, had not been completed at the close of the year.

Nearly all of the Portland cement manufactories hitherto established in Ontario have made use of marl as one of the ingredients, but there is a tendency towards substitution of solid limestone, where this can be obtained of suitable composition, as it is believed the cost of production can in this way be lessened. The limestone beds at Point Ann on the Bay of Quinte are utilized by the Belleville Portland Cement Company, but all the other plants in the list given above use marl.

The manufacture of natural rock cement, on the other hand, has exhibited a decidedly downward tendency of late years, and from the returns of 1906 appears to be on the point of extinction. In 1901 there were made 138,628 barrels valued at $107,625, while in 1905 three factories produced 14,741 barrels worth $10,402, and the same number of plants turned out in 1906 only 8,453 barrels, valued at $6,000. Nearly the whole of this output was from one factory, the other two having practically suspended operations. The reason assigned for this state of affairs by the manufacturers is the general preference shown by builders and the public generally for Portland cement. Doubtless this preference is due to some extent at least to the more uniform composition, and hence more satisfactory results, of Portland cement as compared with the natural rock article. For a variety of uses, however, where homogeneity is not essential, the latter is quite as useful and considerably cheaper. It is therefore matter for regret that its manufacture appears to be coming to an end.

Table XI.—Production of Cement, 1900 to 1906.

Year.	Bbl.	Value. $	Bbl.	Value. $	Bbl.	Value. $
1900	125,428	99,994	306,726	598,021	432,154	698,015
1901	138,628	107,625	350,660	563,255	489,288	670,880
1902	77,300	50,795	522,899	916,221	609,199	967,016
1903	89,549	69,319	695,260	1,182,799	784,809	1,252,118
1904	85,000	65,250	880,871	1,239,971	965,871	1,305,221
1905	14,741	10,402	1,254,360	1,783,451	1,269,101	1,793,853
1906	8,453	6,000	1,598,815	2,598,815	1,607,268	2,387,014

For the year 1906 the quantities and value of natural rock and Portland cements are given as follows:—

Cement.	Quantity. Bbl.	Value. $	Employees.	Wages. $
Portland	1,598,815	2,381,014	1,035	562,085
Natural rock.	8,453	6,000	27	2,694

ONTARIO'S MINERAL WEALTH.

The report of the Ontario Bureau of Mines, with the figures for 1907, is yet to be published. That of 1906 values the output of Ontario's mines at $22,388,383. This sum is computed at the selling prices of the products at the mines or works, and does not take into account the additional values induced by subsequent refining or treatment. Compared with the production of 1905, up to that time considerably the largest on record, the yield for 1906 shows an increase of $4,534,087, or about 25 per cent. "A period of expansion has set in in the mining industry of the Province, and it may confidently be expected that still higher figures, both as to quantities and values, will be reached in the near future. The larger aggregate of value for 1906, as compared with that for 1905 is partly due to an increase in prices, which is somewhat general throughout the list of products, and in some cases quite marked in character; but for the greater part the excess is due to increased production, especially in the metallic schedule."

Last Year's Figures.

The latest report for 1907, up to September gave the mineral production of the Province as follows:—

Silver	6.919,987 ounces.
Pig iron	180,663 tons.
Iron ore	141,719 "
Steel	120,077 "
Nickel	8,087 "
Copper	5,111 "
Zinc	400 "

Some twenty-five mines shipped ore from Cobalt during 1907, as follows. The amount is given in pounds. La Rose, 5,698,006; Coniagas, 4,797,550; Nipissing, 4,829,949; O'Brien, 2,731,496; Buffalo, 2,344,300; Trethewey, 1,510,138; Silver Queen, 957,148; McKinley-Darragh, 1,369,870; Foster, 691,800; Kerr Lake, 644,89$; Temiskaming, 345,111; Townsite, 286,430; Nova Scotia, 493,000; Hudson Bay, 298,670; Green Meehan, 196,790; Cobalt Central, 141,877; Right-of-Way, 258,220; Drummond, 108,920; City of Cobalt, 101,230; Colonial, 74,250; University, 61,385; Silver Leaf, 93,618; Red Rock, 40,000; Imperial, 37,530; King Edward, 62,250; total, 28,164,428 pounds; or, 14,082 tons.

Psychology of a "Boom."

The Deputy-Minister of Mines, Mr. Gibson, gave some good advice in his 1906 report, respecting the probability of a Cobalt boom, and in his latest report, says:—"The prediction was amply verified, but no warning would have sufficed to stem the tide of speculation which was then steadily rising. To follow the progress of a mining boom is to take a course in the study of psychology. News comes of a rich discovery; almost immediately the ground, good, bad, or indifferent, surrounding the find is staked out as mining claims; a languid public is roused to interest by tales of sudden wealth; exaggerated reports of the richness of the district appear in the press; a host of joint stock companies is formed on lands of very doubtful value, but as near as possible to a known mine; shares in these companies are loudly advertised, and the public, whose appetite has by this time become whetted buys readily.

"The supply of such stocks being inexhaustible, there is little or no chance for prices to go up, and when the disappointed purchasers come to look for profits or returns, they find, in some cases, a variety of excuses, in many nothing whatever. The really valuable properties are either not offered to the public at all, or if offered are to the most part capitalized too highly. In these for a time the speculative fever may send up the price of shares, but the height is quickly reached and a reaction sets in during which everybody wants to sell and none to buy. The stocks of non-operative companies become unsaleable, and those of legitimate concerns drop to something like their real value. The public is "shaken out," and loads with objurgations the mining industry, losing sight of the fact that the real causes of the loss were its own cupidity and the unscrupulousness of promoters.

"That is the story of many mining camps in America, and that is what happened in Cobalt in 1906. In the fall of that year when speculation was at its height, the withdrawal of the Guggenheims, of New York, from an option to purchase a heavy interest in the Nipissing mine precipitated a break in the stock market, from which it has not yet recovered. Though the losses were heavy, it is probable that the slump was a blessing in disguise, for had the excitement continued it would have become more general, and the loss when it came, with the consequent demoralization, would have been more widespread. These recurring periods of excitement do much to hinder the development of mining as a business, and to discredit it in the eyes of people with money looking for safe and remunerative investments."

The Eadie-Douglas Company intend pushing this coming season the sale of their "Esco" products. This line was thoroughly tried out last season in the East, and met with great success where used. "Esco" waterproofing thoroughly waterproofs concrete, brick or stone; prevents the same from absorbing water, and also prevents the discoloring of the stone by the action of its salts or the weather. It is also largely used in foundation or cellar work as a regular waterproofing, and on the inside of walls is used as a damp-proofing to be directly plastered upon. "Esco" steel coating is the greatest steel preservative on the market. It will not peel off, and absolutely protects metals from rust or corrosion, and is equally as good a preservative for wood as for iron or steel.

LATE CONSTRUCTION NEWS.

TENDERS.

New Brunswick.

Tenders will be received for four sections of the Transcontinental Railway, until March 10th, 1908. The sections are as follows:

District "A"—From a point designated on the plans of the Commissioners, about the 58th mile west of Moncton, to the crossing of the Intercolonial Railway at or about mile 97.7, a distance of about 39.7 miles.

District "A"—From a point designated on the plans of the Commissioners at or about the crossing of the Intercolonial Railway by the Transcontinental Railway at mile 97.7 west of Moncton to the Tobique River, at or about mile 165.7 less one mile, a distance of about 67 miles.

District "A"—From a point designated on the plans of the Commissioners at or near the Tobique River to a po'nt shown on the said plans about 2¼ miles west of the Town of Grand Falls, in the Province of New Brunswick, a distance of about 31.5 miles.

District "B"—From a point designated on the plans of the Commissioners at or near the boundary line between the Provinces of Quebec and New Brunswick, westerly a distance of about 52.4 miles.

P. E. Ryan, secretary of the Commissioners of the Transcontinental Railway, Ottawa.

Tenders will be received until February 24th, 1908, for: (1) The metal superstructure for the St. Jacques Bridge. The bridge is of two span, each 160 feet. (2) The metal superstructure for the Black River Mouth Bridge at Wellington. The bridge is three span, each 63 feet. (3) The metal superstructure for the Eel River Bar Bridge at Dalhousie. The bridge is to be three spans, each 117 feet. (4) Broadway Bridge at Grand Falls. The bridge is to be two span, each span 86 feet. C. H. LaBillois, Chief Commissioner, Department Public Work, Fredericton, N.B.

Ontario.

Tenders will be received until March 10th, 1908, for two sections of the Transcontinental Railway in Ontario, as follows:

District "D"—From a point designated on the plans of the Commissioners about eight miles west of the Abitibi River crossing, in the Province of Ontario, westerly for a distance of about 100 miles.

District "E"—From a point designated on the plans of the Commissioners about 19½ miles west of the crossing of Mud River, near Lake Nepigon, in the Province of Ontario, easterly for a distance of about 75 miles.

P. E. Ryan, secretary of the Commissioners, Ottawa.

OTTAWA.—Tenders for steel tugs will be received at this office until Monday, March 2, 1908, inclusively, for the construction of three steel tugs, according to a plan and specification, to be seen at the offices of E. T. P. Shewen, Esq., resident engineer, St. John, N.B.; C. E. W. Dodwell, Esq., resident engineer, Halifax, N.S.; J. G. Sing, Esq., resident engineer, Confederation Life Building, Toronto, Ont.; Chas. Desjardins, Esq., Clerk of Works, Post Office Building, Montreal, and at the Department of Public Works, Ottawa. Fred. Gelinas, secretary. Department of Public Works, Ottawa, February 1, 1908.

TORONTO.—Tenders will be received until March 2nd, 1908, for the construction of a New Western Entrance to the Harbor of Toronto. Plans and specifications to be seen at the office of J. G. Sing, resident engineer, Confederation Life Building, Toronto. Fred. Gelinas, Secretary, Department of Public Works, Ottawa. (Advertised in Canadian Engineer.)

Manitoba.

Tenders will be received until February 20th, 1908, by the City of Brandon, for the construction of a bridge over the Assiniboine River. Tenders are required as follows:

A. Reinforced concrete bridge with approaches.

B. Steel bridge with approaches.

Estimated cost $100,000. H. Brown, city clerk.

W. H. Shillinglaw, City Engineer.

TRADE INQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W.

A correspondent in the Maritime Provinces desires to get into touch with British firms requiring graphite properties in Canada.

From the City Trade Branch, 73 Basinghall Street, London, E.C.:

A London company manufacturing motor boats seeks suitable agents in Nova Scotia.

A general sales agent in Hamilton, Canada, reports an opening for tin, tin foil and tea lead, and is open to represent a manufacturer of these goods.

Superintendent of Commercial Agencies, Inquiries Branch, the Department of Trade and Commerce, Ottawa:

A Scotch firm, manufacturing cast-iron pipes, seeks a responsible agent in Toronto.

ARRANGEMENT OF RAILROAD SHOPS.*

By GEGRGE A. DAMON, Managing Engineer, The Arnold Company, Chicago.

Railroad Repair Shops Cost Money, both to build and to operate. Just at this time it may be of interest to approach the subject of their design, arrangement, and equipment from a financial standpoint. There is hardly a better field for demonstrating that "engineering is the science of making a dollar go the farthest" than the art of designing and building railroad repair shops, and, as nearly all work of this character must start with an "A. F. E." (authority for expenditure), or, perhaps, an "appropriation," it will be instructive to enquire just how great an investment in repair shops will ordinarily be justified.

The original cost of an average modern locomotive may vary from $14,000 to $17,000. The actual expense for labor and material to maintain this locomotive in first-class condition will range from $1,500 to $3,000 per year, each road, of course, having its own individual conditions that influence this cost, and which make it impossible to establish an absolutely definite figure. For our present purposes, however, it may be said that a locomotive costing $15,000 will involve a maintenance cost of about $2,250 per annum, and this expenditure should go far toward overcoming the natural depreciation of and wear on the equipment, and thus keep the locomotive in first-class running order.

The original investment in a complete new locomotive repair shop, fully equipped to efficiently make these repairs, will depend on the location, the size, the design, the selection of the equipment, and the cost of labor and material entering into the buildings. These factors are so variable that it is impossible to determine an average that can be regarded as an exact standard. Even an approximate estimate for any given case can only be obtained after a detailed study has been made of the conditions surrounding the particular problem in hand. The following figures must, therefore, be used with judgment, or they may be misleading. These figures have been taken from the records of the actual cost of a number of repair shops, with the design and construction of which the writer has been connected. The fact that there is such a wide variation emphasizes the danger of deriving a general law from any particular experience, or even of drawing a conclusion for a particular case from a general experience.

The figures, however, should be of assistance in determining the limits outside of which it will ordinarily be unwise to go. To spend less money than indicated in the "low" estimate might be the result of a fortunate set of circumstances contributing to economy, but every precaution should be taken to ensure that the saving accomplished is not at the expense of a false economy. To spend more money than indicated by the "high" estimate may be desirable, or even necessary in certain cases, but ordinarily the higher figures are sufficient to cover all repair shop needs, unless it is the intention of those in charge of the work to erect a monument.

The writer has purposely approached this subject of cost with considerable caution, and it is only because the literature of shop building is so meagre of actual cost data that the risk has been taken of having the figures misunderstood, and, therefore, the information misapplied.

Our records show that locomotive repair shops which are laid out on a basis of the number of pits required equal to six per cent. of the number of locomotives served can be built and equipped complete for an expenditure ranging between $50,000 and $65,000 per pit. If one pit will serve sixteen and two-thirds engines per year, the cost of repair facilities will fall some place between the limits of from $3,000 to $4,000 per locomotive. An investment amounting to the lower limit is absolutely necessary if the engines are to be kept on the road. Just how much more than the lower limit should be spent in order to secure the minimum cost of locomotive maintenance, including all the items of not only actual repair expenses, labor and material, but also interest, depreciation, insurance and taxes upon the plant provided, is a question that should have the most careful consideration.

The following analysis of the total cost will serve to indicate the relative importance of the decisions that must be reached in order to give each dollar expended a maximum earning capaciy. The sum total of the "low" and of the "high" figures shown will result in grand totals which will show a wider range than the 33⅓ per cent. variation indicated by the unit figures of $3,000 to $4,000 per locomotive, but as it is improbable that any shop would be built using either the lowest or the highest estimate for every one of its parts it will be found that only in exceptional cases will the actual total cost fall outside of the limits first given.

Table of Cost Limits for Locomotive Repair Shops on the Basis of Twenty-five Erecting Pits.

Divisions.	Limits of Cost per Pit. "Low."	"High."	Approx. Proportion of Tot. Cost.
Shop Yards.			
Tracks, Crane Runways, Transfer or Turntables	$ 1,400	$ 3,000	4%
Water and Sewer Systems	1,000	1,800	2%
Piping and Wiring Tunnels and Tunnel Piping	500	1,000	1%
Buildings.			
Machine and Erecting Shop	8,000	12,000	17%
Boiler and Tank Shop	3,000	5,000	7%
Forge Shop	1,500	2,400	4%
Storehouse and Offices	1,000	2,500	3%
Locomotive Carpenter Shop	500	1,000	1%
Power House	1,200	2,400	3%
Oil House and Equipment	400	600	1%
Miscellaneous buildings:— Scrap Bins, Material Sheds, Fences	500	1,000	1%
General Equipment for all Departments.			
Power House Equipment	5,000	8,000	11%
Travelling Cranes	1,500	3,000	4%
Tool Equipment	10,000	15,000	22%
Heating System	1,200	2,500	3%
Power and Lighting Systems, including yard wiring and lighting	1,500	4,500	5%
Plumbing and Lockers	300	1,000	1%
Air, Water, Steam and Oil Piping in Buildings	600	1,200	2%
Incidentals, Organization and Engineering	2,000	7,000	8%
			100%

Note.—These figures do not include items for Real Estate and Preparation of the Shop Site, which cost necessarily varies between wide limits.

The Foundry building and equipment are not included in these figures.

The History of "modern" locomotive repair shops may be considered as beginning with the use of what has been called "the electric drive." The use of the electric motor makes possible (a) the arrangement of departments independent of the line shaft requirements; (b) the use of electric cranes; and (c) the construction of all power equipment in one central power plant from which may be distributed heat, water, compressed air, light, and power.

One of the first shops to make use of the electric motor for both individual machines and groups of tools, as well

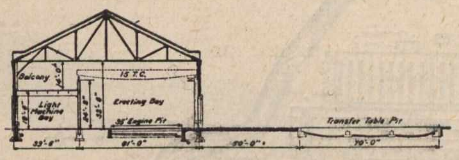
* A paper read before the Canadian Railway Club, Montreal.

as the electric crane and the central power plant, was the Oelwein, Iowa, shops of the Chicago Great Western Railway, which were put in commission in 1900.

Since that date there have been over seventy shops either built entirely new or modernized from previously existing plants. It is safe to say that more than $80,000,000 has been expended upon railroad repair shops and their equipment within the last ten years.

The advance that has been made in the art during this period can best be illustrated by a comparison of the cross section of the Oelwein machine and erecting shop and the cross section of a shop for a similar purpose which is now under consideration, as shown by Fig. 1. The Oelwein erecting shop was equipped with one 80-ton crane and one 15-ton crane, both upon the same runway over the erecting pits. The second and more recent example has one 120-ton crane operating over the erecting pits on a runway above the two 10-ton messenger cranes, while the machine shop is supplied with two 10-ton cranes over the heavy tools, and an additional crane is provided over the covered yard.

It is needless to say that the more elaborate equipment of the latest development in repair shops cost more than the more modest shops which first adopted the electric system, but at the same time locomotive equipment has been gradually increasing in size and cost in such a way as to make these more extensive repair shop facilities an absolute necessity. Care must be exercised, however, to ensure that the repair facilities provided are not greater than the needs



Cross Section of Oelwein Main Shop, C.G.W. Railway.

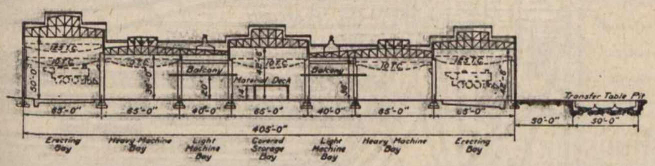


Fig. 1—Cross Section of Main Shop now under Consideration.

of the equipment to be served, which brings us at once to the question of the size of the shops.

Some of the first shops designed to use a central electric power plant were handicapped by the use of the 220-volt direct current electric system, which made it desirable to limit the radius of distribution to about 1,000 feet from the generating plant. The development of the induction motor and the alternating system soon removed this limitation, but as it was still necessary to use the direct current motor to obtain satisfactory electric speed control on many of the independently motor driven tools, a mixed electric system was adopted by many shops. It is still the practice in a number of recent installations to provide both direct and alternating current throughout the shop—using direct current for the cranes, variable speed motors, and, perhaps, the mercury vapor lamps, and alternating current for the constant speed motors, incandescent lights, and the yard lighting systems. The recent improvements in mechanical speed changing devices, the development of the alternating current crane, and the reduction in cost of the induction motor are creating a decided tendency toward the elimination of the direct current system. By these improvements it is possible to distribute power from a central plant over a larger area, and also remove the old limitations of the amount of ground covered by the shop plant.

The Size of a Locomotive Repair Shop will depend primarily upon the number of locomotives to be repaired each year, and the number of days each locomotive under repair must occupy an erecting shop pit. To the pits required for "heavy" repairs must be added a number of pits for "light" repairs, for emergency work, and for future growth. The ratio of the number of pits to the number of locomotives will vary with the assumptions as follows:—

Pits Required in Erecting Shop.

Let A = Number of locomotives served by shop.
B = Percentage of locomotives to undergo "heavy" repairs each year.
C = Average number of days each locomotive occupies an erecting shop pit.
D = Number of working days each year.
P = Number of pits required for "heavy" repairs.
P′ = Number of pits required for "light" repairs.
P″ = Total number of pits required.

Then

$$P = \frac{A \times B \times C}{D} \text{ and}$$

$$P'' = P' + P.$$

The effect of the different assumptions as to the per cent. of the total number of locomotives to be repaired each year and the length of time on a pit are shown by the following table, which was prepared for a shop serving 400 locomotives at present, with a probable increase to 500 within the next five years.

No. of Loco. A	Per cent. Repd. B	Days in Shop. C	Working Days in Year. D	Pits, Heavy Repairs. P	Pits, Light Repairs. P′	Total Pits. P″	P′ / P	P″ / A
500	80%	20	288	28	7	35	25%	7%
500	70%	17	288	21	9	30	43%	6%
500	60%	14	288	15	10	25	66%	5%

From the above table it will be seen that the number of pits may vary from five per cent. to seven per cent. of the total number of locomotives, which variation corresponds with actual practice.

Individual conditions will govern the assumptions for each road, and there are, fortunately, a number of other methods of checking these calculations.

The size of the machine shop space per pit depends largely upon the methods adopted for operating the shop. The work on the pit can be crowded, and the erecting output under normal conditions can be doubled during rush periods, but the output of the machine tools cannot be increased in the same ratio. The tendency at present is to favor the amount of floor space allowed for machine tools. On the other hand, the use of high-speed tools is rapidly increasing the output of each machine, and this development is contributing to the output efficiency of each foot of machine tool space. The space per pit for machine tools varies from 1,500 to 2,500 square feet. This result is often largely influenced by the demands made upon this space for manufacturing new work, or for supplying repair parts to other shops.

An average rule for the size of the boiler shop is to allow one-third as much space for this department as is allotted to the machine and erecting shop, but this rule is affected by the character of boiler repairs to be made. The kind of coal, the conditions of the water supply, and whether or not new boilers are to be constructed must be known before a final decision can be reached.

The blacksmith shop is ordinarily one-third the size of the machine and erecting shop, but local conditions must again be carefully considered before reaching conclusions. The safest way for all shops is to canvass the requirements for output and the capacity and floor space required of each machine, and then design the shop to fit the machines, rather than crowd or spread out the machines into a space the size of which has been too hurriedly determined.

The Preliminary Considerations which must have attention before the problems of relative arrangement of the buildings can be approached involve so much of the "personal equation" that only tendencies of recent practice can be noted, and no hard-and-fast rules can be established.

It is not the province of this paper to discuss the advantages and disadvantages of the various points which must be thoroughly canvassed in order to reach consistent preliminary conclusions, as these subjects have been already covered by special books and technical papers, which are available to those who are interested enough in these subjects to study them in detail. To indicate briefly the problems which must be considered and decided upon by the shop designer early in his work on any particular layout will, however, be of value.

For instance, the question of "transverse shop versus longitudinal shop" for the erecting bay must be settled before much progress can be made. The tendency appears to be in favor of the transverse shop, but the writer must admit that his own personal equation enters into this conclusion.

Whether or not the boiler shop shall be under the same roof with the machine and erecting shop is a question that is usually settled by the experience and preferences of those who are to operate the shop.

The use of a transfer table or a turntable as a means of getting locomotives into the shop is a subject upon which volumes have been and can be written, but this question is usually decided in favor of the desires of the operating official who is to have charge of the shop after it is completed.

The use of yard cranes, telphers, or locomotive cranes for handling materials outside of the buildings is being given more careful attention than formerly, with the result that these auxiliary transportation systems are having a marked influence upon the arrangement of shops. There is a tendency to cover a portion of the yard with a crane, and locate the lye vats and tire furnaces in this covered yard.

The location of the storehouse and the oil house will depend upon their individual use, whether it is the intention for them to serve the entire system or not.

Fireproof concrete construction is having an effect upon bringing the storehouse closer to the various departments to be supplied, the tendency apparently being to locate the storehouse contiguous to the machine and erecting shop, as was originally done at Oelwein.

Whether to locate the car repair department contiguous to the locomotive repair department is a question of policy for the management to decide, and the answer depends largely upon local conditions of operation and organization. The location of the car repair tracks, the desirability of having the common power house near the planing mill to burn refuse, and the location of the forge shop convenient to both departments has a marked influence on the general arrangement of the shops.

The location of the shop itself, as influenced by traffic conditions of the system, and the selection of the shop site after the general location has been decided, are questions in the solution of which serious mistakes have been made. Recent decisions seem to indicate a tendency to locate shops as near as possible to favorable labor markets, instead of in smaller towns, or at some inconvenient distance from the larger cities.

Certain Fundamental Principles should be recognized before attempting a railroad shop arrangement, and as far as possible the arrangement should be worked over until it satisfies these requirements, always recognizing exceptions due to individual conditions.

(1) Liberal space (say 100%) should be allowed for the extension of each department.

(2) The storehouse (with administrative offices in one of the upper floors) should be central, convenient to all departments and easy of access on two tracks from the main line service track.

(3) The forge shop should be convenient to both the locomotive and car repair departments.

(4) The power house should be central and near the planing mill and repair tracks in order to burn refuse.

(5) Yard cranes should be arranged to serve between the storehouse platforms and all departments.

(6) The roundhouse should be very near the shop, or located far enough away to justify a separate machine shop for light repairs.

(7) Tracks, cranes, telphers and storage spaces should be arranged to ensure the movement of materials with the greatest economy of time and labor.

(8) Some consideration should be given to the appearance of the shops and accessory storage facilities, lumber yards, etc., from the main line.

(9) The advantages of a short tunnel of ample cross section for the use of the various steam, air, and water piping systems should not be forgotten.

(10) The possibilities of the adoption of longer and heavier engines similar to the Consolidation or Articulated types should be considered, and some provision made for present or future repair facilities for these larger engines.

(11) The cost of the shops should be consistent with not only the actual necessities, but in proportion to the refinements which the road can afford. All expenditures over and above those required for actual needs should be capitalized and made to show a satisfactory return on the investment.

PLAN No. 1.

Actual Examples of Shop Arrangements can be studied to advantage; in fact, a designer of a new shop should make himself conversant with existing plants, and thus

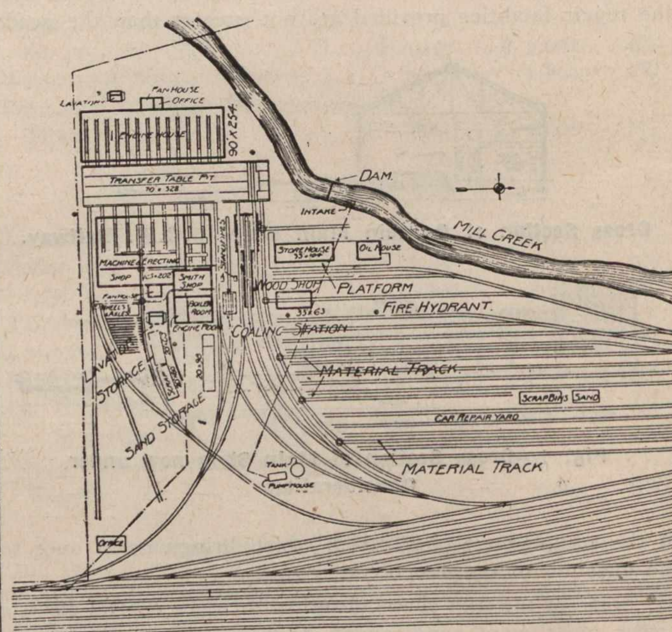


Fig. 2—Ivorydale, Ohio, Shops, C.H. and D. Railway.

make every effort to improve present practice. Advances in any art are usually made step by step, and progress in the right direction can be made with much more certainty if there is a familiarity with the ground already covered by others.

The shop arrangements described in this paper are examples taken from recent practice. None of the plans are advanced as "ideal," but each one is the result of at least twenty preliminary studies, and the reasons for their selection may be of interest.

In two cases the shops are not yet built, and, therefore, their location cannot be disclosed. The perspective views shown are taken as a rule from the preliminary reports, but are sufficiently accurate to illustrate the general arrangements, although in one or two cases these views are not exact as to all minor details.

The Ivorydale Shops of the Cincinnati, Hamilton and Dayton Railway.—These shops were designed to provide facilities for the storage and care of locomotives lying over at Cincinnati between trips, and also for the necessary light running repairs upon engines running in and out of this division point. This shop is, therefore, an example of a terminal locomotive repair plant to take care of "light" repairs only as an auxiliary to the main repairs shop, where all "heavy" repairs are made.

The unique feature of this arrangement is the longitudinal engine house, sometimes called a "square round house." This engine house is served by the same transfer table that serves the erecting shop, the two buildings being directly opposite one another across the transfer table pit. **The yard tracks form a "Y," thus obviating the necessity of a turnable.** Incoming engines pass on to the transfer table over one of two ash pits. There is one outgoing track. Engines can take coal and water either on the way in or out.

The engine house is built of reinforced concrete, and is designed for simply the care and storage of locomotives—no drop pit being provided on the engine house side of the transfer table. The machine and erecting shop has two drop pits in a separate section devoted to light repairs, while the erecting shop proper has a drop table to unwheel engines undergoing more extensive overhauling. One track without a pit is reserved for boiler repairs, which has sufficient space to work on two boilers at one time.

This arrangement makes the most economical use of the space available. It would have been impossible to have introduced the usual turntable plan with a round engine house on the property.

PLAN No. 2.

The Oaklawn Shops of the Chicago and Eastern Illinois Railroad.—The remarkable thing about this plan is that in 1904 the first machine and erecting shop was built with fourteen pits, and the provision made for doubling the shop was considered to be ample for years to come. In 1907, however, the shop was doubled, a fact which emphasizes the necessity of allowing ample room for growth.

In this plant the locomotive department may be said to have been grouped around the engine house from which a shop track running between the machine shop and the boiler shop leads directly on to the transfer table, thus providing a convenient means of transportation to and from all departments.

The coach shop and the paint shop have not yet been constructed, but eventually the transfer table will also serve these two buildings of the car department.

The boiler shop is separate from the machine and erecting shop, and is served by the same transfer table. The blacksmith shop is convenient to the car repair tracks, as well as to the roundhouse and machine shop. The storehouse is central and handy to the main line.

The power house is located between the two departments, and serves the locomotive shop through a pipe tunnel that connects all departments.

Too little space was originally allowed in the machine shop for machine tools, but this defect has been remedied to a certain extent in the recent additions. The general layout has proven so satisfactory in actual use that recently the management has had under consideration the reproduction of the entire plant at another point on the system.

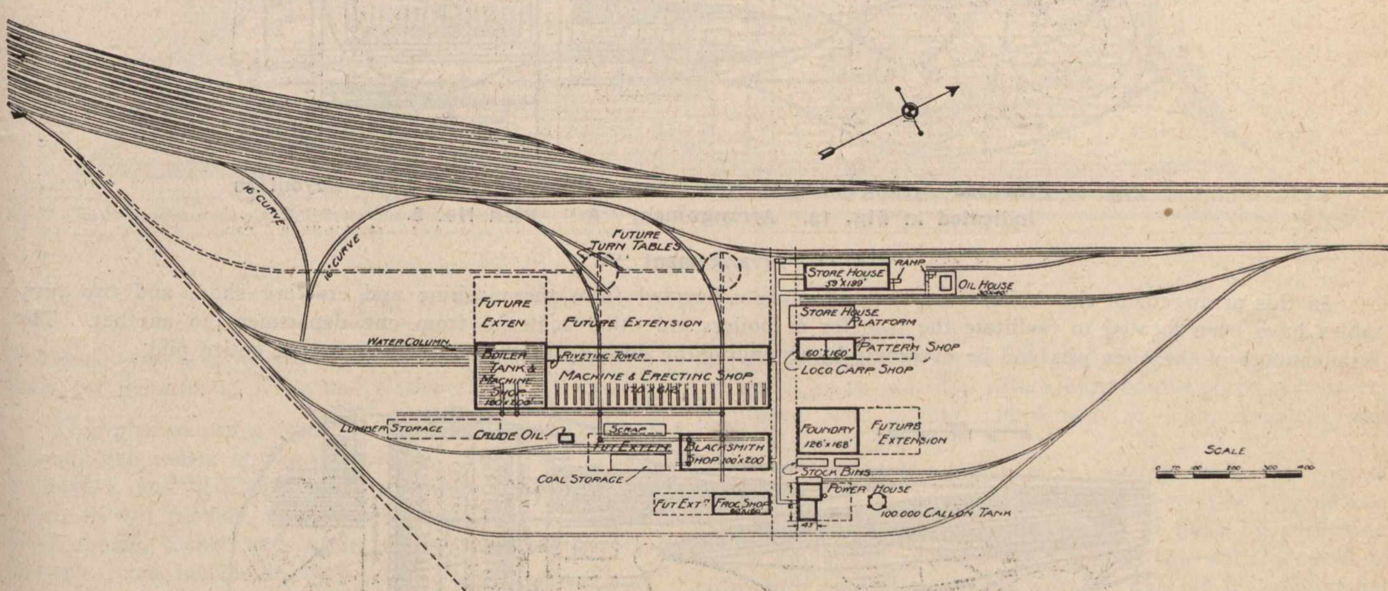
In the main shop of this plant the larger individual motor driven tools are located in the erecting bay, that is made extra wide for this purpose. The disadvantage of this arrangement is the necessity of increasing the span of the travelling cranes, and thereby adding to their cost.

PLAN No. 3.

The Battle Creek Shops of the Grand Trunk System.—The distinguishing feature of this arrangement is the efficient use of the yard crane idea, extending over the storehouse tracks and part of the storehouse platforms. This crane serves all of the ends of the bays of the machine and erecting shop; the foundry, forge shop, and frog shop, and eventually can be extended over the car repair tracks.

The "midway" space under the crane, which will be used partly for storage of materials, is provided with a system of industrial tracks, which are a part of a network extending throughout the entire plant.

The boiler and tank shop in this arrangement are located at one end of the machine and erecting shop, but these departments are at right angles to one another, so as not to interfere with the entire plant being doubled at some future date. Ample openings are left in the wall between the boiler and the erecting shops, so that a boiler can be conveniently passed from one department to another.



The Battle Creek Shops of the Grand Trunk System.—Plan No. 3.

The 100 per cent. extension to the main shop will be accomplished by practically duplicating the present shop, leaving a common machine shop twice the size of the existing one between two parallel erecting shops. This arrangement will eventually provide for fifty erecting pits, and all departments can be extended to meet this maximum requirement.

For the present time the locomotive shop will be served by two tracks, but when extensions are made two turntables can be installed.

The Beech Grove Shops of the Big Four System.—In this layout even more extensive use has been made of the idea of a storage yard served by a high-speed overhead crane. The midway may be said to be the main avenue of travel between all departments, and the space between the buildings can be compared to side or cross streets. This crane serves practically every building except the tank shop, the wheel shop and the freight car repair shop, but all of these shops can be reached easily by industrial tracks.

The second feature of importance in this arrangement is the turntable serving the boiler shop, the tank shop, and the main shop of the locomotive department. Tracks have been provided into each of these buildings independent of this turntable, but for intercommunication or the transfer of parts from one department to another this turntable will be in constant demand.

This turntable arrangement was adopted after the most careful consideration of an alternative plan having a transfer table along each side of the main shop, with the boiler shop on the opposite side of one transfer table, and the tank shop on the opposite side of the other table.

On one side of the yard crane nearly all the buildings extend away from the runway, thus allowing for future extension, while on the other side of the crane the buildings are arranged with their greater length parallel to the main line of travel. The freight car repair department is located along the main line tracks and convenient to the classification yards.

PLAN No. 5.

The Springfield (Mo.) Shops of the Frisco System.— In this arrangement the yard crane is a prominent feature, and the midway and cross street idea has been developed head 120-ton crane, instead of by a transfer table. When the shop is extended to its full capacity, no doubt the transfer table side of the shop will be devoted largely to light repairs, and the double decked crane served side will take care of the heavier repairs.

The storehouse is at one end of the transfer table, and near the centre of the yard crane runway, so that material can be conveniently collected from or delivered to any building on the ground.

The power house is located exactly in the centre of the site. Every department can be increased at least 100 per cent. without unduly extending the lines of travel for men and material.

PLAN No. 6.

Arrangement of Shops Under Construction. — The arrangements indicated in Fig. 5 and Fig. 6 are good examples of shops located on a congested site, which makes

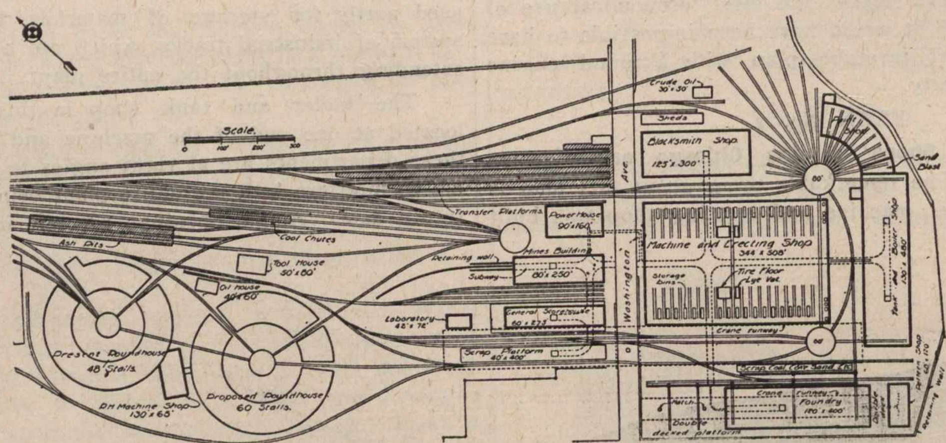


Fig. 5—Proposed Arrangement of New Shops. Superseded by Later Layout as indicated in Fig. 13. Arrangement "A." Plan No. 6.

Arrangement "A."

In this arrangement the boiler and tank shop are separated from the machine and erecting shop, and two turntables have been located to facilitate the transfer of boilers and other material from one department to another. The disadvantage of the open pits will be overcome by extending the decking of the turntable over the entire pit.

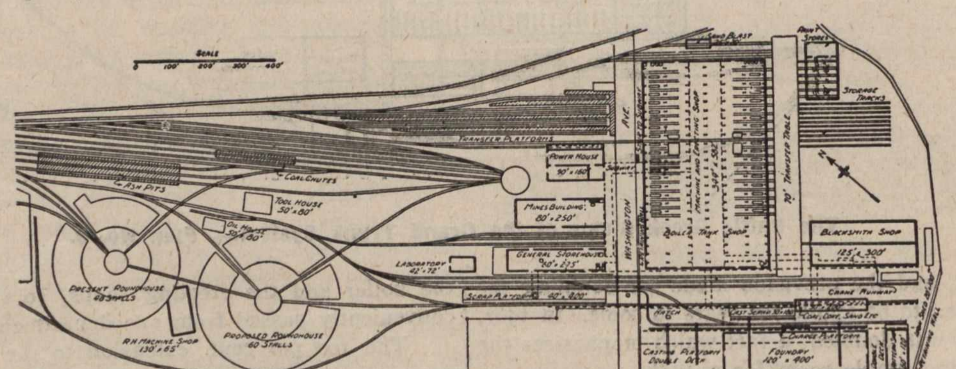


Fig. 6—General Arrangement of New Plant now under Construction. Arrangement "B." Plan No. 6.

Arrangement "B."

In this arrangement the machine and erecting shop is served by means of a transfer table extending along one side of the shop. The boiler and tank shop is located in the extension to the main shop, it being the intention to maintain the same sections of the building throughout.

still further, as all buildings are at right angles to this main avenue of interdepartment travel.

The striking feature of the Frisco shop arrangement, however, is the use of the transfer table serving one side of the erecting shop only. The erecting bay next to the transfer table is "single decked"; that is, the heavy crane used for unwheeling locomotives is not placed on an upper runway, so that it will be impossible to lift one locomotive over another in this shop, and reliance must be placed in the transfer table to put the locomotives on their pits.

Eventually, however, when the shop is doubled, the future erecting bay on the other side of the shop will be "double decked," and the locomotives will be delivered to their respective pits on this side of the shop by an over- it impossible to secure an efficient layout of buildings, or make any liberal allowances for future extension. The advantage of locating the shop plant near the centre of the city, however, is thought to offset the disadvantage of having the shop site cut in two by a city street. Fortunately, the ground is high and the drainage is good, making possible a "subway" under the street, and connecting all departments. This feature adds much to the convenient handling of materials.

The yard crane is again the determining feature of the arrangement, serving nearly all departments, and arranged to take or deliver material from and to the subway, and also the street, which, fortunately, is on a grade, so that it can be bridged.

The location of the foundry was determined by the fact that this department was the only one which could be placed along the retaining wall, which encloses part of the site. The heavy cranes in the erecting shop and the steam hammers in the forge shop make it desirable to locate these latter departments on solid ground.

The transfer platforms, one roundhouse, and the accessory ash pits and coal chutes were in place at the time the new shop arrangement was taken up, but even with these handicaps a fairly satisfactory arrangement of buildings has been worked out.

PLAN No. 7.

Arrangement of Shops Under Consideration.—The layout of shops indicated in Fig. 7 is now under consideration, and provides for a complete locomotive repair shop combined with a proposed terminal car repair plant. The main car department is located elsewhere.

This plan shows a crane served covered yard extending through the centre of the main shop. This yard is not to be heated, and besides furnished storage facilities for material, it will provide a convenient location for fan rooms, toilet rooms, locker and wash rooms, which often occupy valuable room inside the shop.

The outside storage yard is served by a locomotive crane instead of an overhead crane, and this same locomotive crane can be used at all other points in the yard where it can be worked to advantage.

The transfer table serves one side of the machine and erecting shop, as in several of the other plans, two cross tracks being provided to transfer engines in and out of the erecting bay on the futher side.

As the main shop becomes crowded, it is possible to erect a separate boiler and tank shop along the transfer table as shown, but for the present all locomotive repair departments will be under one roof.

The usual precautions have been taken to locate the blacksmith shop and the power house convenient to all departments.

The cross section of the main shop, indicated in Fig. 16, shows the covered yard between the two shops as well as the transfer table serving one side of the building.

Will the Results to be expected with New Shops justify the Investment? This is a question very often asked, particularly in view of the fact that apparently some of the new shops are not showing any better economy as far as actual cost of locomotive maintenance is concerned than is obtained with comparatively older and poorly equipped shops. As a matter of fact, there is no reason why a new shop, handicapped with an undeveloped organization and a lack of an efficient system, should do any better work, or even as good, as an old shop with a harmonious corps of workers equipped with a full complement of jigs, templets, and methods of operation.

The logical developments in cutting down the cost of engine repairs upon any road would appear to be (a), making the best use of the repair equipment at hand by perfecting shop kinks and systems for handling the work adapted to the outfit available; (b), to wear out the old tool equipment in the old shop as far as possible, so that when the building of the new shop cannot be postponed longer, there will be little, if any, temptation, to economize by using the old tools; and (c), with the coming of the new shop, old methods of operation should be improved to fit the changed conditions, and new systems developed and adopted. A new shop should not be considered complete until every man, tool, accessory and system is doing its most effective work. Under these conditions the new shops will show ample results to justify the investment.

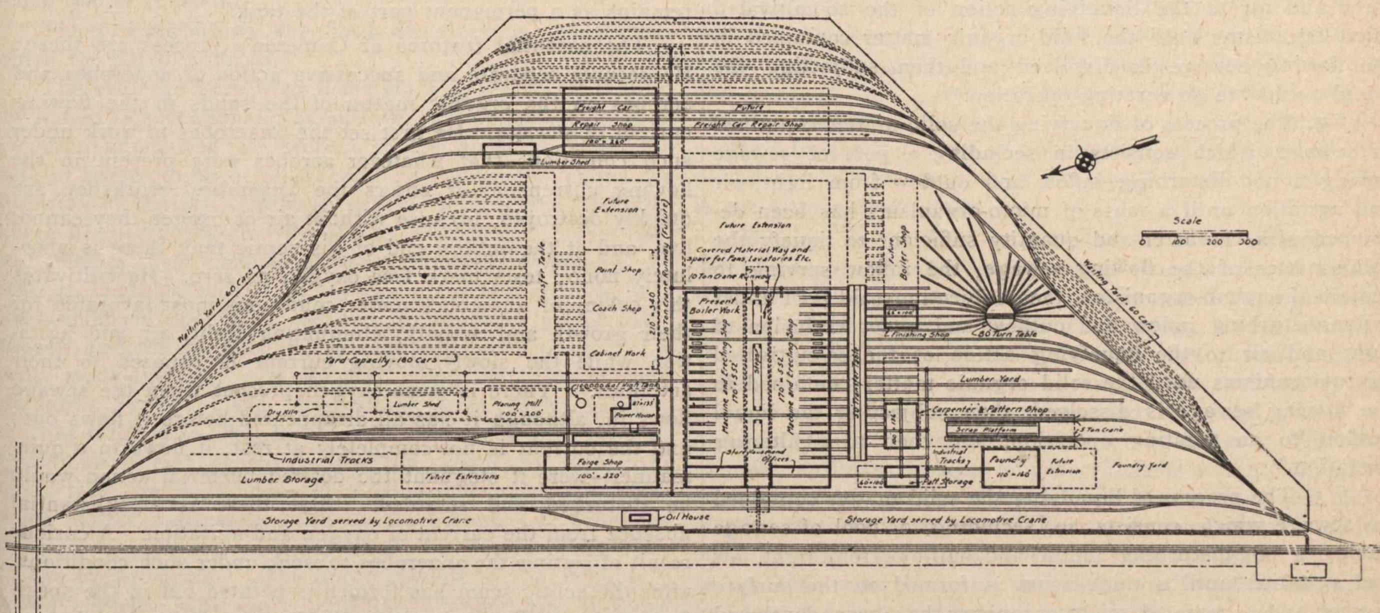


Fig. 7—New Shops now under Consideration. Plan No. 7.

SEPTIC TANKS.

It is not often that a long legal decision is of interest to engineers, but a decision given in the United States Circuit Court of Appeal will be of interest to all interested in sanitary engineering, as it sums up and presents the evidence of many expert witnesses, and describes the septic tank and the action which sewage undergoes in passing through the tanks.

The Cameron Septic Tank Company were the complainants, they having lost their case against the village of Saratoga Springs in a lower court.

The charge was infringing on patent No. 634,423, granted October 3rd, 1899, to Donald Cameron and others for "Process of and Apparatus for Treating Sewage."

The opinion of the court was given by Judge Lacombe in part as follows:—

The opinion from the lower court has quoted at great length from the specifications. There are two groups of claims: those for a process, and those for an apparatus. The subject of discussion may be best introduced by reciting the five process claims which are relied upon, as follows:

"1. The process of purifying sewage which consists in subjecting the sewage under exclusion of air, of light and of agitation to the action of anaerobic bacteria until the whole mass of solid organic matter contained therein becomes liquefied, and then subjecting the liquid effluent to air and light."

"2. The process of liquefying the solid matter contained in sewage, which consists in secluding a pool of sewage having a non-disturbing inflow and outflow, from light, air and agitation until a mass of micro-organisms has been developed of a character and quantity sufficient to liquefy the solid matter of the flowing sewage, the inflow serving to sustain the micro-organisms, and then subjecting said pool under exclusion of light and air and under a non-disturbing inflow and outflow to the liquefying action of the so-cultivated micro-organisms until the solid organic matter contained in the flowing sewage is dissolved.

"3. The process of liquefying the solid matter contained in sewage, which consists in secluding a pool of sewage having a non-disturbing inflow and outflow, from light, air and agitation until a mass of micro-organisms has been developed of a character and quantity sufficient to liquefy the solid matter of the flowing sewage, the inferior serving to sustain the micro-organisms, then subjecting said pool under a non-disturbing inflow and outflow and under exclusion of light and air to the liquefying action of the so-cultivated micro-organisms until the solid organic matter contained in the flowing sewage is dissolved and then subjecting the liquid outflow to an aerating operation."

"4. The process of liquefying the solid matter contained in sewage, which consists in secluding a pool of sewage having a non-disturbing inflow and outflow from light, air and agitation until a mass of micro-organisms has been developed of a character and quantity sufficient to liquefy the solid matter of the flowing sewage, the inflow serving to sustain the micro-organisms, then subjecting said pool under a non-disturbing inflow and outflow and under exclusion of light and air to the liquefying action of the so-cultivated micro-organisms until the solid organic matter contained in the flowing sewage is dissolved, then subjecting the liquid outflow to an aerating operation, and then to a filtering operation."

"5. The process of liquefying the solid matter contained in sewage which consists in secluding a pool of sewage having a non-disturbing inflow and outflow from light, air and agitation until a thick scum is formed on the surface thereof and a mass of micro-organisms has been developed of a character and quantity sufficient to liquefy the solid matter of the flowing sewage, the inflow serving to sustain the micro-organisms, and then subjecting said pool under the cover of said scum and under a non-disturbing inflow and outflow to the liquefying action of the so-cultivated micro-organisms until all the solid matter contained in the flowing sewage is dissolved."

The apparatus for carrying on this process consists of a tank, constructed of any suitable material such as cement-concrete, shallow in comparison with its other dimensions, and in which the "pool sewage" is located. It may be provided with an air-tight cover, for temporary use only, because after the tank has been in operation for two or three days a peculiar brown scum begins to form at the top and eventually becomes two or three inches thick and serves as an air-tight cover for the sewage. The pool which is secluded in the tank is secured against disturbance from inflow or outflow by having inlet and outlet so located and constructed that the sewage will flow through in a quiet manner. From the tank the effluent passes into an aerator, where it is exposed to the action of the air and afterwards passes on to an ordinary filter bed. By reference to the claims it will be perceived that the second and twenty-first cover only so much of the process as takes place in the secluded pool; the first and third cover also the aerating operation; and the fourth adds the final filtering operation.

To a proper understanding of what the patent shows it will be necessary to postulate certain definitions.

Anaerobes are bacteria (micro-organisms) that are killed by air; they can neither act, multiply nor even exist in contact with free oxygen. They are also called the germs of putrefaction.

Aerobes are bacteria that die without air or oxygen. They are also called the germs of oxidation or of nitrification, and their action is often called decomposition or fermentation.

That both these families of bacteria are potent in breaking up the solid parts of the sewage matter was a fact long known to those skilled in the art. The patentee introduced a new word to the art—septic, he calls his tank a septic tank. Defendant's expert concedes that the term was first used by Cameron and applied to the tank which he constructed and put in operation at Exeter, England. However this word may have been used subsequently by others, it should in construing this patent be given the meaning which the patentee gave to it. Examination of the specification and claims shows that the definition contained in complainant's brief is in accord with them.

Septic action is the action of a colony of anaerobes preventing the accumulation of solids, unhampered by the presence of aerobes or oxygen or agitation.

The septic tank is the home and workshop of such anaerobic colony and its structural characteristic as distinguished from other tanks includes the roof of septic scum which is built by the anaerobes over the sewage current and remains as a permanent part of the tank.

The essential features of Cameron's process are these: He secures separate and successive action of anaerobes and aerobes on the organic matter of the solids in the flowing current of sewage. He first set the anaerobes to work under such conditions that whatever aerobes were present in the flowing current as it enters the anaerobes' workshop are quickly destroyed, because without air or oxygen they cannot live, and at the outflow end of his septic tank there is absolutely none; tests mark free oxygen as zero. He cultivates this colony of anaerobes under conditions most favorable for their growth and activity, eliminating light, air and agitation while the slowly moving current is exposed to their activities. There is some oxygen present when the sewage flows in, although it has all disappeared before it flows out; and the current is not completely at rest, it flows in a quiet manner—were it stagnant the desired bacterial action would be disturbed and retarded. But there is a substantial absence from the current of oxygen and agitation. A curious result of setting the anaerobes to work under such conditions, after the septic scum has formed is pointed out in the specifications. "The micro-organisms increase at a fabulous rate, being fed by the incoming solid matter of the sewage until a mass of bacteria is developed sufficient to liquefy substantially all the solid organic matter contained in the sewage passing through the pool .... and the outflow is in the form of a liquid without solid particles of sewage .... The liquefied sewage as it leaves the septic pool has a slight odor ..... and to relieve it of this slight odor it is subjected to an aerating operation." It is contended by the complainant that such effluent is peculiarly adapted for further treatment on a filter bed.

Thus treated the colony of bacteria is continually recruited from incoming solid matter, maintaining such numbers as are sufficient at all times quickly to transform the sewage solids and the wastes of bacterial energy into a liquid effluent. This action is thus described by one of defendant's experts: "In my opinion from six to eight weeks is required in which the liquefying action will be established to the extent of creating an equilibrium beyond which the solids will not accumulate on the bottom of the tank or on the top thereof .... an equilibrium between the accumulated solids in the tank plus those being constantly added thereto by the inflow of the sewage, and the bacterial activities whereby further accumulations are prevented." Moreover, as the patentee states, "by this invention crude sewage can be treated for long periods without practically any sludge at all forming in the tank." In the plant at Saratoga, which treats sewage by the process above described—infringement of these process claims is not denied in defendant's brief—"the tanks have never been emptied since they were put in service in July 1903, a period of 2½ years, and no solid matter has been taken from them." In consequence this equilibrium between the solids and the solid-destroyers, when once established, need not be disturbed, it will continue indefinitely. Having passed his sewage through the secluded pool, where it was exposed to anaerobic action only, it is aerated and then subjected to aerobic action.

It is this method of dividing the process which complainant claims to be novel. Of its essential features the experts for complainant point out that separate action is necessary because the anaerobes cannot successfully act in conjunction with the aerobes which are inimical to their multiplication and even existence; that successive action is necessary because the anaerobes prepare the organic matter for succeeding purification by the aerobes; that the flowing current is essential because it makes a continuous process, takes the matter out of the way of the anaerobes as fast as they are through with it, and prevents the formation of toxins which would impair the value of the anaerobic produce for the purifying action of aerobes.

That the process possesses utility is beyond dispute; it eliminates the problem of removing "sludge," the solid matter which accumulates in the bottom of some sewage tanks and the disposition of which is often troublesome. Moreover, the defendant uses it and thus practically concedes that it is useful.

The process which has been described is the process which the patent indicates.

The evidence as to what takes place in the septic tank of the patent is exceptionally persuasive. It appears that when Cameron announced his process to the world and built his tank at Exeter to put it in practice, he at once challenged the attention of the art. Sewage experts in England and elsewhere discussed his contribution as a startlingly novel one, and some of them came to Exeter to study its workings. In order to facilitate such study a glass inspection chamber was constructed in the tank, wherein an observer might place himself and, through its transparent walls with the aid of a lamp, study the process which was going on. One of complainant's experts made observations from such chamber, and has testified to what he saw. Without indicating specific quotations it may be stated that the conditions within the septic tank are as follows: The deposit consists of a black peaty matter apparently solid at the bottom but gradually merging to a lighter or more mushy or frothy consistency on the upper strata. The upper surface of the scum is a brown leathery substance, immediately underneath it somewhat resembles axle grease, grading off to a mushy substance beneath. The current flowing between the sludge (deposit) and the scum consists of an already liquid portion in which are suspended particles of organic matter which because of their specific gravity remain suspended in the liquid and flow therewith. In this liquid portion also are particles which are detached by the anaerobic action from the floating or settled solids, and which particles cross the liquid in an interchange from top to bottom, or from bottom to top. This interchange is constantly going on, each particle flowing a certain distance with the current at each crossing, each particle being more finely divided at each successive crossing until it is finally merged in the liquid. The expert who had occupied the inspection chamber thus sums up the contention of complainant. "Every particle of solid organic matter suspended in the liquid current of the septic tank finds itself closely surrounded by anaerobes already cultivated in the scum and sediment and completely at their mercy because every other influence is excluded by the 'exclusion of light, air and agitation,' which the patent so frequently repeats. Its liquefaction therefore does not have to wait for the cultivation of anaerobes, but commences immediately and proceeds with great rapidity. Afterwards the liquefied particles find the aerobes all ready for them in the filter, where they in turn have full sway and oxidize and nitrify them, thus completing the purification. The complete separation of the anaerobic and aerobic actions is still further emphasized in the Cameron process by interposing between them the aerating operation, the action of which is to eliminate all the remaining traces of the anaerobic operation in the septic tank which might interfere with the aerobes."

The question of anticipation is greatly simplified by a clear understanding of precisely what the Cameron process is. The crux of the question is stated in complainant's brief as follows: "In all processes of the prior art the aerobic or oxidizing action was continuous from the time the matter left the house as house-waste until the end of its purification as sewage. Cameron's separate anaerobic colony was the first break that was ever made in such aerobic action." It is not disputed that anaerobic action was present to a greater or less extent in prior processes, but it is contended that Cameron was absolutely the first to instruct the art that the problem of removing sludge could be practically eliminated irrespective of securing other advantages by providing the anaerobes with a workshop in which they might act upon the solid contents of the flowing current, unhampered by the presence of air, oxygen, agitation or aerobes. With the question so closely limited the burden of comparing prior patents and publications with the Cameron process is materially reduced.

The decision then cites the patents of Louis Mouras, and literature published by him on septic tanks; also the work of Scott-Moncrieff and of Dibdin and of a German patent to Muller. An English patent is then taken up.

The English patent to Adeney and Parry (3312 of 1890) provides for keeping "the liquor (sewage) to be treated under suitable conditions for the rapid multiplication of micro-organisms." But they point out three methods only, one by chemical treatment, the other two by thorough aeration for the "purpose and object of developing and multiplying the micro-organisms in the sewage"; which certainly is not Cameron's process.

Besides the patents and literature above referred to defendant contends that anticipation is found in certain tanks which were built and used for sewage purification in this country prior to Cameron's date of invention. So far as their structural details are concerned, some of them at least closely resembled Cameron's apparatus; having the shallowness in comparison with other dimensions and inlet and outlet so arranged as to reduce the amount of agitation. Without stopping to consider some minor criticisms which complainant's counsel makes on these alleged anticipations, we may dispose of them in two ways. Tests for oxygen were made at all such as were still in operation when the testimony was being taken with the result that there was found at the outlets free and absorbed oxygen in quantities varying from 24 to 45 per cent., while at the Saratoga plant, embodying the Cameron process, the record for oxygen at the outlet was zero. It further appears from the testimony that of these tanks those most resembling Cameron's were all cleaned and the sediment on the bottom removed, some of them frequently, some once a month, the one most relied upon "at least seven times per year and probably oftener." When it is remembered that all the experts on both sides agree that it takes from six weeks to two months to produce the anaerobic conditions which Cameron prescribes for his septic tank with the scum and deposit of the proper thickness and the condition of equilibrium established which admits of an indefinite retention of the solids it is quite apparent that these are not Cameron septic tanks ; the prescribed conditions are swept away by the hands of the cleaner before they reach practical efficiency. On the contrary at Saratoga there has been no removal of sludge, and therefore no destruction of septic conditions for two years and a half.

It is further contended by defendant that these five claims are void because the process they cover "is a process of nature and one which cannot be covered by any one." As we have seen before, the distinctively novel feature is the septic tank or separate workshop for the microbes. The circuit court, influenced, as it seems to us by the conclusion which it reached that Mouras and Moigne disclosed all that Cameron claims, decided that the process claims could not be sustained, citing O'Reilly v. Morse 15 Howard 62 and other cases. We, however, are satisfied that Cameron was the first one to subject a flowing current of sewage to the action of anaerobes and aerobes under conditions which secured their separate and successive action, the action of the seggregated anaerobes fitting the effluent for subsequent filtration and aerobic action; and by reason of such careful segregation he was the first to secure such specified condition in the anaerobic colony that its capacity for its natural work had increased to such an extent that it became capable of disposing of practically all future inflowing sewage that entered its workshop without accumulating such a deposit of sludge as would require removal. This certainly involved "the use of one of the agencies of nature for a practical purpose." Risdon Locomotive Works v. Medart, 158 U.S. 77. The process is one which puts a force of nature into a certain specified condition and then uses it in that condition for a practical purpose. Bell Telephone 126 U.S. 1, 534. Within the principles enunciated in the two cases last cited we are satisfied that Cameron's process as set forth in these five process claims is patentable. Infringement is not disputed.

The Apparatus Claims.

These are Nos. 5, 6, 7, 8, 11, 12, 20, and 22; infringement is denied of 6, 7, 8 and 12. It is not necessary to quote them, they are set forth in the opinion of the circuit court; each one of them contains as an element of its combination "a septic tank." Speaking generally and disregarding some minor variations of detail, it may be said that the several structural elements of each combination are old and that tanks with covers and with inlets and outlets arranged so as to avoid agitation were not broadly new. The contention of the complainant is this. Cameron introduced the word septic into the art, he defined it and it is used in the claims with the meaning he gave it. The septic tank, therefore, of these claims is the septic tank in which the septic scum and deposit are found, in which the equilibrium above referred to is established and in which the solids may be indefinitely retained. This is a peculiar structure, produced in part by the hand of man, in part by the forces of nature. After the labors of the mason, the plumber, and the ironworker are over the micro-organisms are set to work, and in the course of from six weeks to two months they add an inside floor and a roof of scum to the masonry structure, whereupon its temporary iron cover may be discarded and, then for the first, we have the septic tank of the claims. And because in the prior art there is no masonry (or other) structure which has been thus improved and modified by the action of anaerobic bacteria, this single element of "a septic tank" is sufficiently novel to uphold each combination into which it enters. The question presented is a most curious one; nothing analogous is found in any authority to which we are referred. The argument is ingenious and forceful but in this case we do not find it convincing. The tank of the apparatus is as the specifications state, "a suitable tank for carrying out (the) invention," i.e., a tank suitable for the colonization and cultivation of the anaerobes so that they may in time reach the stage of equilibrium with the solids. The apparatus claims were never, in our opinion, intended to cover any tank other than that which Cameron's human workman built. And this opinion is fortified by the following excerpts from the specifications: "(The sewage) then passes through .... the inlets into the tank A, in which it may be treated either chemically, bacteriologically or otherwise, as desired; but it is preferable to treat it bacteriologically." "The invention also relates to a special form of tank in which a liquid is to be treated for the removal of solid matter by subsidence, flotation or otherwise. .... This form of tank is illustrated in Figs. 4, 5 and 6. .... In the arrangement shown in (these figures) the sewage or other liquid .... passes into the tanks A, where as in the previous arrangement it may be treated either chemically, bacteriologically or otherwise, as desired." We concur with the circuit judge in his conclusion as to these apparatus claims.

The decree is reversed without costs, and cause remanded to the circuit court with instructions to decree in favour of complainant upon claims 1, 2, 3, 4 and 21, and in favour of defendant as to claims 5, 6, 7, 8, 11, 12, 20 and 22, without costs.

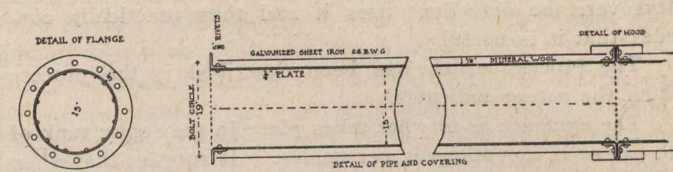
Concrete piles are especially suitable for wet or filled-in areas where the ground-water level is at a depth below the surface. In any other form of construction, it is necessary to excavate to the solid earth in order to start, or in the case of timber piles, excavation must be made to water level, the piles cut off and the pier built from that level. The concrete piles can make a foundation that costs 25 or 50 per cent. less than when these methods are not used.

A SUSPENDED SEWER

W. R. Wortington, B.A. Sc.

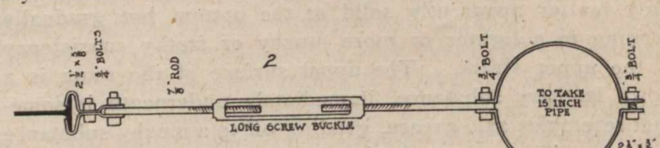
The most desirable residential part of any city is the district intersected by ravines, the hills and hillsides allowing of opportunities for landscape gardening and terracing. These areas are, however, the most difficult to provide with proper drainage and sewerage systems. Toronto is surrounded by ravines, and to show how provision has been made for one of these cut-off districts the following article has been prepared:—

Shortly after the annexation of that suburb of about two hundred acres, known as the North Rosedale District, the



city engineer was instructed to provide drainage for this area. This district is very unique in its relation to Toronto, it being separated by a deep ravine which is spanned by a bridge, known as the Second Glen Road Bridge, approximately six hundred feet in length. The nearest outlet into which we could drain this section was the Rosedale Creek sewer, running through the first ravine to the south into the Don River. The distance between these two ravines is about twenty-five hundred feet.

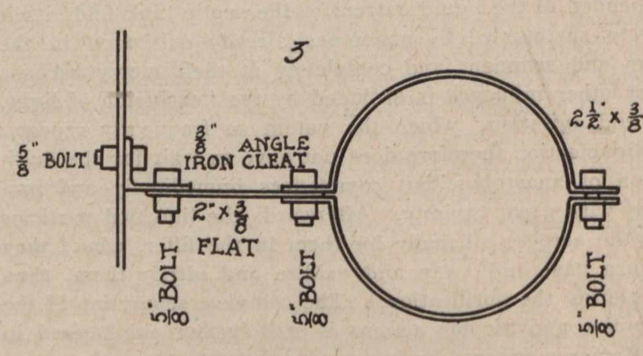
From the north end of the Second Glen Road Bridge to the Rosedale Creek sewer it was decided to provide for the dry weather flow of sewage only, and a 15-inch pipe was



DETAIL OF SLING

found sufficient. That portion across the ravine was constructed of steel pipe, and suspended from the floor beams of the bridge. The pipes were made of ¼-inch tank steel, in 11 foot lengths. Each length was made perfectly straight and the joints thoroughly caulked; the whole to be capable of withstanding a pressure of twenty pounds per square inch. The flange at the ends of each pipe was made according to detail drawing (Fig. 1), the faces being at right angles to the axis of the pipe, and the bolt holes made exactly to one template so as to be interchangeable.

Each of the slings supporting the pipes consists of a ⅜-inch steel band 2½ inches wide which surround the pipe,



DETAIL OF BRACE

and a pair of ⅞-inch iron rods connected in the centre by a turn-buckle. The upper end of the ⅞-inch rod is bolted by ¾-inch bolts to a pair of clamps, clasping the lower flange of the floor beams; for detail see Fig. 2. The turn-buckles were used to adjust the pipes to the elevation shown on plan, and also that the grade line of the pipe could be kept uniform.

In order to prevent horizontal vibration steel bands, similar to those used for the slings, were placed around the pipe opposite each centre post of the bridge and fastened thereto by a ⅜-inch steel arm, two inches wide; for detail see Fig. 3.

In designing this steel pipe there were two very important factors to consider—inspection and expansion and contraction. Owing to the great length of run it was necessary to provide some means for inspection or flushing and, in order to make this possible, a manhole was built in a pipe to be placed in the centre of the run. To provide access to this manhole a permanent platform was built around it and a ladder erected from this platform to a hole cut in the floor of the bridge. The second point to consider was the expansion and contraction which was provided for by a slip joint; see Fig. 4. This slip joint consists of a ¾-inch steel cylinder "a," 17¾-inch in diameter and 12 inches long which has an annular projection on the inside with a 2-inch machine finished face. Upon this surface the ⅝-inch steel cylinder "B," 20 inches long, plays backwards and forwards as the pipe expands or contracts. A perfectly tight fitting joint is secured by an annular ring "C," 4 inches long, fitting snugly around the surface of cylinder "B." After the gasket "D" was put around the cylinder "B," this ring "C" was bolted to cylinder "a," and when drawn up tight it pressed the gasket against the surfaces of "a" and "b," thus giving a water-tight joint.

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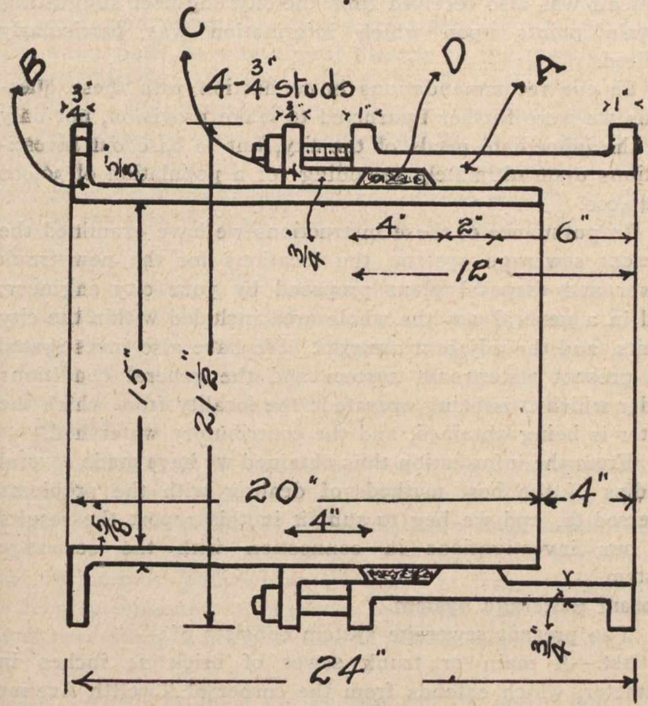

SLIP JOINT

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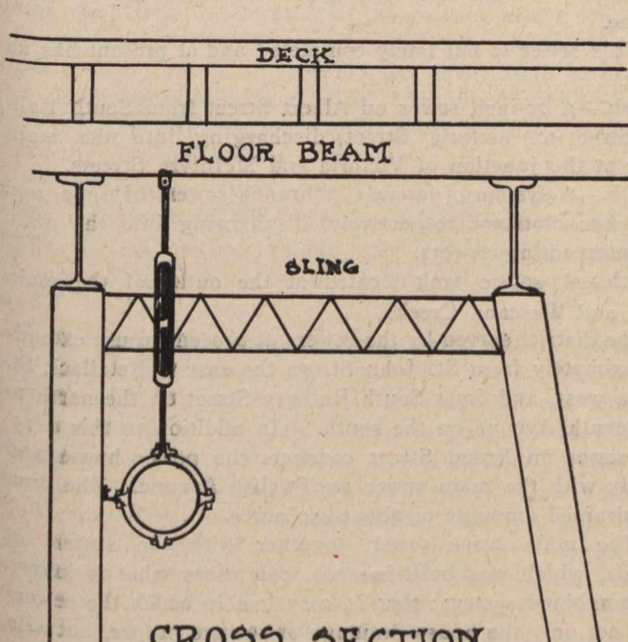

CROSS SECTION

Having given a description of the pipe we will describe the method of carrying out the work.

The location of the pipe was to the east of the centre posts of the bridge, as shown on Fig. 5.

In laying this work out we bored holes through the bridge flooring fifty feet apart and in true line so that a plumb line when dropped below gave the centre line of the steel sewer pipe. The levels were taken over these holes and the grades worked out for the top of the pipe. Then by measuring down the required number of feet and tenths for each station we could get the finished grade of the sewer, The sketch (Fig. 6) shows the relation between the floor of the bridge and the invert of the pipe.

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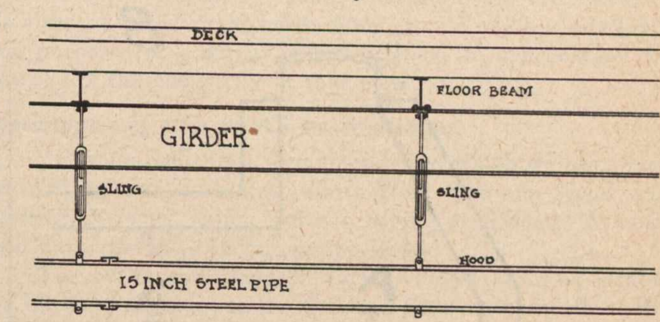

LONGITUDINAL SECTION

The erection of the temporary scaffold as shown by plate 7 was a very difficult task, but after two weeks everything was ready for swinging the pipes. The slings above described were suspended from the floor beams in a true line with the above-mentioned holes, and then by means of the turn-buckles they were brought nearly to the given grade. This done, the pipe with the specially constructed manhole was first taken to the centre of the bridge on a little truck and raised into its slings. Now, working from both ends, the pipe-lengths were brought out and swung in their respective slings. The north end of the pipe pierced the abutment and entered the overflow chamber, which will be described below. Just inside the south abutment the slip joint was bolted with lead gasket between two pipes. The end length of pipe entered the manhole built at the terminus of the 15-inch tile pipe sewer previously described. After all the pipes were in place they were bolted together with ⅛-inch lead gasket between joints, which made the whole water-tight. To test the pipes and joints a steel stopper was screwed on the south end, and the whole steel sewer was filled with water. Following the inspection the pipes were first painted with two coats of asphalt paint and then a cover-

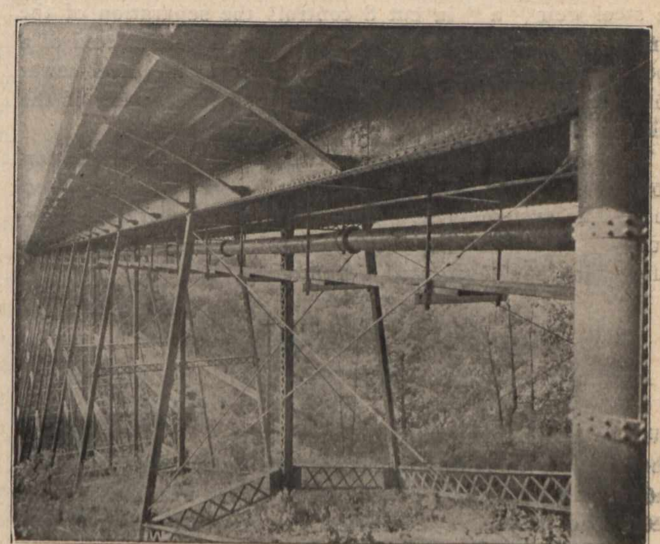

Fig. 7.—Photo by A. Coss.

ing was put on to protect it from frost. The first part of the covering consisted of 1½ inches of mineral wool, made up in small sections, which were wired on and the whole covered with heavy canvas. An outside covering of galvanized sheet iron was wrapped around the mineral wool with the joints on the under side. The flanged joints were covered with a galvanized iron hood. This covering of galvanized iron was designed to protect the mineral wool covering from the weather.

The scaffold flooring was removed and the hangers were left in place so that at any time a few planks could be stretched on them and thus greatly facilitate inspection or repairs.

At the entrance to the steel pipe there is a chamber into which the storm water overflows, and from which it passes

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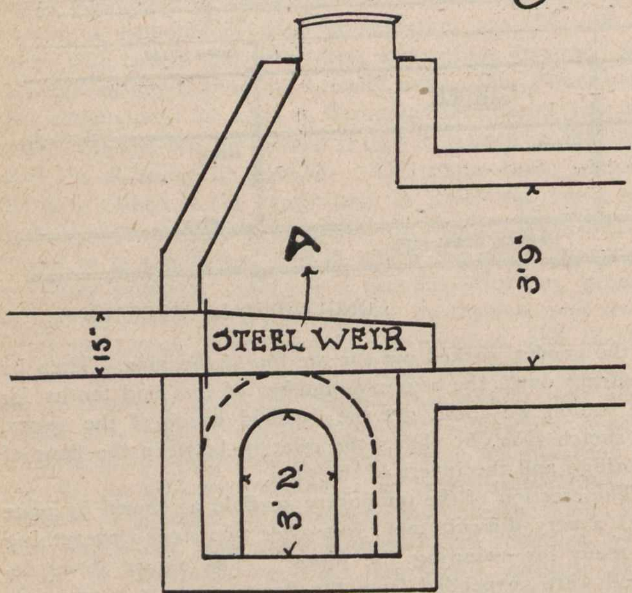


DETAIL OF OVERFLOW CHAMBER

down a box drain into the creek at the bottom of the ravine. The steel weir "a" in cut 8 controls the separation of the storm water and the sewage. This weir is constructed of a 4 foot length of 15-inch steel pipe, bolted to the steel sewer at one end and splayed at the other to fit the invert of the brick sewer.

This work was designed and carried out under the supervision of Mr. J. D. Shields, B.A. Sc., sewer engineer, Toronto. The system is now in operation and working satisfactorily. This is the first piece of engineering of this nature which has confronted Toronto.

CONCRETE PILES.

An illustration of the increasing use of concrete, according to the Inventive Age, is given in the foundation for a plant now being constructed in Jersey City. It was required to be laid on filled-in ground, at the junction of the salt meadow and upland. To obtain a proper bearing the engineers had to go 20 feet below the existing surface, the ground-water level being 10 feet below. To carry a heavy concrete footing to the bearing stratum was too costly, and a timber pile foundation with a concrete cap was rejected for the same reason. It was finally determined to use concrete piles. A heavy pile driver was used to drive a hollow steel form, terminating in a patent jaw. When the form reached the bearing stratum, a small quantity of concrete was dropped inside and the form raised about a foot by a heavy pulling device. A heavy rammer was dropped on the charge of concrete, which caused the jaws to open, and forced the concrete out into the surrounding material. Another charge of concrete was inserted and the form again pulled up a short distance. This process was repeated until the form was entirely out of the ground, and the pile space was filled with concrete.

NEW TRUNK SEWERS AND SEWAGE DISPOSAL WORKS FOR THE CITY OF REGINA, SASK.*

We were given general instructions to investigate and report upon the sewerage system, the system of trunk sewers and disposal works proposed by Mr. Angus Smith, city engineer, and the whole question of the city's water supply. A memo was also received from the city engineer suggesting certain points upon which information was particularly desired.

In our recommendations in connection with these questions we were further instructed to make provision, not only for the immediate needs of the city, but to base our investigations upon ultimately providing for a population of 30,000 to 40,000.

In pursuance of these instructions we have examined the present sewerage system, the locations for the new trunk sewer and disposal plant proposed by your city engineer, and in a general way the whole area included within the city limits, and the adjacent annexes. We have also investigated the present waterworks system and the general conditions under which it is being operated; the locality from which the water is being obtained, and the contributory watershed.

From the information thus obtained we have made several studies of the best methods of dealing with the problems referred to, and we beg to submit in this report the results of our investigations in connection with the sewerage system.

Present Sewerage System.

The present sewerage system consists of:—

1st.—A main or trunk sewer of brick 24 inches in diameter, which extends from the corner of Twelfth Avenue and Broad Street down Twelfth Avenue to McIntyre Street; along McIntyre Street to the city limits, and from there in a south-westerly direction to its outlet, a short distance below the Government dam on Wascana Creek.

2nd.—An intercepting sewer 20 inches in diameter on Fifteenth Avenue, extending from St. John Street to its junction with the main sewer at McIntyre Street.

3rd.—An 18-inch intercepting sewer from Retallack Street to McIntyre Street on Fifteenth Avenue.

4th.—A 15-inch intercepting sewer on Dewdney Street, extending from Broad Street to Elphinstone Street, and designed to discharge into the proposed trunk sewer on Eighth Avenue.

This sewer is but lately completed and at present has no outlet.

5th.—A 20-inch sewer on Albert Street from South Railway Street to Victoria Street, discharging into the main sewer at the junction of Victoria and McIntyre Streets.

6th.—A system of laterals or branch sewers of 9, 12, and 15 inches diameter respectively, discharging into the main and intercepting sewers.

7th.—A septic tank located at the outlet of the main sewer and Wascana Creek.

The district served by the sewers at present in use extends approximately from St. John St. on the east to Retallack St. on the west, and from South Railway Street on the north to Nineteenth Avenue on the south. In addition to this a 15-inch sewer on Broad Street connects the power house and vicinity with the main sewer on Twelfth Avenue. The area thus drained amounts to about 450 acres.

The main brick sewer, together with the system of laterals, which was built in 1904, comprises what is known as a combined system; that is, a system in which the sewers carry not only the house drainage or sewage proper, but also the surface drainage of storm water.

The average density of population of cities is rarely greater than about 15 persons per acre. The quantity of purely domestic sewage may be taken as equal to the average water consumption. On the basis of 100 gallons per

* Being extracts from the report of Lea and Smith, consulting engineers, to the Council of the City of Regina, Sask.

day per person, the quantity of domestic sewage per acre sewered will amount to 1,500 gallons in 24 hours. An inch of rainfall on the same area reaching the sewers in one hour would do so at a rate of 650,000 gallons per acre in 24 hours. The rainfall records at Regina show that during heavy storms on June 28th, 1906, and again in the same month of this year, from 1½ to 2 inches of rain fell in one hour, and no doubt for shorter intervals the rate was much higher than this. The rate at which the water reaches the sewers depends upon the slope and nature of the surface. In closely built areas, and where the streets are steep and well paved, storm water finds its way almost directly to the sewers. In residential districts and where the surface is level, more time is required. But even assuming that the rainfall can only reach the sewers at one-fifth or one-tenth the rate at which it falls, it is very evident that the required capacity of the sewers of a combined system depends almost entirely on the extent of the area drained, and not on the density of population.

The whole area to be sewered is, with the exception of a few local elevations or depressions, practically level. For example, the street surface at the corner of Winnipeg Street and Sixteenth Avenue is 6 inches lower than at the corner of Government Road and Seventh Avenue, a point over three miles distant.

This entire lack of natural gradient makes the problem of drainage both complicated and difficult of solution. To add further to the difficulty, the chief depressions below the general level are at the extreme east and north, and therefore at the furthermost points from the outlet at Wascana Creek. The deep cuttings and large sewers resulting from these conditions necessitate a heavy outlay to provide adequate drainage.

The 24-inch main sewer is laid for its entire length, with a uniform fall of 1 foot in 500 feet, or a little more than 2 inches in 100 feet, and it is therefore of the same capacity from end to end, instead of increasing in capacity from the upper end towards the outlet.

The laterals and intersecting sewers are laid with slopes of from 3 inches to 1 foot per 100. The combined capacity of these sewers is greatly in excess of that of the old brick sewer into which they discharge, the result of which has been shown by the gorging of the sewers during the storms in 1906 and 1907. Taking into account all the existing conditions, and the information received from your officials regarding the extent and duration of the gorging of the sewers, we have estimated that in order to relieve this sewer during periods of heavy rainfall, a storm water sewer from 30 to 36 inches in diameter will be required from Scarth Street and Twelfth Avenue to the new trunk sewer at the corner of Twelfth Avenue and McIntyre Street.

The present dry weather flow of sewage as determined by weir measurements, which we have had made at the outlet, averages about 400,000 gallons per day, varying from a minimum of 250,000 at certain hours to a maximum of 500,000.

The connection between the brick sewer and the present septic tank is so arranged that only this dry weather flow enters the tank, the storm water overflowing into the Creek. The capacity of the tank is 245,000 gallons (when the word gallon is used U.S. gallons are referred to) or rather more than one half days present dry weather flow. It has been in operation two years, and during that time has collected about four feet of sludge. The quantity of sludge is somewhat in excess of what ordinarily might be expected under favorable conditions. It is evident, however, from the composition of the deposit, which has lately been taken out of the tank, that much street detritus and other matter which should have been arrested in the grit chambers, has been allowed to pass into the tank, materially decreasing its capacity and efficiency.

To remedy these conditions we would advise putting coarse screens in the entrance manhole or grit chambers to stop the detritus and inorganic matter from entering the tank proper, and in connection with the same, a regular systematic and frequent cleaning of the grit chambers, and when necessary, of the tank itself.

Properly attended to, the capacity of the tank is quite adequate, so far as this method of treatment goes, for the sewage reaching it at present; but as the system is extended, a greater capacity, of course, will be required.

In view, however, of the probable growth of your city in the neighbourhood of the septic tank, and to the south and west, the proximity of the proposed new Government buildings, and the resultant high price of property in the vicinity, it will, in our opinion, be expedient, if not absolutely necessary, to abandon the present disposal works, and carry the sewerage of the whole territory south of the Canadian Pacific Railway by a new trunk sewer, to the outlet proposed for the north drainage system. Furthermore, the necessity of disposal works at the north outlet, would make it advisable for purposes of economy and efficiency, to concentrate the sewage of the whole city at that point.

Description of New Works Recommended.

The route which we recommend, and which we have used in making our estimates, starts from Toronto Street and Twelfth Avenue, along Toronto Street to Seventh Avenue, and down Seventh Avenue to the Creek.

The outlet and disposal works will therefore be located on the land adjacent to the Creek, a little to the north of the point where the line of Seventh Avenue intersects it. The topography of the ground in this locality offers favorable conditions for the construction of works necessary for present and future requirements, and we advise that steps be taken to acquire an area of not less than ten acres for this purpose.

Disposal Works.

Before stating our recommendations for the proposed new disposal works, it will be proper to refer briefly to the general question of sewage disposal and to enumerate the main facts in connection therewith.

As it flows in the sewers of a modern drainage system, sewage is composed of the discharge from water closets, the liquid wastes of kitchens and laundries, the drainage of butchers' shops, slaughter houses, stables, and the refuse from streets and yards, but in spite of the great variety of these materials, they form only a very small proportion of the total volume of the sewage. Under ordinary circumstances more than 99 per cent. of it is water holding the waste matter partly in solution and partly in suspension. Sewage is therefore, when fresh, a comparatively simple liquid without any particularly unpleasant characteristics; but if allowed to accumulate the organic matter which it contins, inevitably undergoes a process of decomposition which is often attended with offensive odors, and other disagreeable features. The main purpose of sewage disposal is not to prevent this decomposition, because that would be impossible, but by securing uniformly favorable conditions, cause it to take place as rapidly as possible and so thoroughly, that the purified effluent may be freely discharged without any danger of fouling the natural water courses into which it ultimately finds its way.

The process of the decomposition of organic matter is one of oxidation brought about in the presence of oxygen by the action of microscopic organisms known as bacteria, and it should therefore be the aim in all methods of sewage purification to promote the activities of these organisms in every way possible.

The chief difficulty in any method of treating sewage is with the sludge, or the portion composed of the suspended matter which tends to separate from the rest by subsidence. In the "Chemical Precipitation" process, some coagulating substance, such as lime or alum is added to the sewage in order to aid in the precipitation of the suspended matter. But this method of treatment is an expensive one, and instead of purifying the sewage, really only separates it into two portions which have still to be disposed of.

After years of experimenting the processes which have proved most satisfactory under conditions varying according to localities, are as follows:—

1. Broad Irrigation or Sewage Farming.

This method consists in applying the sewage to large areas of cultivated land in small quantities, often not more than from 6,000 to 8,000 gallons per acre. Unless the subsoil is very porous underdrainage is necessary.

2. Intermittent Filtration.

Practically this method is only possible in localities in which large natural deposits of sand and gravel are available. Under such conditions the surface soil is removed and the surface levelled and divided up into beds, upon which the sewage may be discharged at regular intervals, from distributing pipes placed in the embankments separating the beds. Underdrains at a depth of 4 or 5 feet collect the purified effluent. The heaviest and coarsest of the suspended matter is usually removed by screening and subsidence. The resulting sludge is disposed of on sludge beds, where after being thoroughly drained it is plowed into the ground. The degree of purification which can be obtained under favorable circumstaces is very great, the effluent from the underdrains being sometimes chemically purer than many domestic water supplies.

3. Contact Beds.

In this method the sewage after a preliminary screening and settlement is treated in contact beds. These consist of water-tight reservoirs of concrete or masonry filled to a depth of 4 or 5 feet with a porous material such as broken stone, coke breeze, furnace slag, cinders, etc. The sewage is applied to these beds in the following manner:—

They are first slowly filled through a sytem of distributing pipes, and are kept full for two or three hours depending upon the rate at which the system is worked. The outlet valves are then opened and the bed is slowly emptied. It is then allowed to rest empty for a definite period, at the end of which, the process is again repeated. A complete cycle of operations thus includes the time of filling, resting full, emptying and resting empty, and ordinarily is repeated two or three times in twenty-four hours. This method requires the constant service of attendants to insure the proper working of the valves, and for general supervision.

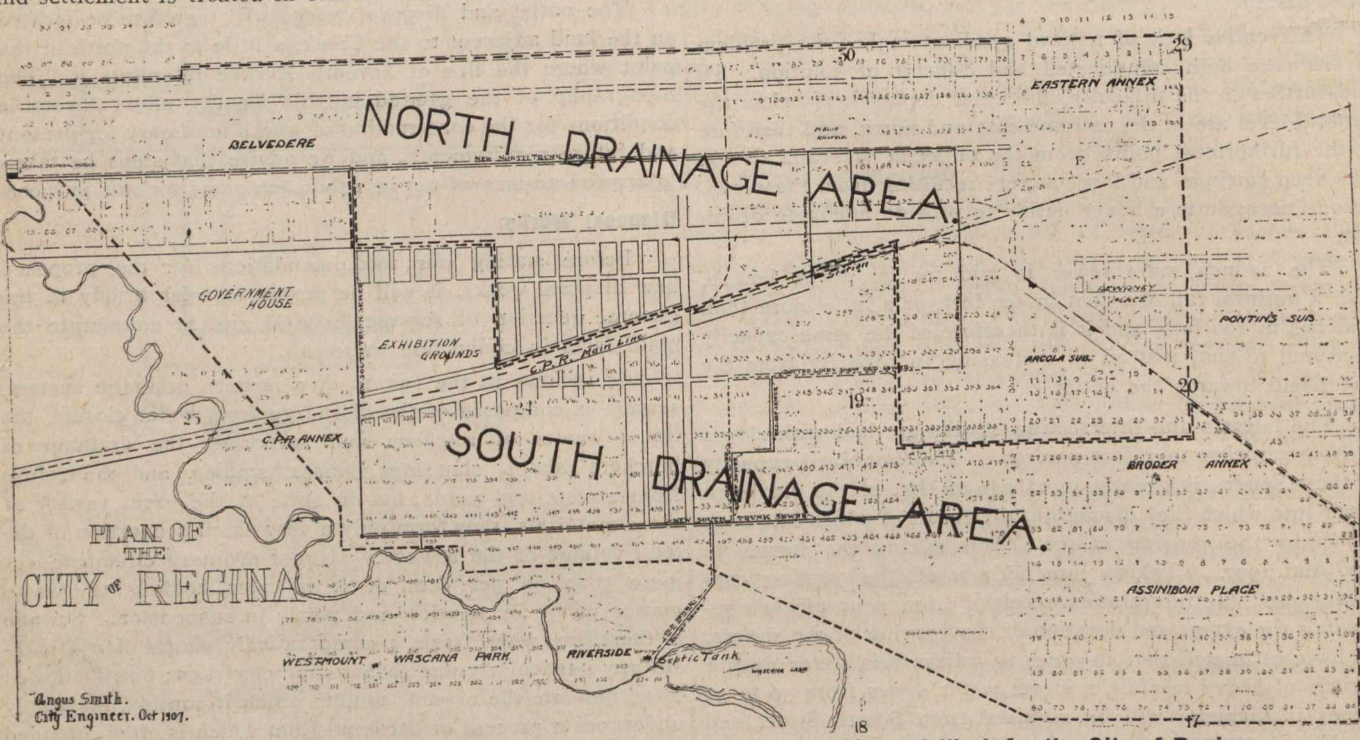
4. Sprinkling Filters.

In this process the filtering medium is similar to that used in contact beds, but the sewage is applied in a different manner. By various methods, such as revolving distributing pipes, or nozzles from which it issues in the form of a spray, the sewage is sprinkled over the surface and allowed to continuously trickle through the filtering material without filling the interstices. A system of open jointed drain pipes provides for the removal of the effluent. Experience with this type of plant is limited, but experiments so far conducted, indicate that a greater degree of purification can be effected by this method than by the contact beds, and they may be operated at a much higher rate. Obviously they would be difficult to operate in cold climates.

5. The Septic Tank.

This system of sewage disposal was first put in practical operation about twelve years ago in the city of Exeter, England. The sewage after passing through a grit chamber enters a reservoir or tank large enough to hold from one quarter to a whole day's supply. The inlets and outlets are so arranged as to cause as little disturbance as possible of the sewage while passing through the tank. Here most of the suspended matter separates by subsidence and as the conditions are favorable to the action of the anaerobic bacteria which thrive in the absence of oxygen, a large proportion of the sludge is liquefied, and much of the organic matter in solution is converted into gas.

While the purification effected is by no means complete, the percentage of organic matter is greatly reduced, and what remains is largely in solution, in which condition it is more readily oxidized. Hence in many cases the effluent may be permitted to discharge without any further treatment. The process is, however, even under the best conditions, necessarily incomplete, and where the volume of the stream into which the effluent must be discharged is small, further purification is necessary. This is usually accomplished by subjecting it to one of the processes already referred to.



Part of Plan that Accompanied Report on Sewers and Sewage Disposal Work for the City of Regina. R. S. Lea, and O. W. Smith, Consulting Engineers.

We have not been able to obtain any records of actual gaugings of the dry weather flow of Wascana Creek, but from observation and enquiry we are of the opinion that, as the sewerage system is extended, the flow in the Creek will not afford sufficient dilution to admit the direct discharge of the effluent from the septic tank. We have therefore provided in our estimates for a secondary plant for its further treatment.

All of the processes above discussed, are being successfully carried on in different parts of the world, but up to the present, with the exception of the septic tank, no installation of the kind has yet been tried under climatic conditions, as rigorous as those of the winter in the Canadian North-West, and consequently we are in some doubt as to the effect of the extreme cold of this location, upon their successful operation. It is reasonable, however, to assume that the contact filter is the best type to operate under such conditions, and we believe that it is the only method which is likely to prove successful. We are of the opinion, however, that special provision will have to be made in the way of frost proof coverings and otherwise to insure a continuous and efficient service. We therefore recommend that before entering into the expense of construction of works of this kind, a practical test be made during the coming winter, with a small experimental plant, which can be constructed close to the present septic tank. This plant should consist of two contact filter beds, each with an area of about 125 square feet. One of these should be provided with a double wooden roof providing an air space for protection against extreme frost, and the other allowed to remain exposed to the atmosphere as in ordinary filter construction. The walls and bottoms of these beds may be constructed of 2-inch plank. The filtering medium, which should be preferably about 3 feet deep, may be screened furnace slag, coke breeze, or clean broken stone, and of sizes ranging from ½ to 2 inches. Connection with the effluent chamber of the septic tank should be so arranged as to enable the sewage to be delivered at the proper intervals into the beds, either at the bottom, or about 6 inches below the surface. Open jointed tile pipe will serve for distribution and removal of the sewage.

The services of two attendants working under the direction of an expert analyst, will be required, to look after and manage the continuous operation of the beds. Regular analyses should be made of the crude sewage, the septic tank effluent, and the effluent from the beds. The method of operating the beds should be varied from time to time, beginning with an eight hour cycle, of two hours for filling, two hours resting full, two hours for emptying, and two hours for resting empty. These periods should be changed to ascertain the best periods of treatment to obtain satisfactory purification, as indicated by the analyses of the effluents.

The cost of the experimental plant and the necessary attendance for six months would be from $1,200 to $1,500. In this we do not include the cost of the services of the analyst, under whose supervision the tests should be made. Inasmuch however, as the information obtained, will be of value to the whole country as well as Regina, we would suggest that the co-operation of the Provincial Government be obtained in connection with these experiments.

We wish here to repeat our opinion that it would be unwise to undertake the construction of any secondary purification works, until the results of the experiments previously referred to, have demonstrated the feasibility of their operation.

The septic tank should be connected to the main trunk sewer, and provided with regulating valves to confine the sewage flow within the proper limits. In some instances an eight hour flow has been found sufficient time for the septic process on an advantageous and practical scale. As, however, localities vary in the constituents of their sewage, a proper adjustment of the operation guided and governed by the results obtained, is necessary in works of this nature.

The experience with your present septic tank and the results as reported from other tanks in operation, would indicate that a deposit of sludge in the tank may be expected, varying from one to three cubic yards per million gallons of sewage. The question of the final disposal of the sludge is one which should be taken into consideration, in the design of the tank.

Owing to the difficulty in obtaining satisfactory gradients for the main trunk sewers, the outlet will have to be kept as low as consistent with the head required for operating the disposal works. This will make it impossible to deliver sludge from the bottom of the tank through valves, except during periods of low water flow in the Creek. The discharge of sludge into the Creek during periods of low water would in all probability result in seriously polluting the stream. During periods of high water, which usually occur in the spring and early summer, the sludge can be turned directly into the Creek, as the dilution will then be sufficient to prevent any serious contamination.

It is, of course, feasible to dispose of the sludge, resulting from the process upon the land adjoining the purificat'on works, and this plan will have to be adopted at the periods, in which it would not be proper to deliver it into the Creek. As this method is both laborious and expensive, it would be advisable in practice to make the septic tank of such a size that sludge can be safely allowed to accumulate in the tank for six months or more, especially during the periods of cold dry weather in winter, and then cleaned out during the high water stages of the Creek. The sludge taken out during other periods should be deposited on the land and then ploughed in.

Screens should be provided in the grit chambers of the septic tank or preferably in a separate screen chamber. These screens are for the purpose of arresting the street detritus and other matter, which should not be allowed to enter the tank proper. At least daily inspection and cleaning of these screens will be necessary.

In view of these facts we recommend for the first installation a septic tank with a capacity of 600,000 gallons. This capacity should be sufficient for a population of 10,000 people. As it is probable that its full capacity will not be required at first, it would be advisable to build it in two parts, so that one half may be operated at a time.

As far as the secondary treatment of your sewage is concerned it will depend entirely upon the results obtained from the experimental plant. In our estimates we have included a sum sufficient to provide for contact beds with a capacity corresponding to that of the septic tank. This whole plant may be extended from time to time as the population increases.

The proper capacity of the trunk sewers does not, however, depend upon population. As has been previously explained, their size is determined by the quantity of storm water they must carry, and as this will be the same whether the whole area sewered is built up or not, these sewers must necessarily be of much larger capacity than the immediate population requires. For this reason we do not recommend any scheme which would provide for an area less than that within the city limits, and the population which it will contain when entirely built up.

Our recommendations and estimates as presented in this report are based upon two schemes which we will refer to as No. 1 and No. 2.

No. 1 provides a system of trunk sewers and overflow sufficient for the drainage of the area within the present city limits, which is approximately 2,000 acres.

No. 2 includes not only the area provided for in No. 1 but in addition, the newly laid out areas of Assiniboia Place, Broder Annex, Arcola Suburb, Dewdney Place, Eatern Annex, Belvedere, a portion of the Canadian Pacific Railway annex and of the Government property south of Sixteenth Avenue, with a total area of about 3,500 acres.

The accompanying plan indicates the areas drained.

In connection with both of these schemes, provision has been made for the domestic sewage of the annexes and the Provincial Government property south of the Creek. This can be brought over to the main sewer by way of the proposed new bridge, or under the Creek by an inverted syphon. The storm water of these areas can be taken off by a separate storm water system, and delivered into the creek at some point below the Government Dam.

We have also provided for the relief of the present brick sewer as previously referred to, by a storm water sewer from Scarth Street and Twelfth Avenue to McIntyre Street and Fifteenth Avenue. This relief sewer should be built at once, and particularly before any of the streets along which it is to be built, are permanently paved.

Scheme No. 1.

Providing for only the area within the city limits. So far as the trunk sewers are concerned, this system will provide for a population, at 15 people to the acre, of 30,000.

Disposal works for 10,000 people should be sufficient for a first installation.

1st.—A relief sewer will be required for storm water. It should be 3 feet in diameter, and extend from Fifteenth Avenue and McIntyre Street to a connection with the old brick sewer at Thirteenth Avenue and McIntyre Street, and from the last mentioned point, a 2 feet 6 inch sewer to Scarth Street and Twelfth Avenue, where it again taps the brick sewer.

2nd.—A relief sewer some 20 inches in diameter from South Railway Street to Seventh Avenue on Hamilton Street. This sewer will also provide for the drainage of the C.P.R. yards.

In determining the proper capacity of the south trunk sewer we have decided to take advantage of the proximity of the Wascana Creek to provide for relief overflows during the heaviest storms. The present brick sewer from Fifteenth Avenue and McIntyre Street to the present outlet will serve for one overflow, and the second must be provided at Princess Street.

Under ordinary wet weather conditions there would be no discharge through these overflows. The main sewer is designed to be of sufficient capacity to carry 4 cubic feet per second for each 1,000 population. This corresponds to a dilution of about 30 to 1. Such a degree of dilution has been found in many instances to be sufficient to take care of the continuous discharge of untreated sewage. In this case the overflow would not take place more than once or twice in a year, and then only for a short time, and probably at those periods when the natural flow in the Creek is the largest.

Where the overflow sewer leaves the main, chambers must be constructed with provision for controlling the overflow and causing it to begin when the flow in the main sewer reaches the allowable maximum.

Estimate cost of scheme (No. 1), comprising trunk sewers, relief sewers, and disposal plant to provide for area within the city limits and corresponding to a total population of from 20,000 to 30,000.

1. (Present septic tank abandoned.) Main sewers and relief sewers $384,900

Disposal Works.

Septic tank and overflow chamber, etc., at outlet of north trunk sewer	$17,000
Contact beds at outlet of north trunk sewer	50,000
	$451,900
Add 10 per cent. for Eng. and Cont.	45,190
Total	$497,090

Until such time as the present septic tank is abandoned, it will only be necessary to build the south trunk sewer, as far as the Princess Street overflow. Under this arrangement it will act as a relief sewer for the old system, until the connection is made through to the north trunk sewer at Seventh Avenue. Deducting the cost of this sewer from Princess Street to Seventh Avenue, viz., $65,000, the cost of this arrangement would be $386,900. Add 10 per cent. for Eng. and Contingencies, $36,690; total, $425,590.

Scheme No. 2.

In this scheme the north trunk sewer provides for the drainage of the Arcola Suburb, Dewdney Place, and the Eastern Annex. The capacity of the portion west of Government Road must be sufficient to accommodate a portion of Belvedere and the additional areas belonging to the south system shown on the accompanying map. Starting as before at Twelfth Avenue and Toronto Street, the required diameters would be as follows:—

North Trunk Sewer.

Street.	From.	To.	Size.
Toronto	Twelfth Avenue	Ninth Avenue	4′-0″ diameter
"	Ninth Avenue	Seventh Avenue	5′-2″ "
Seventh	Toronto Street	Hamilton Street	5′-7″ "
"	Hamilton Street	Albert Street	6′-3″ "
"	Albert Street	Elphinstone	6′-7″ "
"	Elphinstone	Government Rd.	7′-0″ "
"	Government Rd.	Outlet	6′-0″ "

South Trunk Sewer.

The south trunk sewer starts at the eastern boundary of the city on Sixteenth Avenue, and from that point to McIntyre Street will carry the sewage of Assiniboia Place, and Broder Annex. At McIntyre Street and Fifteenth Avenue an overflow sewer 3 feet 6 inches in diameter discharging at the present outlet, will be necessary. At Princess Street a second overflow into the Creek of 2 feet 6 inches diameter should be provided. The locations and dimensions of this sewer are as follows:

Estimate of cost of scheme (No. 2), comprising trunk sewers, relief sewers, and disposal plant to provide for area within the city limits and additional areas as shown on the accompanying plan. Estimated population 45,000 to 50,000 people.

Main sewers and relief $498,600

Disposal Works.

Septic tanks and overflows, etc., at outlet of north trunk sewer	$ 17,000
Contact beds	50,000
	$565,600
Add 10 per cent. for eng. and contingencies	56,760
Total	$622,360

The whole of this scheme need not be carried out at the present time. That portion of the south trunk sewer between Winnipeg Street and McIntyre Street and the new overflow sewer at McIntyre Street, will not be required until it becomes expedient to provide drainage for the outlying districts of Assiniboia Place and Broder Annex. Again until the present septic tank is abandoned, the south trunk sewer need only be constructed from McIntyre Street to the Princess Street overflow.

Deducting the cost of the sewer from Winnipeg Street to McIntyre Street, viz., $63,500, would leave a total of	$504,100
Add 10 per cent. for eng. and contingencies	50,410
Total	$554,510
Deducting the cost of that portion of the south trunk sewer from Princess Street to Seventh Avenue, viz., $73,000 would leave a total of	$431,100
Add 10 per cent. for eng. and contingencies	43,110
Total	$474,210

General Recommendations.

In determining the proper sizes of the different sewers in the above scheme, and in estimating the cost, we have assumed that the material employed for all, except the smallest sizes, will be reinforced concrete, which we consider the most economical form of construction under the circumstances.

Inasmuch as the available fall is in every case so slight, it is particularly essential that the greatest care should be exercised in executing the work true to line and grade. This will not add to the necessary cost of construction, but will require absolute accuracy in the laying out of the work, and efficient inspection of the manner in which it is carried out.

There is another point which should be referred to in connection with the flat grades to which these sewers must be laid. The ordinary flow of sewage is such a small proportion of the storm water flow (for which the sewer is designed) that it would only run a few inches deep in the bottom of the large circular sewers. Hence in order that the dry weather flow may have the greatest depth and velocity possible, a special form of invert must be designed of a radius suitable to the ordinary flow. The same result may be obtained by using an egg-shaped section instead of the circular.

The elevations and distances used in our calculations have been supplied by the city engineer, who has had several of them checked at our request. We, however, consider that it would be advisable before undertaking the construction of works of such magnitude, that a careful study of the whole system, including submains and laterals, should be made, and comprehensive plans prepared at once to include the whole district, according to which all future additions could be carried out.

The lack of natural gradients and other local conditions of your city, make it advisable that particular attention should be paid to properly ventilating the sewers. Emanations of sewer gas from drains have given cause for much complaint in cities with local conditions similar to those of Regina. It will, therefore, be in order in this report to discuss briefly, the subject of ventilation.

The production of sewer gas may be greatly lessened by the exercise of care in laying the sewers and house connections, so that there will be no sags or depressions in which deposits of solid matter can accumulate. But as it is impossible in practice to wholly prevent the formation of foul gases in sewers, means should be provided for their escape without causing a nuisance; and the aim should be to secure the greatest number of suitable connections with the outer air, that the circulation of the air in the sewers may be as free as possible. Many expedients have been tried for this purpose. Among which may be mentioned, connecting the sewers to street lamps, by ventilating shafts on manholes, removing the air by suction, leaving the main house drains untrapped, etc. The latter method appears to give the most satisfactory results. It offers a greater number of outlets for the sewer air and the majority of cases delivers it into the atmosphere at points where the liability of creating a nuisance is small. The fact that as a rule the house connections are more foul than the sewers, indicates the necessity of making provision for their ventilation. A certain amount of ventilation can be got by venting each trap throughout the buildings; but much better results are obtained both in the sewer and in the house connections, by omitting the main trap on the house drain, and permitting the air from the main sewer to pass unobstructed through the soil pipe.

If careful and properly tested plumbing is done within the building we are of the opinion that the main trap on the house drain is unnecessary and for the purpose of ventilation should be omitted.

The immediate construction of the north trunk sewer is necessary in order to provide a proper outlet for the sewers which have been laid north of the Canadian Pacific Railway. The proposal to provide a temporary outlet for this part, by allowing the Albert Street sewer to overflow into the old system, would, in our opinion, result in the creation of a nuisance and also necessitate frequent cleaning of this portion of the system to prevent clogging. It will also be necessary to construct as soon as possible that part of the south trunk sewer from McIntyre Street to the Princess Street overflow. This portion will act during heavy storms as a relief for the old brick sewer, and for this purpose it will need to be included as part of the first construction.

Comparing the two schemes as outlined it may be noted that while the large system exceeds the smaller in cost, to the amount of $127,270, it will provide drainage for a territory over one-third larger, and an estimated population 20,000 greater than that served by the smaller system. In view of this large increase of service as compared with the increase of cost, we are of the opinion that the larger system would in the end be the most economical one to adopt.

Summary of Conclusions.

Summarized, our conclusions on the whole question of your sewerage system, both as to the present conditions and future requirements, are as follows:

1. The present brick sewer is inadequate to give satisfactory drainage during times of heavy rainfall.

2. This sewer should be relieved by overflows and relief sewers at various points, as explained in the body of this report.

3. Owing to the local conditions in the vicinity of the present outlet and disposal works, we would advise that the present septic tank and outlet be abandoned, and that all the sewage be taken to a point further down the creek to a new disposal works and a new outlet.

4. So far as the method of septic treatment goes, we think that the present septic tank properly attended to is adequate for the sewage reaching it at present.

5. We recommend the immediate construction of a new trunk sewer to be built on Seventh Avenue to drain the northern portion of the city and some of the territory at the eastern city limits.

6. A new south trunk sewer will be required to drain the territory south of the Canadian Pacific Railway. This sewer by connecting it to the present system at Fifteenth Avenue and McIntyre Street will take the present as well as the future drainage to the new disposal works and outlet further down the creek.

7. Owing to the small flow of Wascana Creek in the dry season, we do not consider septic tank purification alone will prevent nuisance in the creek, when the volume of sewage is materially increased, and, therefore, some further purification of the tank effluent will be necessary.

8. As no filters for the purification of sewage have ever been operated in such low temperatures as are to be met with in Regina during the winter season, and inasmuch as we are not satisfied that the ordinary methods of construction and operation of sewage filters would be successful under such circumstances, we consider it advisable that immediate steps be taken to install in connection with your present septic tank, experimental filter beds. These beds should be operated and tested during the coming winter. An experienced man with technical knowledge will be required to study the operation of the filters, make tests and in general collect the information required. We would suggest that the co-operation of the Provincial Government be secured to aid in acquiring this information.

9. Under local conditions found here, we are of the opinion that, as a secondary treatment, contact filters are the most likely to operate successfully, but it will remain for the experiments advised, to prove the correctness of this opinion.

10. We conclude this disposal works to serve a population of 10,000, will be sufficient for the first installation.

11. The complete installation of purification works will comprise a septic tank for the treatment of the crude sewage, having a capacity of approximately 600,000 gallons, and a further treatment of the septic tank effluent through contact filters if they are found to operate satisfactorily, during the winter season.

In conclusion we may say, that owing to the unfavorable natural conditions, the construction of a satisfactory sewerage system for Regina, necessitates a large initial expense. The local conditions are such, that a small system would only drain efficiently a limited area, and the saving in cost of the first construction, would have more than a corresponding disadvantage in limited service. In view of the importance of Regina, both as a commercial centre and as the capital city of Saskatchewan, and also considering its rapid growth, and the way in which the first installment of municipal works have been outgrown, we believe a sewer system on a comprehensive scale is the proper one to adopt. The question of sewage disposal, while a difficult one, is also very important. The experimental plant advised will doubtless add materially to the information already obtained on the subject, at other experimental stations. So far as we knew no experiments of this kind have yet been made in Western Canada. It, therefore, remains for Regina to be a leader in seeking the satisfactory solution of a problem, which is of great importance both to the city and the whole country.

BOOK REVIEWS.

The Electric Furnace. By Alfred Stansfield, D.Sc.; publishers: The Canadian Engineer, Toronto, Canada. Size, 6 x 9. Pages, 200. Price, $2.

The book is based upon a series of articles with the same title, which appeared in the Canadian Engineer during 1906. These have been largely re-written, and the subject matter increased and brought up-to-date.

Electric smelting is a subject of increasing importance to Canadian Engineers and others, and this book contains a clear and connected account of the principles on which electric furnaces are constructed, the uses to which they can be put and the more important details of their construction.

The book is not merely a list of electric furnaces and processes, but a systematic treatment of the electric furnace, comprising its history classification, theory, efficiency, and construction, with details of a number of furnaces selected as types.

Careful consideration is given to the question of cost of electrical heating, and efficiency of electrical and other furnaces, and a table is given showing the amount of heat that can be obtained from different fuels and from the electric current.

In the chapter on the construction of electric furnaces the important nature of different refractory materials is dealt with, in addition to the more purely electrical parts of the subject.

An important section of the book is that which is devoted to the electro-metallurgy of iron and steel, and it is this that will appeal most strongly to the average reader who wishes to know whether the schemes put forward for electrically smelting iron ores, or making steel are practicable.

Other electric furnace processes have been described such as the manufacture of graphite, carborundum, siloxicon and calcium carbide, while a full account is given of the electric smelting of ores of zinc and lead on which the author has made many experiments.

The final chapter is prophetic in character, and looks forward to the day when all the coal will have been exhausted, and the "white coal" of our water-powers may be the only available source of heat or power.

Professor Stansfield is to be congratulated on producing such a work, dealing as it does with a difficult subject in an interesting and readable manner.

The book is clearly written and illustrated, and there is very little padding in its 200 pages, while numerous footnotes refer the reader to the original articles for fuller details than could be included in a book of these dimensions. An unusually full index will add to the usefulness of the book by enabling any point in it to be easily found.

The Science Year Book, 1908. Published by King, Sell and Olding, Limited, 27 Chancery Lane, London, Eng.

A diary directory, and scientific reference book. This is a particularly valuable publication, for not only has it a page for every day in the year to be used as a diary, but also detachable leaves for daily engagements. Besides a splendid biographical directory it also contains an astronomical ephemesis, glossary of scientific terms, and a list of scientific societies and universities.

Proceedings of the American Waterworks Association, 1907. Being a report containing the papers read before the twenty-seventh annual convention held at Toronto, Canada, June 17th-21st, 1907. Published by the secretary, J. M. Diven, 15 George Street, Charleston, S.C.

Many conventions have been held in Toronto, but few have been more profitable to the interest they represent than the Convention of the American Waterworks Association. Almost every phase of water supply and delivery was discussed, and the most important items of discussion has been published in the proceedings for 1907. The purity of water; pumping and pumping engines; conveying and distributing; metering and water rates all were discussed by men specialists in their own department. The volume is neatly bound and printed, and contains many diagrams and illustrations. Page 527. Size, 6 x 9.

The Practical Engineer Pocket Book, 1908. Technical Publishing Company, 55 and 56 Chancery Lane, London, Eng., $3.25.

The first thing that strikes one on examining the pocket book is the complete index it contains. One can readily tell whether the information sought is contained here. The mechanical engineer, the man interested in machines and their construction, whether hydraulic, gas, electric, or steam plants will likely find just what he is looking for here. The list of tables alone made the book indispensable to an engineer.

The Canadian Almanac. Published by Copp, Clark & Co., Limited, Toronto, Ont. Size, 6 x 9. Pages, 488. Price, 50 cents.

This issue of the Canadian Almanac, which forms the sixty-first of the series is unusually valuable. No other publication we have seen contains the information here given of interest to surveyors and engineers. The Astronomical Calculations, the Eclipses, Star and Latitude Tables are indispensable to the surveyor in the field. The other tables and information lists are of great value in every office containing as they do authentic information handily arranged.

The Engineering Digest. Published monthly by the Technical Literature Company, 220 Broadway, New York.

The magazine was formerly Technical Literature, but as some misapprehension existed as to the contents of a journal described by such a title it was thought wise to change to the Engineering Digest. The policy of the magazine has not changed. It will continue to publish a wide range of technical information, and will be an invaluable companion to technical men.

Electrocraft. Published by the Electrocraft Publishing Company, Detroit, Mich. Size, 5 x 8. Price, 50 cents.

The October 1907 issue of Electrocraft is a very complete edition. Its list of illustrated approved electrical fittings suggests equipment suitable for every kind of wiring and electric fixtures. As an appendix is added the National Electrical Code being the rules and requirements of the National Board of Fire Underwriters for the electric wiring and apparatus. These regulations cover the requirements of the United States Underwriters' Association. The Electrocraft is practically indispensable to buyers and users of electrical fittings.

PUBLICATIONS RECEIVED.

Canadian Electrical Association.—Proceedings of the 17th annual convention held at Montreal, September 11th to 13th, 1907. T. S. Young, Confederation Life Building, Toronto, Secretary. Size, 6 x 9. Pages, 200. Folding and other plates. Text, illustrated.

Journal Western Society of Engineers.—Proceedings of the society, papers and discussions, published by the society at 1734-41 Monadnock Block, Chicago. Size, 6 x 9. Pages, 180. Paper. Text, illustrated.

Ontario Bureau of Mines.—Annual report for 1907, being part one of the report containing reports on iron ranges of Lake Nepigon, Larder Lake district, and Lake Abitibi gold deposits. F. Cochrane, Minister of Mines, Geological Map of Larder Lake region. Text, illustrated.

Department of Mines, Dominion of Canada, Geological Survey.—Being the report for 1907 as contained in sessional paper No. 26, contains a summary report for the men in the field in each province and territory.

Railway Statistics.—Being the annual report of the Comptroller of Railway Statistics for the year ending June 30th, 1907. Size, 6 x 9. Pages, 140.

CATALOGUES AND CALENDARS.

Corliss Engines.—The Murray Iron Works Company, Burlington, Iowa. This booklet called Nomenclature of Murray Corliss Engines is well illustrated and gives the names and position of the various parts of their engine. Size, 7 x 10.

Hadfield's Steel Foundry Company.—Tinsley, Sheffield, Eng. Peacock Bros., Canada Life Building, Montreal, Canadian agents, sole makers of Era, Manganese Steel, send their calendar illustrated with cuts of the various articles they cast. Steel locomotive castings, rock crushers, bridge castings, etc.

Hamilton Facing Mill Company, Limited, Hamilton, send us a calendar which is truly artistic, and will doubtless be highly appreciated by all who may be favored with a copy. The subject is Dutch, and is the work of a Dutch artist, C. J. Thijsen.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

RAILWAYS—STEAM AND ELECTRIC.

Ontario.

PARRY SOUND.—John Olson is suing Angus Sinclair of the Town of Parry Sound for $10,000 balance due for work done and material supplied by Olson as sub-contractor for Sinclair in the construction of the James Bay Railway, and for a railway construction plant and machinery alleged to have been converted by Sinclair to his own use.

TORONTO.—Robert E. Kemerer was arraigned before Magistrate Denison, charged with stealing $11,119.86 from McCrae, Chandler, and McNeil, railroad contractors on the Temiskaming and Northern Ontario Railway. They claimed that Mr. Kemerer entered into an agreement with them whereby he was to advance $45,000, of which $33,880.14 had been turned over. As neither the Crown nor Mr. Kemerer was ready to go on, the case was adjourned. "In the process of loaning the money to the firm," said Mr. Kemerer, "instead of paying them the money I placed several sums to their account and paid sums to Medland Brothers, grocers, the Levack Beef Company, and to the Rice, Lewis, and Son Company, Limited, for food and camp supplies. They contend now that I had no business paying the bills. In consequence, they charge me with the theft of $11,119.86. It is purely a civil court case, I think."

British Columbia.

MISSION CITY.—The C.P.R. has begun construction of its new steel bridge across the river.

VANCOUVER.—Messrs. A. Guthrie & Company have taken over the contract from the B. C. General Contract Company, for the building of the Great Northern from Cloverdale to Abbotsford as the result of the assignment of the B. C. General Contract Company.

CRESTON.—A company is being formed to develop electricity at the Goat River canyon, three and a half miles from here.

FERNIE.—The C.P.R. will spend $50,000 on new trackage, new freight sheds and other improvements at Fernie this year.

Manitoba.

PORTAGE LA PRAIRIE.—The piers for the Grand Trunk Pacific bridge across the Assiniboine River have been completed. The steel gang can now commence work on the upper steel work.

SEWERAGE AND WATERWORKS.

Ontario.

NORTH BAY.—The Council have instructed their engineer to prepare plans and estimate of cost of a reservoir at Trout Lake. The reservoir is to be designed to hold at least one million gallons.

TORONTO.—Of nine tenders received for the construction of the 15,000,000 gallon pumping engine which will be needed when the tunnel under the bay is completed, the lowest is that of the Canada Foundry Company for $130,000, but as they tendered on the basis of producer gas as power, and neglected to send a cheque, the mayor discarded it yesterday. The other tenders were sent to the city engineer for a report. A representative of the Canada Foundry Company said that the tender was intended more as a suggestion for the consideration of the controllers than as a tender.

MISCELLANEOUS.

Ontario.

PORT ARTHUR, ONT.—There is every expectation that the work on the extension of the breakwater will be continued this winter. Owing to the illness of contractor Hogan in the East the work has been suspended for some time. It is altogether likely that work will be resumed at an early date when some 50 men will be given employment. When spring opens up this force will be increased to 400 or 500. It is understood that arrangements have been completed for the building of the extension out 1,000 feet from the present breakwater, as recommended by the Council and Board of Trade.

TWEED.—The buildings of the Ontario Powder Company near here were utterly destroyed by a terrific explosion on the morning of February 4th. No lives were lost. One of the vats containing nitric acid boiled over and the acid set fire to the nitro-glycerine mixer. This was said to be the cause of the explosion. It is also said that the extremely cold weather congealed the nitro-glycerine, and it entered the mixer, thus causing the boiling over and the consequent setting fire to the building. Another explanation of the explosion is to the effect that it occurred in the building where the gelignite blasting cartridges were made. The company had just commenced the manufacture of this powerful explosive. The chimney of the Steel Trough and Machine Company, which is located not far distant from the powder factory, was hurled to the ground, as well as the glass in the factory being broken. Some plate fronts in Madoc, sixteen miles away, were even cracked. The loss in plate glass and other windows in this town is thought to be $1,000. The company's loss will probably reach $25,000.

New Brunswick.

GRAND FALLS, N.B.—A serious accident occurred at Grand Falls, which will greatly affect construction work on the big dam. For some time a large number of logs had been lying against the coffer-dam, and over these logs the river ice was continually piling, until the pressure became so great that the woodwork of the dam could withstand it no longer. The river had become swollen to such an extent that the water rose over the big concrete dam, causing the ice and logs to surge with relentless force against the coffer-dam, carrying away two sections of it. It was hoped to have had the main dam completed in March; but owing to this accident the company will not be able to resume work on its construction until next summer.

Alberta.

EDMONTON, ALTA.—At a special joint meeting held for the purpose of considering the high level bridge proposition between the City Councils of Strathcona and Edmonton and the members of the local Government it was arranged that Edmonton will contribute $42,500 and Strathcona $17,500 of the $60,000 required besides amounts promised by both the local and the Dominion Governments. By-laws will be shortly submitted to the burgesses of the sister cities authorizing the raising of the respective amounts.

British Columbia.

NEW WESTMINSTER.—Good progress is being made on the preliminary preparations for the proposed extensive improvements to navigation and traffic on the Fraser River. Engineer LeBaron, who has been brought from the Eastern States to make a complete examination of the river and draw up estimates of the proposed improvements, is rapidly finishing his work, and when it is completed Mayor Keary will go east to Ottawa to lay the entire scheme before the Department of Public Works at the capital.

BUILDINGS.

Manitoba.

PORTAGE LA PRAIRIE.—Indications point to a coming season of building operations on Portage Avenue that will not be very far behind other years in this regard. In the early spring the bricklayers will commence work on a three storey structure at the corner of Carlton Street for the Manitoba and Ontario Loan Company. The steel columns for this building are being made of sufficient size to allow of three additional stories being added when necessary.

WINNIPEG.—Plans are being prepared in the office of H. C. Stone, architect, for the Winnipeg new theatre, to be situated at the corner of Princess Street and Notre Dame Avenue, adjoining the Ryan Wholesale Shoe Warehouse. Tenders will be called within the next couple of weeks, and work will commence on the excavations early in March. The structure is to cost $100,000.

CONTRACTS AWARDED.

Ontario.

CLAYTON.—Joseph Leopold & Co., of New York, have just closed contracts with Edward C. Lewis, of Wells' Island, and the Picton Island Red Granite Company, of Clayton, for stock for one of the largest jobs of paving stone recorded, amounting to $3,000,000. Leopold & Co. have contracted with the Picton Island Red Granite Company for stock from its quarry. They will employ 250 men on Wells Island and 50 men on Picton Island. The plant on Picton Island is already erected, and one will be erected on the Lewis farm, consisting of four hoisting engines and two compressors, to work the pneumatic tools. The granite ground on the Lewis farm is grained pink, and is one of the finest to be found in the United States.

PERSONAL.

MR. W. BRAWLEY, of the Sheffield Engineering Company, has gone to England on a business trip, and will be gone about six weeks.

MR. T. P. PAYNE, contracting engineer, manager of the Berlin Construction Company, has opened offices in the Stair Building, Toronto.

MR. CHARLES E. GRAVES has been appointed district passenger agent of the Niagara Gorge Railway Company, with headquarters at Toronto. Mr. Graves is a very well-known railway man, having been formerly connected in Toronto with the Grand Trunk Railway and the Great Northern Railway.

MR. R. H. JUPP, of Orillia, has been appointed County Engineer for Simcoe.

MR. W. A. COWAN, Resident Engineer of C.P.R., Toronto, has been appointed to the London section.

MR. FRANK COOPER, Resident Engineer C.P.R., London, has been transferred to District No. 2, Toronto.

MR. W. MONDS, C.E., has just completed a survey of Dog Lake and a transmission line to Port Arthur. The work is being carried on under Cecil B. Smith.

For Tenders see page 89.

MARKET CONDITIONS.

Toronto, Feb. 6, 1908.

At this season of the year, and especially in such very cold and snowy weather, the building trade is naturally dull. In iron and steel heavy structural material the dullness is pronounced, but for hardware and machinery enquiries are becoming more numerous; for roofing and building paper, too, carload orders are coming in from south-west Ontario points. Other building materials quiet: lumber firm, with the outlook upward.

British mail advices are that Scotch pig is dull and lifeless, with values tending downward. Manfactured iron mills have hardly enough to keep them open. Structural steel was reduced on 20th January 10s. per ton, but not much business resulted. Values of tin somewhat strengthened; a better feeling in copper; lead and zinc moderately active.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

American Bessemer.—Fourteen-gauge, $2.45; 17, 18, and 20-gauge, $2.60; 22 and 24-gauge, $2.65; 26-gauge, $2.80; 28-gauge, $3.

Antimony.—Quiet, but inquiries are coming in more freely; we quote 11½ to 13c.

Bar Iron.—$2.20 base, from stock to the wholesale dealer. A moderate supply on hand.

Beams and channels, $2.75 to $3, according to size and quantity; angles, 1¼ by 3-16 and larger, $2.65; tees, $2.90 to $3 per 100 pounds. Extras for smaller sizes.

Boiler Heads.—25c. per 100 pounds advance on boiler plate.

Boiler Plates.—¼-inch and heavier, $2.50. Supply probably adequate and quotations still firm.

Boiler Tubes.—Lap-welded steel, 1¼-in., 10c.; 1½-in., 9c. per foot; 2-in., $9.10; 2¼-in., $10.85; 2½-in., $12; 3-in., $13.50; 3½-in., $16.75; 4-in., $21 per 100 ft.

Building Paper.—Plain, 32c. per roll; tarred, 40c. per roll, and the market decidedly strong at these prices.

Bricks.—Common structural $10 per thousand, wholesale; small lots $12 to $13, and the demand fairly brisk. Red and buff pressed are worth $18 at Don Valley Works.

Cement.—Star brand, Toronto, 1,000 barrel lots, $2.25 per barrel, 350 pounds net, including bags, or $1.85 ex-package, small lots cost $2.10 warehouse, $2.15 delivered. National and Lakefield prices are identical; English, Anchor, $3 per barrel in wood. Demand continues moderate.

Felt Paper—Roofing Tarred.—Market steady at $2 per 100 lbs. More orders coming in this week.

Fire Bricks.—In steady request; English, $32 to $35; Scotch, $30 to $35; American, $25 to $35 per 1,000.

Galvanized Sheets—Apollo Gauge.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.25; 12-14-gauge, $3.35; 16, 18, 20, $3.50; 22-24, $3.70; 26, $3.95; 28, $4.40; 29 or 10¾, $4.70 per 100 pounds. Stocks very low.

Ingot Copper.—Market more active, but very irregular. Our quotation is 15 to 16⅛c.

Lead.—The market is active and strong; our quotation 4½c.

Nails.—Wire, $2.55 base; cut, $2.70; spikes, $3.15. Supply moderate.

Pitch.—Quiet at 75c. per 100 lbs.

Pig Iron.—Summerlee No. 1, always in demand, generally for small lots, quotes now, nominally, $27; Glengarnock, $26.50; No. 2, $26; Cleveland, No. 1, $23.50, $24; Clarence, No. 3, procurable in Montreal, price here $23 to $24.00. But a small business doing; buyers cautious.

Steel Rails.—80-lb., $35 to $38 per ton.

Sheet Steel.—In moderate supply; 10-gauge, $2.65; 12-gauge, $2.70.

Tar.—Market unsettled, $3.50 per barrel the ruling price.

Tank Plate.—3-16-in., $2.65.

Tin.—Irregular, but active, fluctuating in Singapore and London. We still quote 31 to 32c. here.

Tool Steel.—Jowitt's special pink label, 10½c. per pound; Capital, 12c.; Conqueror, highspeed, 70c. base.

Wrought Steam and Water Pipe.—Trade prices per 100 feet are: Black, ¼ and ⅜-in., $2.59; ½-in., $2.89; ¾-in., $3.90; 1-in., $5.60; 1¼-in., $7.65; 1½-in., $9.18; 2-in., $12.24; 2½-in., $20.10; 3-in., $26.40. Galvanized, ¼ and ⅜-in., $3.41; ½-in., $3.74; ¾-in., $5.06; 1-in., $7.26; 1¼-in., $9.90; 1½-in., $11.88; 2-in., $15.84; 3½-in., black, $34.20; 4-in., $38.85. Larger sizes lower since Canadian mills can now supply them.

Zinc.—The market is steady and fairly active; quotation, Toronto, slab, $5.50; sheet, $7.50.

Montreal, February 5, 1908.

Antimony.—The tone of the market is weaker but prices hold steady at 12½ to 13c. per pound.

Bar Iron and Steel.—Mills are prepared to accept very much lower prices than formerly, owing to the absence of demand and the fact that import prices are lower. There has been a decline of fully 10 per cent. all round, the following prices being now quoted: Bar iron, $2 per 100 pounds; best refined horseshoe iron, $2.25, and forged iron, $2.15; mild steel, $2.10; sleigh shoe steel, $2.10 for 1 x ⅜-base; tire steel, $2.10 for 1 x ⅜-base; toe calk steel, $2.60; machine steel, iron finsh, $2.15.

Boiler Tubes.—The market holds steady, demand being fair. Prices are as follows: Two-inch tubes, 8 to 8¼c.; 2½-inch, 11c.; 3-inch, 12 to 12¼c.; 3½-inch, 15 to 15¼c.; 4-inch, 19¼ to 19½c.

Cement—Canadian and American.—Canadian cement is generally quoted at $1.80 to $1.90 per barrel, in cotton bags, and $2.10 to $2.20 in wood, weights in both cases 350 pounds. There are four bags of 87½ pounds each, net, to a barrel, and 10 cents must be added to the above prices for each bag. Bags in good condition are purchased at 10 cents each. Where paper bags are wanted instead of cotton, the charge is 2½ cents for each, or 10 cents per barrel weight. American cement is steady at $1.15 per 350 pounds, basis Glens Falls, cotton or paper bags. When the cotton bags are returned in good condition, only 7½ cents is allowed for them. American cement sold at $2 on track.

Cement—English and European.—English cement is unchanged at $1.90 to $2.20 per barrel in jute sacks of 82½ pounds each (including price of sacks) and $2.10 to $2.20 in wood, per 350 pounds, gross. Belgian cement is quoted at $1.90 to $2.10 per barrel, in wood. German is $2.52 to $2.55 per barrel of 400 pounds for Dyckerhoff.

Copper.—The market for copper shows very little change this week, being perhaps slightly firmer in tone. Prices hold at 15 to 15½c. per pound.

Iron. — Dealers make the claim that they will not accept less than the following for carload lots: Londonderry is only offering for future shipments, and is quoted at $24 f.o.b. Montreal for No. 1. Toronto prices are about $1.25 more. Summerlee iron is arriving, and is quoted at $24 f.o.b. on cars, Montreal, for No. 2 selected, and $25 for No. 1. No. 1 Cleveland is unobtainable at the present time, and Clarence at $20 to $21. Carron special, $24; soft, $23.75, to arrive.

Lead.—Prices show a slight advance, this week, at $4 to $4.10 per 100 pounds. Demand is fair.

Nails.—Demand is still dull and although cut nails are still quoted steady at $2.50 per keg, it has been found necessary to reduce prices on wire, to $2.40, base price.

Pipe—Cast Iron.—The market is next thing to dead, as nothing is used during the winter. Prices are steady at $36 for 8-inch pipe and larger; $37 for 6-inch pipe, $38 for 5-inch, and $39 for 4-inch at the foundry. Gas pipe is quoted at about $1 more than the above.

Pipe, Wrought. — Trade continues on the dull side. Quotations and discounts for small lots, screwed and coupled, are as follows: ¼-inch to ⅜-inch, $5.50, with 53 per cent. off for black and 38 per cent. off for galvanized. The discount on the following is 66 per cent. off for black and 56 per cent. off for galvanized: ½-inch, $8.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; and 3-inch, $75.50.

Spikes.—Railway spikes are not in very good demand, $2.60 per 100 pounds, base of 5½ x 9-16 Ship spikes are steady at $3.15 per 100 pounds, base of ⅝ x 10 inch and ⅝ x 12 inch.

Steel Shafting.—At the present time prices are steady at the list, less 25 per cent. Demand is very dull and lower figures would hardly be refused.

Steel Plates.—Demand is quite dull and a firm bid at lower figures than quotations would be considered. Quotations are: $2.75 for 3-16, and $2.50 for ¼ and thicker, in small lots.

Tin.—The market for tin shows a slight advance, this week, at 31½ to 32c. per pound.

Tool Steel.—Demand is light but the market is firm. Base prices are as follows: Jessop's best unannealed, 14½c. per pound, annealed being 15½c.; second grade, 8½c., and high-speed, "Ark," 60c., and "Novo," 65c.; "Conquerer," 55 to 60c.; Sanderson Bros. and Newbould's "Saben," high-speed, 60c.; extra cast tool steel, 14c., and "Colorado" cast tool steel, 8c., base prices. Sanderson's "Rex A" is quoted at 75c. and upward; Self-Hardening, 45c.; Extra, 15c.; Superior, 12c.; and Crucible, 8c.; "Edgar Allan's Air-Hardening," 55 to 65c. per pound.

Zinc.—Demand is on the dull side and prices show a slight decline as compared with a week ago, being $5.20 to $5.45 per 100 pounds.

QUEBEC MINERALS.

The official figures of the mineral output of Quebec Province for the year 1906 show that the value of minerals was $5,019,032 as compared with $3,755,060 in 1905. The metallic part of this total was but small, the respective items being copper ore, $176,681; chromic iron, $91,834; bog iron ore, $61,175. The non-metallic portion of the list bulks well; value of asbestos and asbestic, $2,162,528; mica, $168,887; slate, $24,446; calcined ochre, $19,620; small quantities (which one would think should be, and must presently be, larger) of phosphate and graphite; flagstones, $2,050.

Manufactures of a mineral kind make a good display, too. For example the cement made was valued at $625,570; bricks at $525,000; tiles and pottery, $270,000; lime, $96,000. The granite output, and that of limestone were large, $560,236 for granite and $223,580 for limestone. The asbestos miners numbered 1,950, and the brick-makers, 1,462; the latter producing 94 millions of bricks, mainly in the district of Montreal. The whole mineral industry gave employment to 5,679 men, who earned $1,829,000 in the year.

Some sections of the Province have newly come into prominence recently as producers of minerals. Gold-bearing quartz has been discovered near Lake Opasatica, to the north of Pontiac County; while at Chibogamoo, much farther north, the existence of cobalt is noted in addition to a variety of other metals and minerals said to exist thereabout in quantity.

Men's Christian Association has completed a $65,000 building. In the way of schools, a fine four-storey Separate School has been built by the Roman Catholics of the city, and a new $55,000 Public School in the east end of the city will be ready for opening in February. In addition to these more important items in Edmonton's building programme, there has been built the usual number of stores, office buildings and warehouses, including the beginning of operations on the new packing plant, the installation of which means a great deal to the farmers of Central Alberta.

There still remains for 1908 the beginning of the new Parliament Buildings, which are to be commenced as soon as weather conditions will permit. Work will be continued probably until late in 1911, it being the hope of the Government to have the buildings completed within three years.

The total value of the buildings erected, or in course of erection, in Toronto last year, amounted to $13,826,580, which is over a $1,000,000 more than in 1906. The first half of the year was phenomally good; from August onward there was a falling off; due, doubtless, to the condition of the money market, and the difficulty experienced in getting loans. The district lies in the great mineralized belt which, beginning about Sudbury, sweeps across eastward and northward in both Ontario and Quebec.

TENDERS

SEALED TENDERS addressed to the undersigned, and endorsed "Tender for New Entrance to Toronto Harbour, Ont.," will be received at this office until Monday, March 2, 1908, inclusively, for the construction of a New Western Entrance to the Harbour of Toronto, in the County of York, Ontario, according to plans and specification to be seen at the office of J. G. Sing, Esq., Resident Engineer, Confederation Life Building, Toronto, at the office of H. J. Lamb, Esq., Resident Engineer, London, Ont., at the office of J. L. Michaud, Esq., Resident Engineer, Merchants' Bank Building, St. James St., Montreal, P.Q., and the Department of Public Works, Ottawa.

Tenders will not be considered unless made on the printed form supplied, and signed with the actual signatures of tenderers.

An accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, for forty-eight thousand dollars ($48,000.00), must accompany each tender. The cheque will be forfeited if the person tendering decline the contract or fail to complete the work contracted for, and will be returned in case of non-acceptance of tender.

The Department does not bind itself to accept the lowest or any tender.

By order,
FRED. GELINAS,
Secretary.
Department of Public Works,
Ottawa, January 31, 1908.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.