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The Canadian Engineer

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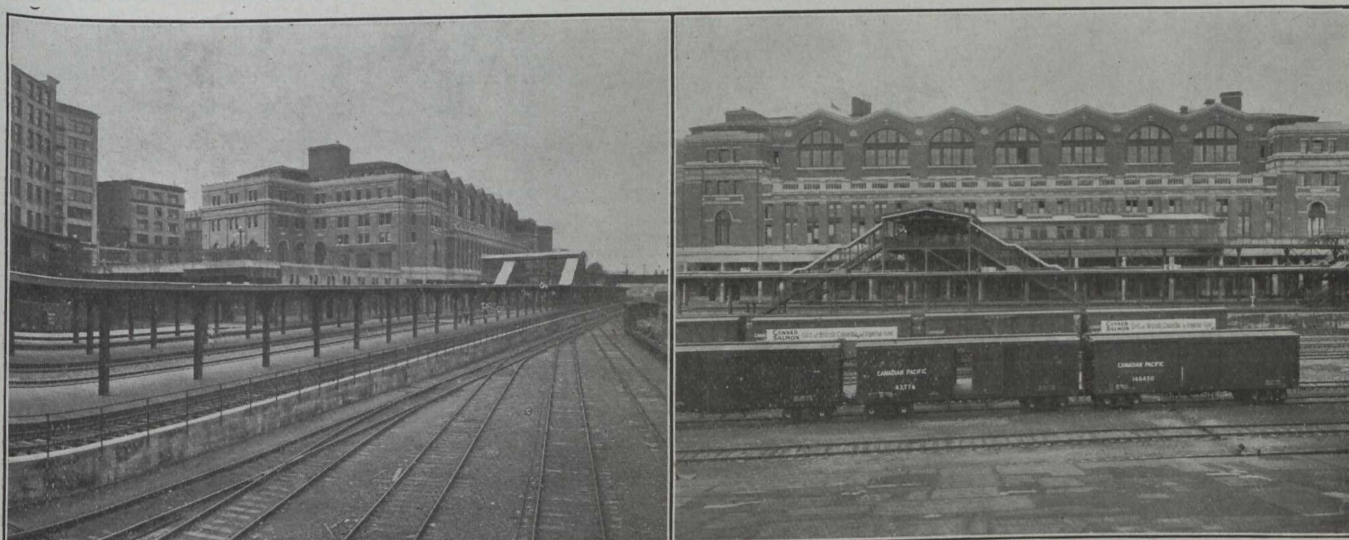
TERMINAL IMPROVEMENTS AT VANCOUVER

NOTES ON THE NEW CANADIAN PACIFIC RAILWAY STATION, STEAMSHIP PIER AND TRACK LAY-OUT AT VANCOUVER TERMINAL FOR TRANSCONTINENTAL AND TRANS-PACIFIC TRAFFIC.

IN *The Canadian Engineer* for April 23rd, 1914, a brief description was given of the Vancouver terminal improvements then under way for the Canadian Pacific Railway Co. These consisted chiefly of a new passenger station and a pier for coast steamships. The undertaking was practically completed in midsummer of last year, whereupon the new extensions were immediately put into service. The accompanying reproductions illustrate a number of unique engineering features possessed by the new arrangement.

Vancouver is the terminal point of the company's trans-Pacific and coastal steamship traffic, as well as for its transcontinental business. The resulting interchange of traffic between steamship and railway lines had increased to such an extent during recent years as to necessitate vastly increased facilities for handling it.

The old passenger station at the foot of Granville Street was removed and a new brick and stone structure, shown herewith, erected in its stead. This is a 4-story building, of the 2-level station type, with the passenger floor at the level of Granville Street, which is 30 feet above track level. The baggage, express, etc., facilities are on the track-level floor and electrically operated lifts provide communication between the two. These are the more necessary owing to the fact that Granville Street is extended over the passenger and freight tracks to the new pier, baggage consigned to which is raised from the track platform in the above manner. The lifts as well as the electric lighting and other services, are provided with alternating current purchased from the public service company, while the building is heated by its own steam plant with a capacity of 450 h.p. The boilers are of the horizontal return tubular type and are designed for the consumption of oil fuel. The same plant supplies the steam heating system for the steamship passenger station on the pier.



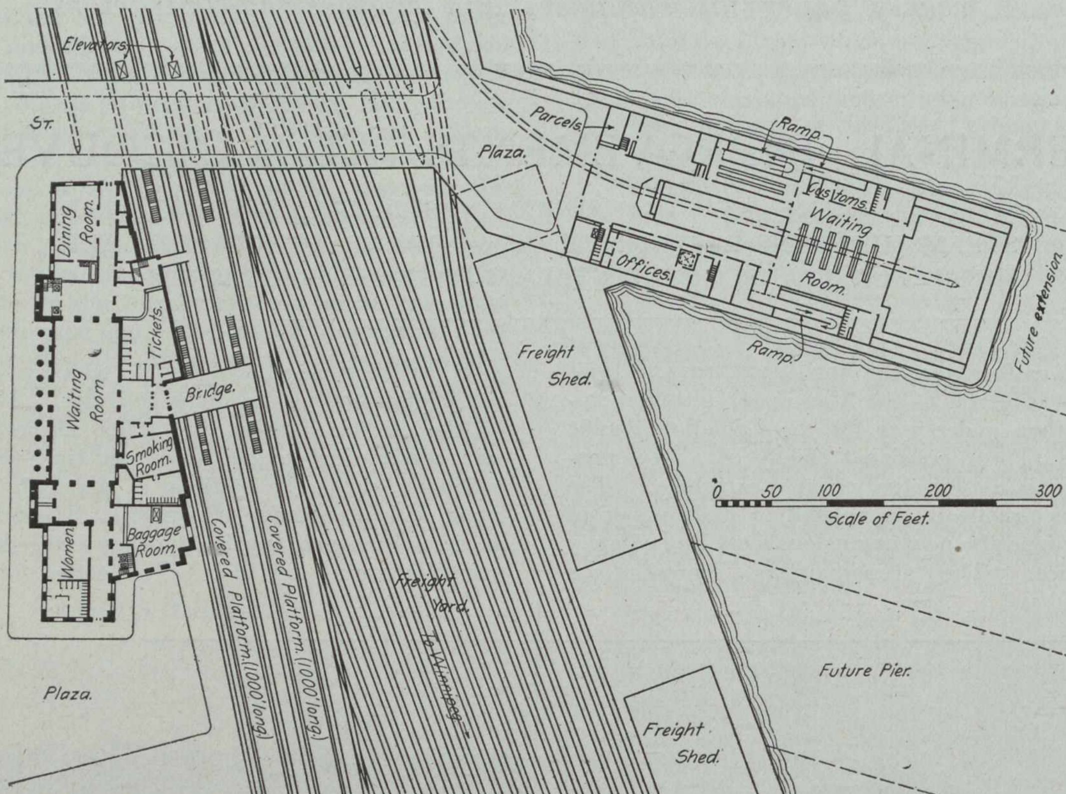
Views of C.P.R. Station at Vancouver, Showing Covered Bridge and Platforms, and Separation of Freight and Passenger Yards.

As the accompanying drawing shows, the layout of the passenger track system provides four through tracks. These are elevated about 5 feet above the old grade and thereby reduce the vertical distance between the track and street levels. Provision is made for additional passenger tracks to the north over the site now occupied by freight track, when increased traffic requires such an extension. The four passenger tracks are in pairs, two for inbound and two for outbound trains, separate platforms being provided. There is also a platform used exclusively for express, baggage, etc.

The viaduct over the tracks is 80 feet in width and joins Granville Street with the upper level of the new steamship pier. There is another viaduct over the tracks at Burrard Street, built to afford access to the steamship pier built in 1908 and used for trans-Pacific traffic. This pier extends out to the harbor line to provide accommodation for the larger liners.

The new pier is 490 feet long and 200 feet wide. The sub-structure is built of creosoted timber to withstand the attacks of the toredo, which is very active in the Burrard Inlet. At high tide the depth of water prior to construction was over 60 feet at the outer end of the pier. This depth was materially reduced by fill, and about 3,000 piles, ranging in length from 80 to 110 feet, were then driven. Large logs are chained together and used as fenders to provide protection and distribute undue shocks occasioned by the striking of a vessel in docking. The superstructure of the pier is also of timber construction. As in the case of the railway station, the 2-story type is used, and baggage and express facilities are provided with electrically operated lifts on each side of the pier.

The firm of Westinghouse, Church, Kerr & Company, Montreal and New York, designed and constructed the improvement under the direction of the engineering department of the Canadian Pacific Railway western lines, of which Mr. J. G. G. Sullivan is chief engineer. The architects for the passenger station were Messrs. Barrott, Blackader and Webster, of Montreal.



Layout of New C.P.R. Station, Yards and Pier at Vancouver.

Detail of Passenger Train Shed Arrangement.

RAILWAY BUILDING IN AUSTRALIA.

A transcontinental railway extending from Kalgoorlie in Western Australia to Port Augusta in South Australia, about 1,063 miles in length, is under construction, and practically one-third has been completed. When in operation, it will connect the present railways of the west with those of South Australia, Victoria, Queensland and New South Wales, to form a route 2,500 miles in length. It was started at Port Augusta in 1912, and will cost in the neighborhood of $24,000,000. It is of 4-ft. 8½-in. gauge. This gauge was also used on the railways of New South Wales, but those of Victoria, Queensland, Western Australia and part of those of South Australia are of different gauges, *viz.*, 5 ft. 3 ins. and 3 ft. 6 ins. respectively. The commonwealth of Australia has under consideration the adoption of a standard gauge and may require its railways to do so in the near future. The cost of conversion of the existing roads from the present to standard gauge is estimated at $200,000,000.

Within the next few years it is probable that a line will be built northward for a distance of about 1,000 miles to connect with an existing line to Port Darwin on the coast of the Northern Territory.

PEAT AND COAL AS GAS-PRODUCING FUELS.

A DEPARTMENT of Mines report, prepared by B. F. Haanel, B.Sc., on the value of peat, lignite and coal gas as fuels for the production of gas and power in the by-product recovery producer shows that under favorable conditions peat can be utilized for the production of a power and domestic fuel gas in such producers. The maximum moisture content in order to effect the most efficient utilization of the peat must be not more than 40 per cent.—preferably 30 per cent.—and the cost per ton containing 30 per cent. moisture should not exceed $1.50. When the nitrogen content falls below 1½ per cent. on the absolutely dry fuel, its utilization in a by-product recovery producer should not be attempted, since there are certain factors in the winning and utilization of peat which are more or less uncertain. Ample margin must, therefore, be provided to cover losses which are liable to occur, either through an insufficiency of supply of fuel or an excessive moisture content due to an extremely wet season. Certain peat bogs are cited where the production of a power and fuel gas might prove profitable. In these cases the nitrogen content is above the average and the process under the conditions cited could be carried on for the recovery of ammonium sulphate alone. The problem of manufacturing and storing the requisite quantities of fuel for a year's operation are fully discussed, and it is shown how, in the case of a European plant, these difficulties have been overcome. The steam power plant on the Wiesmoor in Germany, designed for the exclusive use of peat fuel, is described in detail. This plant has proven a greater success than was anticipated by its designers and promoters, and with peat costing one and a quarter dollars per ton, at the plant, power can be produced at a lower figure than from coal costing about three dollars and a half per ton. In the case of the Mond by-product recovery power gas plant at Osnabrück the operation was not an entire success, owing in part to the selection of an unsuitable bog for the manufacture of peat. Time was not available for thoroughly draining before beginning manufacturing operations, and the average nitrogen content was too low—in the vicinity of 1 per cent. Contracts were made to deliver power at a definite date before the erection of the plant was begun, it was consequently impossible to devote the required time to the preparation of the bog. The result was high cost of fuel with an excessive moisture content and reported failure to live up to the contract. On the other hand, marked success was achieved in the case of the Mond gas plant situated near Orentano, Italy.

It is shown in the report that under favorable conditions power can be produced on certain of the Canadian peat bogs at a cost equal to or below that possible with a hydro-electric plant.

The feasibility of utilizing coal and lignite for the production of a power or fuel gas in the by-product recovery producer is discussed in some detail. The Mond gas plant in South Staffordshire, England, which manufactures and distributes a power and fuel gas over a large industrial district, is fully described. At this plant it has been demonstrated that a gas suitable for industrial purpose can be sold at a cost per 1,000 cubic feet far below that of a quantity of town gas of equal heating value. The field for serving towns and cities with such gas for domestic purposes is a very large one, but its distribution among householders is at present prohibited by an existing parliamentary act. In those portions of Canada where a domestic fuel gas is in demand and where a suitable domestic fuel cannot be obtained at reasonable prices, the distribution of producer gas, manufactured according to the process described, should prove of great economic advantage to the entire country as well as the individual community directly benefited. In this connection it is pointed out how the lignites of the western provinces might be efficiently utilized, especially those lignite deposits situated with respect to Edmonton and other smaller communities.

For the representative coals of Canada, the average nitrogen contents of general samples are cited to show which coals are particularly suited for the by-product recovery process.

When the establishment of a by-product recovery producer gas plant is considered either for the production of a power or fuel gas, or for the recovery of the ammonium sulphate alone, the exact estimates of costs of plant delivered on site and the cost of erection and operation must be obtained in every case from the manufacturers; and since sulphuric acid is an important factor in the recovery process, the cheapest means for obtaining it must be fully considered. On the Atlantic coast or a short distance inboard the cost of sulphuric acid manufactured at the plant has been placed at $8 per ton. This cost, it must be understood, is merely an estimate, although it will not vary much in either direction.

In conclusion, the writer states that by-product recovery producer gas plants can be profitably operated for the production of a power or fuel gas—and in certain cases for the manufacture of ammonium sulphate alone—at certain of the Canadian peat bogs, and in the western provinces at certain of the lignite deposits. When a disposition can be made of the gas generated, this process can be profitably applied to the Canadian bituminous coals; but since coking plants are already established at the principal coal mines where coking coal is found and the gas generated by this means is very probably sufficient to answer all requirements for some time to come, it would be better from a financial standpoint to establish by-product recovery plants in connection with the coke ovens. This, in fact, is being done both in Nova Scotia and Sault Ste. Marie, Ont.

IRON ORE SHIPMENTS

The iron ore shipments from mines in Canada during 1914 are reported as 244,854 short tons valued at $542,041. These shipments included 199,292 tons of hematite and roasted siderite and 45,562 tons of magnetite and concentrates. The total shipments of ore in 1913 were 307,634 tons, including 92,386 tons of hematite and roasted siderite, 209,886 tons of magnetite and concentrates and 5,362 tons of titaniferous ore.

Exports of iron ore from Canada during 1914 were recorded by the customs department as 135,451 tons valued at $360,974.

According to mine operators' reports, however, 184,444 tons were shipped to Canadian smelters, and 60,410 tons were exported to the United States. The imports into the United States from Canada are also reported by the Washington trade statistics as 58,816 tons, valued at $153,415.

Imports of iron ore in 1914 were, according to customs records, 1,147,108 tons, valued at $2,387,358.

Shipments of iron ore from the Wabana mines, Newfoundland, in 1914, by the two Canadian companies operating there were 639,430 short tons, of which 422,920 tons were shipped to Sydney, Cape Breton, and 216,510 tons to the United States and Europe. In 1913 the shipments were 1,605,920 short tons, of which 1,048,432 tons were shipped to Sydney, and 557,488 tons to the United States and Europe.

The total production of pig iron in Canadian blast furnaces in 1914 was 783,164 tons of 2,000 pounds, valued at approximately $10,002,856, as compared with 1,128,967 tons, valued at $16,540,012 in 1913.

WEARING SURFACES.*

By Geo. W. Tillson,
Consulting Engineer, Borough of Brooklyn, New York City.

THE question of improved roads first became important when the transportation of commodities and passengers by wheeled vehicles came into vogue. This was in comparatively recent times, as the world's history goes, for as late as one hundred years after the reign of Queen Elizabeth regular pack trains for the transportation of goods were operated in England, and even at that time wheeled vehicles for passengers were very little used. Writers tell us that in the seventeenth century the nobles, in travelling from their homes to London in private carriages, were often robbed by highwaymen, so frequently indeed that a highwayman, when convicted, was punished with death. It is also stated that the bad condition of the roads aided the highwaymen very materially in making their hold-ups.

Ever since that time there has been much discussion regarding road construction, but it was not until 1764, when M. Tresaguet, in France, began to build broken stone roads of somewhat the same character as are now well known in America by the name of macadam, that much improvement was noted; and it was about sixty years after this that systematic road building was begun in England, under the direction of Telford and Macadam, from which latter name has come the term in general use for macadam broken stone roads.

It would seem, too, that road construction in those days received more attention than pavement construction in cities, as it is stated that an English engineer in 1826 publicly remarked that "however true it may be that an observant traveller cannot fail of being struck with admiration at the excellence of the turnpikes and other roads throughout this country, he must at the same time be very much surprised at the badness of the carriage pavements, even of the principal streets of the metropolis."

The importance of road building in this country has been known for many years, but it did not receive much attention until about 1895, when the advent of the bicycle and its great popularity for a time made necessary the construction of improved roads if the bicycle were to be used to its best advantage.

When the use of the bicycle began to wane, the development of the automobile caused the subject to be taken up anew, and with increased vigor. The people using the automobile were much more influential and wealthy than those using the bicycle, and the result has been that a wonderful good roads movement has been extended all over the country. It has grown to such an extent that in the state of New York alone during the past six or eight years issues of bonds to the amount of $100,000,000 have been authorized, and the greater part of this amount has been spent to date.

J. C. Pennybacker, chief of road economics, U.S. Office of Public Roads, recently stated that 16,000 miles of surfaced roads were constructed in the United States during 1913, and 18,000 miles during 1914, or a total of 34,000 miles in the brief period of two years. He estimated that the total outlay for 1914 for good roads was $225,000,000, while in 1904 the total expenditure in all states slightly exceeded $79,000,000. This $225,000,000 represents an expenditure of $2.25 per capita for the entire United States, being about $20,000,000 for New York State alone for one year.

*Paper presented at the Second Canadian and International Good Roads Convention, Toronto, March 23, 1915.

These figures are enormous, and one has to wonder if the work can be kept up, and also if, with this enormous amount of road building, sufficient provision, both in organization and in money, will be provided for proper maintenance.

Earth Roads.—The cheapest form of road, of course, is the ordinary graded road, without any attempt to surface with any foreign material. Although this cannot be considered an improved road, still with proper attention to it, results can be obtained that seem remarkable when compared with an earth road that receives no care at all. By the use of road drags and a little attention during bad weather, earth roads can be kept in fairly good condition for ordinary traffic.

Sand-Clay Roads.—These roads are made either by the application of clay to the ordinary sand surface or the application of sand to a clay surface, according to the original condition of the road to be improved. In proportioning sand and clay in this method of construction it must be understood that the clay acts practically as does cement in cement mortar, and consequently an amount of clay sufficient to fill the voids only should be used. This is more important than in the case of mortar, because if too large an amount of clay is used it will allow the particles of sand to move too freely, while if the amount is too small the particles of sand will not be bound together.

It must be understood, too, in this general treatment, that the quantity of sand to be used depends upon the character of both the sand and clay, a clean, sharp sand requiring more clay than one which has a certain amount of loam, and, too, the quality of the clay is an important factor, whether it is pure or whether it has an admixture of sand.

When a clay road is to be treated, the surface should be brought approximately to the form that is desired and loosened up, when the sand should be spread over the surface in sufficient quantities and thoroughly mixed. The surface should then be smoothed off and compacted with a light roller or road drag.

When the original soil is sand, the road is levelled off and the clay spread upon it to the required width and thoroughly mixed with the sand, when the roadbed is shaped up, and, if necessary, more sand applied. The surface is then smoothed and compacted as for the clay subsoil.

Gravel Roads.—Very satisfactory and fairly durable roads can be made with gravel, the exact method of construction depending upon the quality of the gravel itself. But in the main, it is spread over the road to such a depth as to give proper thickness when completed and then rolled until it becomes hard and firm. Whether it will require any filling or binding in order to make the surface hard and compact depends upon the quality of the gravel. It can be said, however, that the softer the gravel, the more easily it will be compacted, but, for the same reason, it is less durable under traffic. These roads are often used in parks, and even on state roads where the traffic is light and where a permanent material is expensive. It is difficult to give an estimate of their cost, as this depends entirely upon the distances the gravel must be brought, and its first cost. An estimate of 50 or 60 cents per square yard would probably be not far from correct for a gravel road 6 inches deep.

Water-bound Macadam.—This is the well-known broken stone road surface, which is made up of different layers of broken stone, the surface layer being about 3 inches thick and formed of stone that will pass through a 2-inch ring, the character of the stone depending a great deal, as in gravel, upon its binding easily. As a rule, limestones are of such a character that sometimes no rolling is required to obtain a smooth and hard surface, while trap rock, on the contrary, must have the interstices filled with fine material in order to get the stone sufficiently bound together. Water-bound macadam was laid in New York State in 1914 at a cost of 30 to 40 cents per square yard for a wearing surface 3 inches thick.

Bituminous Roads.—When the automobile, with its pneumatic tires, came into use, it was found that it presented an entirely different problem from the old horse-drawn vehicle with its steel tires. The former caused the macadam to disintegrate and ravel, while the latter had a tendency to compact it in a manner somewhat similar to steam rollers. This fact was recognized first in Europe, because the automobile was used there to a considerable extent previous to its use in America, and different methods of treatment were instituted to overcome the bad effect. The first method was to spray the surface with tar, and after many experiments, schemes were worked out that were fairly satisfactory. This method has been employed to quite an extent in America, but, with surface treatments, asphaltic oils are generally used, as they are cheaper and, some engineers think, better. The volatile parts of these oils evaporate upon exposure, leaving an asphaltic carpet over the surface which is much like an asphalt in its general appearance.

In Brooklyn, New York, nearly all of the park roads are of gravel, and a great portion of them have been treated as follows: Heavy asphaltic oil is spread on the surface at the rate of .7 gal. per square yard. The ruts and holes in the road are all repaired previous to the application of the oil. The oil is applied by gravity distributors, it being taken from tank cars, which are heated to a temperature of about 200° F. before being unloaded. The oil is maintained in the distributor at this temperature and applied to the roadway surface. After the oil has been applied, a coating of coarse sand is spread at such a rate that 1 cu. yd. of sand covers 53 sq. yds. of surface. The roadway is closed to traffic for 24 hours after the spreading of the sand.

This process has been in use for two or three years and has given good results. It must be remembered, of course, that on the park roads no heavy vehicles are allowed, and it is undoubtedly true that with heavy steel-tired vehicles this treatment would not be satisfactory. Some trouble, even with the automobile traffic, occurs, in the shape of creeping and bunching of the surface, but the bunches are cut out and easily repaired.

The cost of the asphaltic oil delivered in cars is 6 cts. per gal., the cost of sand alongside the road, $1.35 per cu. yd., and the cost of the complete treatment, including labor and materials, but not including overhead charges, has averaged 8 cts. per sq. yd., for three years.

Another method of building bituminous roads is what is known as the penetration method, when, after the stone is spread upon the road, the upper surface is sprinkled with the bituminous material, whether tar or asphalt, and then rolled and completed with certain surface treatments. In New York State during the past year this treatment has cost from 50 to 60 cts. per sq. yd. for a wearing surface 3 inches thick.

In Massachusetts, by the penetration method, using 2¼ gals. per sq. yd. of Bermudez asphalt, 2 ins. thick, the cost has been 66 to 80 cts. per sq. yd.

In Massachusetts, too, in 1914, there was used a surface composed of oil, asphalt, and gravel, using 18 gals. of asphalt per cu. yd. of gravel, and spread so as to have a thickness of 2 ins. after rolling, at a cost of 30 to 35 cts. per sq. yd., while with oil, asphalt and sand, mixed and spread to a depth of 4 ins., after rolling, the cost was 54 to 60 cts. per sq. yd. Using the penetration method with tar instead of asphalt, with 2¼ gals. per sq. yd. of surface, 2 ins. thick after rolling, the cost was 45 to 65 cts. per sq. yd. It must be understood, of course, that these costs will vary, as in some cases gravel was used which cost 80 cts. per cu. yd., while in others trap rock was used, which cost $2.50 per ton, which is considerably more than the cost of gravel per cubic yard.

There are many other methods of using bituminous wearing surfaces. One of these is known as the Topeka mixture, as it was first used in Topeka, Kansas, and has been decided by the courts not to be an infringement on any patents. It is laid much as is sheet asphalt pavement, but with a larger aggregate. In 1912 over one hundred miles of roads were surfaced in the Borough of Queens, New York, with practically this kind of pavement. The specifications for the wearing surface for this work read as follows:

The finished pavement shall contain between 7 per cent. and 11 per cent. of bitumen soluble in carbon disulphide, depending upon its mesh composition, but in all cases sufficient asphalt cement shall be used to thoroughly coat all of the particles of the mineral aggregate.

Mineral aggregate shall be proportioned as follows:

Mineral aggregate passing 200-mesh screen, from 5 to 11 per cent.

Mineral aggregate passing 40-mesh screen, from 18 to 30 per cent.

Mineral aggregate passing 10-mesh screen, from 25 to 55 per cent.

Mineral aggregate passing 4-mesh screen, from 8 to 22 per cent.

Mineral aggregate passing 2-mesh screen, less than 10 per cent.

Screens to be used in the order named.

Roads of this character were laid in New York State in 1914 by the State Highway Department, at a cost of 85 to 95 cts. per sq. yd.

During 1914 some twenty-five or thirty miles of bituminous roads were built at the Ashokan Reservoir of the new water supply system for New York City. The wearing course was formed of stone passing over a ½-in. screen and through a 1½-in. screen. By an adjustment of the jackets on the screens a sufficiently graduated stone was obtained to produce proper results. The broken stone was heated and mixed, in a machine similar to one used for sheet asphalt, with an asphaltic cement so that the resulting mixture should contain between 5 and 7½ per cent. by weight of bitumen. The mixture was spread upon the road and thoroughly rolled, when a seal coat of hot asphaltic cement was spread over the same, by a proper appliance, and then smoothed off with squeegees. The asphaltic cement was applied on the average at the rate of a little less than 1 gal. per sq. yd. Upon this squeegee coat stone chips were placed, which were thoroughly rolled into the surface, any lack of chips being supplied by a second distribution. The wearing surface 2 ins. thick cost $1.01 per sq. yd., native stone being used.

It would be difficult, and perhaps unnecessary, to go into a detailed description of the many kinds of bituminous roads. Those herein described give a fair idea of what are in ordinary use.

Concrete Roads.—During the last five or six years quite a large amount of roads have been constructed having a wearing surface of cement concrete. It was thought at first that this would not give satisfactory results, as it was feared that the concrete would be so affected by the changes in temperature as to crack in cold weather or bulge in warm weather; also that it would be difficult to keep in repair.

Possibly the best and best known examples of concrete roads are located in Wayne County, Michigan, in the vicinity of Detroit. The writer had an opportunity of driving over these roads last summer, and he was very much surprised at their good condition. One in particular that was only 9 ft. wide and half a mile long had been in use five years, and had cost during the entire five years but $26 for repairs. It is true that on this section the traffic was not great, but on another road, where the pavement had also been laid five years under quite heavy traffic, the concrete was still in good condition. The cost of these pavements varied according to conditions, as practically all of the material had to be brought from out of the state, and the cost of even the water was great, as many of the roads extended into the country long distances from any watermains. The concrete for these roads was generally laid to a depth of about 6 ins., and the cost on the average was about $1.35 per sq. yd. On Michigan Avenue, however, the concrete was laid an average depth of 7 ins., mixed in the proportion of 1 part cement, 1½ parts of sand, and 3 parts of gravel. In this particular case the cost of the concrete was $1.47 per sq. yd.

In Massachusetts the cement concrete roads laid in 1914 were of an average depth of 7¼ ins., and cost from $1.40 to $1.55 per sq. yd., while in New York State, with a mixture of 1 part of cement, 1½ parts of sand and 3 parts of broken stone, averaging 6 ins. in thickness, they cost $1 per sq. yd.

Concrete roads are sometimes covered with a thin coat of bitumen, the idea being to prevent the wear of the concrete and get a more resilient and a less noisy road. There has been some difficulty in making the bitumen adhere to the concrete. The practice of using the bitumen has not yet become general.

Brick Roads.—In the Central West, where paving brick is cheap and good, a great many brick roads have been laid. This is especially true of Ohio, and particularly around Cleveland. The writer in 1914 made an examination of many of these roads; while some of them showed defects, probably due to lack of drainage, as a whole they were in extremely good condition and must be a great boom to the farmers and other people living in the vicinity of Cleveland. It happened that the time the inspection was made was soon after a rain, when the clay of that country was in exceedingly wet and sticky condition, so that, when sometimes it became necessary to take an unimproved road to get from one brick road to another, the value and convenience of the brick roads were especially appreciated. These roads are expensive, as all of the material has to be transported for quite a distance, and much of it by horse-drawn or motor vehicles, as the roads are sometimes quite a distance from the railroads. The cost in Ohio for brick on concrete averages about $1.80 per sq. yd.

In New York State, in 1914, brick cost $1.55 per square yard.

It sometimes happens that, on account of the heavy traffic in the vicinity of cities, roads are constructed that are practically street pavements. In New York State, in the eastern district, some asphalt block pavement was laid in 1914 at a cost of $1.40 per sq. yd.

It does not seem necessary or pertinent at this time to go into the merits or descriptions of the different kinds of road pavements, as that would mean an extended discussion.

Type to be Selected.—Which one of the foregoing methods of improved road construction is to be used depends upon several conditions. The first of these is the ability of the county or state to pay for the work, and then there must be considered the amount of traffic which will use the road, and its character. There is absolutely no use to plan a road, no matter how well adapted it is to conditions, if there are no funds to pay for it. With a limited amount of money the problem is to obtain results with that money, and in order to do this a complete investigation must be made of both the amount and character of traffic, because if the road is to be used by heavy vehicles, a different form of construction is required from what would be called for if the same tonnage were to be drawn over the road in smaller loads. It is possible that heavy loads may be so infrequent that they can be left out of consideration entirely, but if considered, upon their frequency will depend the treatment that should be given to the road.

If, however, funds are available to build the best road, from an economic standpoint, the problem is somewhat different, as the matter of first cost is not so important as ultimate cost. In considering the ultimate cost and assuming that the roads are built out of the proceeds of a bond issue, as they are in New York State, the expense is not the first cost, but the interest on the first cost, the cost of repairs, and the amount of money to be paid in each year for a sinking fund that will pay off the bonds when they become due. And in this connection is should be said that in any bond issue made for a road improvement, or for any other improvement, the term of years for which the bonds are issued should be equal to the life of the improvement as nearly as it can be estimated.

It is also necessary that the deciding official should understand fully the properties of each one of the different roads so that he will know the ability of each one to sustain the traffic that he finds will be applied to it when constructed. He must understand, too, that a road when improved is likely to attract traffic, and that as a general rule the traffic will be much greater after a road is improved than before.

Having determined the type of road to be used, the exact material must be determined. This is an engineering proposition, and the availability of the material must govern the choice to a great extent. Trap rock, for instance, might work out as the most economical from a general standpoint, but might be prohibitive on account of the cost of transportation. It often happens that a less valuable material will prove more economical, on account of its propinquity to the road, than a better material which must be transported some distance.

In this consideration it must be understood that there is a natural as well as a traffic life to road material, that is, gravel, stone or brick will have a life according to the traffic as they are not acted upon by atmospheric conditions, while, on the other hand, asphalt, coal tar, or other bitumens are acted upon directly by the atmosphere, and, even without traffic have a certain life.

A careful study must be made as to all of these conditions, the first cost and the cost of repairs of the different kinds of wearing surfaces, together with their characteristics, as well as the availability of the different materials. With all these items before him, an official can determine pretty accurately which is the best surface to be used.

A PORTABLE DRAGLINE EXCAVATOR.

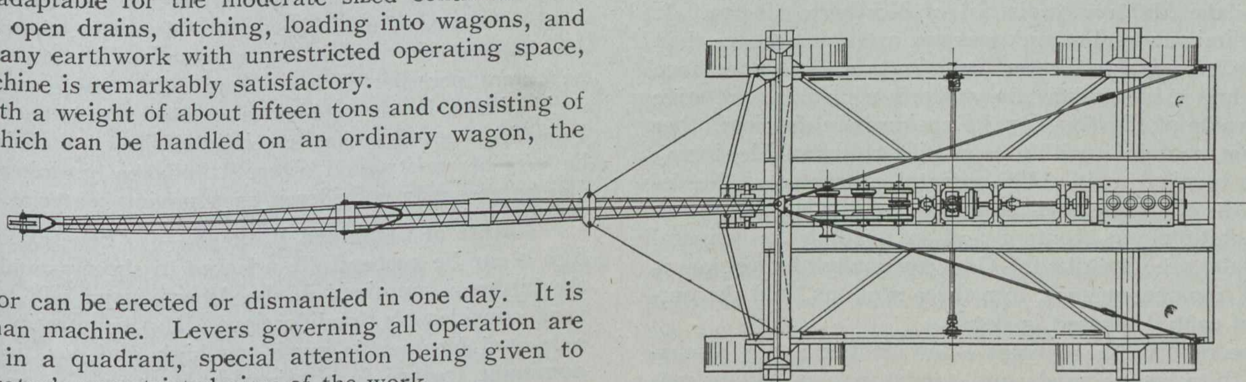
A New type of dragline excavator (patent pending) has just been placed upon the market. Its extreme simplicity and general efficiency make it specially adaptable for the moderate sized contract. For tile and open drains, ditching, loading into wagons, and in fact any earthwork with unrestricted operating space, the machine is remarkably satisfactory.

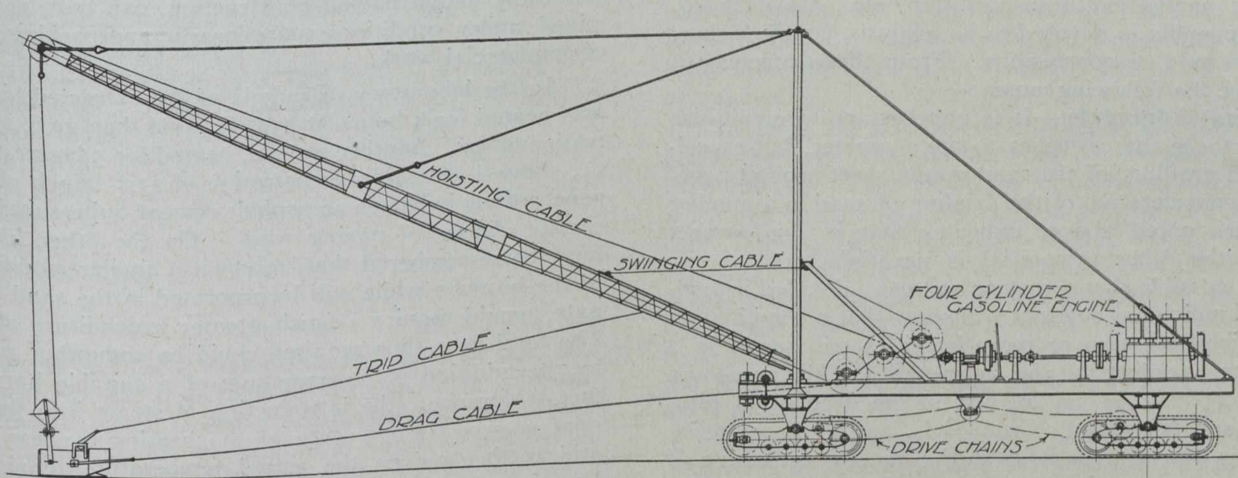
With a weight of about fifteen tons and consisting of units which can be handled on an ordinary wagon, the excavator can be erected or dismantled in one day. It is a one-man machine. Levers governing all operation are banked in a quadrant, special attention being given to the operator's unrestricted view of the work.

The excavator measures 23 ft. by 30 ft. The boom extends 50 ft. with a 10-ft. removable section, and handles a ¾-yard scraper. The drive shaft has flexible connections both at engine and hoist with a universal joint and ball and socket bearings by which it adjusts itself to undue strain or distortion in the frame.

Ample power is provided by a four-cylinder gasoline engine.

A distinctive feature for a light type machine is the caterpillar tread. All four treads are direct driven. A change in direction is effected by releasing the clutch on either side. The ground pressure due to the large area of the treads is less than 4½ pounds per square inch. The machine can therefore travel, without planking, over ground that will barely sustain a man. The shoes are of pressed steel and designed to overlap in such a manner as to obviate the dangers due to the lodging of stones between the shoes.





General Design of New ¾-yard Portable Drag-line Excavator.

The general idea of the excavator has been evolved by Mr. C. T. Lount, of Regina, Sask., who has had considerable experience in construction work, and who has had the details worked out by one of the foremost designers of machinery in Canada.

ROAD IMPROVEMENT IN NORTHERN ONTARIO.

According to the report of Mr. J. F. Whitson on the construction of roads in northern and northwestern Ontario during 1914, up to October 31, about $802,575 was expended. Seven hundred and eight miles of road was under construction, of which 255 miles is new road cut through forest. Two hundred and ninety-six miles of road was graded, 108 miles surfaced with gravel or crushed rock. Two hundred and fourteen miles of road was partly graded or improved by hill-cutting, ditching, etc. Forty bridges were constructed, the longest being across the Black River at Matheron, with a length of 650 feet—and another at Kakabeka Falls, with a length of 300 feet.

During the three years in which operations have been carried on under the Northern Development Branch of the Provincial Government the following mileages have been improved:

	1912. Miles.	1913. Miles.	1914. Miles.	Total. Miles.
New and old roads graded..	39	500	405	944
New and old roads partly graded	..	40	214	254
New bush roads cut out ready for grading, and old roads improved	194	224	89	507
Total mileage under construction	233	764	708	1,705

REPORT ON BITUMINOUS SANDS OF NORTHERN ALBERTA.

We have just received a copy of a report prepared by S. C. Ells, for the Mines Branch, Department of Mines, Canada, on the bituminous deposits in the McMurray district of Northern Alberta. It is a preliminary report and does not attempt to more than serve as a basis for further investigation, the importance of which is evidenced by the writer's conclusions relative to the value of the deposits. Exposures in districts other than that contained within a 60-mile radius of McMurray are not touched upon. The general character of the deposits, the thickness and nature of overburden, the variation in bituminous content and in grading of mineral aggregate are described. Geographically the region is divided, for convenience, into three sections, and the outcrops of each discussed in detail.

The report then devotes a few chapters to a discussion of bituminous sands and sandstones as paving material and to the experiences of United States firms in the extraction of bitumen therefrom. Useful notes for those undertaking the prospecting of these sands, including data respecting navigation, transportation, etc., are included.

An appendix is devoted to an analysis, by the writer, of samples and to conclusions. From these conclusions we extract the following notes:—

Mineral Aggregate.—It is unnecessary to emphasize the importance that attaches to the character, but especially to the grading, of the sand in any sheet asphalt pavement. A consideration of the grading of sand in a number of samples noted above, indicates that in this respect much of the Alberta material is unsatisfactory. It is, however, possible that a further and more detailed investigation of individual deposits will show that a combination of material from two or more localities will result in a satisfactory grading of the aggregate. This procedure has been adopted in making use of the deposits of bituminous sand near Santa Cruz, Cal., and at Carpinteria, Cal. This lack of uniformity in the mineral aggregate of the bituminous sand constitutes probably its greatest drawback as a suitable paving material.

Percentage of Contained Bitumen.—In general, the per cent. of asphalt cement required in various classes of bituminous road construction ranges from 6 to 12. The average per cent. of bitumen contained in samples of Alberta bituminous sand examined is about 15. Of this amount, 15 to 17 per cent. will be lost in necessary preliminary heating. On such a basis the bituminous content actually available in the anhydrous sand will thus be reduced to 12 to 13 per cent.

It is not uncommon for paving contractors to attempt to work up old paving material, as taken from the streets, and, by the addition of further bitumen, use it a second time. Generally speaking, it is believed that such efforts have not proved successful. It is, however, quite possible to soften such partially worn asphalt in properly constructed steam-heated tanks. The material is then transferred to a regular asphalt mixing machine where such bitumen as may be required is added. In the case of 12-13 per cent. bituminous sand, it would evidently be a much more difficult matter to materially reduce the percentage of bitumen by the addition of fresh sand. If, however, the mixer used be furnished with sufficient power and the sand itself be preheated, the desired reduction could doubtless be effected.

In considering the possible use of such machines, the number of units that would be required at once suggests itself. It appears that what is usually known as a one-thousand-pound batch—one mixer full—of the regulation artificial mixture for sheet asphalt, is required in laying 5 square yards of sheet asphalt topping 2 inches thick when compressed upon the street. In order, therefore, to enable a contractor to lay 1,250-1,500 square yards of pavement per day, it is evident that a large number of such mixers, involving high labor cost, would be required. Indeed, it appears that specially designed machines will have to be constructed before Athabaska bituminous sand can be seriously considered as a paving material.

Nature of Contained Bitumen.—(1) Penetration. Before it can be successfully adapted to sheet asphalt work, the bitumen contained in the Alberta sand will require a very considerable modification. The penetration of the extracted bitumen is much too high and constitutes the dominant feature in considering its value as an asphalt cement. In the laboratory this feature can be sufficiently modified by proper heating and fluxing. Whether this will be found practicable when undertaken under conditions governing actual paving construction, can best be determined under conditions more nearly approaching those of commercial work.

In the laboratory, a sample of the extracted bitumen was heated for 4 hours at 250° C., and then gave a penetration of 52. Another sample, heated for 5 hours at 205° C., showed a modified penetration of 112. Each of these penetrations indicates an asphalt cement quite suitable for certain classes of paving work. On the other hand, it must be remembered that, to effect a similar modification of the bitumen while still incorporated in the sand aggregate, would require a much greater expenditure of heat. The total heat thus required could be somewhat reduced by the addition of a percentage of a suitable hardening flux. Moreover, the introduction of steam into the bituminous sand as a feature of the heating process would still further reduce the actual temperature required by lowering the distillation temperatures of the lighter fractions. To determine such considerations is of importance, and further laboratory work will be required before complete data can be made available.

(2) Susceptibility Factor.[1] After being modified by heat treatment until a penetration of 52 has been attained, the bitumen derived from the Alberta bituminous sand is less susceptible to changes in temperature than either Trinidad or Bermudez asphalt cements, the susceptibility factor of the first being 36.5, as against 42.5 for the Trinidad cement, and 53.0 for the Bermudez cement.

(3) Ductility. The ductility of the asphalt cement for the Alberta bituminous sand at a penetration of 52, is correspondingly greater at 115°, 77° and 32° F., than that of either the Trinidad or Bermudez cements, with the possible exception of the ductility at 32° F., which is slightly greater in the case of the Trinidad cement.

4. Effect of subsequent heating on 58 penetration bitumen.

As giving some indication of the liability of the cements to change on heating, and to harden on use, the second heating of the penetration residual bitumen is of interest. Refined Trinidad Lake asphalt, when heated for 7 hours at 165° C., shows a loss of 1.1 per cent. When heated 7 hours at 205° C. the loss is 4.0 per cent.

It is here unnecessary to discuss considerations presented by sulphur, paraffin scale, naphtha solubility, fusing temperature, etc., since the analyses available indicate that none of these will constitute unfavorable features.

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[1]The susceptibility factor is equal to the difference in hardness at 32° and at 115° F., divided by the fusing temperature and multiplied by 100.

In view of the variety and widely differing specifications under which bituminous roads and pavements are now constructed, considerable laboratory experimentation will be necessary before it can be stated to what class of bituminous road construction, if any, the bituminous sands of Alberta are best adapted.

Meanwhile, it is evident that either in its soft condition, or when reduced to the hardness of an asphalt cement, the bitumen from the bituminous sand would make an excellent binder, either in the internal or surface treatment of roads. This and other possible uses, depending on a successful extraction process, need not be discussed at the present time. It furnishes, however, a further indication of the value and importance that would attach to the development of such a process.

In the McMurray district, there is thus a very large body of bituminous sand, the prospecting and development of which will be confined to stream valleys. The following constitutes a summary of the outcrops noted by the writer:

Name of stream.	Distances through which exposures recur.	Number of separate outcrops noted.
Athabaska River	105 miles	55 outcrops
Horse Creek	6 "	32 "
Hangingstone Creek	6 "	11 "
Clearwater River	1 mile	1 outcrop
Christina River	9 miles	31 outcrops
Steepbank River	13 "	35 "
Muskeg River	7 "	4 "
Calumet River	3 "	8 "
Tar River	6 "	7 "
Moose River	13 "	25 "
McKay (Red) River	16 "	38 "
	185 miles	247 outcrops

Only after careful exploration by means of adequate equipment can the true value of any deposit be affirmed. Nevertheless, owing to heavy overburden and lack of uniformity in the quality of bituminous sand, it is probable that quite 80 per cent. of the exposures may be eliminated from further consideration at the present time. Considerations affecting transportation will still further reduce the remaining number. Certain of the outcrops should, however, lend themselves to development on a commercial scale.

The present application of bituminous sand-rock is limited to its use as a paving material. The value of the Alberta product for such a purpose can best be demonstrated by actual experimental paving construction. Meanwhile, it appears that if the development of the Alberta deposits of bituminous sand is possible, success will largely depend on making no false move in the first place, and in having no "lost motions" in operating the quarry itself.

A process that can be successfully adapted to an efficient commercial extraction of the bitumen from the sand aggregate, would prove of very considerable value in any attempts that may be made to utilize these deposits of bituminous sand. After considering the many attempts at such extraction that have been made during the past twenty years, the writer does not know of any instance where the outcome has proved a commercial success. It appears, however, that under favorable conditions the development of a successful extraction process may be possible.

Meanwhile, the discovery of petroleum fields in Western Canada will have a direct bearing on any proposed development of the Alberta deposits of bituminous sand.

RIVER ST. LAWRENCE SHIP CHANNEL.

THE St. Lawrence, owing to its situation, is the natural route from the Atlantic to the northern and northwestern half of the North American continent. The opening of the Lachine Canal, connecting Montreal with the Great Lakes, in 1825, established the route commercially. The light-draught sailing vessels could then reach Montreal without trouble, except during a few weeks in the autumn, when they resorted to lightering. In 1844, it was in an effort to give navigation up to Montreal for vessels of 500 tons, that the first work of dredging was undertaken.

The first proposals for improvements were discussed in 1825, the national character of the work being then recognized. Surveys were made and reported upon in 1831 and again in 1838. In 1841, during an investigation, the committee proposed a tonnage duty sufficient to provide for the cost of the improved channel, which was considered would be less than that of lighterage. It was, however, agreed that in order to draw produce of the west down the St. Lawrence it was expedient to make the transit charges as light as possible. Operations were commenced by the "Board of Works" in 1844 and continued until 1847 when, owing to opposition as to the location of the channel, in Lake St. Peter, the work was abandoned.

In 1850, the harbor commissioners of Montreal proposed that they could do the work more economically and expeditiously. They asked for authority to undertake the work and to charge a tonnage duty to pay for the 8 per cent. interest and 2 per cent. sinking fund. This plan was adopted in August, 1850, and the commissioners were authorized to proceed in such a manner as they should deem best, the Government plant being transferred to them. The harbor commissioners, after examination and the best advice obtainable, adopted the location of the deepest natural channel in Lake St. Peter. This results in the present channel with five tangents, instead of two long straight courses as at first commenced. The original depth through Lake St. Peter was 10 feet 6 inches.

From 1850 the channel was deepened from stage to stage until in 1888, when the Government decided to complete the channel as a national work. From that time the channel has been open free to the commerce of the world. At that date the channel had been deepened to 27½ feet at ordinary low water from Montreal to Cap à la Roche, and from there to Quebec the tide was available.

The work was then conducted by the Department of Public Works of Canada, from 1889 until 1904, when the management and control of the river, together with the ships and dredges, were handed over to the Department of Marine and Fisheries, which department had general charge of navigation.

When the Department of Public Works was given charge of the enterprise in 1889, it set out to provide a channel with a depth of 30 feet at extreme low water, with a minimum width of 450 feet upon the straight portions, and from 550 feet to 750 feet wide at the curves, with an anchorage of 800 feet wide at White Buoy Curve in Lake St. Peter. The Government programme at that date did not contemplate any work below Quebec, this being included with the original project when the supervision of the undertaking was transferred to the Department of Marine and Fisheries in 1904.

The River St. Lawrence Ship Channel extends in reality from Father Point to Montreal, a distance of 340 statute miles, but the contracted part of the river, which may be called the ship channel proper, begins at the Traverse, 60 miles below Quebec, giving a length of 220 miles. The additional section was taken in hand in order to insure a 30-foot channel at extreme low tide at St. Thomas flats and Beaujeu bank. This work was begun in 1906.

The 30-foot Project.

Locality.	Distance, English miles.	Total length requiring dredging. Miles.	Length dredged in 1913. Miles.	Total length of 30-foot channel dredged. Miles.
Division 1—				
Montreal to Sorel	45	22.90	....	22.90
Division 2—				
Sorel to Batiscan	36	12.45	....	12.45
Division 3—				
Lake St. Peter	20	18.00	....	* 0.20 †17.80
Division 4—				
Batiscan to Quebec ..	59	10.00	0.40	8.20
Division 5—				
Quebec to the Traverse	60	6.65	....	4.65
Total	220	70.00	0.40	66.20

*Not widened. †Widened.

Divisions 1 and 2 are completed, while there is still 1.80 miles to be dredged on Division 4 and 2.00 miles on Division 5.

The Beaujeu Bank channel was completed to a depth of 30 feet at extreme low tide, and with a width of 1,000 feet, in 1910, while the St. Thomas channel was completed to a similar depth and width and opened to navigation in 1912. When the South Channel was completed,

The 35-foot Project.

Locality.	Distance, English miles.	Total length requiring dredging. Miles.	Length dredged in 1913. Miles.	Total length of 35-foot channel dredged. Miles.
Division 1—				
Montreal to Sorel	45	28.63	0.63	1.77
Division 2—				
Sorel to Batiscan	36	19.75	0.64	1.24
Division 3—				
Lake St. Peter	20	18.32	2.38	12.56
Division 4—				
Batiscan to Quebec ..	59	15.54	....	.....
Division 5—				
Quebec to Goose Cape (North Channel)..	66	8.14	0.25	0.75
Total	226	90.38	3.90	16.32

There are still 74.06 miles to be dredged in this project, made up as follows: Division 1, 26.86 miles; Division 2, 18.51 miles; Division 3, 5.76 miles; Division 4, 15.54 miles; Division 5, 7.39 miles

The following table shows the total cost of the dredging plant and the quantities dredged to March 31, 1914:

	Cost of dredging.	Expenditure for plant, shops, surveys, etc.	Quantities dredged.
Montreal Harbor Commissioners, 1851 to 1888.			
Dredging Montreal to Cap à la Roche to 27½ feet at O.L.W. and from Cap à la Roche to Quebec to 27½ feet at half tide	$ 3,402,494.35	$ 534,809.65	$19,865,693
Department of Public Works.			
Dredging consisting of widening and cleaning up of channel, deepening Cap à la Roche to Cap Charles to 27½ feet at O.L.W. and dredging at Grondines, Lotbinière and Ste. Croix, 1889 to June 30, 1899	829,583.08	486,971.79	3,558,733
Project of 1899.			
Dredging channel between Montreal and Quebec to 30 feet at lowest water of 1897, also widening to a minimum width of 450 feet and straightening.			
Fiscal year 1899-1900..........	100,191.01	265,270.78	1,107,894
" " 1900-1901..........	136,680.83	287,040.04	2,479,385
" " 1901-1902..........	185,420.80	479,731.47	3,098,350
" " 1902-1903..........	255,776.55	277,703.50	6,544,605
" " 1903-1904..........	276,958.59	308,765.44	4,619,260
Department of Marine and Fisheries.			
This includes the work below Quebec.			
Fiscal year 1904-1905..........	311,087.93	277,225.69	2,716,220
" " 1905-1906..........	431,768.30	317,327.37	4,047,530
" " 1906-1907 (July 1, '06 to March 31, '07)..........	302,677.37	275,003.61	3,001,010
" " 1907-1908..........	478,209.66	417,390.22	4,831,875
" " 1908-1909..........	497,686.03	340,861.86	5,896,737
" " 1909-1910..........	572,950.71	321,375.80	6,354,285
" " 1910-1911..........	576,838.02	488,248.88	5,600,050
" " 1911-1912..........	588,697.60	499,799.58	4,509,904
" " 1912-1913..........	663,229.74	430,107.86	6,929,344
" " 1913-1914..........	895,235.59	426,018.12	6,140,867
	$10,505,495.16	$6,433,651.66	$91,301,742

the Government immediately resolved to improve the North Channel below Quebec, which was strongly recommended by the shipping interests. As it was found, however, that owing to the increased size of vessels using the ship channel, a depth of 30 feet at extreme low tide was unlikely to meet the future requirements of navigation, it was decided to deepen the North Channel to a depth of 35 feet at extreme low tide, and with a width of 1,000 feet. This work is now in active progress.

At the present time a splendid channel of 30 feet at extreme low water exists from Montreal to Cap à la Roche, and to Quebec by taking advantage of the tide.

The success of the work is in a great measure due to the geographical situation of the route, the physical features of the river being favorable for improvement, the determination and public spirit of the business men and industrial corporations of Montreal, and to the recognition by the Government of Canada of the national character of the project.

The accompanying tables denote the progress of dredging operations made up to the close of the season 1913, as given in the 1913-14 report of the Department of Marine and Fisheries:

PREVENTION OF ELECTROLYSIS BY PAINTING.

THE use of protective paint upon steel to be embedded in concrete work, in order to prevent any damage which may be caused by electrolysis, is the subject of a report by Henry A. Gardner, assistant director of the Institute of Industrial Research, Washington, on tests made upon painted steel rods embedded in cylinders of 1:2 Portland cement mortar. These tests form the basis of an article appearing in the Journal for March of the Franklin Institute. They form a valuable addition to previous literature on the subject. The effect of stray electric currents upon reinforcing steel in concrete structures has been a live topic of discussion for several years. The presence of moisture is known to accelerate the disintegration by electrolytic action. The proposal to protect the surface of the steel by a coat of paint met with criticism in view of the fact that such a procedure would tend to weaken the bond between steel and concrete. Further tests seemed to indicate that common paints did not entirely exclude the moisture from contact with the metal. The reader is referred for particulars to *The Canadian Engineer* for January 2, 1913, which contains an article based upon investigations by E. B. Rosa, B. McCollum and O. S. Peters, of the U.S. Bureau of Standards. These investigators found that of over 40 paints, none withstood as much as 4 volts for any considerable time, and from their observations they concluded that the paints might even increase electrolytic action. The knowledge of the value of paint as a protective covering for the steel did not, therefore, support its use, and for this reason the results of the recent tests by Mr. Gardner will undoubtedly be found of interest. The following is a summary of his report:—

The ordinary forms of iron corrosion have been found to be due to auto-electrolysis, the presence of segregated impurities being responsible for differences in potential at certain areas, which set up galvanic action and cause solution and the formation of rust at the positive nodes. A similar but more rapid action takes place when an electric current is passed through an iron anode immersed in an electrolyte such, for instance, as salt water. When damp cement contains an embedded iron anode the cement acts as an electrolyte, and the same rusting action takes place, regardless of the fact that concrete contains sufficient lime to inhibit corrosion when no electrical currents are present. With the electrolytic change of metal into oxide comes an increase in volume of the products of reaction, and there is developed an enormous expansive force of mechanical pressure, which is sufficient to crack the strongest forms of concrete.

Corrosion may therefore be expected, with its attendant results, when sufficiently high voltage direct currents enter the iron of a new concrete building, either through contact with conductors of light and power circuits, contact with water or gas pipes carrying direct currents from grounded power lines, through defective insulation of electrical wiring, or from similar sources. That the damage is greatest to new structures is due to the fact that the concrete is then damp and a better electrolyte than when it becomes dry from age. That examples of reinforced concrete structures damaged from stray currents are not more common may be due to the fact that engineers are active in their endeavors to prevent high-voltage currents from running wild in many localities. This fact, however, does not justify a disregard of what might happen in the future and what may now be happening to some structures which have not been carefully guarded against stray current electrolysis. That much of this damage may be prevented by the adoption of suitable forms of foundation waterproofing, exterior insulating joints for pipe lines, isolation of lead-covered cables entering buildings, and other insulating devices, is shown by Rosa, McCollum and Peters in what is probably the most valuable contribution to the subject of reinforcement electrolysis that has ever been published. Of equal importance, however, should be the safeguarding of the metal with suitable insulating and bonding paints before it is embedded in cement. The adoption of this precaution, if followed by the use of the safety devices noted above, will guard against the causes which contribute to electrolysis and render our modern concrete structures safe from destruction by reinforcement corrosion.

Mr. Gardner made two series of tests. The first was made by embedding in concrete cylinders painted iron rods ½-inch diameter and 12 inches long, the rods having been previously thoroughly cleaned and given two coats of paint with a week between coats for drying. At the age of one month the cylinders were all connected up in parallel for 24 hours under 30 volts; then, since the current passing was found to be very small, they were placed in about 2 inches of water for one week. In a few cases it was found that cracks appeared near the bottom where moisture had affected the films of paint. They were then immersed in water up to within 1 inch of the top and continued under 30 volts for 10 days longer.

The second series was similar to the first, but was continued for 240 hours under 30 volts and 60 hours under 55 volts with the cylinders immersed in water up to within one inch of the top. Current readings were made daily in both cases.

The kinds of paint used included bituminous, oil and aqueous paints, oils, varnishes and lacquers. The report contains much detail respecting the composition of the paint and the results in both series of tests. Two specimens were tested, for purposes of comparison, with unpainted rods. These cracked in a comparatively short time and showed considerable pitting, corroding and general disintegration. The results from the others indicate considerable protection attained by the use of some bituminous paints and a few of the oil paints, lacquers and varnishes.

To determine the effect of paint upon the bond between the metal and the concrete, similar specimens were tested in a Riehle machine, pressure being applied to the top of the rod until the bond was destroyed. In this way it was found that some of the water paints and lacquers showed bonding strength about as high as the plain steel, but failed to act as insulators; while others were good insulators, but low in bonding strength. Most of the oil-pigment paints made with raw linseed oil gave poor or only fair results, while much better results were obtained with boiled linseed oil, which dries to a harder, less porous, and more fully saturated film.

In making up the specimens for test Mr. Gardner applied fine, clean sand to the painted surface of the steel before the paint was dry. In this way the bond between the painted steel and the concrete was effectively increased. In some cases the bonding strength, owing to this rough surface, was increased by practically 100%. This method also gave better insulating values.

The results showed that wherever there were voids in the surrounding mortar, at or around the painted rods, corrosion was most severe, and pitting was shown. The breaking down of a paint film, probably due to its having been broken through by enclosed hydrogen gas developed by the electrolysis of the water in the damp concrete, was always recorded by a sharp rise in the amount of current passed, and a noticeable fizzing sound. Bubbles of gas which burst with an audible explosion when lighted were brought to the top around the iron electrodes, sometimes carrying soft, oily products. Such disintegrating effects of electrolytic hydrogenation might be prevented by thoroughly oxidized coatings, which could be obtained by allowing a period of 60 days for the drying of oil paints before using in the cement.

Mr. Gardner's conclusions are as follow: The corrosion of metal embedded in concrete structures, by stray currents of high voltage, is often productive of serious effects. The use of properly made paints upon such metal constitutes a safeguard that should not be neglected by the engineer. Such paints should contain: Boiled or bodied oils or products which dry to a fairly saturated film; oils which dry by semi-polymerization rather than oxidation; oils which dry to a flat rather than a highly gloss surface.

The solid portion should contain a percentage of: Pigments which are coarse and which therefore tend to form films having a rough surface; pigments which are inert and which do not act as conductors of electricity; pigments which are either basic or of the chromate type. The painted metal should be "sanded" if possible.

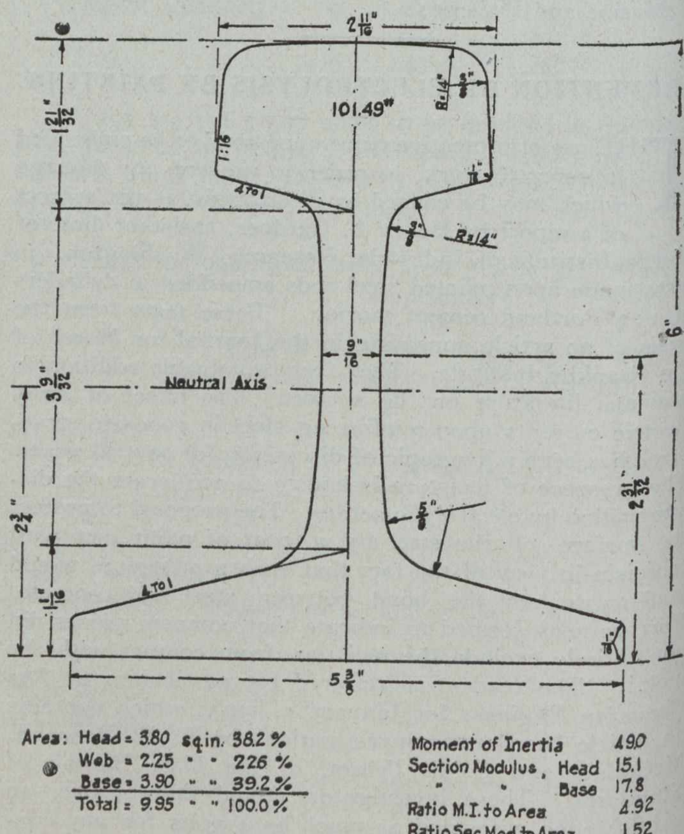
BRIDGE WORK IN NEW BRUNSWICK

Several permanent steel bridges are in process of construction, or being planned, in the province of New Brunswick. The new sprandrel arch bridge across the reversing falls at St. John has the unique record of having the longest span of any bridge of that kind in the world. It will be finished up in a few months, and will be available for street car and other traffic. Then there is a new bridge at Grand Falls, which is to take the place of the old structure there. A substantial steel bridge has been constructed over the Miramichi at Newcastle. A bridge of a permanent character is planned over the Petitcodiac near Moncton. Tenders were opened recently for this proposed structure, and a contract for the substructure was about to be awarded to the Foundation Company, Montreal, when it was decided to make an alteration in the design to provide for a draw span. As a result new tenders are being called for. The bridge, as contemplated, will cost about $300,000.

NEW STANDARD RAIL SECTIONS.

At the recent annual convention of the American Railway Engineering Association, new standard sections for rails weighing 100, 110 and 120 pounds per yard were recommended by the Committee on Rails and adopted by the Association. The Committee also submitted designs for sections weighing 130 and 140 pounds per yard, but did not consider them necessary and they were not recommended or adopted. Concerning the 90-pound section, the Committee recommended that the American Railway Association's A section be adopted as standard and that for sections below 90 pounds any changes were inadvisable. The dimensions of the adopted sections are shown herewith.

It is of interest to note that a set of standard rail sections was adopted in 1893 by the American Society of Civil Engineers and was used without material alteration for about fifteen years. In 1908 the American Railway Association adopted new sections for light rails up to 100 pounds, the aim being to design a rail in which the metal

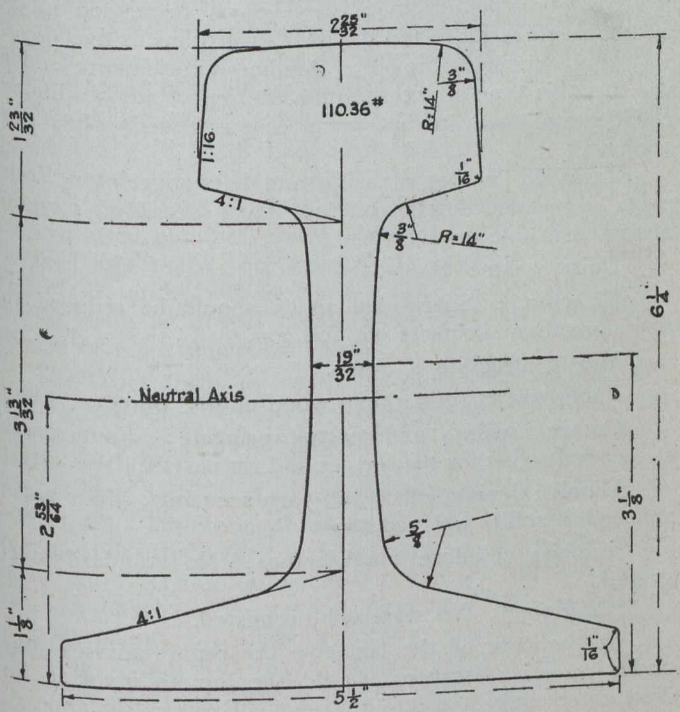


Section and Dimensions of Newly Adopted 100-lb. Rail.

was more evenly distributed in the head and flange. The unequal distribution of metal in the earlier sections caused the rails to curve in cooling and compelled a stoppage of the rolling process as soon as the foot of the rail had cooled and before the steel in the head had been sufficiently worked. Two sets of standard rail sections were adopted by the A.R.A., known as the A and B sections, the former tall and slender and the latter short and thick. These two sections were adopted instead of one owing to the divergent views of the rail committee recommending the same, the idea being to determine by experience which was the more suitable.

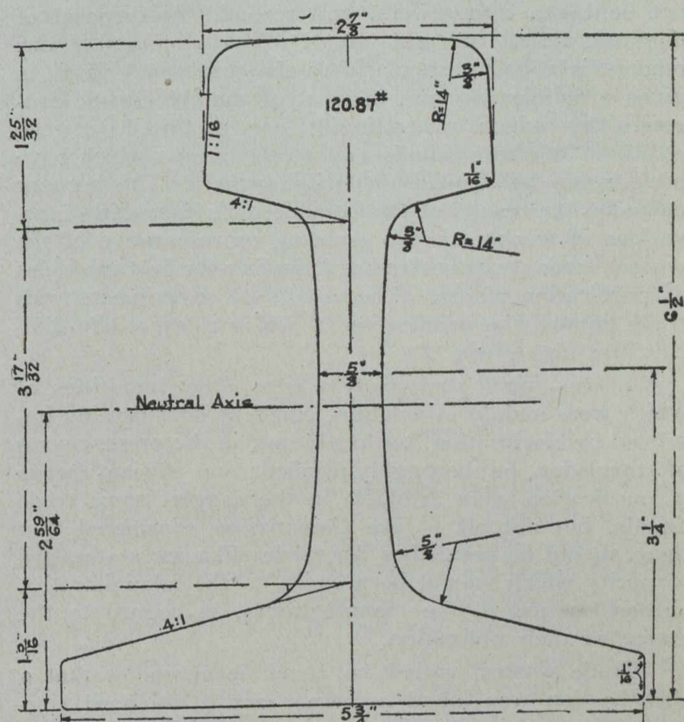
A few years ago the American Railway Engineering Association was asked by the A.R.A to recommend a single set for adoption as standard. The new standards are the result. It will be noted that the tendency is decidedly toward the adoption of sections similar to the slender A sections mentioned above.

In its report the Committee states that in the design submitted the feature of the rail as a girder has been constantly in view, and a design having the highest ratio of section modulus to area of section kept in mind. The



Area:			
Head	= 4.04 sq.in		37.4 %
Web	= 2.49 "	"	23.0 %
Base	= 4.29 "	"	39.6 %
Total	= 10.82 "	"	100.0 %

Moment of Inertia	57.0
Section Modulus, Head	16.7
" " , Base	20.1
Ratio M.I to Area	5.27
Ratio Sec. Mod to Area	1.55



Area:			
Head	= 4.40 sq.in.		37.1 %
Web	= 2.69 "	"	22.7 %
Base	= 4.76 "	"	40.2 %
Total	= 11.85 "	"	100.0 %

Moment of Inertia	67.6
Section Modulus, Head	18.9
" " , Base	23.1
Ratio M.I. to Area	5.71
Ratio Sec. Mod. to Area	1.59

Sections and Dimensions of the 110 and 120 lb. per yard Rails, as Adopted Recently by the American Railway Engineering Association.

radia of the fillets between the head and web and between the web and base have been made as large as possible without interfering with the area of the joint bars.

Relative to its recommendation of the use of the A design of the A.R.A. for sections under 100 pounds, and the 90-pound A section for the single type standard, the Committee points out that the sections now in general use do not vary sufficiently from those that might be submitted as to make any marked difference so far as mill practice or wear in service are concerned, the distribution of metal in the sections of 80 pounds and under being such that it cannot be varied except in minute details that will not affect the life or safety of the rail in service. It is thought that the use of these sections will be limited and will decrease because of the increasing wheel loads, and that no new sections will be purchased, all the mills being equipped with rolls for the existing sections.

The report goes on to state:

"Suggestions have been made to the Committee that a common fishing space should be used for more than one section; also, that a common width of base should be used for more than one section. To use a common fishing space for more than one section would result in a greater sacrifice in designing some of the sections than seems desirable. To do so would be sacrificing one of the most expensive parts of our track, in order to help out a much less expensive part, and to do so would appear to be a violation of the economical or thearetical principles, which should control our work.

"In regard to a common base for more than one weight of rail—this is less objectionable, and the only feature in the design that would necessarily be sacrificed in order to use a common width of base for more than one weight of rail would be the matter of stability against overturning. It seems desirable, however, on the part of the Committee to propose different widths of base for each of the sections recommended."

The Committee's conclusion respecting these sections are being presented to the American Railway Association for adoption.

PAVING IN MONTREAL.

The city has announced its paving programme for the coming season. The sum of $1,800,230.30 will be spent on pavements, the greater part of which will be asphalt. It has been previously the practice of the city to lay considerable scoria and granite blocks on streets with heavy traffic. Owing to the noise, however, there is a tendency to lessen their use. Where necessary, asphalt will be laid with a 3-inch thickness instead of the customary 2-inch and heavier foundations will be constructed accordingly.

It is noted that the programme comprises the paving of a portion of St. Lawrence Boulevard, which, when completed, will provide an asphalt pavement from one side of the Island to the other, and a long stretch of Notre Dame Street, extending from the limits of Maisonneuve to St. Jean de Dieu. It is proposed to spend about $800,000 on macadam work and about $300,000 on new sidewalks, details of which have not as yet been announced.

NINTH REPORT OF ROYAL COMMISSION ON SEWAGE DISPOSAL, GREAT BRITAIN.

IN its last sectional report on the problem of sewage disposal in Great Britain, the Royal Commission has dealt with two important things; first, the discharge of manufacturing wastes which for any reason may not be taken into sewers, and second, the disposal of domestic refuse in rural areas. The attention of our readers is called particularly to the first part. In it is given a detailed account of most of the chief trade processes by which water liquids are produced, of the character of those liquids and of the means which have been or may be adopted for purifying them. This account embodies the results of the Commission's extended observations of works selected as being representative of the various trade processes and as including the best examples of purification plants. The results of experiments with trade liquids, the purification of which is especially difficult, are also given.

It was found that many wastes, the impurities of which were mainly in solution, could be considerably improved by clarification, but could not, in the present state of knowledge, be thoroughly purified; that efficient means of purification were available in the case of some trade liquids, but not all. The Commission considered that there should be prescribed for trade effluence a standard of purity which should be a guide to the administrative authorities and to the manufacturers, in regard to the extent of their obligation.

Trade wastes varied so much in character that a classification was found necessary and a standard suggested for each. The classification is as follows:

(A) Waste liquors resulting from (1) coal washing, tin mining, lead and zinc mining, china-clay works, stone quarrying, stone polishing, wood pulp paper works; (2) brewing, malting, distilling, tin plating, galvanizing, wire drawing, shale oil distillation, woolscouring, tanning, leather dressing, fellmongering, dairying.

In the cases listed under (1) adequate reduction of solids in suspension may be regarded as efficient purification. In those under (2) dissolved impurities should be removed.

(B) Waste liquors resulting from (1) bleaching, waste bleaching, paper works (except where paper is made from wood pulp only), cotton dyeing, cotton printing, woolen dyeing, woolen piece and yarn scouring with dye liquor; (2) sulphite cellulose manufacture, gas and coke production.

The report observes that no practicable means are known for rendering completely harmless the liquids included in this class, but that nearly all of them can be considerably improved by clarification.

In other words, class A relates to those trade wastes for which efficient purification is practicable and class B for which efficient purification is not practicable in the present state of knowledge. The suggested standards covering these classifications are briefly summarized from the report as follows:

Coal washing: Effluent should not contain more than four parts of suspended solids per 100,000.

Tin, lead and zinc mines, china clay works, stone quarries and stone polishing works: Provisional standard of maximum of six parts suspended solids per 100,000.

Wood pulp paper mills: Effluent should contain not more than four parts per 100,000.

Breweries and maltings: Not more than four parts per 100,000, and not more than four parts per 100,000 dissolved oxygen taken up in five days.

Distilleries: Three parts suspended and two parts dissolved oxygen absorption in five days.

Tin plating, galvanizing and wire drawing: Six parts suspended solids per 100,000.

Shale oil installation: Four parts suspended solids and four parts dissolved oxygen absorption in five days.

Wool scouring liquor: Pending experiments under way for this type of precipitation the report advises liquor clarification down to six parts of suspended solids per 100,000.

Tanning, leather dressing and fellmongering: Four parts suspended solids and four parts dissolved oxygen absorbed in five days.

Dairy waste: Same.

Bleaching: Suspended solids should be reduced to not more than six parts per 100,000.

Waste bleaching: Same.

Paper works (other than wood pulp): Same.

Cotton dyeing and cotton printing: Four parts suspended solids for the former and six parts for the latter.

Woolen dyeing, piece and yarn scouring: Four parts suspended solids per 100,000.

Sulphite cellulose manufacture: No standard suggested.

Gas liquor: No standard suggested.

In the case of the last two the report advises that under no circumstances should the liquors involved be discharged untreated into a stream. Evaporation appears to be the only practicable alternative at present. It is stated that in the case of some trade wastes additional standards may have to be imposed—*e.g.*, standards of hardness and of "caustic" alkalinity or acidity, or a requirement of neutrality, for the effluents from various branches of the cotton, woolen and paper trades and from metal works; a standard for arsenic or other poisonous metal for trades in which those substances are used or mined; an oil-film standard for the wastes from oil, gas, grease or soap works, etc. Some further investigation may be required before such standards—or some of them—can properly be laid down.

The second part of the report contains observations on the disposal of solid and liquid domestic refuse in rural districts. A public system of sewerage and sewage disposal is advocated for towns and densely populated areas. In sparsely populated districts, owing to expense, a public water supply and sewerage system is found to be impracticable and alternative conservancy methods are reviewed.

The following figures show the progress of the mineral industry in the Province of Quebec since 1902:—

	Value of mineral production.
1902	$ 2,985,463
1903	2,772,762
1904	3,023,568
1905	3,750,300
1906	5,019,932
1907	5,391,368
1908	5,458,998
1909	5,552,062
1910	7,323,281
1911	8,679,786
1912	11,187,110
1913	13,119,811
1914	11,325,428

HARD SURFACING OF ROADS.*

By Philip P. Sharples.

EACH locality has its own peculiar road problems which must be solved after a thorough study of the local factors and after much practical experience in applying the general principles which have been laid down. Manitoba, especially that part of it lying in the Red River Valley, has peculiar problems of its own that are by no means easy of solution.

Those interested in Manitoba roads can gain much by the study of roads built elsewhere, but the attempt should not be made to adopt the same solution without change. Manitoba's needs should be studied and the methods used in other places should be changed to suit the local conditions. For many years to come, the crying need of Manitoba will be for a large mileage of good natural earth or gravel roads rather than for a smaller mileage of more expensive roads.

The latter forms of road will be justified in places, and of these the macadam is the least expensive, and at the same time a thoroughly satisfactory road if properly built.

The first requisite in building a macadam road is a good stone. Manitoba produces several varieties which have proved satisfactory in other places. A certain degree of hardness and toughness is necessary and machines have been developed for testing these qualities. In building waterbound macadam a certain quality called the cementing value is required. Certain rocks when wetted and rolled seem to form a natural cement which holds them together; others do not have this quality. A study of this problem by the Office of Public Roads, Washington, showed that the property was dependent on a superficial decomposition of the rock by water. Rocks containing feldspar and calcium carbonate form the cement readily, while silica, not being attacked by water, forms practically no cement. Quartzose rocks for this reason make poor waterbound macadam. By the use of modern bituminous binders, the non-cementing rocks are now made available, providing they are sufficiently hard and tough.

The foundation of a macadam road, like the foundation of a house, is a most important part of the structure. Without a proper foundation a macadam road cannot be a success. The drainage must be thoroughly attended to. Since a macadam road is a relatively more expensive type than a gravel road, it pays to provide even more thoroughly for proper drainage. Each district presents its own drainage problems, and they must be solved for each locality. Side ditches, tile drains, French drains, even V-drains extending the entire width of the roads, must be used each in its proper place. The problem is to get the bottom well drained and solid enough to prevent the individual stone from being forced into the foundation or to prevent the foundation from working up into the stone of the macadam.

Sometimes the placing of large stone on the foundation, after the manner of Telford, is the cheapest way of making the base firm. At other times stone screenings, gravel or even straw can be used on a soft base to keep it from working up into the macadam.

The stone for the road must be properly crushed and sized through screens of the right size. The stone sizes most commonly used are 3½ to 2¼, 2¼ to 1¼, 1¼ to ½, and ½ to dust. They are used in the order named, and for economy the amounts used should be such as to take the entire output of the crusher.

Next to the foundation, the rolling of a macadam road is the most important item in the construction. Sometimes stone is dumped on a road, levelled off and left for the traffic to roll out. A road of this description bears as much relation to a macadam road as a pile of bricks dumped on the ground does to a brick house.

A good power roller, weighing eight to ten tons, is almost indispensable in building macadam, and it must be run by a man who understands the art of rolling, for an art it is to roll properly the foundation and each layer of stone from bottom to top so as to preserve the contour and make the best possible road with the materials available.

Once built, the care and maintenance of a macadam road presents new problems. It is possible, with proper maintenance, to keep a macadam road in good condition at all times, so that at the end of any period it will be in as good condition as in the first year. This sort of maintenance is, in the end, true economy, for nowhere does the proverbial stitch in time save more than on a macadam road.

The maintenance problem is much complicated by the advent of the automobile. If the auto traffic increases beyond a certain minimum percentage of the whole traffic, the fine particles of rock which form the binder for the road are scoured out of the road. Without the binder the stone begins to ravel and the road soon disintegrates.

The remedy has been found in the use of refined tars and other bituminous coatings. These retain the fine particles in the road and add a strength and toughness to the road surface which prevents its disintegration by the automobiles.

The problem has become very acute in the vicinity of every large city and on the trunk line state highways. The study of proper materials for the work has become a science in itself.

As the automobile traffic becomes more concentrated and as motor trucking increases the strain on the roadway, the strengthening of the macadam is carried further yet. The bituminous materials are introduced as binders in the building of the macadam. Many successful forms of tar-bound macadam and asphaltic concrete have been developed to meet these new conditions. With tar binders the penetration method has met with marked success in solving cheaply this new and difficult problem. The asphaltic binders are more usually used by mixing methods.

The time has not yet come when these higher types of roads are required in solving road problems in Manitoba, except in a very limited field. The problem should, however, not be neglected in a forecast of future road development. With the rapid increase in automobiles which has already begun the problem will soon be a live one.

*Delivered before the Manitoba Agricultural College, March 4, 1915.

The production of pig iron by provinces in 1914 was as follows:—

	Tons.	Value.	Value per ton.
Nova Scotia	227,052	$2,951,676	$13.00
Ontario	556,112	7,051,180	12.68
	783,164	$10,002,856	$12.77

There was also a production during 1914 in electric furnaces of 7,524 tons of ferro alloys (ferro-silicon and ferro-phosphorus) valued at $478,354, compared with 8,075 tons valued at $493,018 in 1913. This production is chiefly 50 per cent. ferro-silicon.

COUNTRY ROADS.

By W. F. Tallman, Street Commissioner, City of Winnipeg

THE problems involved in the construction of country roads are quite different from those connected with similar operations on city pavements, and may, in general, be divided into three periods: (1) Locating, or laying out, the route; (2) making the roadbed; (3) making the road surface.

Location.—The location of country roads is the scientific determination of the most suitable route and gradients for proposed line of communication. In the earliest days or in the early days of new settlements, routes were made according to the line of least resistance, and without regard to any consideration other than the easiest method of travelling, or of conveying goods, from one place to another.

The Romans, at a very great expense, built their roads up and down hills, through and over all obstacles, in perfectly straight lines, in the belief that this was the shortest distance between two points, and constituted the best location. Theoretically, they were right, but practically they were correct to a very limited degree, for a straight road over a hill is not necessarily any shorter than a curved road around it. Both are curved, one in its vertical and the other in its horizontal plane, and they may be precisely the same length, but the one over the hill is said to be straight, only because its vertical curvature is less apparent to the eye.

Of the two roads of equal length, the route over the hill has the disadvantages of greater first cost, greater maintenance expense, greater damage from rains and other causes, greater wear on horses and vehicles in the haulage of goods over it, and consequently greater cost to those using it. But even if the level, curved road were much longer than the straight and steep one, the former would, as a rule, be the more economical on account of the ease of travel over it.

Economy forms the true basis of proper location; that is, ultimate economy in making the route as direct and, subject to drainage requirements, as level as practical, in achieving the best results at the least present and future expense.

Too much economy should not, however, be urged in the work of location. There is an old saying, "Nothing pays like first cost in road building," meaning simply that money expended in intelligent study of the location is the most economical expenditure in the construction of a road. The importance of the selection of the best route cannot be too strongly urged, because an error made in this first stage of road making will cause a heavy expense for rectification, and, until rectified, imposes a perpetual tax upon the public for maintenance.

Grades.—There are two kinds of grades to be considered here—maximum and minimum. The maximum grade is the steepest which is permissible and the minimum grade is the least allowable for good drainage.

A level road is desirable and preferable, but as it can seldom be obtained, the road-builder must investigate the effects of grades upon the cost of construction and maintenance, and also determine the most suitable grade under the special conditions.

When there is a grade to be overcome, it can be reduced by (1)going around the hill; (2) zig-zagging up the slope; (3) cutting through the hill. In the case of a long slope, the first or second must be employed, but if the grade is short, the third method is usually the cheapest.

Earth Roads.—This term includes all those constructed of natural soil, whether loam, clay or sand, without a crust or other road covering. The earth road is the cheapest form of road as regards first cost, and is generally the pioneer in any new country.

In its simplest form it consists of dirt from the sides, simply thrown up into the centre, with little or no regard for the formation of a crown for the lateral shedding of rain water. The bulk of the country roads of Canada are made of earth alone, and as a well made earth road forms an excellent foundation for a gravelled or broken stone road, and its construction is in many cases preparatory to a more permanent improvement, the importance of scientific design and construction will be easily seen.

If, as it is often done, the loose earth be thrown into the middle of the road to be compacted by the wheels of the traffic, the action of the wheels will be to cut it, or at least to pack it in a very uneven manner, producing a surface uneven and full of ruts, which will hold water and ultimately cause the destruction of the road. In case, however, the surface be properly rolled, it may usually be made sufficiently firm to hold up the wheels and retain its form under the traffic and, if kept free from ruts until thoroughly compacted, will thus be rendered much more capable of resisting the penetration of water and shedding it into side gutters.

The first step in the construction of a new road in most localities is to clear the surface over the entire width of all stumps, brush, vegetable matter, rocks and boulders. These should be removed and the resulting holes filled in with suitable materials thoroughly tamped and rolled, before the road embankment is commenced. No perishable material should be used in forming the permanent embankment.

In wet districts or where the soil is naturally damp the trees and shrubs should be cleared the full width of the right-of-way to allow of proper evaporation, but in hot and dry districts where the comforts of travellers must be considered, it is well to leave growing trees each side of the roadway.

Whenever the subgrade soil is found unsuitable it should be removed and replaced with good material rolled to a bearing. The roadbed having been brought to the required grade and crown, should be rolled several times to compact the surface, and all irregularities levelled up and re-rolled. On this prepared subgrade the earth should be spread, harrowed, if necessary, and then rolled to a bearing by passing the road roller a number of times over every portion of the surface.

In level countries and with narrow roads, enough material can generally be excavated in forming the side ditches to raise the roadway above the subgrade. If not, the required earth may be obtained by widening the side excavations, or from cuttings on the line of the new roadway, or from borrow pits close by. When the earth is brought up to the final height it is again narrowed, then trimmed by means of road levellers or road machines and ultimately rolled to a smooth and solid surface, the cross-section of the road being maintained during the last rolling stage by the addition of earth as needed. Before the earth road is open to traffic, the side ditches should be cleaned and left in good working order.

On account of the loose character of the material, earth roads require most careful design in order that the road may be kept dry. Water is the great destroyer of earth roads, and drainage is especially important in their proper making and maintenance because the material of the roadway is more susceptible to the action of the water and more easily destroyed than any other material used in the construction of roads. If not properly drained, the rain and snow soften it and it soon becomes impassible mud. If, on the other hand, water is allowed to run on the road surface, it will soon wash away the earth and form gullies. Drainage alone will often change a bad earth road to a good one, and the best road may be quickly destroyed by the absence of proper drainage.

The great point in having good roads is the care of them after they are made. It is absolutely necessary in order to have good roads that it must be the constant duty of someone to look after them after the road is built, especially during and following a rain, the water may be kept off as far as possible. Dirt roads are readily repaired by a judicial use of road machines.

Any small breaks in the surface must be immediately repaired and ruts filled and smoothed before they become serious.

Earth roads, under the most favorable conditions, are expensive to maintain, and especially so under the common system of repairing once or twice a year, or at long intervals. This system is not only costly in the work required which usually amounts to a practical reconstruction of the road each time repairs are undertaken, but it is ineffectual in that the road for the larger portion of the time is out of repair and in bad condition, even if the work of construction has been well done.

The only way to keep an earth road in condition is by the employment of men whose business it shall be to continually watch the road, and make such small repairs as may be necessary from time to time. The small washes that may occur during heavy storms, ruts formed by wagons travelling in the same tracks, or in passing over soft spots when the road is wet, or any small breaks in the surface of the road, should be at once attended to and carefully filled with new material.

The difficulty in the cost of maintaining the road will, of course, vary with the nature of traffic that passes over it. A road for light driving will be much easier to keep in repair than one used by heavy loads, and as the amount of heavy traffic becomes greater the economy of the earth surface is lessened, and the desirability of the substitution of a more durable wearing surface increases.

Gravel Roads.—Gravel furnishes a very acceptable substitute for stone as a material for the construction of roads with a moderate amount of travel, and, when well constructed, a gravel road is a satisfactory one. It has to commend it, ease of laying, ease of repair, but it has not the durable qualities of a good broken stone road when subjected to heavy travel.

Gravel roads can be constructed, as they most often are, by simply dumping the unscreened gravel on the road and letting the traffic do the rest.

Gravel to be used on roads should be sharp and comparatively clean. If it runs very unevenly in the pit it should be screened. After screening, the sand or clay left in the gravel should be no more than just enough to fill the voids in the stone, and the less it takes to do this the better the gravel is for road purposes. After spreading, the gravel should be gone over once or twice with a harrow to mix it thoroughly to get rid of all small pockets of sand or dirt which, however, can often be prevented by careful selection in the pit.

There are a few pits from which very satisfactory gravel roads can be built by using the gravel just as it occurs, without screening or crushing. A community that has such material is blessed above all others.

Too much cannot be said about road construction and maintenance as a noted writer once said, "Tell me the condition of the churches of the city and I will tell you the prosperity of that city." If this is true of the churches, how much more truly it can be said of the the roads. Probably no one condition strikes a stranger more forcibly than the appearance and condition of the roads.

(The above is a paper read at the Convention on Highway Construction at the Manitoba Agricultural College, Winnipeg, under the joint auspices of the College and the Provincial Department of Public Works.)

MATERIAL REMOVAL IN TUNNELING.

THERE has been a number of tunneling records broken during recent years, and Canadian railway work has figured very prominently in the new arrangement of laurels. These new records are largely the fruits of the great progress that has been striven for toward more efficient methods in driving operations. The removal of blasted material is one phase of the problem that has demanded some thorough and comprehensive study. The results and conclusions arrived at by D. W. Brunton and J. A. Davis in their report to the U.S. Bureau of Mines on the whole subject of tunneling methods contain some plain directions and facts suggestive of economy and efficiency in material removal. The following abstracts will be found of value:—

For rapid progress in the construction of a tunnel it is necessary that the muck be removed as speedily as possible as the shovelers must always do other things after the main work of loading the debris has been accomplished. The space in the tunnel heading is most restricted, and if too many men attempt to work there simultaneously they will so seriously interfere with one another as to offset any possible gain from the employment of the extra men. On the other hand, if too few men are at work it will be impossible for them to remove the debris within the time allowable.

Analysis of the most satisfactory practice at a number of tunnels shows that, under the conditions prevailing in the heading, a man shoveling requires 2½ to 3 feet of floor space. That is, for a tunnel 10 feet wide, not more than 4 shovelers should be used simultaneously, whereas not more than 2 men can work to advantage side by side in a 6-ft. heading. In addition to these, however, it is desirable to have a man or two at work packing down the rock pile in front of the shovelers, loosening boulders, assisting in the handling of the cars, or doing any of the many things that make for speed in loading the muck. Accordingly, at tunnels 6 to 10 feet wide the proper number of men in the mucking crew ranges from 3 to 8.

The advantage of giving the men a rest from the grind of steady shoveling can be obtained without the necessity of extra laborers by changing their positions regularly. At the Laramie-Poudre tunnel the six muckers worked according to the following cycle of operations: As soon as a car (1) was filled with waste two shovelers, who will be designated as A and B, took it at once to the rear, while two other shovelers, C and D, jumped to an empty car (2) near by (which had previously been thrown off the track on its side), set it upright on the track and pushed it into a position to be filled. In the meantime the remaining two, E and F, stopped picking down the rock pile, took the shovels left by A and B, and started at once to assist C and D in filling car 2. Another car (3) was then brought up by A and B as near as possible to the car (2) being filled, and was thrown off the track on its side in the position formerly occupied by the second car. A and B then picked down the rock pile for the other four during the remainder of the time consumed in loading car 2. When filled this car was removed by C and D, while E and F set up the third car and filled it with the assistance of A and B. The fourth empty car was meanwhile brought up by C and D, who then took their turn at picking down, and the cycle was completed when E and F took the third loaded car to the rear, returning with another empty, and then resumed their original position on the muck pile. It will be seen that by this method every man spent at least one-third of the time in tramming or picking down the rock pile, either operation being easier work than that of shoveling, and amounting virtually to a rest which, although perhaps not as complete as if no work at all had been done during that period, was still sufficient to relieve greatly the hard monotony of shoveling.

The regularity and mechanical exactness of procedure with this system is a still more important advantage. Each man soon learns precisely what is expected of him for each step of the operation and hence there is absolutely no confusion, no lost motion. There is rarely any occasion for the foreman to give an order to the men except under unusual circumstances, and in consequence he does not acquire the habit of shouting at the men constantly, an unfortunate phase of this work, only too noticeable at some tunnels; nor, on the other hand, do the men form the time-wasteful habit of running to him for guidance in every minor contingency that arises. The statement that the little things make for success can nowhere apply better than in planning the utmost work attainable in the limited space of a tunnel heading; indeed, this seeming detail of eliminated friction and confusion warrants and deserves the most serious consideration.

In addition to advantages in organization, the speed obtainable with the method leaves little, if indeed, anything, to be desired. Cars of 16-cubic foot capacity were filled at the Laramie-Poudre tunnel ordinarily in 3 or 4 minutes, and on one occasion (which, however, was somewhat exceptional as the men realized that they were being timed) only 1 minute and 30 seconds was needed. At the Rawley tunnel, where a similar system was used, with only four muckers, 25 cars, having a capacity of 17 cubic feet, were filled in exactly 2 hours, and on a different shift 20 cars were loaded in 1 hour and 45 minutes. The usual time required for mucking at the Rawley tunnel is not far from the average of these figures (which include all ordinary delay incident to making the cars up into trains), a value somewhat less than 6 minutes per cubic yard of rock loaded.

The method of handling the tunnel cars is still another detail of consequence in the operation of mucking. One of the most common arrangements is to have them trammed from the face by hand to a siding or switch where they are made up into trains and hauled to the portal by whatever means are provided for that purpose. This system, however, possesses some disadvantages. The switch must be moved frequently at no little expense and trouble in order to keep pace with the tunnel advance, or else it will soon be so far from the face that it is practically worthless. There is considerable loss of time while the loaded cars are being removed and the empty ones are being brought to the face; even although every effort be made to reduce this lost time to the minimum, the switch can not well be located nearer than 100 feet from the face, whereas in practice 300 to 500 feet is more apt to be the actual distance. Moreover, the full car must usually be taken by hand the entire distance to the switch before the empty can pass it; when this system is employed heavy cars, almost without exception, are used, and on this account to move them any distance by hand entails heavy exertions on the part of the mucking crew.

In most cases it is much better to use cars of smaller capacity; then the empty ones are tipped off the track to allow the full ones to pass and can be righted when needed and placed back easily by two men, thus avoiding all the complications and extra work arising from the use of a siding or switch. The smaller cars are also easier to load, for, as they do not occupy so much space in the tunnel heading, there is more room for the shovelers to work; also, the sides of the smaller cars being lower, each shovelful of rock does not have to be lifted so high in order to get it into the car, saving both time and energy. They are likewise easier to handle in case of a derailment, and as fewer men are required for tramming them out of the heading when full, a larger percentage of the time of the shoveling crew can be spent in the actual process of loading.

When the smaller cars are used, however, the work of handling them must be thoroughly systematized in order to prevent waste of time through avoidable delays. Although similar to that in use in a number of tunnels, the system employed at the Rawley tunnel was perhaps more carefully planned in detail than in most others. Upon arrival at the heading the empty cars were pulled as near as possible to the full cars waiting to be removed, which at this juncture ordinarily stood on the track some 75 to 100 feet from the face of the tunnel. The mule was then detached from the empty "trip" and used to pull the full cars back to the car being loaded, usually the last one of the previous empty trip; or if they had all been loaded the full cars were pulled back as near the face as possible. The empty cars were then hauled up to the full ones and tipped off the track on their sides out of the way. All of this work was performed by the mule driver alone, except when the shovelers had completed the loading of the empty cars, when they assisted wherever possible in order to expedite the work. After seeing that the cars of the full trip were properly coupled up, the driver then started with them for the dump and the muckers took the two empty cars nearest the portal, set them on the track, and trammed them to the face where one car was again tipped off on its side while the other was being loaded. Unless the mule driver was delayed in getting to the heading so that he did not arrive before all of the cars of the previous trip were filled, the operation of getting the loaded trip out of the heading and an empty car again in position to be loaded rarely occupied more than three to five minutes. The remainder of the cycle was similar to that just described for the Laramie-Poudre tunnel, each full car being trammed a short distance beyond the last one of the empty trip, which was then taken up to the face and thrown on its side ready for use without delay when needed.

The use of steel floor plates from which to shovel rock broken by the blast has become so general that mention of this feature of mucking should hardly be necessary. Even the most cursory study of the efforts of the men in pushing the shovels into the rock pile along the uneven surface of the bottom of the tunnel, and comparing the time required to load a car with results at other tunnels where steel sheets are in use, should make it evident that much energy and time is being wasted needlessly. It cannot be denied that a man can work to much better advantage and handle more rock during a given time if he shovels from a smooth surface. When he is shoveling from the pile the shovel can rarely be pushed more than an inch or two without encountering a piece of rock too big to be shoved aside, and there must therefore be a distinct stop.

EFFECT OF AGE AND CURING ON THE STRENGTH OF CONCRETE.

THE opinion is commonly expressed that the strength of concrete increases with age. It is quite true that the relation of the strength of concrete to its age is a vital consideration of the efficiency of the material. There are a number of factors, however, that have a bearing upon this relation. The rate and magnitude of the increase in strength of concrete depends primarily on (1) the nature of the ingredients, (2) proportion of cement and aggregate, (3) percentage of water, (4) thoroughness of mixing, and (5) conditions of curing.

A great deal has been said and written concerning the first four of these factors. There has been a need for information, however, concerning the relation of strength of concrete to its age for the most common curing conditions, and some results obtained by Professor M. O. Withey, of Wisconsin University, are of considerable value in this respect. These tests, as described in the Wisconsin Engineer, belong to a series of experiments lasting over twenty years and involving 450 concrete specimens. On account of the impossibility of covering all the variables effecting this particular problem, Prof. Withey decided to vary only the proportions, age and curing conditions in the tests. The test pieces were constructed in the following way:—

The volumes of cement and air-dried aggregate required for fifteen 6-in. x 18-in. cylinders were weighed. Water was proportioned by a volumetric device placed on a calibrated tank. The concrete was mixed in a No. 0 Smith mixer. All of the materials were mixed dry for ¾ of a minute and for 2¼ minutes after the water was added. At the end of the mixing period the entire batch was immediately dumped into three wheelbarrows. In order to collect all of the mortar from the inside of the mixer, it was allowed to drain into the last wheelbarrow for about five minutes.

Metal molds for the compression cylinders were assembled on level steel plates. Every cylinder was filled about ⅓ full of concrete from each wheelbarrow and puddled with an iron rod to expel the air bubbles. After the concrete had partially set, the tops of the specimens were roughened and capped with a thin layer of 1:1½ mortar.

Neat cement and mortar test pieces were made in accordance with the standard methods employed in testing cement.

After three days in the molds, the concrete specimens were marked, measured and weighed. They were then stored in a sprinkling chamber and wet twice a day for eleven days. Subsequent to this treatment the specimens were subjected to one of the following conditions:

1. Specimens were submerged in a water tank in which the temperature varied from 60° to 70° F. approximately. The water in this tank was changed frequently during the first two months and about once a month thereafter.

2. Specimens were placed end up on the ground in a cage. This cage was uncovered and had a northeast exposure so that the test pieces were subjected to atmospheric conditions prevailing in this locality. The mean temperature for the past four-year period, according to the local weather bureau, was 46.3° F., the maximum being 98 and the minimum −25° F. The mean humidity was approximately 70 per cent., with occasional departures of 25 per cent. on either side of the mean.

3. Specimens were placed end up on the ground in a cellar, the estimated range in humidity being from 50 to 75 per cent. and in temperature from 35 to 70° F. Care was taken to distribute the specimens throughout the range of testing ages so that no two specimens made in the same batch and cured under like conditions would be broken at the same age.

The neat cement and mortar test pieces were stored for one day in the moist closet and 13 days in the water bath before being subjected to the storage conditions mentioned above. The mortar specimens which were placed

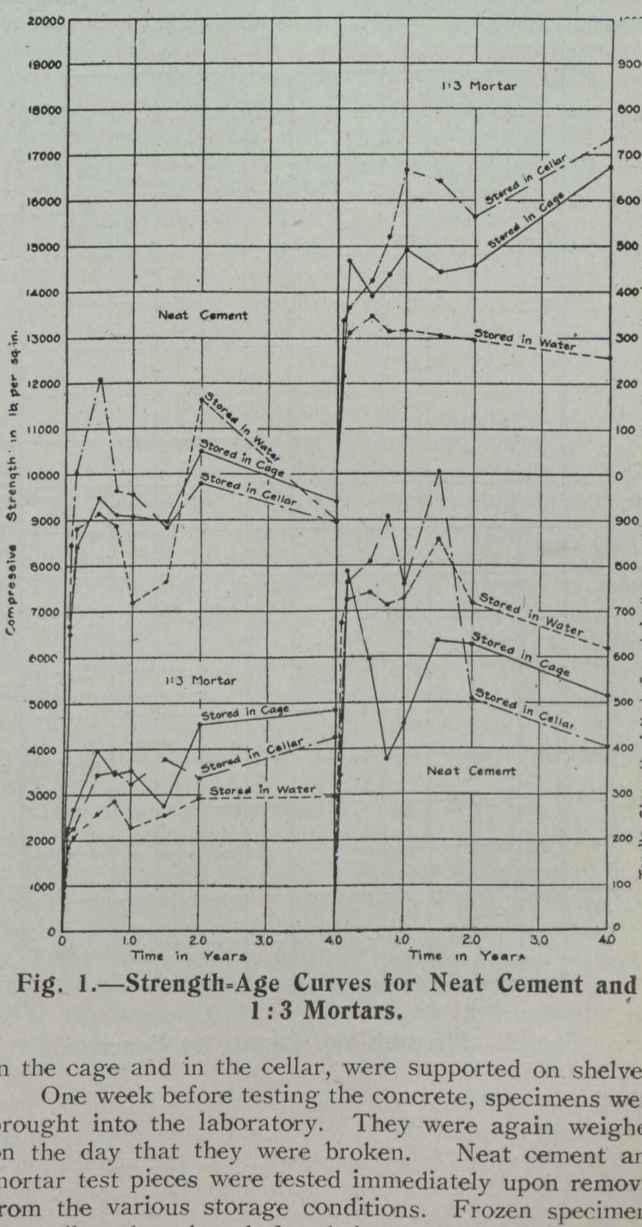


Fig. 1.—Strength-Age Curves for Neat Cement and 1:3 Mortars.

in the cage and in the cellar, were supported on shelves.

One week before testing the concrete, specimens were brought into the laboratory. They were again weighed on the day that they were broken. Neat cement and mortar test pieces were tested immediately upon removal from the various storage conditions. Frozen specimens were allowed to thaw before being broken.

After storage of one week in the cage, it was found that the soundness pats had left the glasses upon which they were made and had cracked. After four years they were seemingly in about the same condition. Pats stored in the cellar and in the water bath were sound at the end of the four-year period. Those which were stored in the cellar, however, had separated from the glasses. Neat briquettes and cubes which were stored in the cage were crazed, or hair-cracked, quite badly within a short time after they were subjected to that storage condition. Specimens subjected to the other storage conditions did not give evidence of these surface defects.

Figs. 1 and 3 give strength-age curves for the tests of neat cement and mortar specimens. Each point on the curve represents the average of three or four results. It is evident from a consideration of these curves that there is no definite law between strength and age; but there are several facts, however, worth noting. For the neat cement tensile test pieces, water storage appears to be the most advantageous. The low one-month tensile strength obtained from specimens stored in the cellar and in the cage are probably traceable to the drying action which followed their removal from the water bath. Judging from the appearances of the specimens stored in the cage, the effective cross-section must be considerably decreased by the hair-cracks. It is also quite likely that the specimens subjected to either air storage condition were more brittle than the water-cured specimens. Consequently the effect of any eccentricity in the application of the load would have a more marked weakening effect than would be the case in testing the water-cured specimens. The compressive strength of the neat specimens does not appear to have been greatly affected by the differences in curing conditions.

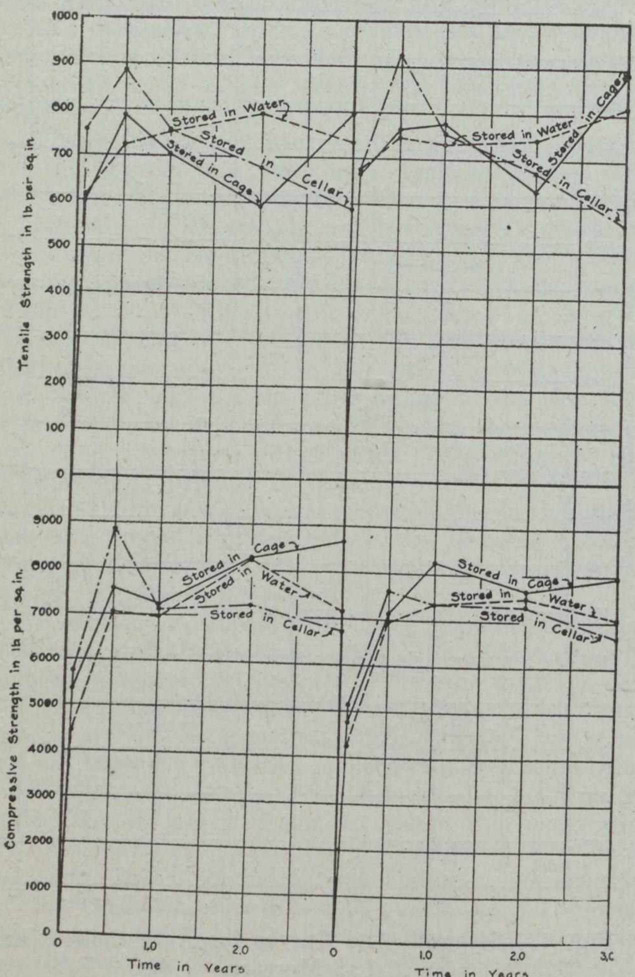


Fig. 2.—Strength-Age Curves for Concrete.

The variations in curing conditions appear to have little effect on the strength of the 1:1 mortar specimens. Apparently they reached their full strength in tension when about one month old, and in compression when six months old; thereafter the variation was not great.

From a consideration of the age-strength curves of the 1:3 mortar specimens, it appears that either air-storage condition is ultimately much more favorable to high strength than the water storage. The discrepancies in strength are most marked for the tensile tests. Why there should be such a marked difference in the effects of curving conditions on neat and 1:3 specimens is not apparent. Possibly the greater porosity and the more permeable nature of the 1:3 mortar specimens may have a bearing upon this point. It seems quite evident, from a comparison of the results of the mortar tests with those obtained from the concrete specimens, that surface effects due to storage condition must have played a very large part in reducing the strength of the small mortar test pieces. It seems probable, therefore, that mortar specimens of the same mixture but larger in size would not have varied so much in strength.

The strength-age curves for the concrete cylinders are given in Fig. 2. It will be noted that they are much more regular than those for the mortar specimens and are indicative of continued strength, whereas some of the similar curves for the mortar test pieces show a gradual decline in strength. There is, however, a marked difference in the strength of the concrete subjected to different curing conditions. At most ages the water-cured concrete shows the greatest strength with the concrete cured in the open air a close second. The average strength of the water-cured concrete is about twenty per cent. greater than that of the cellar-cured. It will also be observed that the cellar-cured specimens lost the most weight, with the air-cured and water-cured following in the order named. It, therefore, seems probable that the diminished strength of the cellar-cured concrete was due to the dryness of the atmosphere surrounding the specimens.

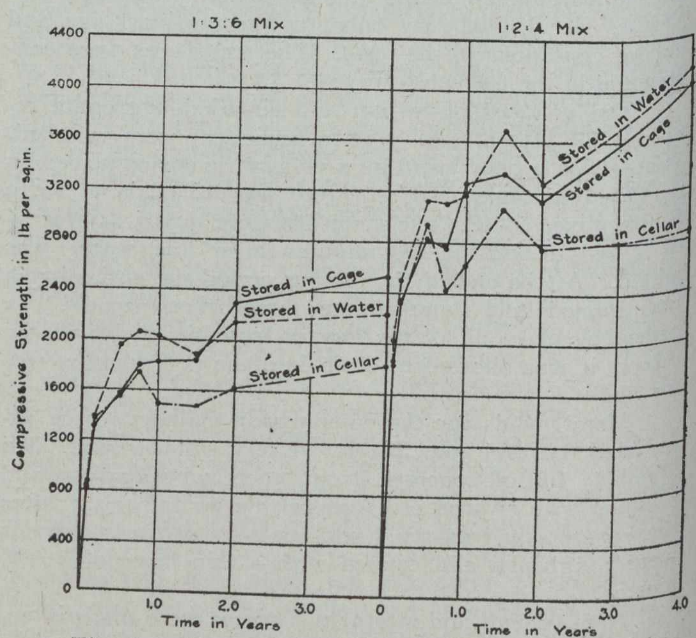


Fig. 3.—Strength-Age Curves for 1:1 Mortar.

One of the remarkable things about these tests is the effect which the moisture content in the surrounding medium has upon the concrete even after it is over a year old. Since only one brand of cement and one set of aggregates were used in the main portion of these experiments, it is not possible to draw wide applications from the results obtained. Nevertheless, it seems quite apparent that, under curing conditions which will ordinarily exist in well-executed constructions in this climate, we may expect concrete to secure the major portion of its strength in about six months to a year. The rate of increase in strength thereafter will be largely dependent upon the humidity of the atmosphere. From these tests it does not appear that there is any cause for fear of a decline in the strength of normally cured material.

Editorial

ROYAL COMMISSION ON SEWAGE DISPOSAL, GREAT BRITAIN.

After sixteen years' work, the ninth and final reports of the Royal Commission on Sewage Disposal were issued on March 31st, 1915. Previously submitted reports of this investigation have been commented upon in these columns as they appeared. The ninth report deals with the discharge of manufacturing waste that cannot be removed through sewer systems, and also with the disposal of refuse in rural districts. A summary of this report appears elsewhere in this issue.

The Royal Commission has done a great deal toward standardizing and placing before sanitary and municipal officials in Great Britain all available information pertaining to the subject. The first report was of an interim character and merely presented some conclusions concerning effluent and sewage purification. The second covered the purification of domestic sewage discharging into streams as presented in a number of scientific papers. The third dealt with the discharge of manufacturing effluents and the relations between local authorities and manufacturers. The fourth was of a somewhat special nature and pertained to the pollution of tidal waters with special reference to the contamination of shell fish. The fifth report took up again the purification of domestic sewage, dealing chiefly with the relative merits of the various methods available for town sewage purification. This report was an exceedingly useful and important one, and the recommendations contained therein have been largely adopted by the Local Government Board and applied to many systems recently installed. The sixth report dealt with the purification of distillery wastes. The seventh had to do with nuisances due to green seaweeds in sewage-polluted estuaries. The eighth took up the question of standards to be applied to sewage discharging into streams and of the determination of these standards by tests. This fixation of a general standard was a decided advance upon previous accomplishments with respect to disposal work. It contained provisions for the fixing also of special standards to cover special conditions. The object of the proposal was to devise "a system whereby a local authority should not be required to incur any further expenditure on sewage disposal than would suffice to prevent the occurrence of actual nuisance." The subject matter of the ninth report is as noted above. The final report is a recapitulation of the conclusions of the earlier ones.

The benefit of the work of the Commission to the sanitary side of engineering, when considered in connection with the immense annual expenditure involved in the matter of sewage disposal, places the findings and recommendations among the most important works upon the subject. It is quite true that conditions vary in different localities and in different countries, and that the report deals primarily with conditions obtaining in England. But at the same time there are numerous conclusions and presentations to which sanitary engineers in other countries have and are directing their attention. Canada has her own problems in this regard, and those who are bent upon solving those problems appreciate the immense amount of labor which the Royal Commission has accomplished and brought to a close in Great Britain.

T. H. & B. GRADE SEPARATION, HAMILTON.

In our issue of September 4th, 1913, we gave an outline of the railway situation in Hamilton as it stood at that date. Since then considerable progress has been made—at least the problem seems to have been narrowed down to something more definite. At that time the city was applying to the Dominion Railway Board for an order to compel the T. H. & B. Railway to move its tracks from their present location on Hunter Street in the centre of the city to a common right-of-way along the G.T.R. tracks in the northern section. The case was argued before the Board in December, 1913, and the Board ruled that it had not the power to order the deviation of the railway more than one mile from its present location. As part of the proposed common right-of-way lay more than this distance from the T. H. & B. the city gave up the idea of forcing the railway to move.

At the meeting of the Board in Hamilton on December 10th, 1914, the original petition was pressed, *viz.*, that the railway be ordered to depress its tracks through the centre of the city. The railway presented its alternative scheme for elevating its tracks. In order to get those two propositions on a common basis it was arranged to have a meeting of the engineers of the parties interested to go over them and agree on the estimates of cost. Meetings have since been held in January and April 7th, 1915, in Ottawa, and on February 10th, in Hamilton. The outcome of these meetings has been some modification of the plans as outlined in the article referred to above. The estimates of cost as now agreed on are as follow:—

For track elevation	$673,000
For track depression	965,700

These figures are exclusive of land damages.

The matter is now in shape for consideration by the Board and they will probably take it up in the near future.

The attitude of the present Hamilton Board of Control and Council toward this question is apparently not one of aggression. One of the controllers is recently reported to have stated: "If the T. H. & B. desires grade separation and is willing to pay for it, the city has no objection, in fact, I think, would be pleased, and, if the city council has any say in the matter, I believe, would prefer track depression to track elevation." Other members of the council, however, who have carefully studied the two schemes, feel that the city could afford to pay handsomely for the removal of the tracks from Hunter Street and the opening up of streets now practically blocked rather than permit an embankment to be built through the centre of the city and have several main streets depressed through subways. However, at most, the friends of the depression scheme do not seem to expect immediate action, but if the question could be decided favorably now it would at least relieve the present uncertainty of a large number of property owners who might be affected one way or another.

To aid legislatures in revising road laws and framing new road legislation, a series of papers dealing with existing road laws in each state will be issued under an arrangement made by the American Highway Association with the Bureau of Municipal Research of New York City.

ARTIFICIAL CONTROL SECTIONS FOR RIVER MEASUREMENT STATIONS.*

By John C. Hoyt, C.E.,
Hydraulic Engineer, in Charge Division of Surface Waters, U.S. Geological Survey.

THE elevation of the water surface of a stream flowing in an open channel is determined from point to point by a succession of controls that may conveniently be referred to as control sections. These control sections of the stream may be dams or weirs, crests of rapids or abrupt falls, bars of rock extending across the river, or, where the channel is permanent and the slope is uniform, long stretches of the river bed. The water surface above each control section is determined by the height of water at the control section.

Computations of daily discharge are based on the assumption that so long as the character of the river at the control section remains unchanged the discharge will remain constant for the same stage and will vary with the stage according to some definite law. It is, therefore, possible to determine the daily flow of streams with permanent controls by a comparatively few discharge measurements and daily observations of stage. Unfortunately, however, the beds of many streams are composed of materials which render them liable to frequent changes in cross-section, which destroy the relation between stage and discharge and make the determination of daily discharge difficult.

For the past two years the water resources branch of the U.S. Geological Survey has been experimenting with various types of structures for the improvement of the channels of changeable-bed rivers, in order to obtain permanent control sections. These experiments show that on many streams it is feasible to construct at a reasonable expense controls that will insure conditions sufficiently stable to permit the use of ordinary methods in determining the daily flow.

In the design and construction of a control, care must be taken not to modify the cross-section or alignment of the stream to such an extent as to change the natural conditions of approximate equilibrium. Therefore, the control should follow closely the natural bed of the stream and should not project far into the channel.

In addition to maintaining a constant relation between discharge and stage, the control section also determines the relative change in stage corresponding to a given increment in discharge. This relation is spoken of as the sensitiveness of the station. For example, a station at which the addition of 100 second-feet discharge will change the stage .02 of a foot would be considered less sensitive than one at which this discharge will change the gauge height a tenth of a foot or more. The accuracy of records for a station will vary with its sensitiveness.

The most successful control so far constructed consists of a low submerged dam which in many places may be made on a reef or bar of gravel or boulders by grouting with cement. In other places it may be necessary to excavate the bed and build a concrete structure or to drive sheet piling across the section nearly flush with the bottom. Such structures will tend to prevent scour and at the same time so limit the channel that the natural current reduces the probability of silting.

Structures which project far into the cross-section of the stream will usually destroy the sensitiveness of the station and, in addition, will so interfere with the natural condition of flow that counteraction is set up, making them hard to maintain.

The construction of artificial controls make it possible to obtain accurate records of the flow of streams on which, prior to the use of such controls, accurate records could not be obtained except at great expense. The cost of constructing control sections on ordinary small streams ranges from $10 to $100; the cost of operation of a station with a permanent control is reduced to a minimum by the small number of meter measurements that are necessary.

*Cornell Civil Engineer.

RETAINING WALLS FOR SOFT FOUNDATIONS.

IN railway work the occasion frequently arises where a retaining wall is to be built on soft and insecure underlying ground, and where the whole of the railway company's right-of-way is valuable, under these conditions the proper selection of the type of wall is somewhat of a problem. In such a case the functions of a retaining wall are:—

(1) It should retain the railway embankment laterally.

(2) It should be vertical or nearly so to avoid reduction of width of right-of-way.

Of the several types in use, *viz.*, the heavy front batter mass wall on natural foundation, the block wall, the cellular wall and the mass wall on piles, the following advantages and disadvantages are noteworthy:

The block wall is economical; settlement in an irregular manner will not be conspicuous; it may be constructed in several stages; it does not occupy much space before filling. As disadvantages the heavy front batter causes a waste of property which will encourage encroachments, and unless built with a smooth front batter will encourage trespassing. Because of its loose-jointed nature, the block wall does not, under some circumstances, possess as much of a potential factor of safety against the unforeseen contingency as a monolithic structure.

The heavy batter mass wall is economical but will cause criticism if it settles or tips appreciably, and is subject to the same objections as the block wall on account of the heavy front batter.

Advantages of the cellular wall: It occupies the right-of-way in such a way as to afford little opportunity for encroachment. It may settle considerably, but offers great resistance to overturning or sliding. It permits of ready driving of a pile trestle directly over it. Disadvantages: It occupies considerable space before filling and may thus interfere with the use of tracks. Settlement may also give an unpleasing appearance.

The mass wall on piles gives maximum security, but is expensive and may lead to difficulties, because of possible damage, which the pile driving may do to adjacent buildings on insecure foundation, a consideration which was given much weight in the search for a substitute for the structure on piles.

These conclusions are from the result of an investigation carried out by the Chicago, Milwaukee and St. Paul in the course of about 1½ miles of grade separation work in Milwaukee. Improved ground, attended by considerable settlement, led to a study of various types and to tests of the block and cell walls. Of the two, the cell wall is being favored in Milwaukee on account of the fuller utilization of the right-of-way. A full report of the tests performed appears in a paper read before the Western Society of Engineers by Walter S. Lacker, on February 8th, 1915.

Coast to Coast

Dauphin, Man.—A good roads convention opened here on April 21st.

Vancouver, B.C.—Members of the Dominion Shell Committee were in the city last week arranging for the letting of local contracts for the manufacture of shrapnel shells.

Newmarket, Ont.—The site of the 100,000-gallon reservoir under construction in connection with the water supply extensions has been completely excavated and concrete work is about to start.

West St. John, N.B.—The military camp of the Canadian Pacific Railway overseas construction corps is being established here, Col. C. W. P. Ramsey, formerly engineer of construction for the C.P.R., commanding.

Lillooet, B.C.—The Pacific Great Eastern Railway bridge across the Fraser River here has been practically completed. The steel rails have been laid upon it and track-laying is being advanced toward Prince George.

Winnipeg, Man.—The city has 28,653 water meters in use, 93 new meters being added since the beginning of the year. Operation of the waterworks system since January 1st has cost $35,081.10, of which $1,397.17 was the cost of repairs to meters.

Hull, Que.—A substitute for gasoline is claimed to have been found by Mr. Gideon Charbonneau, a local chemist. At a test before officials of the Department of Public Works, Ottawa, last week, it is unofficially reported that two tablespoonfuls of the fluid, which he calls Charbo-oil, ran a 2¾ h.p. engine for 1½ hours continuously. The discoverer claims that the liquid can be manufactured at 4 cents per gallon. It does not emit smoke or odor.

Ottawa, Ont.—A good example of water waste has been revealed by the city engineering staff. The city supplies the village of Rockliffe on the same basis (flat rate) as its own residents. A test made by the city waterworks department between March 2 and 10 disclosed the alarming fact that the 58 householders in the village are using 1,725 gallons of water daily each, which means that over 100,000 gallons of water is being supplied every 24 hours to the 58 Rockliffe families who take water from the city.

Victoria, B.C.—On the Victoria breakwater at Ogden Point, about 7,000 cubic yards of concrete have been laid to date. Of this amount 2,361 cubic yards were laid in March. Some 844,911 tons of rubble and core filling (which is composed of fine rock) have been dumped on the site of the breakwater, and about 29,040 tons of granite block have been used in facing the sides of the breakwater below water level. A considerable section of the breakwater is now visible above the water line. Sir John Jackson, of Canada, Limited, are the contractors.

Victoria, B.C.—The establishment of a copper refinery on the coast, to reduce copper matte and blister copper from the smelters in the province is under consideration. A conference was held last week, attended by Dr. A. W. G. Wilson, chief of the metal division of the Department of Mines, Ottawa, and Dr. A. Stansfield, Birks professor of metallurgy, McGill University, the mining committee of the Vancouver Board of Trade, and representatives of the Granby Consolidated Mining and Smelting Co., the Britannia Mining Co., and other copper-producing concerns.

Ottawa, Ont.—Construction work is progressing rapidly on the new customs warehouse on Sussex Street. The contractors commenced operations in July, 1913, and the specifications call for its completion within thirty months. About $600,000 has already been spent on the structure. Serious difficulties were encountered in the work of excavation. The west side of the building rests on a ledge of solid rock, but the east wall descends some 140 feet through an old river bed, and rests on solid rock supposed to have been the river bottom. The Foundation Company of Montreal placed the foundations, and Peter Lyall & Company of Montreal are erecting the building.

Britannia, B.C.—The 4,000-ft. tunnel at present under construction at the Britannia mines, is again resuming signs of activity, following the serious destruction of the camp by an avalanche some months ago. It is unlikely, however, that actual mining will be proceeded with for several months at least. The present work is of an interesting nature. The mining camp was at an elevation of 3,250 feet, while the tunnel is at an elevation of 2,250 feet. The tunnel mouth is just to the side of the course followed by the slide, and remained undamaged. The tunnel runs in, as stated, 4,000 feet, and the upraise will, it is estimated, be about 1,000 feet and will strike just behind the location of the old camp. Two shafts will be put in and the ore will be dropped down to the main tunnel, through which it will be removed in future. An aerial tramway was previously used.

PERSONAL.

WILLIAM MURDOCK, city engineer of St. John, N.B., addressed the Calgary Branch of the Canadian Society of Civil Engineers last week, his subject being engineering problems in the city of St. John.

G. W. BRITNELL has been appointed sales manager at Toronto of the Sarnia Metal Products Company.

S. A. LANG, B.A.Sc., who went to Chile a year ago to engage in metallurgical work for the Beaden Copper Company, has been promoted at Rancagua to head of the sampling department.

J. G. G. SULLIVAN, chief engineer of western lines of the C.P.R., read a paper at the last meeting for the season of the Western Canada Railway Club, Winnipeg, on the construction of the Roger's Pass Tunnel.

H. S. JACOBY, who was for some time chief engineer of the Standard Steel Construction Co., Limited, at Welland, Ont., has accepted a position on the staff of the faculty of civil engineering at Pennsylvania State College.

E. R. GRAY, B.A.Sc., has been recommended by the board of control and city engineer of Hamilton, as assistant city engineer for that city. For a number of years Mr. Gray has been assistant engineer in the sewer department, city of Toronto.

R. D. BROWN, A.M.Inst.C.E., who returned to Scotland in February last, resigning his position as an assistant engineer on the shaft of the New Welland Ship Canal, has been appointed assistant borough surveyor of Helensburgh, Scotland. Mr. Brown was formerly city engineer of St. Catharines, Ont.

J. A. TILSTON, of the staff of the Toronto Hydro-Electric System; R. E. HEWSON, of the staff of the Toronto Harbor Commission; W. G. FRENCH and W. D. POWELL, fourth year students in engineering, University of Toronto, have been enlisted in the C.P.R. Overseas Construction Corps, and left for the camp at West Vancouver on April 17th.

OBITUARY.

On April 10th the death occurred at Windsor, N.S., of J. W. Churchill, one of the pioneers of the shipbuilding industry in Nova Scotia.

The death occurred in Halifax on April 12th of Mr. Charles F. Mott, whose activity in manufacturing and mining circles some years ago was extremely well known, particularly when gold mining had created considerable interest in the province of Nova Scotia. At that time he owned the Dufferin mine at Salmon River.

On April 18th Mr. A. J. Wilson, manager for the past 18 years of the Linde Canadian Refrigerator Company, Toronto, died suddenly during an attack of heart trouble. The deceased was 39 years of age.

The death has been announced of Lieut.-Col. Lacey R. Johnson, general welfare agent of the Canadian Pacific Railway. Deceased was in his 60th year. He had been connected with the C.P.R. since 1882 and was for some time general superintendent of the Angus shops. Col. Johnson was to have addressed the Canadian Railway Club last week on "Modern Heavy Guns, as Used in the Present War," had not his serious illness, due to peritonitis, confined him to his bed. The deceased was a native of Berkshire, England.

OTTAWA BRANCH, CANADIAN SOCIETY OF CIVIL ENGINEERS.

The last luncheon meeting for this season was held on April 15th. It was addressed by Hon. Sir George E. Foster, Minister of Trade and Commerce.

EDMONTON BRANCH, CANADIAN SOCIETY OF CIVIL ENGINEERS.

At the regular meeting of the Edmonton Branch, Canadian Society of Civil Engineers, held on the 7th inst., Mr. W. F. Ferrier, B.A.Sc., F.G.S., mining engineer and geologist, addressed the engineers on "A Mining Trip to Prince William Sound, Alaska, in the Early Stages of Development." Mr. Ferrier illustrated his address with a large number of interesting views taken on his trip into that country, including photographs of Latouche Island, Prince William Sound, the objective of Mr. Ferrier's visit. This island was supposed to contain a large deposit of copper ore, and Mr. Ferrier's visit was to investigate the value of this deposit. Numerous open-cuts were made and a cross-cut driven through the ore body for 64 feet. Owing to the very deep snow and unskilled labor, work was attended with considerable difficulties, but the examination was finally successfully accomplished. It might be mentioned also that as the result of Mr. Ferrier's examination, the mine was developed and proved to be an extremely profitable investment.

Not the least interesting part of the lecture were the descriptions and photographs of the methods of transportation in the early days of the development of that country.

The following have been elected to the Canadian Society of Forest Engineers: Active member, Mr. Gutches, Forest Supervisor for Alberta, and for associate membership, Mr. Geo. Tunstell, Mr. Davis W. Lusk, Jr., Mr. Geo. S. Smith and Mr. W. J. Boyd, all of the Dominion Forest Service.

TORONTO BRANCH, CANADIAN SOCIETY OF CIVIL ENGINEERS.

The regular monthly meeting of the Toronto Branch of the Canadian Society of Civil Engineers is being held to-night (April 22nd) at the Engineers' Club, and is being addressed by Mr. H. S. Van Scoyoc, chief engineer of the Toronto-Hamilton Highway Commission, his subject being "Concrete Highway Construction." The address is to be illustrated with lantern slides. Mr. J. R. W. Ambrose is chairman of the Branch.

PAN-AMERICAN ROAD CONGRESS.

At a meeting of the executive committee of the Pan-American Road Congress, held in New York, N.Y., April 16, it was definitely decided to hold the congress at Oakland, Cal., during the week of September 13. This date was fixed upon because it was felt that it would enable engineers who would attend the International Engineering Congress to attend the Pan-American Road Congress as well.

It is expected that this congress will bring together those interested in highway improvement—not only from all parts of the United States and Canada, but also from the South American countries—all of whom will be invited officially to participate. The Pan-American Road Congress will be held under the joint auspices of the American Road Builders' Association and the American Highway Association.

COMING MEETINGS.

AMERICAN WATERWORKS ASSOCIATION.—The 35th annual convention, to be held in Cincinnati, Ohio, May 10th to 14th, 1915. Secretary, J. M. Diven, 47 State Street, Troy, N.Y.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.—Annual meeting to be held at the Iowa State College, Ames, Iowa, June 22nd to 25th, 1915. Secretary, F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Annual meeting to be held in Atlantic City, N.J., June 22nd to 26th. Secretary, Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Annual convention to be held in San Francisco, Cal., September 16th to 18th, 1915. Secretary, Charles Warren Hunt, 220 West 57th Street, New York.

INTERNATIONAL ENGINEERING CONGRESS.—To be held in San Francisco, Cal., September 20th to 25th, 1915. Secretary, W. A. Catell, Foxcroft Building, San Francisco, Cal.

AMERICAN ELECTRIC RAILWAY ASSOCIATION.—Annual convention to be held in San Francisco, Cal., October 4th to 8th, 1915. Secretary, E. B. Burritt, 29 West 39th Street, New York.

The Nova Scotia Engineering Society will be addressed on April 23rd by Mr. George Henderson, of Brandram-Henderson, Limited, the subject being "Paints for the Protection of Structural Steel."