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THE RED RIVER BRIDGE FOR THE NATIONAL TRANSCONTINENTAL RAILWAY

By D. C. TENNANT.

The double track bridge over the Red River for the National Transcontinental Railway, has presented, both in design and construction, many very interesting problems. To such an extent is this true, that there will be room in this paper for only a general description of the more important features. The whole bridge, with its approach spans, comprises a length of almost half a mile. The bridge over Water Street, Winnipeg, shown at the left-hand side of plate No. 1, is the most westerly work of the Transcontinental Commission. Beyond this point the line is being constructed by the Winnipeg Terminal Co., for the Grand Trunk Pacific and Canadian Northern Railways.

Coming from the east, on the St. Boniface side of the river, the double track road is carried on an earth embankment with side slopes of one and one-half horizontal to one vertical, and the first span is a deck plate girder with solid floor, spanning a 67 ft. 2 in. clear opening at Taché Avenue. After another short stretch of earth embankment the road is carried over two spur tracks of the Canadian Northern Railway by a 58 ft. through plate girder span with floor beams, stringers, and wooden ties. This brings us to the main bridge over the Red River itself, and first we have four 150 ft. 0 in. C. to C. double track through truss spans, the most easterly one having one end supported on the same pier that carries the end of the girder span already mentioned, and the others resting on piers 1, 2, 3 and 4, which are carried down to rock in the bed of the river. Red River is navigable at this point for fairly large steamers, and a clear waterway of about 110 ft. width was required. As the bridge was at no great height above the water it became necessary to provide a span of some movable type. The deepest channel being near the Winnipeg shore where economy of space is ever becoming a more important consideration, it was decided to use a Strauss Trunnion Bascule span. The moving leaf—129 ft. 6 in. long C. to C.—is towards the east, the toe resting when the span is closed on pier No. 4, which also carries the end of one of the one hundred and fifty foot fixed spans. The counterweight tower is forty feet long C. to C., spanning between piers Nos. 5 and 6. Westward from this there is a viaduct crossing over two tracks of the Winnipeg Transfer Co., a spur railroad track, Mill Street, and a lane. As these are all

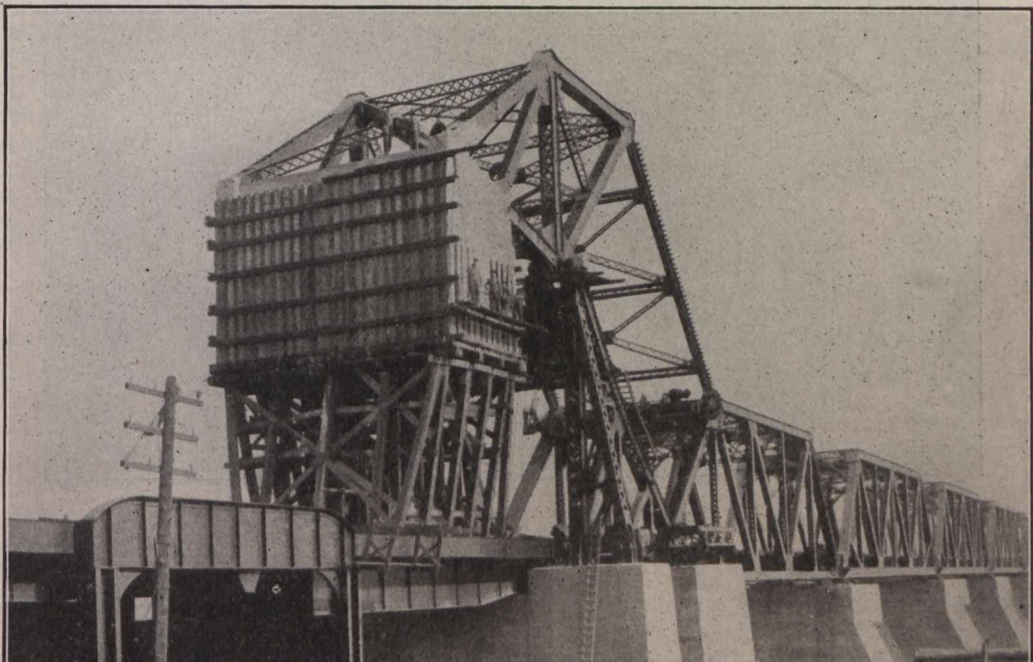


Fig. 1.—View Taken from the South Side Looking East.

crossed on the skew, and as the line of the Transcontinental commences to curve to the south at a short distance beyond the Bascule span, it will be readily understood that the actual size of this viaduct, though not inconsiderable, gives a most inadequate idea of the amount of work in the design and manufacture. The curve continues to the west and south, the tracks being carried on an earth embankment with vertical retaining walls of concrete. The embankment is pierced at four points: first by Thistle Lane and a spur track, next by another spur track and then at Notre Dame Street and at Water Street, the opening at Notre Dame Street being 66 ft. 0 in. clear, and that at Water Street 60 ft. 4 in. clear. In general, the floors of the viaduct and of the isolated spans forming this western approach are similar to that of the Taché Avenue bridge, consisting of four deck plate girders, two under each track, carrying a concrete floor and ballast. The concrete floor is supported on I beams running across the tops of the deck girders and cantilevering out on each side supporting longitudinal facia girders. In the viaduct, and at Notre Dame and Water Streets, the main girders are carried on posts and heavy cross floor beams. Where the tracks cross under the viaduct, through plate girders were used instead of deck girders, to give the necessary headroom. At the two small openings in the embankment, for Thistle Lane and the two spur tracks, the solid floor was not necessary. A through girder span with four stringers under each track was used at Thistle Lane, and at the other opening the stringers rest directly on the retaining walls, without floor beams or side girders. As shown on Plate No. 1, the main bridge, with its long curved tail of a western approach spotted here and there with small bridges, resembles a huge rocket fired from Fort Garry station, which is only a fraction of a mile farther west.

Fig. 2.—View Showing Viaduct and Erection Traveller.

The general design of substructure and superstructure was made in the Bridge Department of the Transcontinental Railway. The designing of the details of the whole of the steel work was made by the Dominion Bridge Company, of Montreal, the Strauss Bascule Bridge Company, of Chicago, furnishing the drawings and details of the Bascule span, from which the shop drawings were prepared. All detail shop drawings were made by The Dominion Bridge Co., and the steel work was manufactured by them at the Lachine shop and erected by their own erection department. The contractors for the substructure, including piers, pedestals, retaining walls, etc., were Messrs. Haney, Quinlan and Robertson, Toronto. The entire structure was completed at the end of the year 1911.

The river piers, numbered from 1 to 6 on Plate No. 1, are of concrete construction and of the dimensions shown in the plate. It has been stated that this is the only bridge in the vicinity in which the foundations rest on solid rock. The abutments and retaining walls on land are not carried down to bed rock, but rest on piles driven into the superstratum, which is a thick clay. The drawings of all concrete foundations were prepared by the National Transcontinental Railway.

The steel work was designed in accordance with the general specifications for steel superstructures of the Department of Railways and Canals, of 1908. The assumed live load was the two standard locomotives followed by the uniform train load, belonging to class "Heavy" of the specification, or a load of 120,000 lbs. on two axles 7 feet apart, whichever gave the greater stress. This live load is given in detail on Plate No. 1, and is the live load for which all Transcontinental Railway bridges are designed. To provide for impact the resultant from the dead and live load stresses is increased by the quotient of the square of the live load stress divided by the sum of the dead and live load stresses. In spans under 80 ft. in length a further allowance is made for impact by multiplying the live load by the factor $\left(1.40 - \frac{L}{200}\right)$ in which L = the length of the loaded distance in feet, which produces the maximum stress. The permissible unit stress in tension on medium steel was taken at 16,000 lbs. per square inch. The allowable stress for compression was:

$$\frac{16,000}{1 + \left(\frac{L^2}{9,000 R^2}\right)}$$

L and R both being in inches.

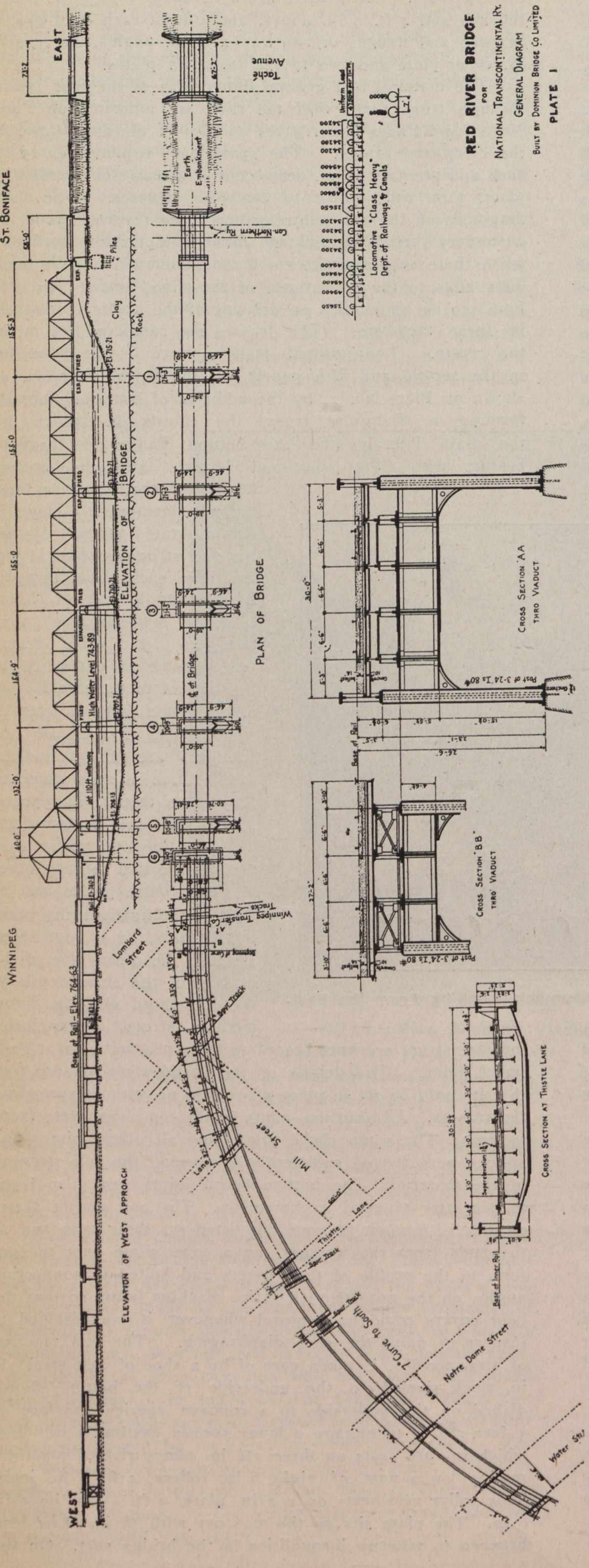
but in no case was the stress in compression allowed to exceed 13,000 lbs. per square inch. In the Bascule span the maximum allowable stress in either tension or compression with the bridge moving was 13,000 lbs. per sq. inch. The permissible stresses in shop rivets were for shear 10,000 lbs. per square inch, and for bearing 20,000 lbs. per square inch. All field rivets being driven by power, the number was increased ten per cent. over the number necessary for shop rivets. All rivets throughout the work were made ⅞ inch diameter.

The deck span over Taché Avenue has a cross section similar to that shown on section B.B. on Plate No. 1. The cross beams carrying the concrete floor are 9 in. I's at 21 lbs. spaced 18 in. centre to centre. These rest on the top flanges of the four main girders and cantilever out to the sides supporting facia girders 27 ft. 2 in. apart. The facia girders consist each of a 30 x 5/16 in. web with two 3 x 3 x 5/16 in. angles forming the top flange, and one 3 x 3 x 5/16 in. angle at the bottom. The top flange of the facia girders is set 4 inches above the base of the rail. The 9-in. cross beams support a concrete slab 10 in. thick, the top of which is 2¼ in. above the top of the beams. This concrete slab supports 14 inches of ballast, the top of the ballast being level with the base of rail, so that the top of the 9-in. beams is 16¼ in. below the base rail, or 20¼ in. below the top of the facia girders. The beams are connected to the facia girders with web connections and the girders are stiffened with vertical gussets from the top of every fourth cross beam. At the abutment there is an apron plate spanning from the last cross beam to the top of the ballast wall. The four main girders span the whole width of the street without posts, making a length centre to centre of end bearings of 71 ft. 0 in. They each have a 72 x 7/16 in. web plate and top and bottom flanges of two 8 x 8 x ¾ in angles, two 18 x 11/16 in. cover plates, and one 18 x ⅝ in. cover plate. These four girders are spaced traversely, making three equal spans of 6 ft. 6 in. centre to centre. There are no top laterals, as the concrete floor forms a most effectual bracing. The two girders under each track have a bottom lateral system, and all four girders are connected together with brace frames, spaced about twelve feet apart longitudinally. The pier members are of the Standard Transcontinental type, consisting of a heavy cast iron bed plate with a turned spherical disc surface on top, and a thick shoe on the girder dished on the under side to suit the disc, the shoe plate and casting together making a height of about 1 ft. 4 in.

In the 58-ft. through span over the spur tracks of the Canadian Northern Railway, the standard open floor of the Transcontinental was used with 8 x 10 in. ties notched ½ in. over the stringers, and laid in two lengths of 13 ft. 6 in. butting in the centre of the bridge, making the outer ends 7 feet from the centre line of the track. It was necessary to have 22 ft. 6 in. clearance from the base of rail of the spur tracks to the under side of the bridge, but only for a width of 7 feet over each track. It was, therefore, possible, by arranging the floor-beams to come between the tracks of the Canadian Northern, to allow their bottom flanges to be about 2 feet lower than the bottom of the stringers and main girders. The side girders are 31 feet apart and the bending moment on the floor beams consequently large, so that the extra depth thus obtained for them was most desirable. The cross section of this span is typically the same as that shown for Thistle Lane on Plate No. 1, but the outer rail has no superelevation as at Thistle Lane, and there are but two lines of stringers under each track instead of four. This span is divided by the two floor beams into three panels. The stringers—two under each rail—are built girders, 30¼ in. deep. The floor beams have 60 x ⅜ in. webs and a flange composed of two 8 x 8 x ¾ in. angles, one 17 x 11/16 in. plate and one 17 x ⅝ in. plate. The bottom flange is curved up at the ends to meet the bottom of the main girders. The girders are 8 ft. deep, 3 ft. 3 in. below the rail and 4 ft. 9 in. above, and consist each of a 96 x ⅜ in. web and flanges of two 8 x 8 x ¾ in. angles, one 17 x ⅝ in. cover plate and two 17 x ½ in. cover plates.

Fig. 3.—Curved Western Approach, Looking From the East.

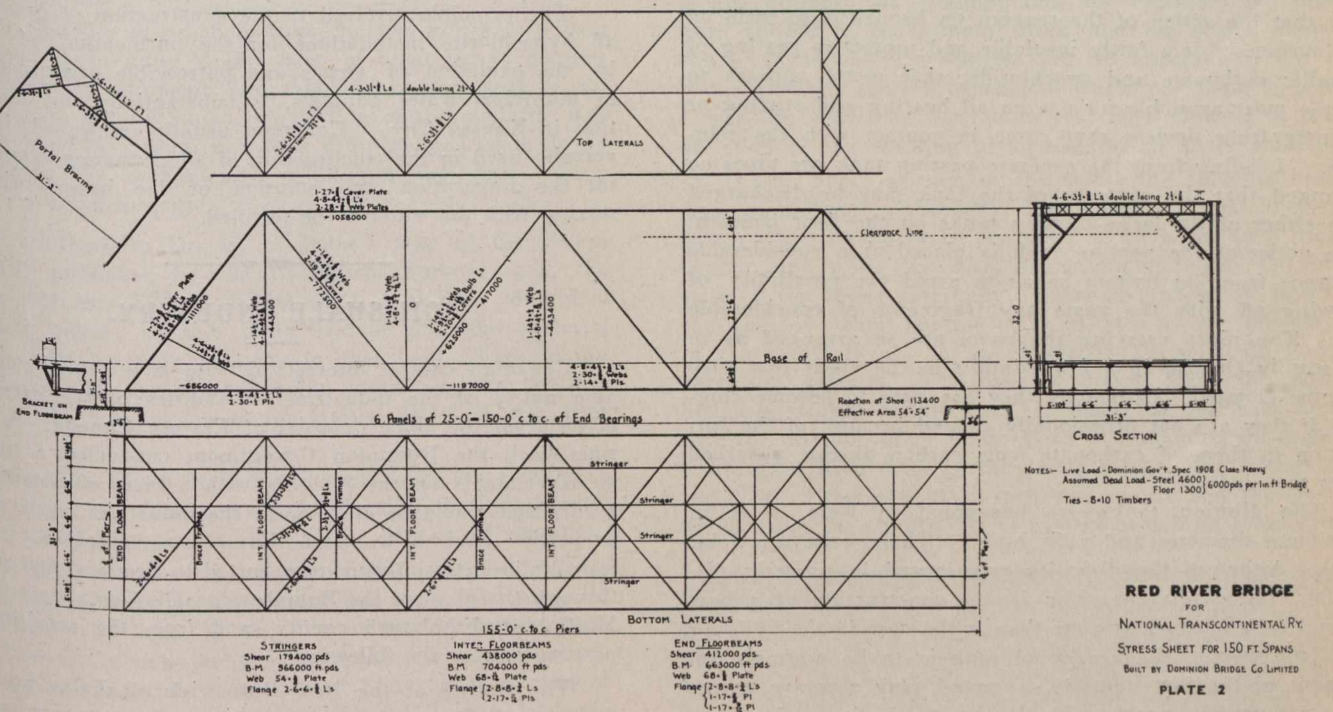
The material and general dimensions of the four 150-ft. through truss spans over the river are indicated on Plate No. 2, and Photo No. 1 gives an idea of the appearance of the completed bridge. The spans have 6 panels of 25 ft. each and are 32 ft. 0 in. deep, centre to centre of chords and 31 ft. 3 in. wide centre to centre of trusses. The main diagonals in the two centre panels were reversed from the customary direction, making them compression members when there is a symmetrical arrangement of the live load. This adds to the appearance of the truss, and it was also found to be economical on account of the reversal of stress in these members. The trusses are cambered 1⅛ in. at the centre. Longitudinal tractive force is provided for in the second and fifth panels of the bottom laterals, as shown on Plate No. 2, by the addition of some sub-laterals forming a triangular truss, the chords of which are the main laterals and the bottom flange of the floor beams, while the additional laterals and the bottom flanges of the stringers form the web members. There is no separate lateral system for the stringers, but at the centre of each panel there is a continuous line of brace frames, between the four stringers, and the centre brace frame is connected at the bottom to the intersection of the main bottom laterals. The bottom flanges of the stringers are also connected to the main laterals wherever they cross them. The portal strut and the intermediate sway struts at each truss vertical are tied to each other at their centre points and to the intersections of the main top laterals, by a continuous strut on the centre line of the bridge, of the same depth as the top chord and the intermediate struts. The intermediate struts are knee-braced to the truss verticals at each panel point. The details of the portal were arranged so that it could be set in place all riveted up without spreading the trusses. All abutting joints in the top chord were faced to bear. These top chord joints and all other joints and splices were riveted sufficiently to develop the full strength of the material. The bottom chord joints were also faced as a matter of good workmanship. The end gusset plates on the bottom chord were protected on their tops and at the ends from the weather, by a cover plate bent to conform to the profile of the gussets and bolted to connection angles on the gussets with ⅞ in. machine bolts, so that the bent covers could be removed whenever it was decided to inspect or paint the shoe diaphragms. The end reaction of 1,134,000 lbs. is taken care of by a shoe of cast steel 3½ in. thick riveted to the underside of the bottom chord, dished on the underside to a concave sperical surface of 3 feet radius to engage a lower convex casting 5 in. thick which in turn rests on three 2¼ in. plates riveted together, resting on a nest of eight 6 in. rollers, 4 ft. 3 in. long. This roller nest rests on a 2 in. plate, 4 ft. 11 in. by 5 ft. 0 in. The plate sits on the masonry with ⅛ in. sheet lead between to take up inequalities in the bridge seat. On the



river piers there is an additional ¾ in. plate running continuously under the bed plate of the two adjacent spans. The spans are anchored at each corner by two 1¾ in. anchor bolts, 6 ft. 6 in. long, connecting to brackets on either side of the bottom chord, and running 2 feet into the masonry, set after the trusses are in place. It was desirable to have a fixed end next the toe of the bascule on pier No. 4, so the west ends of all four spans were made fixed and their east ends roller.

Leaving the bascule span in the meantime, let us note a few things in connection with the long viaduct of the western approach. Cross sections AA and BB on Plate No. 1 show typically the construction of the different portions. Except where the viaduct crosses over the tracks of the Winnipeg Transfer Co. and the other spur track, the cross section is as shown at BB, and similar to the span over Taché Avenue—four deck girders with 9-inch cross beams on top cantilevering out supporting facia girders. On the curve the superelevation of the outer rail is attained in the ballast of the floor. The longest and heaviest of the deck girders are the four spanning from pier 6 to the first bent. These are 54 ft. long centre to centre of bearings, and have each a 72 x 7/16 in. web and flanges of two 8 x 8 x ¾ in. angles, and two 18 x ½ in. cover plates. The smallest deck girder is one of 13 ft. 8 in. span at the 20 ft. 6 in. chord over the east side of Mill Street, and it has a 47 x ⅜ in. web and flanges of 2 ft. 6 in. x 4 x ⅜ in. angles. The 33-ft. girders have 46 x ½ in. webs and flanges, of two 8 x 8 x ¾ in. angles and one 18 x ⅜ in. cover plate, while the 36-ft. girders over Mill Street have 45 x 9/16 in. webs and flanges of two 8 x 8 x ¾ in. angles and one 18 x ⅝ in. cover plate. These deck girders have lateral bracing on the bottom flange only. In the 36 ft. 1¼ in. span over the Transfer tracks, deck girders would not have given sufficient under clearance, so through side girders were used, as shown on section AA, with one intermediate floor beam, which was skewed to suit the tracks and carries built stringers 27 in. deep, two under each track. The floor beam and the stringers were made flush on top with the 9-inch beams, so that these latter had to rest on shelf angles on the webs of the stringers and side girders; otherwise the construction is similar to the rest of the viaduct. A side view of this span is shown in Photo No. 1. The side girders are 70 in. deep. Crossing over the other spur track the span is only 23 ft. 7 3/16 in., so that there was no necessity for an intermediate floor beam or side girders, the stringers being plate girders 26 in. deep. Here, however, the supporting posts are only 19 ft. 6 in. apart transversely, and as the 9-inch beams do not cantilever it was necessary to put side brackets on the post, in order to carry the facia girders, which are 27 ft. 2 in. apart, and which are heavier than usual at this span, as they are designed to take the load of a derailed train, which load is ordinarily carried on the cross beams, cantilevering. The deck of the viaduct is carried throughout on posts and cross floor beams. The posts are 30 ft. apart crosswise for the through span and 19 ft. 6 in. elsewhere. The height from base of rail to top of concrete pedestals varies from 26 ft. 6 in. to 23 ft. 6 in. Most of the posts are made of three 24-in. I's at 80 lbs., but some are heavier, the heaviest being two at the sides of the Mill Street, composed of one 23½ x ⅝ in. web, four 5 x 3½ x ½ in. angles, and two 24-in. I's at 100 lbs. The heaviest cross girder is at the first bent west of pier 6, and has an 80 x ¾ in. web and flanges of two 8 x 8 x ¾ in. angles, two 18 x ½ in. plates, and one 18 x 7/16 in. plate. Expansion was provided for at the points indicated on Plate No. 1; an apron plate was made to cover the tops of the cross beams adjacent to the expansion joint, to prevent the ballast from falling into the opening. The base of each post was anchored to the pedestal with two 1¾ in. anchors, and where a post is in a street the base is protected by a cast iron fender filled with concrete.

The cross section of the Thistle Lane span is shown



RED RIVER BRIDGE
FOR
NATIONAL TRANSCONTINENTAL RY.
STRESS SHEET FOR 150 FT SPANS
BUILT BY DOMINION BRIDGE CO LIMITED
PLATE 2

on Plate No. 1. The floor beam was made parallel to the spur track. As the stringers were very close together it would have entailed considerable work to run a lateral system between them, so laterals were put only between the two centre stringers and between the side stringers and the main girders, the remaining stringers being connected up to this system with cross frames. The span over the next opening farther west is similar to the one at Thistle Lane, but it has no floor beam or side girders.

The spans at Notre Dame Street and Water Street have solid floors similar to the large viaduct, but the stringers are made flush on top with the cross beams and the side facia girders are carried on brackets from the post, as in the 23 ft. 7 3/16 in. chord of the viaduct. The stringers in both crossings are composed of one 44 x 9/16 in. web plate and flanges of two 8 x 8 x ¾ in. angles and one 18 x ⅝ in. plate. The facia girders are made 5 ft. 4¼ in. deep, which brings them flush on bottom with the main stringers and adds to the appearance of the bridges, as seen from the streets. In both cases there is a central bent, the posts and cross beams being similar to those of the long viaduct. In all cases where a ballast floor adjoins an abutment apron plates are used and the side facia girders are extended about 2 feet beyond the face of the ballast wall, so that there will be no possibility of the ballast escaping.

REINFORCED CONCRETE FOR HYPOCHLORITE SOLUTION TANKS.*

By Dr. Walter M. Cross.

During the year 1911 an experimental installation of the hypochlorite process for the approximate sterilization of the entire municipal water supply of Kansas City, Mo., was so remarkably successful in diminishing the sickness and death rate in the city on account of typhoid fever as well as other forms of intestinal disease, that the Kansas City Fire & Water Board undertook the construction of a permanent building and apparatus for the application of this purification process to the water supply.

A separate building was constructed to make possible the satisfactory storage, handling and making of the solution of hypochlorite ready for mixing with the sedimented water.

The building itself was designed by Mr. W. C. Root, architect, and the apparatus for use in connection with the sterilization process was installed under the direction and supervision of Mr. Burton Lowther, engineer in charge, and Mr. S. Y. High, superintendent of the waterworks department.

The apparatus for the handling of the hypochlorite and the supports for it are of reinforced concrete. It is to be observed that no other material is so well suited for use in connection with this sterilizing agent as good concrete for the reason that all other materials that are capable of oxidation are promptly attacked by the hypochlorite solution and become rapidly deteriorated. The prime consideration with regard to this class of installation is to employ such methods of construction and to use material that is so permanent in character as to obviate the necessity of repairs which would force the discontinuance of the application of the sterilizing agent even for an hour.

The basement of the building is used for storage of the reagent that is kept in reserve. The main floor is used to house the dilution tanks and the feeding devices, while on the floor above is placed the tank in which the hypochlorite

* From a paper presented at the eighth annual convention of the National Association of Cement Users.

is reduced to paste of a creamy consistency before being delivered to the dilution tanks beneath. This pasting tank, 3 ft. in diameter and 4 ft. high, is provided with a stirring device carrying two rather heavy rollers which are located horizontally at its lower end.

The rollers clear the bottom of the concrete tank only by a fraction of an inch, thus insuring the mashing and disintegration of all of the small lumps that are invariably present in commercial calcium hypochlorite. Owing to the fact that the action of the reagent on bronze is to form on the surface of it a fairly insoluble and protective coating of metallic carbonate and oxychloride, that metal appears to be the most available for use on all bearing and stirring or disintegrating devices that come in contact with the solution. Leading from the concrete pasting tank are pipes so arranged that the contents of the tank may be discharged into either of the large dilution tanks on the floor beneath. The outlet of the pasting tank is placed at a considerable distance from its bottom so as to avoid the possibility of drawing off with the paste any fragments of considerable size. The pipes carrying the paste are so arranged as to be readily cleaned in a few minutes in the event that they become clogged. Ultimately they are sure to become clogged if they are not occasionally cleared because of the formation in them of carbonate from carbon dioxide absorbed from the air.

The dilution tanks are hexagonal in form, 9 ft. in maximum diameter and 7 ft. high. Their walls are 6 in. thick. Although the difficulty experienced in properly disposing the reniforcing iron in the construction of a hexagonal tank is much greater than is the case in the building of a round one, the hexagonal tank is to be preferred on account of the fact that in a round tank a rotary stirrer does not produce nearly such thorough agitation and mixing of the solution of hypochlorite as the same stirrer can do in the hexagonal tank. The paste is mixed with water in the dilution tanks until a uniform solution of a strength of 2 per cent. occurs. The use of the two tanks makes it possible to adjust accurately the strength of the solution in one dilution tank while the contents of the other is being utilized. The dilution tanks are placed on supports high enough to permit the use of a gravity feed to the orifice box, which is placed on the floor of the room housing the big tanks.

Bronze pipes, 1½ in. in size, so arranged as to be readily cleaned in the event of stoppage, connect the dilution tanks with a gauging tank 4 ft. in diameter. This gauging tank contains a float, scale and pointer so arranged that the man in charge can accurately check the speed of outflow of solution from his orifice box into the big water main carrying the entire city water supply from the settling basins to the pumps. The solution passes through the gauging tank to the orifice box. Each division on the gauge represents 1 gal. of the hypochlorite solution.

The orifice box is oblong in shape and carries a float of about 250 cu. in. displacement. The float operates a valve which, by either opening slightly or closing, maintains the hypochlorite solution in the orifice box to a constant level. One end of the orifice box is of plate glass to enable the operator to see at a glance that the solution is filling the box to the proper height. Attached to the plate glass and covering a hole in it, is a hard rubber disc having near its periphery several slits, the adjustment of which represents the size of a stream of the per cent. hypochlorite solution that will be the proper amount to treat the quantity of water passing through the main. All movements of the hypochlorite solution after its preparation, are by gravity. Ample opportunity for the hypochlorite to react with any putrescible organic matter and germs in the water is afforded during the time in which the water passes through the centrifugal pumps, the flow line and a small storage basin at Turkey Creek before it is pumped to the domestic water users.

All of the stirring devices are run by an electric motor belted to a line shaft carrying clutches so placed as to make possible the running of any one of the stirrers whether or not any of the others are running.

The principle involved in the construction of practically all hypochlorite installations for the purification of water by the oxidation of germs and putrescible organic matter in municipal water supplies, is substantially the same as that in Kansas City. Concrete, usually reinforced, is universally used in the construction of all permanent apparatus for the preparation and solution of the hypochlorite for mixing with the water to be purified.

OIL-SHALE INDUSTRY.

Canadian capital interests of late have taken considerable notice of the industrial possibilities of the extraction of oil from the shale deposits of Eastern Canada. A short time back the Dominion Government conducted a number of experiments on these shales with a view of obtaining a report that would be of value in the industrial future of the properties covered by these bituminous materials. Fifty tons of the material were transported to Scotland and passed through the plant of the Pumpherston Oil Company's works, MidCalder, Edinburgh county, and from the resulting report we extract the following:

The testing of the New Brunswick oil-shales was conducted on a large scale, and with complete success, at the Pumpherston Oil Company's works, MidCalder, Edinburgh county, Scotland. The various operations were performed under the direct supervision of Dr. R. W. Ells—representing the Mines Branch of the Department of Mines, Canada—and of Mr. W. A. Hamor, assistant to Dr. Charles Baskerville, of the Science Faculty of the College of the City of New York—acting for the Albertite, Oilite and Cannel Coal Company, of that city.

In 1868 Prof. Henry Howe published a mineralogy of Nova Scotia, and concerning the oil-shales, reports in Hants county a 15 foot seam that will yield at least 20 gallons per ton. The non-productive coal-measures of Hants county afford large quantities of shale, which have led to the expectation of finding coal, but the amount of oil that they yield has not yet (1868) been ascertained. The deposits of shale in Antigonish county may be of the same age.

The centre of the Antigonish basin is occupied by highly bituminous limestone overlying the oil-coal and oil-shale beds and from this fact it is thought that the whole group is upper Devonian or lower Carboniferous rocks, which are not known in this country to contain coal beds of any value. On this point Prof. Howe mentions that in a depth of about 180 feet in the neighborhood of Windsor only one small seam of coal, some 6 inches thick, was found in 1864, and that in a shaft sunk at Hantsport in similar rocks, to a considerable depth, no coal was obtained.

The bituminous beds appear to be divided into two groups, the lower of which appears to be about 70 to 80 feet in thickness, 20 feet of which may be regarded as good oil-shale, including 5 feet of curly cannel rich in oil. The upper band, which lies in immediate contact with the limestone, cannot be much short of 150 feet in vertical thickness of strata, containing a large percentage of oil. Of this great bed of oil-batt about 30 feet will in all probability yield from 20 to 25 gallons to the ton. The 5-ft. seam of curly cannel will yield at least 40 gallons crude oil per ton, and the 15 feet of the best section of the oil-batt will yield at least 20 gallons to the ton, and taking this as worth 25 cents per gallon at the shipping port, there are in all $370,533,325 worth of oil which can be obtained from 20 feet in thickness of strata, underlying 2,000 acres of land comprising a basin underlaid by at least 50 feet in thickness of beds rich in soil.

The quantity of oil-shale from the two mines at Pictou was about 4,000 tons, of the value of about $8.35 per ton at the place of shipment, and this was in part sent to oil-works in the United States. A portion of the stellarite was used in the Province to mix with ordinary gas coals as an enricher in the manufacture of illuminating gas. This shale was found in 1859.

By reference to Dr. H. S. Poole's map of the Pictou coal-field, published by the Geological Survey, 1904, the presence of this oil-coal is noted at a number of widely divergent points, so that it is evident that the material should occur in large quantity in this field. The raising of this mineral was stopped many years ago, on the discovery of the mineral oils in the United States shortly after 1860.

The shales tested in Scotland were from the County of Albert, N.B., and it is toward this locality that the capital referred to above has given the major portion of attention.

The commercial value of the oil-shale can be best inferred from a study of the prices and quantities obtained by distillation. Thus in the case of the shipment made from New Brunswick the yield of crude oil was found to be 40 gallons imperial, or 48 United States gallons, and of sulphate of ammonia 77 pounds. These, it may be mentioned, are practically the two most valuable substances obtained from the first distillation. A further series of distillations, or fractionations, will give other valuable by-products, but for the present the conditions attending the production of the crude oil and sulphate of ammonia may suffice, since for these two sufficient data is now available to form a fair estimate of the cost of manufacture, the value of the shales, and the possible profits to be expected from their manufacture.

Assuming the value of crude oil at present prices, per barrel, to be $0.025 per gallon, and of sulphate of ammonia, at £12 per ton, as $0.029 per pound, we have as the value of the shale tested in Scotland in 1908:—

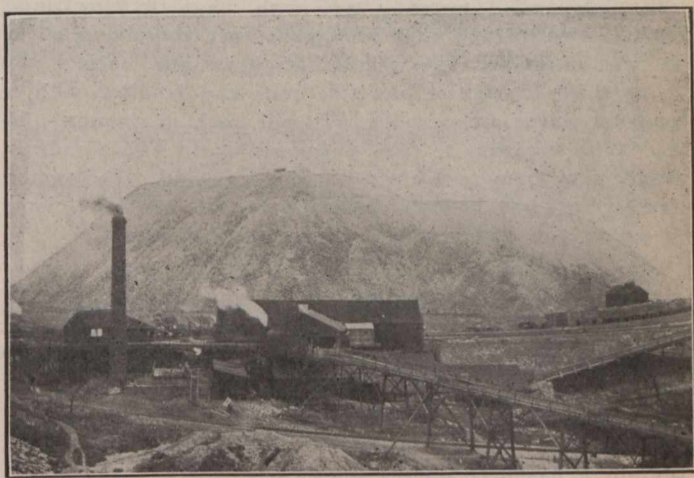
48 United States gallons crude at $0.025....	$1.20
77 pounds sulphate of ammonia at $0.029...	2.23
Bonus from government at 1½ cts. per gallon	.72
	$4.15

Should these oil-shales be worked and a new industry for Canada come into existence the engineer will find a new direction and field for the working of his profession.

Of late this great industry in Scotland has turned serious attention to the possibilities and application of electricity in the manufacture of oil from shales, and according to the Iron and Coal Trades Review, oil works in Scotland up to the year 1901 had not their power centralized or running economically, and it was often difficult to discern the nature of the work because of smoke and steam emanating from so many small steam plants. In 1901 the pioneer scheme for electrifying oil works was carried out by Messrs. J. Wishart and A. C. Thomson, of the Oakbank Oil Company, Limited, backed by a progressive board of directors. Many were sceptical, but the justification of the scheme is that nearly the whole of the Scottish oil companies have centralized their power and adopted electrical distribution. This has revolutionized the industry and enables the local firms to successfully compete with more fortunate oil companies in Russia, America, Galicia, etc., who have not to do any mining or retorting, but simply to bore for the oil.

To briefly describe the process, the shale from which the oil and ammonia are distilled outcrops in many cases at the surface. At Duddingston, for example, the mines were started in the mineral itself and the steam followed down. Some shales resemble slate in appearance, but the better qualities show a conchoidal fracture. Shale is in the Lower Carboniferous formation, and the following is a description of the working of an electric oil shale plant:—

In the upper portion of the retort the shale is heated to a temperature of 900 deg. Fah. and oil gas liberated Lower down in the retort the shale is subjected to a higher temperature, 1,700 deg. Fah. being maintained on the lower part of the retort externally. Some 80 gallons of water in the form of steam, per ton of shale, is sent into the bottom of the retort to aid in the formation of ammonia and to carry off vapours. The exhaust steam from the power-house is utilized in this way. If steam had not been necessary for this and other purposes of manufacture, oil engines would have been used as the prime mover. Exhausters are installed at the end of 24-inch gas mains and the gas is drawn from the retorts. It comes off at a high temperature



Breaker House, Showing Trams from Mine and to Retorts. Heaps of Spent Shale in Rear, Broxburn, Scotland.

and is conducted through multitubular heaters through which the feed water is passed. The temperature of the water is thus raised to 180 deg. Fah. The feed water then passes through a fuel economizer heated by the waste gases which heat the retorts externally. The feed water is at nearly 300 deg. Fah. before it goes into the boilers. After the gases have been condensed there still remains an incondensible gas which is scrubbed with water to remove the last trace of ammonia, also with mineral oil to remove the last trace of light spirit. One ton of shale can be mined and retorted on a consumption of 140 lbs. of coal.

The five boilers are of Stirling water-tube type and generate steam at 160 lbs. Chain-grate stokers are fitted, also an undertype conveyer for carrying away the ashes. The fuel is a dross having a mean calorific value of 10,700 B.Th.U. A CO_2 recorder is fitted which takes periodical quantitative analyses of the flue gases. It usually records 11 per cent. CO_2 gas.

The generating plant consists of two Westinghouse single-acting compound two-cylinder 18 by 30 by 16-inch engines coupled to Westinghouse 200-kw. alternators with belt-driven exciters; two Belliss-Morcom double-acting compound three-cylinder 21 by 23 by 16-inch engines and 500-kw. Twenty-five-cycle 3-phase Westinghouse alternators with direct-driven exciters. Each set has a generator panel consisting of isolating links, current transformer and ammeters, potential transformer, synchronizer, voltmeter plug and automatic oil switch. There are two shunt rheostats in the exciter field, one being mounted on the floor level for emergency, the other on the switchboard. There is also a rheostat in the rotating field. There are three single-phase (shell type) transformers 100-kw. each and one spare, transforming from 3,300 to 440 volts, and three 37 kw. single-phase and one spare to operate a 100-kw. rotary converter for use on the trolley wire. Another rotary of 150 kw. is also installed at the mines two miles away. They are run in parallel, both on A.C. and D.C. sides, which makes the drop on the D.C. a minimum. The transformers are delta on the high-tension and low-tension sides. The generators are star wound, the neutral being insulated.

The installation runs for months without a circuit-breaker coming out. The motor-driven exhausters have run for five years with a stop of only 1½ hours.

The trolley wire is No. 00, and the traction equipment consists of two locomotives each having two 25-horse-power series tramway motors geared to the axles. The armatures are in parallel, one resistance being used for both. The controllers are of tramway type with magnetic blow outs. Each locomotive will haul 20 wagons each containing 26 to 30 cwts. of shale. The wagons weigh 15 cwts. each.

A third locomotive has side rods and is fitted with a 100-horse-power series motor. It will haul 40 wagons. As the trolley wire has to pass under two roads and a railway arch it runs from 10 to 16 ft. above the ground. The trolley pole successfully follows the wire by the use of a long spring of 5-16 section and 33 turns 3-inch diameter.

The high-tension line has also to pass under the bridges and it is trifurcated into three-core cables at each bridge. The cable provides a good method of transposing the line. The trifurcating boxes are covered over, and the leads go through porcelain tubes. The reason for covering the box over was that the sun tended to soften the bitumen, and in one instance rain got in and caused a short in the box. Lightning has been on the lines twelve times, and none of the three cores has gone to earth.

The separation of costs in the operation of the plant is exceedingly difficult, as all economies are based upon lbs. of coal per ton of shale. The power required per ton of shale mined and retorted is eight kilowatts. The cost of running the power house, with maintenance, is 0.08d. per kw.-hour. The cost of running the locomotives is 0.05d. per ton mile. This includes cost of electric energy and the maintenance, etc. The steam consumption of the generating plant is 28.5 lbs. per kw.-hour, non-condensing.

THE STRIKE SITUATION.

There were three more strikes in existence, according to the Department of Labor's monthly record, in Canada during March than in February, and three more than in March, 1911. About 14 firms and 2,000 employees were involved. The loss in working days was estimated at 44,800, compared with 10,080 in February, and 33,600 in March, 1911. The only strike involving more than 200 employees was one of tailors at Toronto.

STRESSES IN FLOOR SYSTEMS OF REINFORCED CONCRETE BUILDINGS.

The following are extracts from the report of the Committee on Reinforced Concrete and Building Laws as presented by Prof. A. N. Talbot at the eighth annual convention of the National Association of Cement Users. The tests described in this report were made in the Wenalden building in Chicago and the Turner-Carter building in Brooklyn, both buildings of the beam and girder type of construction. The tests were conducted by members of the staff of the Engineering Experiment Station of the University of Illinois under the direct supervision of Professor A. N. Talbot and with the aid and co-operation of the contractors for both buildings.

The general method of the testing followed the plan outlined by Mr. Arthur R. Lord in the paper, "A Test of a Flat Slab Floor in a Reinforced Concrete Building," presented at the New York Convention. Holes were cut in the concrete until the reinforcing bars were bared and gauge holes were then drilled in these bars with spacings such as to give the proper gauge lengths. Where measurements of deformation of the concrete were desired, holes were cut in the concrete and a steel plug inserted in which the gauge holes were later drilled. These gauge lines were selected in places where it was thought that critical stresses would be determined. In some places for one reason or another the reinforcing bars were inaccessible and it was impracticable to obtain measurements to give information which would have been of interest. In some cases a series of gauge lines were used to determine the change of stress or distribution from one point to another as at the end of a restrained beam and across the flat slab between beams.

The measurements were made by means of Berry extensometers of the form developed at the University of Illinois. The instrument reads to 1/5,000 in. and is estimated to 1/10,000 in. In making measurement the legs of the instrument were inserted in the gauge holes, a reading taken, the instrument taken out and again inserted and read, and this proceeding repeated until a number of readings without serious discrepancies were found.

Wenalden Building Test.—The Wenalden building is a ten-storey reinforced structure located at 18th and Lumber Streets, Chicago. It was built by the Ferro-Concrete Construction Company, Cincinnati, Ohio, in accordance with the plans and specifications of Howard Chapman, architect. It is now occupied by Carson, Pirie, Scott & Company as a warehouse. The building is of the beam and girder type, with floor panels 15 by 20 ft. The girders are placed between columns in the short direction. Floor beams extend the long way of the panel, there being two intermediate beams built into and supported by the girders and a column beam built into and supported by the columns. The floor, 3⅞ in. thick (including the top finish), was built continuously with the beams and girders.

The reinforcement is the form used by the Ferro-Concrete Construction Company. The main reinforcing bars (twisted bars) are carried along the bottom of the beam from the end of a panel to a point beyond the middle of the panel where they are bent up to the top of the beam and carried horizontally to a corresponding point on the other side of the support, then bent down and continued along the bottom of the beam to the end of the next panel, these reinforcing bars thus having a length of two panels. In the intermediate beams at the bottom and middle there are four rods ¾ in. square and in the side beams one rod ¾ in. square and three rods ⅝ in. square. In the girders there are four rods ⅞ in. square, the disposition of which is similar to that in the beams. By this plan there is twice as much of the main reinforcing steel in the bottom of the beam or girder at the middle of the span as there is at the top over the supports, except that four ⅜-in. square rods placed in the floor slab are also availale for end reinforcement of the intermediate beams. The beams are 6¼ in. wide and the girders 7½ in. The general position of the reinforcement is shown in the accompanying drawing. The position of the vertical stirrups is not shown.

The contractors report that the concrete was composed of one part Portland Cement, two parts torpedo sand, and four parts crushed limestone. Although the building was not fully completed when the test was made, the floor test had been built more than 12 months before the time of the test.

Method of Testing.—The test was made on the first floor of the building, which was the only one which could be reached with the loading material. At various points at the top and bottom of beams the holes were dug into the concrete until the reinforcement was bared and small gauge holes were drilled in the bars 6 or 10 inches apart for use in inserting the instruments with which the measurements of elongation were made. Where stresses in the concrete were to be measured, holes were cut in the concrete and short pieces of steel were set in plaster of paris. Gauge holes were drilled in these steel inserts in such a way as to give gauge lines 6 or 10 inches long. For the work of measuring deflections, steel balls were affixed to the under side of beams and girders at various places and other balls were placed about 7 in. lower on supports which had been built up independently of the observing platforms. A number of these points of deflection were used to determine the inflection points of the beams.

For any observation several instrument readings, usually five, were taken on each gauge line and these were averaged. Measurements were made on the calibration bar before and after each series of observations to permit corrections for instrumental changes.

Method of Loading.—The floor was designed for a live load of 200 lb. per square foot and the test load was made 400 lb. per square foot over panels loaded.

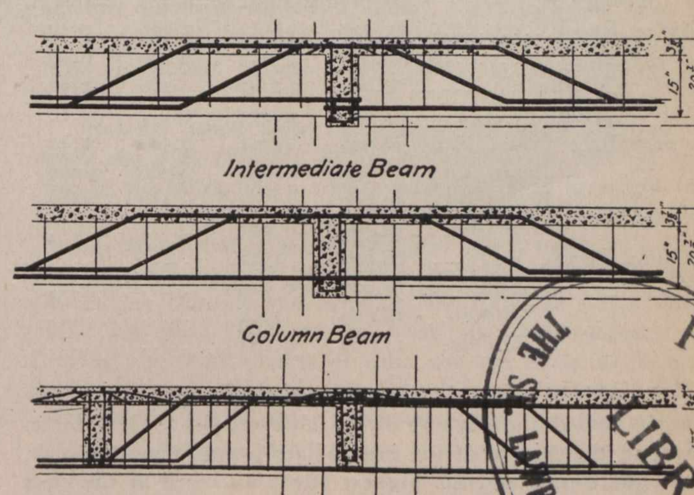
The loading was done by piling brick and bags of cement in piers separated by aisles in such a way as to give access for points of measurements and to prevent arching effects influencing the tests. The load was put on in increments of about 80 lb. per square foot of the total panel area, and a set of observations was taken at each increment of load. Brick was used in the first part of the loading and cement in the later work. The average weight of the brick was determined by weighing a considerable number and such care was given to determine the number of brick and sacks of cement that it is believed the weights of these materials are accurately known.

The following is the general plan of the test. A single panel was first loaded and this load was then removed. The load was then applied on three panels in tandem. Then, leaving this load on, a load was applied along three adjacent panels covering two-thirds of the width and making in all the equivalent of five loaded panels. The total load, which amounted to 60,000 lb., was then taken off by increments.

The Deformations and Stresses.—The results of observations for various gauge lines were plotted and from a study of these it was readily seen that the general trend of some of the lines should be taken rather than the absolute values.

In translating from unit-deformation to unit-stress the modulus of elasticity of steel was taken at 30,000,000 lb. per square inch and that of the concrete has been assumed to be 3.000,000 lb. per square inch. For simplicity the straight line stress-deformation relation for concrete has been assumed, though it is evident that this relation does not hold for the higher stresses and that calculated stresses based upon this assumption are in excess of the actual stress The interpreted stress for a number of gauge lines is recorded in Table 1.

Table 2 gives calculated stresses and calculated bending moment coefficients. The first line of each set gives the calculated stresses in the reinforcement and in the concrete based upon the value of the bending moment quite commonly assumed in design calculations, 1/12 Wl, where W is the total distributed load on the beam and l is the span length. In these cases the span length was taken as 3 in. longer than the clear span. Measurements had been made upon the position of the bars and the depth of the reinforcement which were not always exactly according to the plans, and the calculations have been based upon the dimensions found. In the second line of each group the maximum stress obtained in the measurements is given in the column of stresses, and the bending moment coefficient (the coefficient of Wl) corresponding to these stresses is recorded in the adjacent column. In these calculations the common assumptions of design calculations are followed



Reinforcement in Wenalden Building.

except that the width of a T-beam is taken as equal to the distance from center to center of beams. In calculating the bending moment coefficient from the measured stress, the position of the neutral axis and the value of the moment arm are assumed to be the same as given by the ordinary assumptions. Although the stress in the reinforcement is measured at the surface of a bar of the outer layer, this stress is considered as being the same as that acting at the center of gravity of the group of bars, for the actual variation in the group is unknown and this method will give a bending moment coefficient larger than that found by considering that the stress in the bars of the other layer is smaller.

Table 1.—Stress Indications in Wenalden Building Test.

	Single Panel	Three Panels	Five Panels
Reinforcement at end of girder	.....	8,000	7,000
	7,000	12,000	13,000
	.....	.....	9,000
Reinforcement at middle of girder	.....	10,000	11,000
	8,000	14,000	17,000
	6,000	16,000	17,000
Concrete at end of girder	1,100	1,600	2,200
Reinforcement at end of intermediate beam	.....	9,000	10,000
	2,000	9,000	14,000
	9,000	14,000	14,000
	9,000	16,000	16,000
	11,000	13,000	13,000
	13,000	13,000	14,000
Reinforcement at middle of intermediate beam	.....	14,000	16,000
	8,000	7,000	11,000
	.....	16,000	16,000
	6,000	11,000	11,000
Concrete at end of intermediate beam	.....	.....	1,300
	1,500	1,700	2,000
Concrete at middle of intermediate beam	Low	Low	Low

Table 2.—Maximum Stresses and Moment Coefficients in Wenalden Building Test.

Member	Reinforcement Stress	Reinforcement Coeffiient	Concrete Stress	Concrete Co-efficient
Girder End	47,000	1/12	2,600	1/12
" End	13,000	0.023	2,200	0.07
" Middle	19,000	1/12	420	1/12
" Middle	17,000	0.075	.....	....
Intermediate Beam. End	36,000	1/12	2,500	1/12
" Beam End	16,000	0.037	2,000	0.067
" Beam Mid.	22,000	1/12	440	1/12
" Beam Mid.	16,000	0.061	.....	....
Column Beam, End	66,000	1/12	.....	....
" End	15,000	0.019	.....	....
" Middle.	26,000	1/12	.....	....
" Middle.	11,000	0.035	.....	....

It will be seen that in the tests with three and five panels loaded the highest stress observed in the reinforcement in the middle of the intermdiate beams was 16,000 lb. per square inch and the highest stress observed at the ends of the beams was 16,000 lb. per square inch. The stresses observed in bars having similar positions were lower, and probably the highest stress is not representative of the general stresses. However, it may be best to make comparison on the basis of the highest stresses.

The bending moment given in the table as derived from the measured stresses is 0.06 Wl at the middle of the beam and 0.037 at the end of the beam. Measurement of the compression of the concrete in this test was less satisfactory than the measurement of the reinforcement deformations, and considerable variation was found at the different points of observation. Not enough gauge lines gave satisfactory measurement to warrant making quantitative conclusions, but the indications of the action of the concrete may be useful. The value of the bending moment which corresponds to the concrete stresses, on the assumptions made, is 0.067 Wl for the end of the beam. For the middle of the beam the stresses were so small and the indications so irregular that no value of bending moment can be given.

In the beams at the sides of the panel (column beams) the stresses were in general somewhat lower, but with a full loading a stress of 15,000 lb. per square inch at the middle of the beam was observed and 11,000 lb. per square inch at the end.

Fewer measurements were made on the reinforcement of the girder. A stress of 17,000 lb. per square inch was observed at the middle of the girder and 13,000 lb. per square inch at the end. On the same assumptions these values correspond to bending moments of 0.075 Wl and 0.023 Wl, respectively. The stress in the concrete at the end of the girder was also very high, but the corresponding bending moment (0.07 Wl) is less than that for a restraining beam.

Calculating with the usual assumptions of beam formulas, the total compressive stress in the concrete at the end of the beam is greater than the total tensile stress in the reinforcement. Two elements probably enter into the results, the tensile strength of concrete which may be considerable as distributed over the width of the floor, and an arching action of the structure. However, it should be noted that the value of the bending moment coefficient derived from the reinforcement stresses at the middle of the beams and girder is not much less than values commonly used and also that the calculated resisting moment developed at the end of the beam based on the concrete stresses is not far below the amount usually assumed.

Attention should be called to the fact that the compressive stress in the concrete, both that calculated from an assumed bending moment and that calculated from the measured deformation, is much higher than that to be found by the use of the parabolic stress deformation relation and the actual stress will be less than that given in the table.

Measurements were made on the concrete at the top of the floor slabs in a direction parallel with the beams to find the distribution of compressive stresses between beams. These measurements were not fully satisfactory, but within the limits of accuracy of the measurements no difference in the amount of shortening over the beam and at points between beams could be determined and the whole floor evidently acted as a part of the compression member of the T-beam so formed.

Test Cracks.—The surface of the beam and girder had received a white coat, which permitted very fine cracks to be detected, much finer than may be observed on uncoated concrete. In the test, as the load was applied, fine tension cracks in the concrete through the middle of the length of the beam were observable at stresses in the reinforcement corresponding to the stresses at which load cracks are detected in the tests of beams in laboratory work. To an experienced observer development of the cracks was confirmation of the measurements of the low stresses developed in the reinforcement. Upon removal of the load most of these cracks closed until they were not visible to the eye.

As the calculated reaction on the end of a girder was upward of 40,000 lb., it will be seen that the vertical shearing stresses were very high. Diagonal tension cracks developed in these girders just outside the junction with the intermediate beams, making an angle of nearly 45 deg. with the horizontal. These cracks did not entirely close on the removal of the load. No measurements were taken to determine the diagonal deformations. It seems probable that the restraint at the end of the girder and the tensile strength of the concrete acted to prevent the fuller development of these cracks. No diagonal cracks were observed in the beams. As may be expected, the deflection in the middle panel was greater for one panel loaded than when three panels were loaded.

POTASH IN "BORAX LAKE."

The two Federal Bureaus of the United States engaged in the search for potash—the Bureau of Soils of the Department of Agriculture, and the Geological Survey of the Department of the Interior—are in receipt of promising telegraphic news from their field representatives. A potash deposit of apparently great importance has been discovered at Borax or Searles Lake in the northwestern corner of San Bernardino County, California. This lake or playa is the last remaining pocket of a once much greater lake which has almost dried up and its central depression contains a large body of crystalline salts known to consist of common salt and sulphate and carbonate of soda with smaller quantities of borax. This salt body is saturated with brine, and interested persons, stimulated by the governmental search for potash, recently secured an analysis of old sample material from this brine. The result being significant, the lake was visited jointly by representatives of the Geological Survey and of the Bureau of Soils, who took brine samples from six wells distributed over the salt flat. Analyses of these samples have been made by the co-operative laboratory at the Mackay School of Mines, at Reno, Nevada, and show an average of 6.78 per cent. of potassium oxide (K_2O) in solution. The average salinity of the brine is 43.82 grams of the solids per one hundred cubic centimeters. Comparison of results indicates that the brines are nearly uniform throughout the flat. The probable importance of the deposit is due to the occurrence of the potassium salts in soluble form in a natural saturated brine, and under climatic and other conditions especially favorable to its separation and recovery by solar evaporation. Existing data give reasonable assurance that the brine saturated salt body is at least 60 feet thick and covers an area of at least eleven square miles. Assuming the salt body to contain twenty-five per cent by volume of the brine, the total amount of potassium oxide is estimated at over four million short tons. This estimate is believed to be very conservative, and the available tonnage may well be expected to exceed ten million tons, which would supply the country, at the present rate of consumption of potash, for thirty years. At any rate, it appears that this locality constitutes a very important source of potash in probably readily available commercial form.

Methods of separating potash from brines are now under investigation by the Bureau of Soils.

Borax Lake or Searles Lake is one of the many playas or intermittently wet and dry lakes common throughout the arid regions of the West. It lies between the Argus and Slate ranges, in the Mohave Desert of Southern California. Borax Lake was the original scene of the famous 20-mule team borax mine, the borax being hauled in great wagons drawn by 20 to 28 big mules to the Southern Pacific Railroad at Mohave, a distance of 80 miles. The lake or flat is about 10 miles long and 5 miles wide, and has received the drainage from the surrounding hills for many thousands of years, vast quantities of dissolved minerals being thus concentrated in it. The water has been evaporated under the intense heat of the long, hot seasons, but the salts have remained, so that for most of the year, in fact often throughout the year, the bed is a glistening plain of white salts, in attempting to cross which under a brazen sun men have lost their lives.

The mirage plays its strange tricks here, and at the dryest places the traveller can generally see what appears to be a broad expanse of water covering the bed a little way ahead—always a little distance off, until he approaches the shore of Borax Lake. Then, when he looks behind him, he sees the water apparently covering the ground over which he has just come. The lake occupies a valley made by faults—breaks and slips in the earth's crust—where a great area has been dropped down. Borings have been made through the mud and water underlying the lake to a depth of some hundreds of feet, the deepest borings made bringing up hot mud.

A reconnaissance of the general region was made by one of the geologists of the United States Geological Survey in 1900, and is described in the Survey's Bulletin 200, now out of print. Borax Lake itself, however, was not visited. The lake is also shown on a map in Water-Supply Paper 224 of the Survey, "Some Desert Watering Places in Southeastern California and Southwestern Nevada." Its nearest railroad is the Owenyo branch of the Southern Pacific, running from Mohave past Owens Lake. Borax Lake is situated about 20 miles from the station of Searles, on this railroad.

Many useful and curious minerals are found in the muds and other deposits of Borax Lake, including, of course, borax. Among them are gypsum, glauberite, carbonate and sulphate of soda, salt, thenardite and hanskite. The last carries as much as 2.33 per cent. of potassium, equivalent to 4.44 per cent. of potassium chloride.

The salts are not evenly distributed over the surface of the lake. Borax was found plentifully over about 3 square miles, common salt is everywhere, and sodium carbonate and sodium sulphate are widely distributed. One boring is said to have passed through 28 feet of solid trona (hydrous carbonate of soda) of great purity. At other places there is 25 feet of solid mixed sulphate and carbonate of soda with smaller quantities of other salts. Although the lake bed is dry most of the time, a few inches under the outer crust there is always water—a bittern heavily impregnated with salts.

Several years ago an English company attempted to work the soda deposits on an extensive scale, but for some reason the work has not been pushed. This company sunk a number of wells, casing them through the soda deposits. It was found that a heavy stream of water could be pumped continuously without preceptibly lowering the water level. Potassium chloride and sulphate, the forms in which potash salts are most likely to be found in such deposits, are among the most soluble of salts and are likely to be much more generally diffused than salts less easily soluble. That the entire body of water and mud in the lake contains potash in a more or less uniform degree, is indicated by the results thus far attained. However, there are modifying agencies, such as springs and streams, that bring in fresh water, for the movement of water through the lake will be slow owing to the presence of the sand and salts that fill the basin.

RAILLESS TRAMS IN LONDON.

It is announced by the Highway Committee of the London County Council that they have decided provisionally to recommend the council in due course to seek authority in the Session of Parliament of 1913 to enable it to run cars on the railless trolley system of electric traction on certain routes. In order that the information which will be required to be given as evidence in support of the bill may be prepared, it will be necessary for certain experiments to be carried out and for diagrams and drawings to be made, and they therefore ask the council to sanction the expenditure of $1,000 for this purpose.

BRIDGES AND RAILWAYS IN NOVA SCOTIA.

It must appear to a casual observer that the eastern portions of this country do not, in a general way, receive the same amount of publicity as falls to the lot of the central and western parts. The reason for this might be difficult to state, but that the Province of Nova Scotia is not lacking in government engineering enterprise is amply demonstrated by a report recently issued from the offices of the Provincial Engineer at Halifax. In this report the matter of provincial railways is shown to be in a satisfactory condition, but no construction work was attempted during the past year. Railway surveys and preparations, however, have been exceedingly active.

The Intercolonial Railway with a mileage of 467 miles, owned and operated by the Federal Government, and coming under the control of the Minister of Railways; the Dominion Atlantic Railway with a mileage of 221 miles, coming under the jurisdiction of the Railway Commission; and the following lines coming under the jurisdiction of the Government of Nova Scotia and therefore under this Department:—

Cape Breton Railway Company with a	mileage of	31	miles.
Colchester Coal and Ry. Co. with a	"	4	"
Cumberland Coal and Ry. Co. with a	"	32	"
Halifax and South Western Railway—			
Halifax to Yarmouth with a	"	247	"
Bridgewater to Middleton with a	"	55	"
Liverpool and Milton with a	"	5	"
Mahone to Lunenburg with a	"	7	"
Caledonia Branch with a	"	22	"
Victoria Beach Branch with a	"	40	"
Inverness Railway and Coal Co. with a	"	61	"
Maritime Coal, Ry. & Power Co. with a	"	15	"
Midland Railway with a	"	58	"
Minudie Railway Company with a	"	6	"
Nova Scotia Steel & Coal Co.'s. Ry. with a	"	12	"
Sydney and Louisburg Railway with a	"	52	"

A total of ten companies with a mileage of 647 miles.

Owing to the fact that there has been little or no railway construction in the Province for the last two or three years, whereas the railway mileage in Canada has increased very greatly, Nova Scotia, which three years ago had one mile of railway for about every three hundred and fifty people and which had almost as much mileage in proportion to its population as any part of Canada, is now somewhat behind in that respect.

The last returns show a mileage of 1,333 in Nova Scotia for a population of about 500,000 or one mile for every 370 people whereas that of Canada shows a mileage of 25,400 with a population of 7,200,000 or one mile for every 285 people.

On the completion, however, of the Halifax and Guysboro Railway, which is now an assured fact and which will add about 10 per cent. to the mileage in Nova Scotia, this will probably bring us very nearly up to the same proportion as that of Canada and in any case will then provide almost all parts of Nova Scotia with railway accommodation.

The returns for the year show an increase of nearly twenty per cent., so that there is a general improvement as regards gross receipts. As regards operating expenses there is also a considerable increase, so as to overbalance in some cases the increase in receipts, thus reducing the net receipts below that of last year. On the whole, however, there is a general increase in the net receipts, there being an increase in the Inverness Railway and Coal Company, the Maritime Coal, Railway and Power Company and the Sydney and Louisburg Railway.

As has happened for the last four or five years, the Cape Breton Railway and the Nova Scotia Steel Company's Railway show a loss on operation for the year. The Sydney and Louisburg, the Maritime Coal, Railway and Power Company and the Inverness Railway and Coal Company show a profit of between $1,500 and $1.650 per mile, equal to over five per cent. on $30,000 per mile, certainly a very good showing. The Halifax and South Western Railway and the Cumberland Railway and Coal Company show a small profit.

If we examine the operating expenses, however, we find as usual a great difference between the various companies, but not nearly as much as usual. This is probably due not so much to the fact, that there has been a change in the working of some of the lines, but that the figures are more correctly made up as far as train mileage is concerned.

The receipts per mile vary from $280 in the case of the Cape Breton Railway Company to $8,763 in the case of the Sydney and Louisburg Railway and the operating expenses from $587 in the case of the Cape Breton Railway Company to $7,134 in the case of the Sydney and Louisburg Railway.

The Government of Nova Scotia undertakes the construction of all large bridges and the majority of these bridges are of iron and steel superstructure with abutments of concrete. The steel superstructure is in all cases let by tender and contract, the contract including not only the supplying of the materials but its erection and the providing of the flooring. The piers and abutments are constructed and built by the Department by day labor. During the past year contracts for the erection of the iron and steel portions of eighteen bridges, with a total of twenty-seven spans. The largest of these bridges was constructed at Wallace Harbour, N.S. The distance across this stretch is 3,110 feet.

After careful examination it was decided that the most economical method would be to build five spans of 100 feet, one of 150 feet crossing the main channel and a draw span of 100 feet, making a total of seven hundred and seventy-three feet over all, including the piers, with an embankment of earth protected with stone for the remaining twenty-one hundred feet.

Careful soundings were taken, and in the channel at a depth of 27 feet below low tide mud and oyster shells were encountered, which continued for about 25 feet more to solid rock. This rock was found to continue across the whole bed of the stream at pretty much the same level, but rose gradually towards the shore. The surface of the mud at the abutments being about 12 feet, and the surface of the rock about 18 feet below high water.

Owing to the prevalence of the Teredo it was necessary to have all the submerged timber in the foundation creosoted. Creosoted cribs were built on the shore and floated into place, piles were driven, spaced about 4 feet apart, and the cribs were filled with rock, the whole being brought up to a little above low water. On this foundation the concrete was started, and carried up to the top of the piers and the whole work was done by day labor. The embankment of earth and stone contained about thirty-seven thousand yards.

This work was carried on along with the work of the substructure under the superintendence of Mr. Thomas Rawding, and the season closed with the work practically completed and for a much less sum than that of the lowest tender and the whole work reflects great credit on the skill and economy with which it was carried out by the superintendent.

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CONTENTS OF THIS ISSUE.

ICEBERG DETECTION.

The recent terrible catastrophe, in which the White Star liner, Titanic, collided with an iceberg on her initial trip, brings to mind a question of the possibilities of preventing such accidents. The detection of icebergs by means of thermometer reading has been considered for some time, but until within the last few years no practical results seemed possible. About eleven years ago Dr. H. T. Barnes Macdonald, Professor of Physics of McGill University, investigated the condition underlying the formation of frazil and anchorites by means of the micro-thermometer. Since that time the micro-thermometer has been developed, until now it is possible to determine temperature variations of water of a few thousandths of a degree. This highly-developed instrument records temperature so minutely as to pick out the slightest variation in sea temperature, and opens up a new field of work in studying the small variations in the surface temperature of the sea. Investigations carried on during the past two years show that the micro-thermometer is capable of recording a temperature gradient of one-tenth of a degree per mile with accuracy. There appears to be little question that it will become an important instrument in the detection of icebergs in ocean travel, for the tests already made show that it is capable of such detection up to a distance of two miles, and the effect remains for seven miles past the berg. If the Titanic had been equipped with such an instrument, even at the present state of its development, no doubt the accident would have been prevented.

As noted by Dr. Barnes, there remain a number of problems to be solved in connection with the successful application of the micro-thermometer to the detection of icebergs. They are, however, academic questions, and, while it is unsafe to predict the whole result of the most unfavorable conditions until experiments are actually tried, still it appears that where navigation is most important the conditions are the best for the operation of the micro-thermometer.

WATER POWERS IN NEW YORK STATE.

During the past five or six years there has been great agitation throughout New York State to induce the Legislature to take over the development of all water powers, and the generation, transmission and sale of electric power to the municipalities and factories of the State. Up to the present time, those favorable to the proposal have been unable to secure legislation. On March 27th a measure was passed by the Senate, in line with the State Conservation Commission requests, providing for the development of the State-controlled water powers. Considerable objection was raised to the measure, it being claimed by the opponents of the bill that if the State developed its water powers they would be compelled to buy private water powers and establish steam plants to be able to furnish 1,500,000 horse-power, which is the amount used in the State, as the State water powers have a maximum capacity of only 220,000 horse-power. In his explanation of the provisions of the bill, Senator Bayne stated that it proposed to give the people the sole benefit from the development of the water powers of the State, and the consequent generation of electricity, instead of turning the State resources over to private corporations. Under this bill the State will develop and distribute electric power made possible by the construction of water storage dams directly to municipalities and factories, without permitting private corporations to act as middlemen.

If the above measure is carried into force, as no doubt it will, it will be a great benefit to the citizens of the States. The State-owned water powers are practically all of them storage propositions, so that their development will mean many other advantages to the State, in the prevention of flood conditions and the conservation and regulation of the water supplies.

New York State has gone a step farther than the Province of Ontario, in that the State will develop its own power, while the Province only distributes power bought. It is only a question of time, however, until Ontario, if the Hydro-Electric policy is to be a success, must develop auxiliary water powers to tie with the present system, in order to relieve peak load condition, and this, no doubt, will mean water storage conditions similar to those confronting New York State.

GAS-ELECTRIC CARS.

The development of the steam locomotive has almost reached a climax. The highest possible state of efficiency has been obtained, and, while it may increase in size, still the steam locomotive as a piece of mechanism is very nearly perfection. The application of oil fuel to the locomotive has opened up the final field, and a number of these oil-burning locomotives are now being used in the West. A new era has dawned for Canadian roads in the use of the gas-electric motor car on a steam line. The Canadian Northern Railway have just bought a new gas-electric car for tourist use between Quebec and Indian Lorette. This is the first car of its type to be used in Canada, and the Canadian Northern are to be congratulated on their enterprise. The cost of operation of such a car, including all maintenance charges, road-bed, etc., averages about eighteen to twenty cents per car mile, although on one line in the United States the operation costs have been reduced to about eleven cents per car mile. The cost compares very favorably with the electric trolley, and there seems to be no reason why there should not be a widespread use for these cars in Canada. For suburban service and for building up feeder and branch lines their use is amply justified, and there is no doubt, now that the car has been developed to a practical state of efficiency, that other roads will see the advantages of their use.

EDITORIAL COMMENT.

The University of Manitoba has been having many difficulties with regard to methods of finance. The early days of educational institutions are usually troubled ones. We are glad, however, to understand that the University Council and the Provincial Premier have had a conference, at which it was decided to re-organize the University and provide additional land for expansion.

* * * *

Steel street cars are rapidly growing in favor. There have been many new installations recently in the United States and a few in Canada. The Ottawa Electric Street Railway Company has just placed an order for twenty new steel cars, the entire construction throughout being of steel, except for the doors and windows. As wood becomes more and more costly and the uses for steel increase, we will probably see greater numbers of these cars in use.

ONTARIO PORT ON HUDSON BAY.

Now that Ontario is to have a port on Hudson Bay, the harbor facilities on James Bay are a matter of considerable importance. Mr. Sydney C. Ells has completed a report of an exploration trip in that vicinity.

From time to time and in a very general way in considering a possible terminus on tide water at James Bay, the estuaries of three rivers—the Albany, the Moose and the Harricanaw—have usually been mentioned. All three streams are of considerable size, are old-established canoe routes—especially the Albany and the Moose—and all lie within the boundaries of the Province of Ontario. Incidentally, it may be said that, apart from these three locations, there is absolutely no other point on James Bay (and within the boundaries of this province) where a potential tide-water terminal can be said to exist.

Regarding the first of these—the Albany River—the stream is for a distance of several miles above its mouth divided into minor channels by numerous islands. The force of the main volume of the river is thus dissipated, with the natural result that many bars and shoals everywhere obstruct the narrow channels. At the outer bar, sailing boats drawing three feet of water must wait for the tide before coming in. In the face of existing conditions, it is, indeed, difficult to understand why the estuary of the Albany should ever have been seriously considered as a possible harbor site.

In the case of the two remaining possibilities, Mr. Ells reports that the estuaries of the Moose and of the Harricanaw, conditions appeared somewhat more favorable. Preliminary surveys were, therefore, made at these two points. The plans which are the result of this work are submitted herewith, and will serve to roughly illustrate such relative as well as absolute advantages as may be looked for at either of these places. In each case some uncertainty still exists regarding the exact range of spring and neap tides, all observation regarding rise and fall being made during the progress of the surveys, and, therefore, extending over but a limited period.

RETURN OF CREDENTIALS.

LETTERS TO THE EDITOR.

To the Editor.

Sir,—Perhaps the experience gained by the writer in answering advertisements in technical papers for engagement in professional work may be of some advantage to others.

In answer to one firm, having gone to a good deal of expense in order to place clearly the extent of his experience, the writer asked that certain typewritten documents, being copies of his credentials and testimonials, might be returned, facilitating in every way the return of the same, but though he has written again he has not been favored with the return of the documents.

If the applicant's qualifications were not suited to the special requiremens demanded, there surely was no need for such a lack of common decency. Granted that in many cases we are generally foolish enough to sell hard brain-work for a remuneration less than manual work we at least hope to be treated with a little more consideration than is generally meted out to a foreign laborer, and due to the small remuneration we are not in the position of some big manufacturing company, that can distribute gratis such copies of their credentials and papers with little felt expenditure.

AN ENGINEER.

A NEW WATER-TESTING DEVICE.

Engineers and superintendents of municipal water supply plants have often wished for a means of determining a change in the composition of the water without resorting to the usual tests as conducted along chemical lines.

There are not many principles on which to establish a method of determination outside of the fact established by Kohlrausch that the electrical conductivity of pure water containing any electrolytic substance in solution is due almost entirely to the dissolved substance, and not to the water itself. The following table is the result of a series of experiments conducted with a view of determining the relative conductivities of waters usually reported as pure.

Source of Water.	Conductivity at 20° C.
Distilled Water:—	
Obtained by F. Kohlrausch, after occupying ten years in cleaning the glass receiver of the distilling apparatus	0.2
Supplied by Messrs. Hopkin & Williams, London; an abnormally pure sample	1.2
Supplied by Messrs. Hopkin & Williams, London; average of several samples	2.0
Supplied by a retail chemist, Birmingham	5.0
Supplied by a retail chemist, London	8.0.
Supplied by a retail chemist, London, (another sample)	14.0
Condensed water, from the hotwells of condensing engines:—	
Shoreditch Electricity Works, London	3.3 (a)
Westminster Electric Supply Corporation, Eccleston Place Station	3.6 (b)
Messrs. Belliss & Morcom's Works, Birmingham	11.7 (c)
Public Water Supplies:—	
Glasgow, from Loch Katrine	34
Manchester, from Thirlmere	48
Blackburn	65
Birmingham, from Rhayader, Wales	80
Dewsbury	109
Glasgow, from Gorbals Waterworks	119
East Surrey Water Company, from wells in chalk (softened by Clark's process)	135
London, West Middlesex District (after softening by Clark's process)	163
London, West Middlesex District (after softening by boiling)	180
Southampton	185
Paris	312
London, West Middlesex District (as supplied by the Metropolitan Water Board)	390
Cooling Water:—	
Westminster Electric Supply Corporation, Eccleston Place Station	472
Messrs. Belliss & Morcom's Works, Birmingham (canal water)	1,760
Sea water; average of samples taken off Harwich and off the Isle of Wight	50,000

(a) This is the lowest value observed by Mr. Digby.

(b) This is the calculated value for no leakage; the lowest value observed by Mr. Partridge was 4.1.

(c) The condenser was in perfect order, and the high value is probably due to the discontinuous working of the steam plant.

Working upon this fact there has of late been perfected an apparatus known as the Dionic water tester, the joint invention of Messrs. Digby and Biggs, of England, and introduced to the American continent by Mr. James G. Biddle, of Philadelphia, Pa., U.S.A.

This apparatus is not used to supplant the usual chemical determinations, but is used as an indicator of any variations in the organic contents after their quantities have been determined by a chemist.

The complete apparatus is shown in Fig. 1, where G is a bent glass tube to contain the water under test, and A and B are the electrodes for passing the electric current through the water. The electrodes are connected by wires to a direct-reading conductivity meter M, and a continuous-current hand-driven dynamo E; so that by turning the handle W of the dynamo, a current traverses the meter and the water in the conductivity tube G. The pointer of the meter is deflected, and comes to rest at some point upon the scale which directly indicates the conductivity of the water in the tube. The test is completed as soon as the pointer has come to rest, usually in two or three seconds.

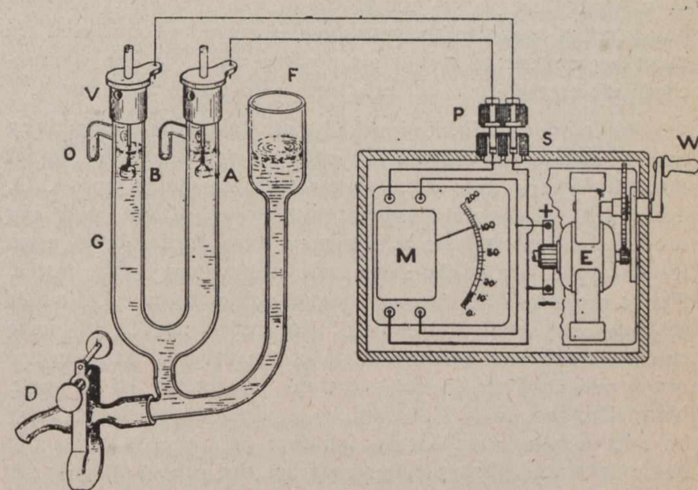

Fig. 1.—Diagram of Dionic Water Tester.

The tube G is made long enough, and the electrodes are given sufficient surface, to make the electric resistacne in the parts of the current-path immediately surrounding the electrodes negligibly small compared with that of the length of water in the tube. Hence, gas bubbles may accumulate on the electrodes without making any observable difference in the measured conductivity. Moreover, gas bubbles liberated from the electrodes rise upwards and escape freely at the upper ends of the tube; they can never diminish the conductivity by traveling downwards into the path of the electric current. The electrodes are short hollow cylinders of platinum, so that they present a large surface, from every part of which gas bubbles are free to escape upwards.

Whatever gas is formed in the electrodes is very small and is all washed away when fresh water is poured through the tube preparatory to another test.

Although the current used is very small, never exceeding .004 amperes under normal conditions, and the time during which it flows is very short, there is more than enough time to establish the maximum polarization of the electrodes: so that unless some means were adopted to eliminate it the error due to back-electromotive force would be considerable. This difficulty is removed by taking the electromotive force into account when calibrating the scale of the conductivity meter. Evidently, any back-electro motive force will make the conductivity of the water in the tube appear to be less than it really is; and what is done is to mark the divisions on the scale so that they represent the true conductivity of the water. To do this it is necessary to take a fair average value for the back-electromotive force of polarization. With bright platinum electrodes in a dilute salt solution the back E.M.F. is about two volts, and this is the value allowed for in marking the scale. The dynamo generates a constant pressure of 100 volts, so that any variations in back E.M.F. above or below two volts are negligibly small by comparison and do not produce any observable error. To maintain the necessary constancy of pressure the dynamo is fitted with the constant-speed clutch. The effect of this device is to keep the pressure constant at 100 volts within one-quarter of a volt, when the dynamo handle is driven at any speed above that at which the clutch is adjusted to slip.

The conductivity meter measures directly, and without calculation, the conductivity of any electrolytic solution in the tube to which it may be connected. The indication is given by an index which ranges over an engraved scale, graduated in units of conductivity.

Conductivity (specific conductance) is the reciprocal of specific resistance, and the most convenient for the purpose of water-testing is the reciprocal of one megohm. No one has given a name to the reciprocal of one megohm, and we must be content to call it simply one unit. In the conductivity meter the scale extends from zero up to 2,000 units.

Referring to Fig. 1, it will be seen that the conductivity tube is so constructed that by pouring water into the funnel F, and allowing it to overflow through the outlet pipes O O, every part of the tube is thoroughly washed out, and any products of electrolysis which may have accumulated upon the electrodes are at the same time swept away by the water. The air vents V V ensure a steady flow from each outlet without any syphoning action. A drain pipe D of pure rubber is provided at the bottom of the tube for the purpose of drawing off the contents at the conclusion of a test. Normally, the drain is closed by a pinch-cock. Water may be left standing in the tube for days at a time without the slightest trace of contamination from the rubber finding its way into the conductivity tube. The only other materials in contact with the contents of the tube are glass and platinum.

The tube is mounted on a strong teak stand designed to afford as much protection as is consistent with accessibility.

The conductivity meter and dynamo are fixed inside a box and once for all connected up to each other and to the terminals of the socket S, which is fixed on the outside of the box. The two-pin plug P is permanently connected up to the electrodes A and B by means of a short length of well insulated twin-flexible cable. Hence, all the user has to do in order to connect the tube to the meter is to push the plug into the socket.

The dynamo and conductivity meter do not need any attention, and, in fact, the box containing them is closed and sealed by the makers. The dial is visible through a window in the top of the box, and the handle of the dynamo is folded back into a recess when not in use.

In making a test the conductivity tube is placed at the edge of a table or bench, so that the overflow and drain pipes may discharge into a vessel of some sort standing below. The meter-box is put down close alongside the tube. The connecting plug is disengaged from its place on the tube-stand and pushed into the socket on the meter. Then the pinch-cock is opened for a moment to make sure that no water previously tested remains in the drain pipe. When the pinch-cock is closed again, the water to get tested is poured into the funnel and allowed to run out of the overflow pipes, until at least a whole tubeful of the water has been discharged. In this way any traces of previous tests are thoroughly washed out. After the dynamo is speeded up and the index needle comes to rest a note is made of its position on the scale and the temperature of the water.

The conductivity of a water is an isolated and barren fact in itself, but becomes a valuable factor when comparisons are available with a known composition, and may be used in many ways, as shown by the following examples.

After the source of hardness in a water is determined by chemistry periodic teste with this apparatus will indicate the slightest changes in the composition of the water as regards the amount of calcium or magnesium carbonates, and it is quite possible after a few experiments to deduct with accuracy the parts per million or the grains per gallon of these constituents. It is also possible to prepare a series of plotted curves of the results of the readings after certain known quantities of quick lime have been added as a softener. As the quantity of lime is increased the conductivity diminishes until a minimum is reached, beyond which the conductivity of the water is increased. The point of minimum conductivity indicates the correct quantity of lime.

In such cases where it is desired to keep a check on the purity of a water supply the use of this instrument dispenses with all analysis excepting the first one to establish the quality of the organic contents; reading obtained at frequent intervals and showing no important variations in the reading will indicate that no changes in the organic contents or purity of the water. By this means the cost of testing is practically confined to the initial outlay for the instrument. The instrument may also be employed to indicate leakage from a surface condensor for boiler priming, for measuring the solution of rivers for periodic tests at sewage works, for the determination of the relative purity of distilled water and for many other purposes.

CAR WORKS AT PORT ARTHUR.

A group of well-known Eastern Canadian financiers and manufacturers, headed by Messrs. F. B. McCurdy, J. R. McLeod, F. M. Brown, and their associates, have concluded arrangements with the city of Port Arthur for the immediate erection of a modern steel and wood car plant, with a capitalization of $5,000,000. These people are the organizers of the Nova Scotia Car Works, Limited, which is operating successfully in the city of Halifax.

For some time past negotiations have been under way between this syndicate and the representatives of Port Arthur. At a meeting of the board of trade and the council of the city of Port Arthur, all details were finally decided on by which the company, which will be known as the Ontario and Western Car Company, Limited, will establish its plant. The company will employ 1,000 men and as the plant will be located at the head of navigation, the center of Canada, it will be in a position to supply freight and passenger cars to the various transcontinental railways at the point where they are most needed. It will also, owing to the geographical location, be able to assemble materials more cheaply, and therefore build cars at a lower cost than any other plant in Canada.

A great deal of credit is due to the Industrial Commissioner, Mr. N. G. Neill, who has been the means of promoting this enterprise and interesting Eastern capital.

PROPOSALS FOR DUST SUPPRESSION AND ROAD IMPROVEMENT.*

By Dr. Guglielminetti.

Owing to the fact that I have, on hygienic grounds, devoted my attention for about ten years past to the study of dust suppression (road-tarring), and that I am a member of the permanent International Road Commission at Paris, which has addressed itself to the practical solution of this problem—viz., the adaptation of existing roads to the new motor traffic—I have lately received several enquiries from Switzerland (among others from Colonel Pfyffer, of Lucerne, and Mr. Megevet, of Geneva) as to what is actually being done in Switzerland against the dust, the prevalence of which is undoubtedly one of the chief causes of the embitterment of the Swiss people against automobilism.

When it is remembered that even during the past excessively hot summer the residents on roads much frequented by motors were obliged to keep their windows closed all day long on account of the dust, that country seats on such roads have depreciated in value, that for a width of several yards near the dusty country roads the cattle refuse to eat the grass, that the clothes and hats of people taking a Sunday walk are spoilt, without mentioning the injurious effect upon our health of this dust as a vehicle of various disease germs—bearing all this in mind, it is not to be wondered at that the vast majority of the Swiss people are embittered against the relatively small minority of motorists. One cannot altogether blame the people, but, on the other hand, the entire blame does not rest upon the motorists.

If a motor, with its broad, absorbent rubber tyres, drives—even at a reasonable speed (30 kilometers = 19 miles per hour)—over a road covered with a layer of dust some inches thick, one must not be surprised at clouds of dust being raised. But if the same motor drives at the same speed on a well-made and well-cared-for country road on which no dust is lying, then there is no dust nuisance there; and, speaking generally, it may be said the better the road, and the more resistance the material with which it is made, the less dust there will be. Now, it would certainly cost too much to cover long stretches of road with asphalt, wood, or paving-stone, which is at present being done, as far as possible, in towns where the traffic is heavy; for country roads in several districts, however, improvement is attempted by making the roads more resistant and by watering, tarring, etc., to lay the dust on their upper surfaces.

The chief requisites for a well-kept road are good road material and a steam roller to roll the road metal in properly.

The solution of the dust problem is, therefore, more or less a question of money. Owing to the yearly increase of general traffic, and especially since the spread of motoring, the need of good roads is becoming ever more urgent in all countries, and naturally also in Switzerland, and therefore the earlier method of road maintenance is no longer sufficient.

Proposed Sources of Funds.—From whence, then, are these necessary additional expenses to be obtained? Speaking generally, it is not only motorists who benefit by well-kept roads, but also carriers, residents on the roads, etc. Good roads are ever a sign of a country's development. Via vita, it is said—i.e., The Way is Life.

*Laid before the presidents and delegates of the Swiss Motor Club and the Traffic and Hotel Union.

Every country ought nowadays to make it a point of honor to have good roads, but every advance costs sacrifices; it is only stagnation that is cheap. An inferior gravel is cheaper than a good one, but it does not last so long; and as the result of a bad road metal everything suffers: there is excessive dust in summer, much mud in rainy weather, and carriers are obliged to reduce their loads. The same applies to the rolling: one horse can draw almost as much on a good, smooth road as two horses on a road covered for miles with loose gravel. The rolling in of the gravel by the heavy traffic is a direct pecuniary loss for every carrier, and by the end of the year it has cost the district more than it would have done to hire or purchase a steam roller. The same applies with almost equal force to road tarring; the initial outlay is greater, but the durability of the road is thereby prolonged to such an extent, and the costs of road maintenance for the period are so much reduced, that the final balance-sheet shows a saving has been effected.

Now, it is beyond all doubt that every Cantonal Government perceives the utility of good roads, yet it cannot possibly make the corresponding increase in its road budget all at once. It is, therefore, very necessary that help should be forthcoming from those whose interests are chiefly concerned. Among these I reckon first of all the motorists (foreign and native), then proprietors of hotels and restaurants, traffic unions, villa residents, all of whom will doubtless be ready and willing to furnish a financial contribution towards a better road maintenance. Motorists who—as, for example, in Aargau—are paying taxes of 10 francs only for a 30-horse power motor car, have told me that they would willingly be prepared to pay taxes up to 100 or 150 francs if these were spent on improving the roads; and such a not too excessive taxation would at once produce an additional yearly revenue of 20,000 francs (£800) for Canton Aargau. If, now, every first-class hotel would contribute, say, 1 franc per bed per annum, and the smaller hotels, say, 50 centimes, this would also yield quite a respectable amount; moreover, the occupier of a country mansion with a garden adjacent to a dusty road would perhaps be willing to spend a few hundred francs in order to be free from dust. At least this is what I have been able to accomplish in the South of France, where the hotels and traffic unions, casinos and villa owners, together with the communes, pay one-half and the State pays the other half of the cost for road-tarring, or for water-sprinkling where tarring is not practicable. This dust laying has in several French departments quite done away with the dust nuisance, and between Nice and Mentone in the height of the season there are more than a thousand motors running in a day, and yet no one complains any more of the dust, notwithstanding the long and warm period of drought on the Riviera. And now the hotel proprietors have nothing more to pay, because the tarring is paying for itself.

Money, however, is not yet everything; much must also depend on how it is spent. As in every other kind of construction, considerable progress has been achieved of late years in road making; and the problem of adapting existing roads to the new traffic at the lowest cost was the subject of two International Road Congresses—at Paris in 1908 and at Brussels in 1910—which were promoted by the French Government, largely as the result of a petition from our Dust League. To these conferences thirty-three civilized States sent their delegates, Switzerland itself, as well as several individual cantons and towns, being also officially represented.

Although it cannot be affirmed that any miraculous remedy against dust was discovered at these two congresses, yet several ways and directions were indicated, along which a nearer approach is being made towards the solution of this problem, and some general rules were laid down which can be very well adapted for every country, and therefore for our beloved Switzerland also.

A Proposed Conference.—For the purpose of obtaining an exchange of opinions on the money question—i.e., how to procure the necessary means—as well as on the cheapest and quickest method of adapting some of the greater main roads for motor traffic, according to the nature and weight of the traffic, the kind of stone, the situation and condition of these roads, etc., it appeared to me that the best way would be to have an Inter-Cantonal Conference of the Directors of Public Works, with the cantonal engineers —a conference to which those chiefly interested, motor clubs, hotel and traffic delegates should be invited, as well as the borough engineers of the larger towns.

I have for this purpose already visited the following directors of public works, Messrs. Councillor Dr. Haab (Zurich), Councillor Keller (Aargau), and Councillor Brodbeck (Liestal), and, indeed, with the presidents of the local motor sections (Messrs. Wunderli-Volkert, An-der-Auer, Bâle, and Francke, Zurlinden, Aargau) and the directors of public works, have gladly welcomed the proposal for a road conference of that kind. Dr. Haab at once declared himself ready to convene such a conference of directors, as he had formerly invited a conference of directors of justice, military affairs and finance, conditionally on his obtaining the necessary assent of his colleagues, of which, however, he felt confident. All three directors thought the moment was opportune, as an ill-wind is blowing over motor affairs in Switzerland at the present time, and there is undoubtedly a tendency to restrict the motor traffic considerably, if not prohibit it altogether. They did not conceal from us that with them the conditions are just now very unfavorable for motorists, and that as quickly as possible it must be ascertained what can be done to counteract the enormous dust nuisance, especially on certain great main roads. There would shortly be sent from the police headquarters to the respective cantons an agreement proposal on behalf of a uniform regulation as to the speed limit for motors, and the directors of public works are in great embarrassment about making such a proposal to their authorities if nothing is going to be done against the dust. Proposals have already been made, first, to debar from certain roads, and only to allow motoring on certain other roads; secondly, to permit the motor traffic only at certain times, and on Sundays, especially, to prohibit it; thirdly, specified roads within villages and communes to be regularly sprinkled with water, or to be tarred, etc. Now, if these various questions could be discussed, and also answered by the directors of public works unitedly, that would be a very welcome result.

Such a conference would afford an opportunity for an exchange of opinions on the possibility of selecting some of the greater through roads and giving special attention to those places thereon which suffer most from dust. In this way the Zurich Motor Club, for example, has already assisted some villages and communes in procuring water-sprinkling casks, and the Cantonal Government of Aargau has also placed steam rollers and tar-machines at the disposal of the communes. It should not matter in which cantons these dusty districts be; indeed, even the cantonal roads nowadays no longer serve only for intercommunication between different places in one canton, but are becoming more and more through roads. A foreign motorist no longer asks in which canton he is; if he is driving on a bad road, he simply says: "The roads in Switzerland are bad." It may be said, too, that the Aargau roads serve not only the Aargau man, but also the Zürich, Berne, or Bâle man who drives through Aargau. It is, therefore, very desirable that there should be a maintenance centre for individual through roads, and it is perhaps possible that the Traffic Office proposed by Mr. Seiler, member of the National Council or Parliament, would form such a centralization of the voluntary contributions for roads improvement.

At a conference such as that suggested above the cantonal engineers would perhaps ascertain which road metal comes cheapest, whether slag (Flusschotter), at 6 francs the cubic metre, or Swiss basalt, at 28 francs; why road tarring is very successful in the cantons of Bâle, Vaud, and Geneva, and less successful in the cantons of Zürich, Lucerne, etc.; how large a traffic must be to make it more economical to replace the road metal by stone paving or asphalte; if it would not be more advisable to hire steam rollers instead of purchasing them. These and several other questions of the kind might be dealt with.

If by means of such a road tribunal a solution of these burning questions could be found which should satisfy residents on the roads, as well as frequenters and users of these roads, a great advance would thereby have been made, and the best proof would be given to the Swiss people that the motorists intend to make good, as far as is in their power, any damage done by them, and we hope that in the general interest those on the other side will then meet the new traffic with somewhat less of antipathy.

APPROXIMATE QUANTITIES FOR TIMBER RAILWAY BRIDGES.

In the March issue of the Manitoba Engineer, a new technical magazine published by the University of Manitoba, appears an article by A. J. Taunton, giving approximate quantities for timber railway bridges. Mr. Taunton says that these figures refer to bridges on the C.N.R., and must be modified to suit other structures. For pile trestles the piles may be estimated directly from the profile, the deck and caps running at about 2,700 f.b.m. per opening of 14 ft. 9 in., and a small allowance for dump plank and bracing depending on the height being made. Allow for lengths of pile in ordinary soil 15 feet more than the height from ground to cut-off. The iron will be about 60 lbs. per M. The piling on frame trestles is also obtained from the profile. The f.b.m. timber may be approximately obtained by multiplying the area of the opening between end bents, the ground, and the base of rail by a factor K, the value of which may vary from 11 to 13½. For long low trestles K may be as high as 13½, and for short deep ones the low limit (11) will be reached. The ratios of the area of the toe slopes at the ends to the whole area, and the timber in the deck to the total quantity, will considerably influence the value of K. Good guessing on the part of the estimator is necessary; thus, combined with experience and judgment, will should give very fair approximate results. The iron will be 57 to 60 lbs. per M.

The following figures are for Howe trusses, exclusive of falsework:—

Span in feet	Equivalent D.G.S. Loading	f.b.m. Timber	lbs. Iron
60	Class III.	33,000	13,000
60	" Heavy	42,000	28,000
80	" III.	56,000	40,000
120	" II.	.....	58,000

(Steel angle blocks used.)

STRAIN MEASUREMENTS OF BRICK PAVEMENTS.*

By James E. Howard.†

A material of superior properties for street pavements is present in the vitrified paving brick of current manufacture. Such excellent qualities have been reached that attention is necessarily attracted by this valuable clay product. The manufacturers of paving brick have done their part in a commendable manner and produced a paving material which has a crushing strength comparing well with strong natural stone, and which exceeds that of many varieties.

A well made paving brick possesses high resistance against abrasion, it is nearly impervious to moisture, in which respect it presents an important sanitary advantage, and furthermore it is attractive in appearance and beautifies a city where it is used.

The mechanical features of manufacture are under such control that regularity of form is secured and with that follows the opportunity of securing a pavement with an even surface, a feature of decided economic importance considering its bearing on the tractive force required for transportation purposes. The necessary material for manufacture seems favorably distributed in many States. From the manufacturing end the problem of producing a satisfactory paving material has been well solved.

The question now appears to be an engineering one to ascertain the manner in which the useful properties of paving brick can best be availed of. The engineering side of the question, however, is a broad one directly concerning the welfare of many communities.

The Bureau of Standards in the performance of its regular functions pertaining to investigate tests of structural materials has inaugurated tests on paving brick in place in the pavements. Laboratory tests on the properties of brick have been carefully made many times and in many places, the results of which are familiar to all. The present tests are intended to extend information to the behavior of the brick as found under service conditions, measuring the strains which are developed in the pavements themselves and from the deformations judge of the stresses or loads which are involved.

Conditions in a pavement are complicated, and in approaching the subject it is essential to make a careful analysis of the case, ascertain and define what the elementary features consist of and so shape the work that one feature after another may be taken up and investigated. Notwithstanding the apparent complexity of the subject it nevertheless admits of being resolved into elementary factors and each in sequence made the object of experimental inquiry.

Some preliminary work was done a year ago at Indianapolis. It has since been extended at Cleveland, during which the bureau has had the co-operation and aid of Mr. Will P. Blair, secretary, and other members of the National Paving Brick Manufacturers' Association, also officials of the cities of Cleveland, East Cleveland and Lakewood.

The work in those cities has been directed toward acquiring data upon the relations of the street car tracks to the pavement and upon the effect of variations in temperature in stressing the pavement. These questions are quite distinct from those which relate to the supporting capacity of pavements against heavy wheel loads, or durability in the matter of wear or surface abrasion. So many streets furnish successful examples of pavements which have carried heavy traffic for a term of years that it was not thought necessary to include such observations at this time.

The tests on the relations of the street car tracks to the pavements consisted of measuring the elastic depression of the track under the weights of cars and acquiring information on its influence on the adjacent pavement. The elastic depressions of the rails were measured on different types of tracks, selecting among the number places where maximum rigidity was likely to prevail.

In general it was found that the vertical elastic movement of street car tracks, that is the difference in level of the rails between a loaded and an unloaded state is greater than can be followed by a monolithic pavement without the formation of cracks alongside the track. Occasionally track in the very best condition may not display excessive depression, but the uncertainty of maintaining such a state renders it hazardous to make a bond between the pavement and the track.

There is in addition to the momentary elastic depression a bodily settlement of the track resulting from insufficient support of the roadbed. Such settlement, when it occurs, involves a permanent depression altogether too great to consider in connection with those lesser movements which we are now describing. The bodily settlement of the car track, however, is a feature which cannot be left unmentioned. Cases are so flagrant at times that a good pavement can hardly be made use of by reason of the ruts of the trolley tracks.

In these tests the sensitive leveling apparatus employed in the observations was such that the presence of a trolley car could be detected by the depression which is caused even in the pavement at a distance of ten feet from the track in the direction of the sidewalk. Such an observation was made on a relaid pavement in which a tar filler had been used, and substantially at that distance with a cement filler, or from 10 to 12 feet away.

At the intersection of two streets, where no trolley tracks were present, the depression caused by the weight of a man was detected at a distance of 12 feet. This observation was made at a place where the hollow rumbling sounds of passing vehicles indicated the pavement did not rest upon the sand cushion or foundation. It was noticed that the pavement at the crown of the street responded more promptly in respect to change of level to a load coming upon it from the side rather than along the centre line of the street.

Pavements are elastic as the properties of the individual brick and the cement filler would indicate, but the amount of transverse bending which a brick or a cement grouted pavement will endure without cracking is very limited in its extent. This is particularly the case when the material is strained in tension. A wider elastic range prevails for compression loads, substantially in the ratio of the compressive to the tensile strength, or from ten to one or more.

Concerning the effects of changes in temperature on the integrity of pavements, data were acquired by the method of strain measurements, a description of which method was presented at your last annual meeting. Gauged lengths of 20 inches each were established in the pavement, in number exceeding 300. It has been found feasible to measure these gauged lengths with an accuracy, commonly to the nearest ten thousandth of an inch. In this manner thermal changes may be followed very closely.

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Gauged lengths were located at the sides and at the middle of the street, in both crosswise and longitudinal directions. During the time in which these strain measurements have been in progress a range of pavement temperatures of 66 degrees F. has been experienced.

In general the expansions or contractions of the crosswise gauged lengths proceeded with greater regularity than the longitudinal movements. Modifying conditions influenced the longitudinal movements and a drop in temperature yielded results which showed normal contraction on some gauged lengths, on others a very slight change, while certain of the measured lengths, those spanning cracks in the pavement, were longer at the lower temperatures.

It was found that transverse cracks which open with a drop in temperature do not always entirely close again, but displayed a tendency to progressively increase in width. Probably that was due to fine particles of sand and abraded material of the pavement lodging in the open fissures. A repetition of the process caused a progressive lengthening of the pavement. During a period of 52 days one set of measurements showed the combined effect of decrease in temperature and progressive increase in width of crack amounted to .0395, practically four hundredths of an inch. This occurred on a pavement which had been laid about four months. The crosswise gauged lengths on the same street and during the same period of time contracted regularly with, lowering of temperature, the maximum amount observed being .0039.

A number of earlier determinations on the coefficient of expansion of building brick gave a value in the vicinity of .0000040 per degree F. This value seems to fit the present tests fairly well. The observed changes were somewhat less than called for by the above value of the coefficient, but the actual range in temperature of the brick was not ascertained with precision. Surface temperatures of the brickwork were used, and not unlikely the range in mean temperature was less than the recorded amount.

Taking the observations as they were made, the contraction of the 40-ft. roadway of Euclid Avenue, for a range in temperature of 100 degrees F. was 0.1043 and 0.1101 respectively at two sections of the roadway. The contraction called for on the basis of the above mentioned value of the coefficient would be 0.1920. That is the total amount, one-half of which might be considered as affecting each side.

During sunny days the temperature of the pavement naturally goes considerably higher than the temperature of the air a few feet above it. Observations on this feature showed a difference of 38 degrees on one occasion. The temperature of the air was, on the day in question, 64 degrees, four feet above the pavement. On the pavement in the shadow of the curb it was 69 degrees. In a freshly drilled pocket for a reference pin, on the sunny side of the street, the temperature was 85 degrees, while in the sun at the angle of the pavement and curb the thermometer rose to 102 degrees.

In the laying of a cement grouted pavement a critical period is encountered at the very outset, during which care must be exercised just as in every cement structure, in order to avoid the formation of incipient cracks before the cement grout has had time to set and acquire strength. On account of the excess of water used in making grout the setting is much retarded and several days may elapse before a substantial degree of hardness is acquired.

During this period the pavement should remain at a constant temperature, if it were possible, day and night. A drop of 20 degrees calls for a contraction of about one-tenth of an inch in a length of 100 feet. It is a fortunate circumstance in laying a pavement when a minimum range in temperature is experienced during the first 48 to 96 hours after grouting. Incipient cracks have been developed at a very early period following the grouting, resulting in injury to the street even before it was opened to traffic. Hot, sunny days followed by cool nights are menacing to freshly grouted pavements.

Transverse cracks have been started, which ultimately extended across the street, by the influence of the end joints of the edge stones against which the pavement was laid. The usual manner of laying pavements, with joints broken in one direction only, affords favorable paths for cracks once started to extend from curb to curb.

Recently an opportunity was furnished for inspection of the streets of the city of Panama, where brick pavements, cement filled, have been laid from five to six years. The pavements were without expansion joints at the sides. There are no street car tracks in Panama.

The pavements are in very fine condition. In one place only were cracks of any kind noticed.

At Panama the temperature is quite high throughout the year, and while the nights are cool still the drop in temperature is not great. It is believed that equable thermal conditions have contriubted toward maintaining the integrity of these pavements, and that pavements in southern climates should in general be aided by the smaller range in temperatures over those experienced in northern climates.

In conclusion, the results now available point to the undesirability of bonding the pavements with street car tracks, excepting possibly those of the very best construction. Cracks parallel to and adjacent to the tracks are likely to develop if the pavement is called upon to follow the usual elastic depression of the rails. Obviously there can be no lateral thrust to the pavement if the rails are left free to depress.

The strain measurements show that transverse expansions and contractions proceed with greater regularity than longitudinal movements. A progressive change in length or creep of a portion of the pavement is due to alternate changes of temperature, open cracks being partly filled with abraded material and prevented from closing when a rise in temperature occurs.

Cautionary warning is found in the behavior of pavements which have developed transverse cracks in the early stages after grouting. At this time exposure to a wide range in temperature is undesirable.

Pavements are probably benefitted by a certain amount of compressive stress in a longitudinal direction. Transverse cracks will be kept closed so far as possible, and if the compressive stress is not excessive spalling would not be induced. The open ends of paved streets, having no buttresses to take the thrust, may be expected to develop transverse cracks.

The minimum amount of crowning necessary to turn the water is advantageous to enable the pavement to resist compressive stresses without causing rupture during spells of sudden heating. Bends and reversed curves in streets are disadvantageous to the pavements.

A superior material is provided in paving brick of current manufacture, the use of which requires careful engineering skill, and it appears that questions pertaining to the effects of temperature changes are among those which require most prominent attention.

SMOKE ABATEMENT.

THE POSSIBILITY OF ESTABLISHING A NEW STANDARD OF SMOKE EMISSION FOR FACTORY CHIMNEYS.*

By Dr. John S. Owens.

My primary object in bringing this paper before you is to suggest the basis for a discussion of the question of smoke emission standard, in the hope that some properly organized effort may be made to deal with the difficulties which have hitherto prevented the adoption of a proper standard.

I do not think that anyone will contradict me when I say that the emission of dense smoke from furnaces consuming bituminous coal is unnecessary and indicative of waste of fuel and bad furnace construction or working. It is true that there are a few special cases, such as heating brewery vats and pottery kilns, where the emission of dense smoke for short periods is by some still considered essential, but it is open to question if this opinion is justifiable. At the same time, it should be remembered that the total absence of all smoke is in practice usually impossible of attainment when the economy of manufacturing processes requires the burning of bituminous coal. An illustration of the difficulty of avoiding all smoke is provided by the large electric generating stations, where unforeseen variations of load occur, such as the increase due to a London fog, with its accompanying demand for artificial light. In such a case as this, it may be necessary to fire up fresh boilers very rapidly, and there is no known furnace which will admit of the smokeless combustion of bituminous coal, until the temperature of the combustion chamber has attained a sufficient height. Even in steady working it is practically impossible to avoid all smoke; a faint brown smoke is regarded as indicating more efficient working of boiler-furnaces than none at all. The emission of some smoke may, therefore, be regarded as inevitable.

The present position, therefore, is this: we know that dense smoke is unnecessary, and that entire absence of smoke is impossible of attainment, but we have not yet settled what, being fair and reasonable, should be permissible in the way of smoke, having regard to the improved methods of combustion which are now at the disposal of manufacturers. This is the question an answer to which is, I submit, within our reach and should be sought for.

The Public Health Act of 1875 supplies the present standard by which smoke is judged throughout the country, except in the case of a few important cities possessing special powers on the subject. In this Act it is stated that "Any chimney not being the chimney of a private dwelling-house sending forth black smoke in such quantity as to be a nuisance shall be deemed to be a nuisance liable to be dealt with summarily under the Act."

There is an alternative method provided by this Act under which proceedings can be taken in respect of fire places or furnaces in connection with factories which do not "as far as practicable consume the smoke arising from the combustible used therein." In practice, however, it has been found that this method of abating smoke is unworkable, owing to the lack of some standard defining the meaning of the words "as far as possible."

The standard "black smoke in such quantity as to be a nuisance" takes cognizance of two separate things in relation to smoke: its quality—that is, it must be black, and its amount—that is, enough to cause a nuisance; but, while these two essentials are taken into account, it is done in such a way that it would be practically impossible to prove in any particular case, either that the smoke was black, or that it was in sufficient quantities to be a nuisance. The point I wish to make is that the two essentials, kind and quantity, form part of the standard.

Since the date of the Public Health Act of 1875, sufficient improvements in the methods of burning bituminous coal have been made to call for a reconsideration of the present standard, and the adoption of a more up-to-date one, which will conform in a reasonable way with the possibilities of modern practice. It is unnecessary to deal at length with the evils attending the emission of smoke, from the point of view of the public. They have to breathe the smoke-polluted air of cities, useful energy and money have to be expended in cleaning away soot, buildings are injured and blackened, the daylight and sunshine are cut off, and in many other ways harm is done which, to a great extent, might be avoided if we had a sound, legally-enforced standard for smoke emission, based on the known results which the proper application of modern methods of combustion give. Manufacturers would then use the best methods of combustion and the most suitable appliances. The loss to the manufacturer in soot, estimated as a percentage of his fuel bill, is probably not more than ¼ to 1 per cent., and this is not great enough to induce much effort to save it. On the other hand, the loss to the public due to the injuries inflicted by smoke is certainly many times greater; hence it is more to the interest of the public than of the manufacturer to reduce smoke.

One difficulty which has always existed is that of dealing with large and small fuel consumers by means of a single standard, and this has militated against the establishment of a more rational standard than that laid down in the Public Health Act. Clearly we cannot limit a large manufacturer to the emission of the same total quantity of soot as a small one. His furnaces might be better designed, and combustion more perfect, than in the case of the small consumer, but the total quantity of soot emitted might be much greater. Such a limitation would, therefore, work unfairly against the large fuel consumer.

At first sight it would seem that the total quantity of soot emitted by any chimney would be the soundest thing to limit, since it determines the amount of pollution of the air by soot from a particular source; but on closer examination it appears that this is not really the best basis. What we are concerned with is the total pollution of the air by soot due to all chimneys in any particular neighborhood. For example, the erection of an electric generating station where large quantities of fuel are burned may, by displacing many small consumers who had previously to generate their own power, actually cause a great reduction in the amount of soot poured into the air. At the same time the total quantity of soot emitted from such a station might be many times greater than that previously emitted by any one of the smaller power units which it displaced; in spite of the fact that the combustion might be better and the amount of soot per ton of fuel burned much less.

What we may reasonably ask for is, that the best and most smokeless methods of combustion should be used. If we could, therefore, fix a sound standard which would be some measure of the efficiency of the methods and appliances used from the present point of view, it would work no hardship against the large fuel consumer.

We come, then, to the conclusion that what is wanted is a standard of efficiency of combustion from the smoke-

*Paper read before Section G of the British Association at Portsmouth.

prevention point of view. This must clearly take into account the amount of fuel burnt, and, if we could measure it, the proportion of the fuel passing out of the chimney as soot would be the ideal standard.

It is the aim of engineers to provide a definite quantity of air for each pound of coal burnt, hence the amount of soot per unit volume of flue gases would vary approximately as the amount of soot per unit weight of fuel, when the air supply is so regulated to suit the amount of fuel burnt. In such cases the measurement of smoke density would be a sound basis for comparison as to efficiency of combustion. It would also be a fair standard to fix, since it would measure the polluting power of the smoke emitted so far as soot is concerned.

I therefore suggest that the word "black" in the present standard should be altered to "smoke of a density exceeding" some fixed standard. The standard should, however, also include a time of emission, and the form suggested is "smoke which exceeds a certain density (as measured in a way to be determined), and which is emitted for a period exceeding so many minutes per hour."

It is necessary next to consider the question of how the smoke is to be measured, since this is an essential part of the problem of establishing a sound standard.

We may set ourselves to measure any one of the following:—

1. Total quantity of soot emitted in a given time.
2. Weight of soot emitted as percentage of fuel burnt.
3. Density of smoke or weight of soot per unit volume of flue gases.
4. Ratio of density to a standard.
5. Color.
6. Opacity, or degree of blackness.

In addition to deciding which of these objects to aim at we must keep in view that whatever method is used, it must give reasonable accuracy and a fair basis of comparison between chimney and chimney, or with a standard; it must also be easily applied from outside the factory by a single observer.

It may be mentioned here that the standard maximum adopted by the Alkalis Act of 1906 for the emission of muriatic acid in smoke or noxious fumes is one-fifth of a grain per cubic foot.

Considering now the various methods of measurement referred to above:—

Total Soot Emitted.—This measures the amount of pollution by a particular chimney, but takes no account of the amount of fuel burnt. As stated previously, it would be unfair to limit a large fuel consumer to the same total quantity of soot as a small one, even supposing we could measure it in a practical way. Its estimation implies access to the chimney and at least two measurements—that is, density of smoke and volume of flue gases.

Percentage of Fuel Lost as Soot.—To measure the weight of soot as a percentage of fuel burnt is open to the same objections as the measurement of the total quantity, but it implies at least the measurement of density of smoke, volume of flue gases, and weight of fuel. It would be a fair basis for a standard, but is quite impracticable as a method for the use of sanitary inspectors.

Density.—A quantitative measure of the density of the smoke might be obtained by the filtration method, in which the soot from a known volume of smoke is trapped and weighed, but it would be too cumbrous for general use. Density can also be measured optically, in which cases access to the chimney or factory would be unnecessary. It would give a fair measure of efficiency of the plant, and a good basis of comparison whatever the quantity of fuel burnt or diameter of the chimney.

Color.—The measurement of the color of smoke may be dismissed as useless, since color bears no relation to quantity of soot emitted or evil done by the smoke.

Opacity.—To measure the opacity of a smoke column or its degree of blackness, which is the commonly accepted method now adopted, is worse than useless, since it is misleading, because opacity alone, unless adjusted for thickness of column, is neither a measure of the density of smoke nor of the amount of pollution of the air. The smoke from different chimneys cannot be fairly compared on this basis because of their different diameters. All smoke-charts, such as the Ringlemann or Donkin, measure the opacity in a crude way; similarly, photographic methods, by which a photograph of the smoke-column is compared with standard shades, are open to the same objections. Instruments in which smoked glass is matched to the shade of the smoke, and in which no adjustment is made for chimney diameter, are equally objectionable. In a word, all these methods are only useful to compare chimneys of similar diameter, or the smoke from the same chimney at different times; when used for general comparison they are misleading.

We are thus reduced to a measurement of smoke density as the only satisfactory basis to work on. I will, therefore, go into this method in more detail.

Suppose we can measure the weight of soot in a column of smoke 1 sq. ft. in section, and the same length as the diameter of the chimney.

Let S = weight of soot in such a column.
V = velocity of flue gases in f.p.s.
D = diameter of chimney in feet.

The weight of soot in 1 cu. ft. of smoke will be $= \frac{S}{D}$,

and the weight emitted per second—

$$\frac{\pi D^2 V S}{4 D} = \frac{\pi}{4} D V S,$$

or D V S × a constant; that is, it varies as the volume of flue gases × the weight of soot per cubic foot. The amount of soot emitted will therefore vary directly as the volume of flue gases, assuming the density to remain constant. Or if we measure only S, the amount of soot emitted will vary as S × V D. If we assume V to be a constant value, the weight of soot emitted will vary as S × D, and the density of the smoke as S ÷ D. This shows that the measurement of S alone is of little use unless an adjustment is made for D, and it must be noted that all smoke-charts now in use measure something which depends on S alone, but neglects D. It also points to the conclusion that with an adjustment for D, the measurement of S can be made to give a fair approximation of the relative weight of soot emitted or to the density of the smoke.

We can measure S indirectly on the basis of the light obstructed. For example, we may compare the degree of opacity of the smoke with a smoked glass which obstructs as much light as a smoke column of known density and thickness. Suppose, then, we take such a glass of an opacity equal to that of a column of smoke of unit thickness and standard density, we might prepare an instrument having several shades of such glass, the lightest being the standard for the smallest chimney, followed by other shades made by superimposing various thicknesses of shade 1, corresponding to various thicknesses of smoke column or chimney-diameter. We could then, by comparing the smoke at the top of a chimney with such a set, say whether or to what extent the standard was being exceeded.

Suppose, for example, the smoked glasses are numbered in the ratio of their thickness, and that No. 1 matches a smoke of density G in one-foot column, the density of smoke matching glass No. N in a column D feet thick will be $\frac{NG}{D}$; that is, the density will vary as $\frac{N}{D}$, and can be given quantitatively by calibrating shade No. 1 to correspond with a known density of smoke in a column one foot thick.

If we attempt to measure the opacity or light cut off by the smoke, we get a figure which does not bear a simple relation to the smoke density such as is borne by the thickness of the smoked glass which matches the smoke. I refer to this because attempts have been made to measure the light obstructed as a basis for comparison between smoke from different chimneys.

Assuming, then, that we can observe with fair accuracy the density of smoke by such a method as I have described, the next step is to fix a certain maximum density which must not be exceeded. This could probably be best defined as: Such a density as would, when viewed by transmitted light alone and in a layer of a certain thickness, permit to pass through it a certain percentage of the light falling on it. This might be referred to a standard density. With improvement in furnaces and appliances for the more perfect combustion of bituminous coal this standard could be altered so as to represent fairly what might be expected from the current state of knowledge and invention.

It would be necessary then to provide an instrument to enable a comparison with such a standard to be easily made. The accompanying drawing illustrates one which I have designed to meet the requirements laid down in this paper. This is in the form of a small telescope, having fixed in the optical system at a point which may be brought into the focus of both object-glass and eye-piece, a revolving eccentric disc containing a number of graduated smoked glasses arranged in cells round the centre. The glasses only fill half of each cell so that by revolving the disc, as each cell with its glass is brought successively into the axis of the telescope, the smoke may be viewed through the open half of the cell and matched to the glass in the other half. The glasses are numbered in the ratio of their thickness, and a table is provided giving the number of the glass divided by the diameter of the chimney, and thus a figure which is a measure of the density of the smoke, and can be made to read the actual weight per cubic foot of soot in the smoke if desired. This necessitates the inspector knowing the chimney diameters in his district; but these may be tabulated once for all. I have found when, in instruments for smoke measurement, the smoke is viewed through a small aperture, as is essential in order not to take in too much background, that it is impossible to get true results owing to the eye being unable to focus at the same time the object aperture and the object; so that the edges of the aperture are hazy and ill-defined. This results in the whole aperture, when small, being overlaid by a hazy film, due to its ill-defined edges, which film prevents accurate readings of the smoke shade. The same applies to the aperture containing smoked glasses for comparison.

There are many difficulties remaining which apply to all optical methods of measuring smoke, but before enumerating these it is well to remind you that we have no other means of attaining our object, since all methods requiring access to a factory or a chimney are useless from the sanitary inspector's point of view. It is easy to imagine the welcome such an inspector would get on presenting himself at the door of a factory and announcing that he had come to measure the density of the smoke from the chimney. Even assuming that he was given access to the chimney, it is unlikely that the dense smoke he had seen from outside would be permitted to continue for him to measure.

I draw attention to this so that while recognizing the difficulties in the way of applying optical methods of measurement too much weight should not be given to such difficulties, nor should the presence of drawbacks to a method prevent its use if it fulfils its purpose, and a better is not forthcoming.

Turning now to a short review of these difficulties, it is well to consider what are the factors which influence the apparent density of smoke, as given by an observation based upon its degree of blackness; these are:—

1. The true density of the smoke.
2. Diameter of chimney.
3. Background of smoke and shade it is compared with.
4. The color of the smoke particles.
5. The size of the smoke particles.
6. The amount and color of the light falling on the smoke from the observer's side.
7. The direction of the line of vision.
8. Presence or absence of wind.
9. The observer's personal factor.

There is not time to discuss each of these in detail, but I may say that 1, 2, and 3 can be dealt with satisfactorily, 4 and 5 are probably sufficiently constant not to affect results seriously, excluding exceptional cases, 6 is the most difficult to deal with, and should be allowed for in making observations, 7 can be overcome, to a great extent, by keeping the angle which the line of vision makes with the horizon fairly constant, 8 would not, as a rule, be a serious obstacle, while 9 is not, I think, of great importance.

Assuming, then, that we have decided on the method of measurement to be adopted, and on the type of standard to be fixed, the question remains, how is the standard to be arrived at? It would seem that this might be done best by the appointment of a technical committee, which would make observations over a certain period, say a year, of certain selected representative chimneys, where up-to-date and well-designed furnaces are installed, and bituminous coal is burnt. A consideration of the results of such observations, both as to smoke density and time of emission, should enable the committee to fix a fair and reasonable standard, both as to the density of the smoke, and the time during which such density should be permitted.

Time does not admit of a consideration of the reasons for and against the legal enforcement of a standard. There is not, however, much room for discussion, for the fact that a legally-enforced, if unsatisfactory, standard has existed for thirty-six years proves that a standard is necessary, and that, to be of use, it must be legally enforcable. The present standard of "black smoke in such quantity as to be a nuisance" has utterly broken down, owing to the impossibility of proving to a magistrate's satisfaction that the smoke emitted was literally black. I have tried to show that it is now possible to fix a sound and workable standard for smoke emission, and to apply it in a practicable way.

RECENT CHANGES IN STEEL WORKS.

The Canadian Bridge Company have recently purchased a large stock of shares of the Wm. P. McNeil Company, New Glasgow, Nova Scotia. Mr. K. W. Bash has been appointed vice-president and engineer, and Mr. W. McNeil is the president and manager of the new company. Extensive improvements were made to the plant during the past year resulting in a well-equipped works for the manufacture of structural steelwork and further improvements are anticipated in the near future. Other than the changes noted above, the policy of the company will remain intact.

Metallurgical Comment

T. R. LOUDON, B.A.Sc.

Correspondence and Discussion Invited

THE SCHUMACHER BRIQUETTING PROCESS.*

By Prof. Joseph W. Richards.

Fresh blast-furnace flue dust mixed with from 5 to 10 per cent. of its weight of magnesium chloride or calcium chloride solution, that is to say, with from 0.25 to 2 per cent. of its weight of magnesium chloride or calcium chloride, acquires the property of setting within a short time, from 15 to 60 min., and forming a hard cemented briquette. Alkaline solutions have no action such as described. When treated in this way the flue dust briquette sets very hard, apparently from pure excess of cementing and setting power. It is, therefore, possible to mix with the flue dust a considerable proportion of inert ore or like material, which has no setting power by this process. A particularly strongly cementing flue dust will carry as much as three times its weight of fine ore or the like, and yet produce a satisfactorily strong briquette.

The Cambria Steel Company has installed at Johnstown, Pa., a small plant consisting of two presses, with a combined capacity of 250 tons of briquettes per day. One of the presses is of the mechanical type, with hydraulic safety regulator; the other is a Ronay hydraulic press. The first makes briquettes the size of an ordinary firebrick, the latter makes briquettes cylindrical in shape, 8 in. long and 8 in. in diameter and using considerably higher pressures than the former.

As seen in operation recently, the warm flue dust from the dust catchers was stored in one hopper, while fine ore, containing from 10 to 12 per cent. of moisture, and quite cold, was stored in another hopper. A rotating feeding device formed a stream of these materials, passing it into the mixing trough with an ordinary spiral, into which at the same time was run a 30 per cent. solution of calcium chloride, the flow of which was regulated by a hand valve. The trough fed the mixture directly into the hopper of the press. The flue dust was warm, approximately at 200 deg. F.; the ore was ice cold; the solution was cold. The mixture fed to the press was just warm to the touch; the bricks going from the press were decidedly hot and steaming, and where loaded into the car they were quite hot to the touch and steamed vigorously. This heating of the mixture as soon as compressed into briquettes is a characteristic of the process, and is an index of the rapid chemical reaction taking place which results in the cementing of the material.

The flue dust carries 18 to 20 per cent. of coke, which is all carried into the mixture, the mixture being 70 of ore to 30 of flue dust. There is from 5.5 to 6 per cent. of coke in a finished briquette. The saving of this coke, 20 per cent. in weight of the flue dust used, represents sufficient value to pay for the entire cost of the briquetting of the dust.

As to physical properties, a briquette made of flue dust, tested by the author, absorbed 11.5 per cent. of its weight of water, representing 27 per cent. of voids, a very satisfactory porosity. Several hundred tons of these briquettes were already in the ordinary furnace bins, ready for use in the furnaces, and appeared to have stood carriage to that point and a drop of 10 to 20 ft., and also subsequent action of ice and snow for several weeks, without deterioration; only a few were broken, and but little dust was made.

*Abstract of paper read before the recent meeting of the American Institute of Mining Engineers.

NEW TYPE OF FURNACE.

The essential feature of the Cayley Robinson furnace, of which a demonstration was given recently in London, E.C., is the gasification of the coal in one chamber and the combustion of the gas in another. The gasification process having been started by lighting the coal in the ordinary way, a small quantity of live coke is transferred from the fire into the adjacent combustion chamber in which the gases are made to circulate centrifugally by means of a jet of steam, and in which, it is claimed, they are completely consumed without ash, smoke, or clinker. The steam is generated from water in a coil of pipes placed in the combustion chamber. No actual tests have yet been carried out with the furnace, but it is stated that over 75 per cent. of the calorific value of the fuel is utilized, and that in a kitchen stove, constructed on this system, 1 lb. of coal has achieved the same results as are usually obtained with about 8 lb. in the ordinary pattern. Experiments are now being carried out with a view to adapting the principle for use in locomotives.

EFFECT OF HEAVY LOADING AND COLD ON RAILS.*

The 4½-in. 65-lb. section of the New York Central & Hudson River Railroad, in service 8½ years in the Fourth Avenue tunnel in New York City, carried 51,000,000 tons with a loss of about ¼ in. in depth of the metal upon the head of the rail. This was an English make of rail with a heavy base and thin head. The 5-in. 80-lb. section which replaced this section was in service eight years and carried 65,000,000 tons with a loss of about ⅛ in. of metal upon the head before it was removed. The 6-in. 100-lb. New York Central section, which was rolled in 1892, and replaced the 5-in. 80-lb. section, was removed in July, 1899, carried 95,000,000 tons and is still in yard service. The loss of metal on the top of the tunnel was about twice as rapid as it was from the same tonnage.

The 6-in. 100-lb. section of rail in 1895 of 0.06 phosphorus and 0.65 in carbon on the "inbound main" from 1895 until August, 1907, carried 375,000,000 tons with a loss of about ⅛ in. in depth on the head of the rail.

The light earlier sections could carry from 60,000,000 to 75,000,000 tons before they were rough and unsuitable for passenger traffic, and when in a location where the tonnage was only 250,000 to 500,000 tons per month, would last in the track many years. The heavier sections which replaced the light ones carried much greater tonnages from the increase in the density of traffic. Their larger area of metal also gave them a capacity for greater tonnages.

The 100-lb. rails in the Fourth Avenue tunnel at the present time carry daily from 150 to 200 train movements. The tonnage per month is in some places nearly as much as the light rails were subjected to in one or two years' service.

Table 1 shows the increase in freight ton-miles from 1890 to 1900, nearly doubled, while it trebled for 1910.

It has been stated that the former rails seem to last so well due to the elimination of the poorer quality of rails by the service in the track. The older rails were cold rolled by the light wheel loads until the surface was sufficiently

*From report of Am. Railway Eng. Assoc. by Dr. P. H. Dudley.

hardened to bear the recent heavier loads without much increased abrasion. New rails of the same section and practically the same physical properties would, when subjected to heavier wheel loads, lose more of the metal by wear, before the surface was rolled as hard as the former sections, and their rate would be much faster.

Dr. Dudley states that it is not considered advisable at the present time to make the composition of the rails which are to be subjected to the present heavy wheel loads so hard that at first they will entirely resist the cold rolling effect of the passing wheels. It is better to make the physical properties of the rails such that a slight flow of the metal will take place under the various worn wheel treads which will run over the rails, and in this way the surface will accommodate itself to the average treads passing over the heads, the surface becoming gradually hard, and in a short time the flow of metal is pracitcally arrested.

In rails which are too soft the surface may be worn away by the wheel loads before it becomes sufficiently hardened for the long wear or the drivers slip on the rails, producing a layer so hard as to require their removal from the track.

The mileage shown for 1830 to 1850 had been constructed mostly with strap iron rails. The mileage for 1850 to 1870 was mostly iron rails, though about one-fifth was steel rails. The mileage for 1880 was more than one-half laid with steel rails, while in that shown for 1890, 1900 and 1910 the mileage would be mostly steel. It would have been impossible to have constructed the mileage shown for 1910 without the invention of Bessemer steel. We have in the United States about 40,000,000 tons of steel in the track, of which 2,500,000 tons are of the basic open-hearth steel.

Basic Bessemer steel and basic open-hearth steels are used abroad in Germany, England, also in Africa, and the wear on the rails under their light wheel loads, particularly on the curves, is stated to be much more rapid than desired. they do in our Northern States and Canada. They use The temperatures in those countries do not fall as low as higher carbon rails in France as a rule than we do in this country with excellent effect. Their wheel loads are also much lighter and they maintain their rotundity for a longer period than the wheels here under our heavier wheel loads and long distance runs.

One of the problems confronting the railroads to-day in those States where the temperatures fall to 20 and 40 deg. below zero is to secure a sufficiently homogeneous metal in the 33 and 36 in. wheels for the entire circumference of the tire or wheel tread to maintain its rotundity. The 36-in. wheels make 560.2 revolutions per mile, and with their static load of 5 tons, the accumulated tonnage upon the tread of the tire or wheel would amount to 2801 tons for each mile which it runs.

The locomotive drivers of 79 in. in diameter make 255.3 revolutions per mile. The Pacific type engines have static loads of 14.3 tons per driver, consequently the static load per mile run upon the metal is 3,651 tons. These figures are sufficient to show that their tonnage upon each portion of the bearing surface on the tread repeats the load for each revolution and for high speed trains with great rapidity, consequently the accumulated tonnage on the tires and wheels enlarges according to the distance run.

First, the direct one which affects the metal, decreasing its ductility, but increasing its tensile strength, elastic limits and modulus of elasticity to a slight extent and making it more sensitive to shocks.

Second, indirect effect by contraction of the metal which may set up the tensile stresses of some magnitude in the rails before the ends rend in the splice bars. The intensity of this effect on the rails is greater in countries subject to temperatures near or below zero, and subject to cold waves from the north, where the temperatures fall many degrees below zero or fall in a short time and continue cold for a few days until broken by a warm wave from a tropical climate.

The experience of the railroads in the Northern and Western States this winter is more severe than ever before. Rails which have heretofore been quite free from breakages have been rendered mor susceptible to the wheel effects of the passing trains and a larger number broken than ever before reported. Such conditions have been studied to render the rails more ductile or of greater tenacity and toughness to withstand the shock of passing wheels in temperatures of from 20 to 40 deg. below zero.

The service tests of rails of large ductility or tenacity and toughness of metal in large tonnages, scattered in many States, show during the past winter an almost entire freedom from breakages and indicate that much has already been accomplished. It is now possible from a definite chemical composition to determine what ductility or toughness may be secured when the steel is properly purified in the bath, and thus increase the factor of safety in the output of the rails.

It seems that to most engineers of maintenance of way who are not conversant fully with the actual steps of the different processes of manufacture, a specification for chemical composition and a few subsequent tests for quality would be sufficient to secure rails to withstand the present service. This is by no means the case, for it is only by a knowledge of the manufacture of the steel and its subsequent use in the track that one obtains the requisite knowledge to provide for the various conditions of service to which rails are subjected.

It is the duty of users of rail to advise the manufacturers of the type and, as far as possible, the cause of failures and breakages of rails in the tracks. The gathering of statistics of rail failures of the past few years and discussing them with the manufacturers has resulted in a co-operation to improve the quality of the output of rails.

It must be remembered that with the present wheel loads and high speeds of the train movements the time factor for reversal of the stresses under the wheels and in the wheel spacing has been materially shortened by the present schedules. The wheel loads also require stresses of large magnitude to be distributed in a shorter time than was necessary with slower speeds and lesser wheel loads.

Table 1.—Miles of Track and Tonnage.

	1830.	1840.	1850.	1860.	1870.	1880.	1890.	1900.	1910.
Miles operated exclusive of side tracks, yards and terminals	23	2,818	9,021	30,626	52,922	93,296	163,597	192,556	239,652
Miles of all tracks	....	....	....	....	....	....	199,875	258,784	349,159
Tons of freight one mile	....	....	....	....	....	....	76,207,047	141,599,159	255,528,643
Passengers one mile	....	....	....	....	....	....	11,847,785	16,039,007	33,949,936
Locomotive weights without tenders (tons)	....	....	....	....	....	....	1,265,880	2,023,702	4,271,000
Freight cars—total capacity (tons)	....	....	....	....	....	....	19,288,301	37,210,720	74,043,000

UTILIZING THE WASTE HEAT OF THE OPEN-HEARTH FURNACE.*

A. Pfoser.

While the most strenuous efforts are being made to utilize the slightest improvements in the efficiency of power plants—steam engines and gas engines—with a view to economizing fuel, and great saving is being effected in this respect by the extended employment of waste-heat plant, the question of increasing the efficiency of furnaces by utilizing their waste heat is comparatively neglected. In smelting works it is true that the waste heat is used for steam raising; but even then the gases pass away into the chimney stack at such a high temperature that the waste of heat is enormous. Apart from this, however, the utilization of the waste heat from open-hearth furnaces is a matter deserving consideration.

The gases leave the open-hearth furnace at a temperature of 600 to 700 deg. C., which entails a very great loss of heat, and considerably lowers the total efficiency of the plant. According to F. Mayer, the heat balance of the open-hearth furnace plant is approximately as follows, expressed in percentages of the total heat generated by the coal consumed:—

	Per cent.
Total net useful effect	27
Losses by radiation from furnace and producers	29
Loss of heat in the waste gases	31
Combustible matter in producer cinders	3
Loss by radiation from producer	10
	100

It is evident, therefore, that the useful effect of the whole plant could be considerably increased by an improvement in the utilization of the very high losses sustained in the waste gases; but at present, no means are available for recovering the waste heat from the gases for utilization in the furnace plant itself.

The idea which first suggests itself, namely, increasing the size of the producers so as to obtain a higher degree of preliminary heating of the gas and air, and thus utilize the heat of the waste gases more effectually, is impracticable, because the pre-heating already raises the gas and air temperatures to that of the waste gases, and therefore cannot be improved upon. Consequently, the only course open for the time being is to utilize for extraneous purposes any waste heat that is capable of being recovered, steam raising being the most important to be considered.

In utilizing the waste heat of the gases so as to lower their temperature from 600—700 to 300 deg. C., about 1¾ tons of steam, at a pressure of 146 lbs., could be raised per hour from a 34-to 35-ton open-hearth furnace, consuming 27 cwts. of coal, with a heating value of 7,200 calories. Assuming 1 lb. of coal to produce 8 lbs. of steam, and that the steam would be utilized day and night for 300 days in the year, this would correspond, in the case of the above furnace, to a saving of 4½ cwts. of coal per hour, or, with coal at 16s. per ton, to an annual saving of £1,330. This saving of coal, amounting to 16.7 per cent. of the total consumption, would amend the heat balance as follows:—

	Per cent.
Total useful effect	27+16.7=43.7
Losses by radiation from furnace and producers	29.0
Loss in waste gases	31 0—16.7=14.3
Combustible matter in producer cinders	3.0
Loss by radiation from producer	10.0
	100.0

* Iron and Coal Trades' Review.

The total efficiency of the open-hearth steel plant is thus improved to the extent of 16.7 per cent. by the provision of a waste-heat boiler.

It is essential that the furnace draft should not be interfered with in the slightest degree by the interposition of such a boiler, the production of steel being the main factor in the working of the furnace. Consequently, the chimney stack must be able to produce the same draft in the furnace as before, in spite of the frictional resistance opposed by the boiler surfaces to the passage of the gases; and the fulfilment of this condition will necessitate an increase in the height of the stack. In many cases this increase will be too great to be obtained with the existing stack, and either a new stack will have to be built, or artificial draft created. In either case, the initial outlay will be recouped in 1½ to 2 years. With artificial draft, the provision of an economizer behind the waste-heat boiler will enable the temperature of the gases to be reduced to 150—200 deg. C., thus increasing the output of steam by about 20 per cent.

METALLURGICAL INVESTIGATIONS.

The work in the Metallurgical Department of the National Physical Laboratory, London, during the last year, included a continuation of the study of the alloys of aluminium with zinc and with zinc and copper together; the metallography of steel at high temperatures; the melting point of iron; the effects of strain at high temperature; and brittleness in steel. In some tests on the inflammability of flake charcoal the material was tested under various conditions of air supply, from 5 to 62 cubic feet a minute for a cubic foot of charcoal; and it was found that spontaneous combustion occurred when the temperature reached from 96 to 110 deg. C., according to the air supply, but that at lower temperatures there was no sign of spontaneous heating. At the request of Lloyd's Register the effect of exposing the charcoal to a current of air containing 5 per cent. of sulphurous acid gas was also tried, and the very startling result was obtained that even at the ordinary temperature (18 deg. C.) spontaneous combustion occurred when the charcoal had been exposed to a current of such air for hours. These experiments show clearly the danger which is involved in using this gas for disinfecting purposes in places where charcoal is used in the walls. The behavior of decayed wood has also been studied from the point of view of spontaneous combustion, but so far as the samples yet tested are concerned this material appears markedly less inflammable than charcoal.

MINING ACCIDENTS IN ONTARIO.

A report by E. T. Corkill, provincial inspector of mines, issued by the Ontario Bureau of Mines, shows that in 1911, 49 men were killed in accidents at mines, metallurgical works and quarries regulated by the Mining Act. The number of men killed and injured is distributed as follows: Mines, 36 killed and 86 injured; metallurgical works, 9 killed and 25 injured; quarries, 4 killed.

The number of men employed at mines is approximately 9,423, so that the ratio of men killed was 3.82 per 1,000. The causes of fatalities underground were: Falls of ground, 2; shaft accidents, 8; explosive accidents, 16; miscellaneous, 7. Of the three men killed on the surface, 2 were the victims of an explosion. These figures show a marked decrease in the accidents from falls of ground and in surface casualities, but a large increase in those caused by explosives.

The following classification distributes the responsibility for the causes of the fatal mine accidents: Due to dangers inherent in the work, 10; arising out of defects in the mine workings, 10; due to fault of fellow workman, 2; due to fault of injured person, 14. Of the 86 non-fatal accidents, 12 were due to explosives. The inspector notes that the provisions of the mining regulations most frequently broken by the workmen are those referring to the use of explosives.

STRIKES DURING FEBRUARY.

The strike situation in Canada continues on the whole favorable according to the latest reports of the Department of Labor. Few disputes of importance occurred during February, the one affecting most employees being that of the cloak and garment workers in the employ of T. Eaton Company, Toronto and Montreal. About 600 employees were affected by this dispute. Altogether there were twelve strikes in existence during February affecting about 50 firms and 1,200 employees. The loss of time in working days was approximately 10,000, compared with 12,000 days lost from the same cause during January, and over 32,000 days lost in February, 1911. Eight strikes remained in existence at the close of the month.

UNIVERSITY OF TORONTO ENGINEERING ALUMNI.

There was a very successful and enthusiastic gathering at the University Club, Vancouver, B.C., on March 30th, of the Engineering Alumni of the University of Toronto, Pacific Coast branch. This branch of the society was organized in Vancouver in January last, the membership being restricted to graduates and undergraduates of the engineering faculty of the University of Toronto and the old School of Practical Science, to the number of about fifty.

Speeches from a number of prominent engineers were included in the function. Among them were Mr. James H. Kennedy, chief engineer of the Great Northern Railway, who replied to the toast of the "Old School," of which he was one of the first graduates. Mr. E. B. Hermon, the president, replied to the toast "The Engineering Profession," Mr. W. A. Clement to "The Canadian Society of Civil Engineers," Mr. R. A. Thomson to "The Canadian Mining Institute," Mr. George Haynes, city engineer of North Vancouver, to "Municipal Engineering"; Mr. A. P. Augustine to "The British Columbia Land Surveyors"; Mr. James Hartney to "The Electric Engineers"; Mr. L. E. Jones and Mr. F. T. Smith to "The University of Toronto," and Mr. K. A. MacKenzie to "The General Engineering Alumni of the University of Toronto"; Mr. F. Broadfoot to "The American Society of Civil Engineers," and Mr. J. A. Mackenzie to "The American Society of Mining Engineers"; Mr. Fyfe and Mr. Broadfoot to "Athletics."

The alumni memorialized the occasion in the University Club by presenting to the club a handsome picture of the University of Toronto, main building. Dr. Wilson, the president of the club, accepted the gift in an appropriate speech.

ENGINEERING NOTES.

Regina, Sask.—During work on the pump well several employees of the city accidentally located a water gusher A five-inch pipe was laid down and the pressure forced the liquid over the end of the pipe which was left clear of the ground. An eight-inch pipe was added, forming an extension of about eight feet above ground level, and the pressure was sufficient to cause the water to flow with some force over the top of this. An investigation will be held, and in the mean time it is hoped that an additional source of water supply has been located.

Calgary, Alta.—Construction work on a new subway under the Canadian Pacific Railway tracks has been started. This subway is on Ninth Avenue East.

Vancouver, B.C.—The architects of this city are now making plans for an exhibition of their works. The display will be composed of line and wash drawings, photographs and models, and will, in all probability, be held in the Pacific Building. Mr. N. A. Leech is president of the association.

Montreal, P.Q.—The Canadian Autobus Company have made a proposition to the city council of Montreal regarding the inauguration of a line of cars on the streets of this city.

Ottawa, Ont.—The new intake pipe was in operation on April 9th last. A decided increase in the water pressure was noticed.

Hull P.Q.—A report states that the average daily water consumption in this city is 1,800,000 gallons, and the average amount pumped about three million gallons. The difference is supposed to be due to leaks in the mains. The individual consumption of water in this city is 166.66 gallons per day.

Regina, Sask.—The Regina Engineering Society has been formed. Mr. A. J. McPherson, late city commissioner, is president of the new organization. The organization has as its members nearly every engineer in the city, and it is proposed to take steps in the near future for the formation of a provincial body. The following list of officers will form the executive of the organization until the annual meeting, which will be held in November: First vice-president, H. S. Carpenter; second vice-president, L. A. Thornton; secretary, J. A. Gibson; corresponding secretary, R. O. Wynne-Roberts; treasurer, R. M. Blackburn; librarian, E. J. Wenger.

PERSONAL.

Mr. H. L. Thompson, of Vancouver, has been appointed construction engineer for the municipality of Burnaby, B.C.

Mr. I. F. Willsie has resigned his position as city engineer for the municipality of London, Ont.

Mr. Harry F. Clayton has been appointed vice-president and general manager of the Canadian Boving Company, Limited. The head offices of this company are in Toronto.

Mr. A. J. McPherson has resigned his position as city commissioner of the city of Regina, and will consider the appointment of chairman of the new Highway Commission of Saskatchewan.

Mr. John Callaghan, of Winnipeg, Man., has been appointed chief engineer of the Pacific Great Eastern Railway and assistant to Mr. B. B. Kelliher, of the Grand Trunk Pacific.

OBITUARY.

A well known trade journalist in the person of **Mr. Ivan Macdonald** has passed away. Mr. Macdonald was the founder and for a time managing editor of "Construction," a journal that devoted its talents to the architectural element. Mr. Macdonald was a Canadian, and had been engaged in editorial work for some years. His death was due to pneumonia. He was thirty years of age.

MEETINGS.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS.

The members of the above institute met in the rooms of the Engineers' Club, West 40th Street, New York City, on Wednesday evening, April 17th, to discuss the question of "Engineer Commissioners." This discussion took place after an enjoyable dinner had been served.

THE SCIENTIFIC CLUB OF WINNIPEG.

The annual meeting of the above was held in Winnipeg on Tuesday, April 2nd last. The secretaries reported that during the year 11 ordinary meetings had been held, at which 18 communications had been made. Of these, 7 belonged to the physical and chemical division of natural science, and 11 to the biological division. The following committee was elected for the ensuing session: Hon. treasurer, Prof. Parker; hon. secretaries, Prof. Vincent, A. T. Cameron; additional members of committee, Principal Bletcher, Prof. Evatt, R. T. Hodgson, Dr. Leeming, Dr. McClung and Dr. Torrance.

CENTRAL RAILWAY CLUB MEETING.

Nearly two hundred attended the annual banquet of the Central Railway and Engineers' Club at the Walker House, Toronto, April 8th. The president, Mr. James Bannon, presided. Amongst those who spoke to the various toasts were: Dean Galbraith of the University of Toronto, Ald. Alfred Maguire and President Willis Chipman of the Engineers' Club.

COMING MEETINGS.

CANADIAN INSTITUTE.—198 College Street, Toronto. Saturday Evening Lectures, 8 p.m. April 20th—"Chemical Interpretations of Vital Phenomena," illustrated. Prof. Leathes. Toronto Univerity. April. 27th—"Early Economic History of Canada," S. A. Cudmore. Toronto University. Nominations.

THE CLEVELAND ENGINEERING SOCIETY.—Special Meeting, Tuesday, April 23rd, 1912, Chamber of Commerce Bldg., Cleveland, O. "Steel and its Heat Treatment" (Illustrated), by Robt. R. Abbott, Metallurgical Engineer, The Peerless Motor Car Co. F. W. Ballard, Secretary.

ONTARIO MUNICIPAL ASSOCIATION.—Annual convention will be held in the City Hall, Toronto, on June 18th and 19th, 1912. Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ont.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE; Secretary. Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving: Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, W. Alan, Kennedy; Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Addrses P.O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-jack; Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION.—President, Chas. Hopewell, Mayor, Ottawa; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson, Sask.

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta.; Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President, W. Sanford Evans, Mayor of Winnipeg; Hon. Secretary-Treasurer, W. D. Lighthall, K.C., Ex-Mayor of Westmount.

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ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

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CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

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CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler, Canadian Building, Ottawa.

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CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. V. Ross.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp; Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

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NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5. Beaver Hall Square, Montreal.

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ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5. Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Dr. A. McGill, Ottawa, President; Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Wm Pierce, Calgary; Secretary-Treasurer, John T. Hall, Brandon, Man.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, 115 Phœnix Block, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

CONSTRUCTION NEWS SECTION

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

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only unless otherwise noted at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close		Noted in issue of
4-15	Cement sidewalks, Battleford, Sask. ..(P. & S.)	4-4
4-30	Tunnel sewer, Edmonton, Alta. ....(S.)	4-4
4-30	Subway, Saskatoon, Sask. ....(P. & S.)	4-18
4-30	Trunk sewer, Edmonton, Alta. ....(S.)	4-11

(Battleford and Saskatoon plans and specifications are on file at The Canadian Engineer Office, 820 Union Bank Building, Winnipeg.)

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Arborg, Man., school house	May 1.	Apr. 11.	59
Bay View, N.S., lifeboat house and dwelling	Apr. 30.	Apr. 11.	60
Calgary, Alta., bridge, Strathcona	Apr. 22.	Apr. 11.	59
Calgary, Alta., concrete structures	May 1.	Mar. 28.	70
Calgary, Alta., designs for aqueduct	May 1.	Feb. 22.	70
Edmonton, Alta., tunnel sewer ..	Apr. 30.	Apr. 4.	72
Edmonton, Alta., trunk sewer ..	Apr. 30.	Apr. 11.	72
Essex, Ont., post office and customs fittings	Apr. 22.	Apr. 11.	60
Holland Island, B.C., lighthouse	Apr. 20.	Mar. 21.	60
Little Pines, Sask., school house, etc.	May. 6.	Apr. 4.	60
London, Ont., cast iron pipe......		Mar. 28.	72
Macdonald, Man., grading	Apr. 24.	Apr. 11.	59
Moose Jaw, Sask., water-tube boilers, etc.	Apr. 17.	Mar. 28.	59
Muncey, Ont., alterations to Industrial School	May. 1.	Apr. 4.	60
Ottawa, Ont., steel tug	Apr. 22.	Apr. 11.	60
Ottawa, Ont., improvements to Lock 15	Apr. 26.	Apr. 11.	60
Penticton, B.C., Hydro-Electric System	Apr. 18.	Apr. 11.	72
Penticton, B.C., power station..	Apr. 18.	Apr. 4.	60
Point Atkinson, B.C., concrete tower, etc.	Apr. 20.	Mar. 21.	60
Point Grey, B.C., plans for university	July 31.	Feb. 7.	60
Regina, Sask., electric supplies Sec. 1 to 5	Apr. 20.	Apr. 11.	72
Regina, Sask., electric supplies, Sec. 6 to 9	May 15.	Apr. 11.	72
Saskatoon, Sask., sewer pipe ..	Apr. 19.	Apr. 4.	72
Stratford, Ont., pavement	Apr. 22.	Apr. 11.	72
Sudbury, Ont., sewers, etc.	Apr. 17.	Mar. 21.	60
Swan River, Man., steel bridge.	Apr. 22.	Apr. 4.	74
St. Norbet, Man., draining and grading	Apr. 23.	Apr. 11.	60
Toronto, Ont., St. Alban's Cathedral	Apr. 22.	Apr. 4.	60
Toronto, Ont., bridge construction	Apr. 23.	Apr. 11.	72
Toronto, Ont., concrete mixer ..	Apr. 23.	Apr. 11.	72
Toronto, Ont., circular brick sewer	Apr. 23.	Apr. 11.	72
Toronto, Ont., storm overflow sewer	Apr. 23.	Apr. 11.	74
Toronto, Ont., concrete walks ..	Apr. 19.	Mar. 28.	60
Vancouver, B.C., pumping engine, hose wagon, etc.	May 2.	Apr. 11.	60
Winnipeg, Man., machine shop..	Apr. 18.	Mar. 28.	60
Yorkton, Sask., school building.	Apr. 22.	Apr. 11.	60

TENDERS.

Brandon, Man.—Tenders will be received by the City Clerk, Brandon, until noon of April 18th, 1912, for the supply of 4,000 bbls. of best quality Portland cement to be delivered f.o.b. cars, Brandon. R. E. Speakman, City Engineer.

Calgary, Alta.—Tenders will be received by A. S. Dawson, Chief Engineer, Canadian Pacific Railway, Calgary, up to noon of May 15th, 1912, for approximately 4,250,000 feet B.M. of timber, and 80,000 cubic yards of excavation. (See advertisement in Canadian Engineer.)

Fort William, Ont.—Tenders will be received by the Works Committee at the office of the City Clerk up to 15th day of May, 1912, for the complete installation, including all buildings, of a fifty-ton incinerator plant and the operation of same for a period of three months after completion. John Wilson, City Engineer. (See advertisement in Canadian Engineer.)

Guelph, Ont.—Messrs. Colwill and Tanner have been appointed architects and will start on the plans immediately for the new Dominion Linen Mill, and tenders will be called for shortly.

High River, Alta.—Tenders will be received by the Secretary-Treasurer, until 8 p.m., April 30th, 1912, for the following works:—

Contract "A"—Labor laying water mains and sewers.
" "C"—Furnishing materials for and erecting water tower.
" "D"—Furnishing C.I. water pipes and special castings.
" "E"—Furnishing fire hydrants, gate valves, etc.
" "O"—Labor on main outfall sewer.
" "S"—Furnishing sewer pipes and junctions.
" "W"—Furnishing 4,500 ft. of 12-inch wooden pipe.

Tenders will be called shortly for power house, machinery and sewage disposal works.

Plans and specifications at the office of the Engineers, Toronto and Winnipeg, and at the Town Hall, High River, Alta. R. A. Wallace, Esq., Mayor. Chipman and Power, Engineers.

Kerrisdale, B.C.—The Corporation of the Municipality of Point Grey is prepared to receive tenders up to April 29th, 1912, for the construction of outfall sewer, main sewers, laterals, manholes and other relative works in the Kerrisdale district. Particulars may be obtained from Mr. D. W. Johnston, Municipal Engineer, Municipal Hall, Kerrisdale. H. Floyd, Clerk, Municipal Council, Kerrisdale.

Moose Jaw, Sask.—Tenders will be received by the City Commissioners, until noon April 30th, 1912, for the construction of a reinforced concrete subway under the Canadian Pacific Railway Company's tracks on Eleventh Avenue. Plans, etc., at the office of the City Engineer or City Clerk, Moose Jaw. (See advt. in Canadian Engineer).

Moose Jaw, Sask.—Tenders will be received until April 24th, 1912, for the erection of a Public Library Building in Crescent Park in the city of Moose Jaw. Plans, etc., can be obtained from Messrs. Reid & MacAlpine, Architects, Howden Block, Moose Jaw. W. F. Heal, Secretary, Public Library Board, Moose Jaw.

North Vancouver, B.C.—Tenders will be received up to noon of April 22, 1912, for supplying 500 lineal feet of 16-in. steel water pipe, according to specifications prepared by the City Engineer, copies of which may be obtained at the Engineer's office, North Vancouver. George S. Hanes, City Engineer.

Ottawa, Ont.—Tenders will be received until May 10th, 1912, for widening lower entrance channel-way, Sault Ste. Marie Canal. Plans, etc., at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Engineer in charge, Sault Ste. Marie, Ont., at which places form of tender may be obtained. L. K. Jones, Secretary, Department of Railways and Canals, Ottawa.

Ottawa, Ont.—Sealed proposals will be received at the Public Works Department up to the 2nd day of July, 1912, for the construction of a dry dock in the Port of Quebec. Dimensions of dry dock to be not less than 1,150-ft. usable length, 110-ft. clear width at entrance, and at least 37-ft. in depth over sill and keel blocks at ordinary high water Spring tide, and to be in three compartments. Dry dock will be located either at Lauson or in the estuary of the River St. Charles, or on the Beauport flats, and applicants will be required to submit with their proposal a report signed by their engineer or engineers setting forth in detail: (1) the respective advantages from the viewpoint of the shipping interests of each of the above-mentioned sites; (2) plans and specifications with full and detailed estimates of cost. R. C. Desrochers, Secretary, Department of Public Works, Ottawa.

Ottawa, Ont.—Separate tenders will be received at the Department of Public Works, until April 30th, 1912, for the supply of hardware, brushes, manilla rope, packing, paint and paint oil, hose, wire rope, oils and greases, steam pipe, chain and steam fittings for the departmental dredging plant. R. C. Desrochers, Secretary, Department of Public Works, Ottawa.

Ottawa, Ont.—Structural Competitive Designs for a monument to be erected at Ottawa, Canada, to His Late Majesty King Edward VII., will be received at the Department of Public Works, Ottawa, up to October 1st, 1912. Full particulars may be had on application to R. C. Desrochers, Secretary, Department of Public Works, Canada.

Ottawa, Ont.—Plans have been completed and tenders will be called shortly for the construction of a new Government steamer to be used in the customs patrol service in the Gulf of St. Lawrence. Vessel will be of steel, will have a length of 200 feet, and cost a quarter of a million dollars.

Ottawa, Ont.—Tenders will be received by G. J. Desbarats, Deputy-Minister of the Naval Service, Department of the Naval Service, up to noon of June 17th, 1912, for the design and construction of a new Fishery Protection Vessel for Service on the Pacific Coast. (See advt. in Canadian Engineer).

Ottawa, Ont.—Tenders for interior fittings, post office, at Nanaimo, B.C., will be received at the Department of Public Works, Ottawa, until April 22, 1912. Plans and specifications to be seen on application to Mr. James May, Clerk of Works, Nanaimo, B.C.; Mr. W. Henderson, Resident Architect, Victoria, B.C., and at the Department of Public Works, Ottawa.

Ottawa, Ont.—Tenders for the erection of a frame schoolhouse on the St. Mary's Reserve, near Fredericton, N.B., will be received at the office of J. D. McLean, Assistant Deputy and Secretary, Department of Indian Affairs, Ottawa, up till noon of May 2nd, 1912. Plans and specifications may be seen at the office of N. J. Smith, Indian Agent, Fredericton, or at the office of the Department of Indian Affairs.

Prince Albert, Sask.—Tenders will be received by the City Commissioners up to noon of April 30th, 1912, for the construction of concrete sidewalks.

Contract 12 H.—About 3 7/10 miles.
Contract 12 J.—About 4 9/10 miles.

Specifications, etc., may be obtained at the office of the City Engineer, of Prince Albert. C. O. Davidson, Secretary-Treasurer, Prince Albert, Sask.

Regina, Sask.—Tenders will be received until Saturday, April 20th, for a three-story fire-proof building for the Engineers' and Plumbers' Supply Company, Limited. Plans and specifications can be seen at the office of N. R. Darrach, Architect, Western Trust Building, Regina.

Saskatoon, Sask.—Tenders will be received by the City Commissioners, up to noon of May 17th, 1912, for furnishing material for and construction of Superstructure 23rd Street Subway. (See Advertisement in Canadian Engineer).

Selkirk P.O., Man.—Tenders will be received until May 7th, 1912, for the building of a bridge over Gunn's Creek, on Lot 162, St. Andrews; bridge to have concrete abutments and a wood top, and to be built according to plans and specifications, which may be seen at the Municipal Office, or at the Department of Public Works, Winnipeg. Thos. Bunn, Secretary-Treasurer, Selkirk P.O., Man.

Winnipeg, Man.—Tenders will be received until April 30th, 1912, for the erection of twelve additional rooms to existing Britannia School, Hampton Street, St. James. Revised plans and specifications can be seen at the office of E. D. Tuttle, Architect, 701 McArthur Bldg., Winnipeg.

CONTRACTS AWARDED.

Calgary, Alta.—Messrs. Doyle & Thompson, 20 Elma Block, Calgary, have received contract for the erection of a school to cost $172,000.

Calgary, Alta.—The contract for the erection of the new King George school in Pleasant Heights was awarded to Jones & Lyttle for $125,620, while the heating and plumbing contract for the building was given to Grant Bros., whose figure was $21,850.

Campbellton, N.B.—Interior fittings, post office; Edward Bates, contractor, St. John, N.B.

Hamilton, Ont.—A report states that the contract for the supply of concrete poles for the hydro-electric service has been awarded to Messrs. Hancock and Sons, brick manufacturers, Hamilton.

Lansdowne Park, Ottawa, Ont.—Machinery Hall; contractors, Messrs. Alexander & Campbell, Ottawa; cost, $81,309.

Lethbridge, Alta.—Contracts for the Galbraith school and for the physical culture building to be erected in connection with the Westminster school, were let to the Lussier Construction Company; the cost of the former being $55,000, and of the latter, $5,950. The Wm. Head Company got the heating and plumbing contract for $14,000. Others tendering for the Galbraith school were: S. Stanford, $59,000; Hotson & Leader Co., $63,000; Odmark Bros., Macleod stone, $56,550, Bedford, $56,550; W. P. Bayne, Macleod, $58,109, Bedford, $57,478; W. H. Holt, Macleod, $56,800, Bedford, $57,270; Smith Bros. & Wilson, Macleod, $56,200, Bedford, $55,850. The building will be of Bedford stone.

Montreal, Que.—General contractor E. G. M. Cape, Beardmore Bldg., Montreal, has received the contract for an addition to the Sarah Maxwell School to cost $37,000. The iron work contract has been awarded to Phoenix Bridge & Iron Works, Ltd., 83 Colborne Street.

Port Arthur, Ont.—Messrs. Barnett & McQueen, Fort William, Ont., have received the contract for the construction of a steel dock for the Canadian Northern Railway, to cost $40,000. Sub-contracts for piling, etc., have been awarded to the Thunder Bay Harbor Improvement Co.

Prince Rupert, B.C.—Messrs. Evans, Coleman & Evans, of Vancouver, have the contract of supplying Prince Rupert with 3,800 feet of 18 inch diameter steel pipe.

Saskatoon, Sask.—Messrs. Fielding & Shepley, of St. Paul, Minn., have received the contract for laying of approximately 23,100 square yards of sandstone block pavement, their price being $117,810.00. Other tenderers were the Forest City Paving and Construction Company, London, Ont., at $124,740, and Messrs. Pastoret & Lawrence, Duluth, Minn., at $126,588.

Toronto, Ont.—The contract for the supply of T-rails for use on the new civic car lines to be constructed on St. Clair Avenue, has been awarded to the United States Steel Products Co., Montreal. The T-rail tender is $35,996, 80 pounds to the foot, and the girder rail tender for 90-pound rails is $43,195. Other contracts for bars, etc., go to the Rail Joint Co. of Canada.

Vancouver, B.C.—Tenders received for the widening of the approaches to the Main Street bridge were: Messrs. McKenzie, Broadfoot & Co., $7,495; T. R. Nickson & Co., $8,635; La Placa Bros., $7,180. The last named was accepted.

Vancouver, B.C.—The contract for the construction of the south section of the Bridge Street trunk sewer has been awarded to J. Shunn, Esq., of Vancouver, for $30,158.00. Eleven other bids were received.

Winnipeg, Man.—The Canadian Mineral Rubber Company, Winnipeg, has been awarded contract for the supply of from 1,200 to 1,500 tons of asphalt cement at $23.50 per net ton.

RAILWAYS—STEAM AND ELECTRIC.

Kingston, Ont.—A report states that the Kingston and Pembroke Railway will expend $205,000 this summer on improvements over the line.

Ottawa, Ont.—The Minister of Railways has placed an order for rolling stock to be used on the lines of the Intercolonial Railway. The sum involved is about $1,125,000. The orders include nine freight locomotives from the Canadian Locomotive Works at Kingston, 400 steel box cars from the Nova Scotia Car Company, two dining cars and two sleepers from the Canadian Foundry Company, and six first-class coaches from the Preston Car Company. In addition a number of flat cars, stock, refrigerator and coal cars are to be ordered.

Ottawa, Ont.—The management of the Ottawa Electric Street Railway Company recently placed an order with the Ottawa Car Company for twenty new steel street cars. The cars will be manufactured of steel throughout excepting the door and window frames.

South Vancouver, B.C.—The ratepayers of the Ferris Road district have prepared a petition calling for an extension of the electric car line from Main Street.

Toronto, Ont.—The municipal railway department under the management of the city engineer, Mr. Rust, has been authorized to purchase the following track supplies without tenders being called for: 6,000 steel ties, 24,000 rail clips, 24,000 tie bolts, 18,000 wood ties.

The track laying programme of the Canadian Northern Railway for this year includes the following works:—Montreal to Hawkesbury, 58 miles; Ottawa to Ottawa River, 32 miles; west from Ruel, Ont., 100 miles; east from Port Arthur, 108 miles; branch lines and extensions in Alberta and Saskatchewan, 400 miles; British Columbia, 75 miles; Sydenham, O., to Ottawa, 80 miles; relaying track on main line west, 200 miles; total, 1,053 miles.

LIGHT, HEAT AND POWER.

Niagara Falls, Ont.—The Dominion Government have decided to construct a new power house and pumping station at this point. This will remove the present plant from Table Rock and increase the efficiency of this department.

Ottawa, Ont.—The estimates for civic lighting call for cluster lights to be installed on Lady Grey Road for a distance of about two miles.

Welland, Ont.—The municipal council have passed a by-law whereby that body will offer the Welland Electrical Company the sum of $50,000.00 for their plant.

GARBAGE, SEWAGE AND WATER.

Cobourg, Ont.—A large water tank belonging to the municipality was demolished by a fall recently. It will cost about $25,000.00 to replace, but it is unlikely that such will be done.

Hull, P.Q.—The ratepayers of the Wrightville district have arranged for the installation of a new sewage system which is to be completed by June 1st, next.

Ingersoll, Ont.—Preliminary steps have been commenced for the installation of a sewerage system for this town. Mr. Chipman, C.E., Toronto, will advise the municipal council in the matter.

Ingersoll, Ont.—The ratepayers of this town will assume control of the water works after May 1st next. The price paid for the property complete was $125,000.00.

Kingston, Ont.—The municipal board of health have requested the city council to install a filtration plant for the purification of the drinking water.

St. Catharines, Ont.—The municipal council have adopted an extensive sewer construction programme which will entail the expenditure of about $25,000.

BUILDINGS AND INDUSTRIAL WORKS.

Barrie, Ont.—The municipal board of education are planning to erect a new collegiate building. The plans as submitted to the members call for an expenditure of approximately $65,000.00.

Guelph, Ont.—Plans for a factory of the Dominion Linen Mills have been prepared. They call for the construction of four buildings of pressed brick and steel sash. The main building will be 380 x 150 with 30 foot windows.

Mildmay, Ont.—The Roman Catholics of this place are about to construct a new church. Mildmay is near Stratford, Ont.

Montreal, P.Q.—The Montreal Association for the blind are erecting a handsome school building in this city.

Regina, Sask.—The Roman Catholics of this city are planning to erect a new cathedral. Bishop Mathieu is takin charge of the preliminaries.

Regina, Sask.—Plans have been prepared for the new Grand Trunk Pacific station at this point. It will be two stories in height, 600 x 250 including the train sheds.

Roche Percee, Sask.—A brick manufacturing concern has been organized to operate in the vicinity of this place. The promoters plan a $30,000 plant with a daily capacity of 40,000 brick. Mr. G. T. Cross, manager of the City Ice and Coal Company, Moose Jaw, Sask., is the president of the new company.

Saskatoon, Sask.—The Board of Education have called tenders to be in by April 25th next for the erection of a new school in the district of Westmount.

Smith's Falls, Ont.—The management of the Canadian Northern Railway will erect a new railroad station in this town.

Toronto, Ont.—A syndicate will erect a five story building at the corner of Bay and Queen Streets. Sir Richard Cartwright is the head of this syndicate.

Vancouver, B.C.—The management of the Molsons Bank are about to erect a handsome branch office in this city. H. L. Stevens and Company, Architectural Engineers, are preparing the plans. It will be of brick six stories in height.

Vancouver, B.C.—The congregation of Trinity Church (Anglican), have decided to erect a new church structure. The rector, Rev. H. Beecham, will appoint a committee to handle the matter.

BRIDGES, ROADS AND PAVEMENTS.

Carleton County, Ont.—The officials of this county have recently given serious consideration to the matter of good roads and repairs to the ones now in use. The council expressed their opinion on the necessity of the purchase of three or four road machines, but no definite action has, as yet been taken. Mr. A. P. Wilson, Osgoode, Ont., is interested in the matter.

Central Ontario.—Reports from Barrie, Ont., of the damage to country bridges from the flood indicate that the loss will amount to about $50,000. A special meeting of the Simcoe County Council will be held to discuss the situation. Five bridges on the Nottawasaga and Boyne Rivers are completely demolished.

Guelph, Ont.—The municipal council have decided to erect a bridge over the river and the Canadian Pacific Railway tracks at Hefferman Street. It will be a foot bridge.

Lower Ontario.—Several bridges along the road of the Canadian Pacific Railway will require considerable repair work following the damage caused by the recent floods. The trains of this company will operate on the lines of the Grand Trunk between Toronto and North Bay during the next few weeks.

Montreal, P.Q.—The municipal council have taken definite steps towards the construction of a subway below the Canadian Pacific Railway tracks on Park Avenue. The structure is to cost between $250,000 and $400,000. The Railway Board will consider the matter at their sitting in Montreal on April 22nd.

Victoria, B.C.—Arrangements are being made for a conference between the Minister of Public Works and several municipalities in this neighborhood to discuss the question of paving the main highway between Vancouver and New Westminster.

Victoria, B.C.—The Municipal Streets Committee have ordered the construction of a new bridge across the ravine of the Gore Road. The City Engineer recommends a reinforced concrete structure at a cost of $24,371. The chairman of the committee, Alderman Stewart, will co-operate with the engineer on the selection of this bridge or a steel structure to cost $32,300.

FIRES.

Fort William, Ont.—A large rink was destroyed by fire in this city recently; the loss is placed at $35,000. The structure was known as the Arena.

Montreal, P.Q.—Fire caused considerable damage to part of the plant of the Caledonian Iron Works. The damage was confined to the moulding shop.

CURRENT NEWS.

Edmonton, Alta.—Recent tests of the new high pressure pumps of the city resulted in a satisfactory report being made by the fire chief.

Ingersoll, Ont.—An inspection of the various dams in the vicinity of this town will be made following an order from the mayor's office.

Lethbridge, Alta.—There is an active movement among the members of the Municipal Board of Trade calling for gas boring operations to be commenced. Some time back the sum of $30,000 was laid aside for this purpose, and of this about $16,000 was spent in an unsuccessful attempt to locate this utility. Several encouraging reports are now to hand and it is on the strength of these that the renewed activities are being undertaken.

Vancouver, B.C.—A new telegraph line will be constructed from this city to Powell River. This line will cost $27,400, and will be installed by the Federal Government.

TRADE ENQUIRIES.

From the branch for City Trade Inquiries, 73 Basinghall Street, E.C.

A London company would like to get into touch with a reliable firm of engineers in Canada who could introduce and sell their oil extraction plant.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

16192—March 29—Authorizing C.N.O. Ry. to cross Sydenham Lake, in Twp. of Loughborough, Ct. Frontenac, and rescinding Order No. 15026 of Oct. 16th, 1911.

16193—March 26—Approving revised location of Algoma Central & H.H. Ry. between mileage 123.74 to 130.87 and connection with N.T.R. at Grant, Ont.

16194—March 28—Authorizing Department of Public Works, B.C., to cross with Park Ave., C.P.R. in Slocan City, B.C.

16195-96—March 28—Authorizing C.P.R. to construct additional track across highways at Basswood and Birtle, Manitoba.

16197—October 9—Authorizing C.P.R. to divert highway at mileage 119.7 on its Medicine Hat Subdivision, Alberta.

16198—March 29—Authorizing V.V. & E. Ry. & N. Co. to construct crossings in Mun. of Sumas, B.C.

16199—March 8—Authorizing G.T.R. to take lands of Samuel McLean, part of Lot 13, R. 1, south of Longwood's Road, Twp. of Ekfrid, County of Middlesex, Ontario.

16200—April 1—Authorizing M.C.R. to use and operate bridge over Bear Creek, at mileage 57.3 St. Clair Division.

16201—March 29—Authorizing G.T.P. Ry. to construct spur for Imperial Oil Company, Ltd., Edmonton, Alta.

16202—March 30—Authorizing G.T.R. to reconstruct bridge No. 50, at mileage 7.47 8th District, Northern Division.

16203—March 30—Authorizing C.P.R. to reconstruct bridge No. 95.8 across Muskrat River, Chalk River Subdivision, Ont.

16204—March 30—Authorizing C.P.R. to construct spur for A. F. Vincent, near Mile End Station, Montreal, Que.

16205—March 21—Authorizing C.N.O. Railway to construct transfer track to connect its Sudbury Branch with Algoma Eastern Ry. through town of Sudbury, Ontario.

16206—March 30—16207—April 1—Approving location of C.N.R. (Calgary-Strathcona Line) through Twp. 40, R. 26, west 4 M., Alberta. Mileage 0.00 to 4.55 and C.N.R. location through 14.9, Ranges 26 and 25, west 4th M., Alberta. Mileage 65.05 to 102.50.

16208—March 30—Dismissing complaint of C. W. Deaver, Viscount, Sask., re cattle pass on G.T.P. Rly.

16209—April 1—Approving location of C.P.R. station at Lydiatt, Manitoba.

16210—March 30—Dismissing complaint of residents of village of Brownlee, Sask., re C.P.R. car supply.

16211—April 1—Authorizing C.P.R. to open for carriage of traffic (freight) its railway from Colvalli to Bull River a distance of 9.2 miles (Kootenay Central Ry.)

16212-13-14—April 1—Authorizing C.P.R. to construct spur for Dominion Match Co., Ltd., Dist. of New Westminster, B.C. For the Sudbury Construction and Machinery Co., Ltd., in town of Sudbury, Ont. For the Canadian Hanson and Van Winkle Co., Ltd., near Morrow Avenue, Toronto, Ont.

16215—March 30—Authorizing C.N.R. to cross Calgary and Edmonton trail, Bailey, Barnett, and Oliver Avenue and Matthias Street, and to close certain lands in town of Lacombe, Alta.

16216—March 30—Authorizing G.T.R. to reconstruct bridge across "Narrows" at mile-post 120.39, 9th Dist. Nor. Div., Ont.

16217—April 2—Authorizing C.P.R. to reconstruct bridge 81.0 on its Sudbury Division.

16218—April 2—Approving revised location of C.P.R., Wilkie, Anglia Branch from Pheasant Hills Branch, in Sec. 6, Twp. 40, R. 19, west 3rd, for a distance of 35.34 miles to a point in Sec. 22, Twp. 34, R. 19, W. 3 M., Sask.

16219—April 2—16220-21—April 1—C.N.O. Rly. Co. (Sudbury Port Arthur Line), approving location through unsurveyed territory, Dist. of Thunder Bay, mileage 343.15 to 363 from Sudbury Jct., and revised location through unsurveyed territory in Dist. of Algoma, mileage 209.1 to 219.43 from Sudbury Jct., and C.N.O. Ry. (Montreal-Port Arthur Line), through unsurveyed territory (revised location), Dist. of Sudbury, mileage 270.9, to 272.83.

16222—April 2—Approving location of C.N.O. Ry. (Calgary-Strathcona Branch through Twps. 47-52, R. 24-26, west 4 M., and part of city of Strathcona, Alberta.

16223—April 3—Approving Standard Passenger Tariff C.R.C. No. 3, of Klondike Mines Railway Company.

16224—April 3—Authorizing C.P.R. to construct its Moose Jaw Southwesterly Branch across 4 highways, mileage 23.22 to 36.65.

16225—April 3—Directing that local tolls of Vancouver, Fraser Valley & Southern Rly. Co., on lumber, etc., shall be same as charged by C.P.R. and G.N.R. for similar distance within their corresponding territories, and directing that joint through rates on lumber to be on basis of one cent per 100 pounds, etc.

16226-27-28—April 3—Disallowing increased tolls of G.T.P., C.N.R., and C.P.R. from 1st day of April, 1912, and restoring lower tolls in effect immediately before that date being rates from Westfort, Port Arthur, Fort William.

16229—April 4—Extending until 1st Oct., 1912, time for completion of C.N.R. spur authorized by Order 1 3:2, March 29, 1911, in city of St. Boniface, Man.

16230—April 4—Extending for 6 months from 30 March, 1912, time for completion of extension of A.C. & H.B. Ry. to Bruce Street, Sault Ste. Marie, Ontario.

16231—April 3—Granting certificate of correction to G.T.P. B.L. Co., for errors in Regina-Moose Jaw Branch location plan.

16232—March 25—Approving location of C.P.R. station at Griffin, Sask.

16233—April 8—Approving Order of Exchequer Court of Canada appointing Frank W. Blair, Dudley E. Waters, and Newman Erb, Receivers of the Pere Marquette R.R. Co., in Canada.

16234—March 11—Rescinding Order 16004 of February 15th, 1912, and authorizing C.N.R. to cross C.P.R. at Lambton, by means of an under-crossing, Twp. of Etobicoke, County York, Ont.

16235—April 1—Amending Order No. 15558, of Dec. 5, 1911, by adding clause directing city of Winnipeg to reimburse .P.R. for services of flagman, etc., at crossing.

16236—April 3—Authorizing Lachine, Jacques Cartier & Maisonneuve Rly. Co. (G.T.R.) to cross Montreal Street Railway by means of overhead bridges at three streets, in Montreal.

16237—April 1—Directing that C.N.R. and C.P.R. protect crossing on Main Street, Gladstone, Man., by watchman.

16238—April 1—Directing G.T.P. Ry. to grade a new crossing parallel with Main St., and open Beaver Hills Road across its right-of-way in village of Ituna, Sask.

16239—April 2—Dismissing application of residents in vicinity of Carrot Creek, Alta., re G.T.P. siding.

16240—April 1—Refusing application of farmers in vicinity of Pleasant Point, near Carberry, Man., for an order directing C.P.R. to construct a siding.

16241—April 1—Directing C.N.R. to fence its right-of-way along the Ou'Appelle, Long Lake & Sask. Rv., between Saskatoon and Regina, that is now unfenced, under penalty of $50 per day after 1st Nov., 1912.

16242—April 2—Directing G.T.P. to cease discriminating in carriage of freight traffic in favor of its contracts as against general public over its line from Hinton, Alta., to west thereof; subject to fine of $100. Petition of towns in B.C. and Alta.

16243—April 6—Authorizing C.N.O. Ry. to cross four highways in Twp. of Nepean, Carleton County, Ontario.

16244—April 6—Authorizing C.N.R. to cross with its Calgary-Edmonton Branch 6 highways in Alberta.

16245—April 1—Authorizing C.N.R. to construct spur to city of Saskatoon Power House, Saskatoon, Sask.

16246—April 3—Authorizing C.N.R. to cross 5 highways in city of Strathcona, Alta.

16247-48—April 4—Approving location of Campbellford, Lake Ontario & Western Ry. (C.P.R.) Glen Tay to Belleville Branch Line from mileage 15, across Twps. of Oso, Bedford, and Hinchinbrooke, crossing K. & P. Ry. near Parham station to westerly boundary of Twp. of Hinchinbrooke, at mileage 38.5, Ct. Frontenac, Ont. And location of Glen Tay to Cobourg Line from mileage 38.5 to mileage 58.5 in United Counties of Lennox and Addington.

16249—April 4—16250—April 6—Authorizing G.T.P. Ry. to construct bridge across Fraser River at mileage 316 and 274 west of Wolf Creek, B.C.

16251—April 2—Refusing application of G.T.P. B.L. Co. re right-of-way Tofield-Calgary Branch.

16252—April 3—Authorizing G.T.B. B.L. Co. to cross the Brandon Branch of the C.P.R. by overhead bridge in N.W. ¼ of Sec. 26, Twp. 10, Range 18, west P.M., Man.

16253-54—April 2—Authorizing C.P.R. to take lands for construction of permanent snow fences in Twp. of Pickering, Ct. Ontario, Ont.

16255—April 4—Relieving C.P.R. from erecting and maintaining fences on portion of its Calgary Subdivision, Alta.

16256-57—April 6—Authorizing G.T.P. B.L. Co. to cross with its Calgary Boundary Branch the C.P.R. Aldersyde Branch in N.E. ¼ of Sec. 4, Twp. 12, R. 23, west 4th M., and in N.W. ¼ of Sec. 26, Twp. 19, Range 28, west 4th M. Interlocking plants to be installed at the two crossings.

16258—April 6—Authorizing G.T.P. B.L. Co. to construct, maintain and operate "wye" connecting its Alberta Coal Branch with Yellowhead Pass Coal & Coke Co.'s Spur, Alberta.

16259—April 9—Rescinding Order 8462, Oct. 29th, 1909, and directing the G.T.P. to construct an overhead crossing on the Fort Saskatchewan Trail; detail plans to be filed within 30 days, and work to be completed within ninety days from approval of plans under penalty of $100 per day, North Edmonton, Alta.

16260—April 10—Authorizing C.P.R. to construct spur for Chinook Coal Company, Ltd., at Kipp, in the Province of Alberta, and rescinding Order 16088, of March 7th, 1912.

16261—April 9—Authorizing G.T.R. to construct spur into premises of Western Foundry Co., Ltd., town of Wingham, Ontario.

16262-63-64—April 9—Authorizing C.P.R. to reconstruct bridge No. 22.5 on its Newport Subdivision; bridge 32.6 on its Ottawa Subdivision; and bridges 24.8, 30.7, 32.2, and 35.8 on its Farnham Subdivision.

16265—April 9—Authorizing C.P.R. to construct its Moose Jaw South-westerly Branch across highway at mileage 36.63.

16266—April 10—Approving revised location of C.N.O. Ry. in the Twp. of Litchfield, mileage 59.13 to 59.73 from Ottawa, Ont.

16267—April 10—Approving location of C.N.R. Co. (Montreal-Port Arthur Line) through Twps of Maclennan, Scadding, Street and Davis, in Dist. of Sudbury, mileage 405.36 to 421.09 from Montreal.

16268—April 10—Authorizing C.N.O. Ry. to connect its tracks with C.P.R. at mileage 2, in Port Arthur, only, for construction purposes only.

16269—April 9—Authorizing C.N.R. to construct its Calgary-Strathcona line across 25 highways in Alberta.

PUBLIC SERVICE OF CANADIAN RAILWAYS.

During the year ended June 30, 1911, there were carried by the railways of Canada 37,097,718 passengers and 79,884,-282 tons of freight. These figures show an increase over the preceding year of 1,203,143 passengers and 5,401,416 tons of freight.

The following table shows the number of passengers carried for various periods:—

	Passengers carried.
1875	5,190,416
1890	12,821,262
1894	14,462,498
1901	18,385,722
1908	34,044,992
1909	32,683,309
1910	35,894,575
1911	37,097,718

The freight record for the same periods was as follows:—

	Tons of freight 2,000 lbs.
1875	5,670,837
1890	20,787,469
1894	20,721,116
1901	36,999,371
1908	63,071,167
1909	66,842,258
1910	74,482,866
1911	79,884,282

In 1875 the number of passengers and tons of freight carried were nearly equal. Thereafter, the development of freight traffic proceeded more rapidly than did the development of passenger business.

The number of passengers carried in 1911 was 37,097,-718—an increase of 3.3 per cent. over 1910. The number of passengers carried one mile was 2,605,968,924, representing an increase of 139,239,260 as compared with the preceding year. The density of passenger traffic—as represented in the number of passengers carried one mile per mile of line—was 102,597. These figures show a gain of 2,855 over 1910. The increase since 1907 has been 11,676.

The following is an interesting table:—

	1910.	1911.
Tons hauled	74,482,866	79,884,282
Tons hauled one mile	15,712,127,701	16,048,478,295
Tons hauled one mile per mile of line	635,321	631,829
Average haul, miles	211	200
Freight train mileage	50,184,108	52,498,866
Mixed train mileage	6,441,440	6,277,468
Revenue from freight	$116,229,894	$124,743,015
Average tons per train	311	305
Average cars per train	18.15	18.03
Average tons per car	17.13	16.91
Average receipts per ton per mile, cent.	.739	.777

The following is an analysis of the commodities which constituted the freight traffic of 1911 and the preceding year:—

	1910. Tons.	1911. Tons.
Products of agriculture—		
Grain	7,435,573	7,545,516
Flour	1,916,934	2,124,080
Other mill products	1,037,282	1,166,323
Hay	1,084,966	1,611,621
Tobacco	40,880	51,672
Cotton	84,928	114,827
Fruit and vegetables	969,122	957,237
Other products of agriculture	321,666	238,260
Products of animals—		
Live stock	1,314,781	1,437,965
Dressed meats	546,791	561,220
Other packing house products	277,739	369,906
Poultry, game and fish	154,820	189,201
Wool	28,814	42,602
Hides and leather	199,853	211,301
Other products of animals	242,208	378,507
Products of mines:		
Anthracite coal	7,498,509	6,017,858
Bituminous coal	9,166,572	12,514,372
Coke	1,384,254	1,416,632
Ores	3,636,607	3,802,162
Stone, sand, etc.	4,084,968	4,417,290
Other products of mines	381,112	483,922

	1910. Tons.	1911. Tons.
Products of forests—		
Lumber	7,302,037	7,364,964
Other products of forests	5,766,903	5,873,383
Manufactures—		
Petroleum and other oils	500,167	591,651
Sugar	617,231	614,529
Naval stores	37,007	18,422
Iron, pig and bloom	889,881	887,801
Iron and steel rails	717,081	616,980
Castings and machinery	1,189,214	1,137,218
Bar and sheet metal	568,901	939,916
Cement, brick and lime	2,254,934	2,495,178
Agricultural implements	434,928	540,061
Wagons, carriages, tools, &c.	173,137	205,106
Wines, liquors and beers	245,626	274,162
Household goods and furniture	388,631	412,529
Other manufactures	1,997,541	4,840,434
Merchandise	2,518,190	2,438,089
Miscellaneous	7,073,078	4,981,385

PROPOSED DRY DOCK AT SAULT STE. MARIE.

A shipbuilding plant and dry dock is to be built at Sault Ste. Marie. The company is working under an Ontario charter, with share capital of $1,200,000 and a proposed bond issue of about $1,000,000. The dock will rate under class C, or third class and will be entitled under the Dry Docks Act to a subsidy from the Dominion Government of 3 per cent. on cost for 20 years. The town of Sault Ste .Marie has also bonused the company to the extent of $5,000 per annum for 20 years, with a binding arrangement as to taxes.

The capital is being supplied by a group of French and Belgian capitalists represented by Mr. Charles Casoretty, LL.D., C.E., of Paris, France. The contract for construction is to be let at once. The operations at first will be confined to the dry dock, to the marine railway and to shipbuilding. Several orders for vesels have already been promised. Later, it is likely that other lines will be added, such as cars, engines, locomotives and the Williams and Janney power transmission device. This is an initial investment in Canada on the part of these capitalists and it may be followed by other investments of an industrial nature.

NON-METALLIC PRODUCTS OF CANADA.

A production of 30 tons of actinolite valued at $330 was reported in 1910; no returns of production being received for 1909.

Returns from three smelters in which arsenic is recovered give a production in 1910 of 1,502 tons valued at $75,328, as compared with 1,129 tons valued at $64,100 in 1909. There were also 547 tons of arsenical ore shipped in 1910, valued at $5,716, as compared with 224 tons valued at $3,346 in 1909. The exports of arsenic in 1910 were 2,256 tons valued at $173,932, and in 1909, 1,556 tons valued at $119,673. The imports of arsenious oxide, in 1910, were 260,415 pounds valued at $6,891, and of sulphate of arsenic 257,451 pounds valued at $8,946.

The shipments of asbestos in 1910 were 77,508 tons valued at $2,555,974, and of asbestic 24,707 tons valued at $17,629. The shipments in 1909 were 63,349 tons of asbestos valued at $2,284,587, and 23,951 tons of asbestic valued at $17,188. The shipments in 1910 consisted of 3,740 tons of crude asbestos valued at $664,508, and 73,768 tons of mill stock valued at $1,891,466. Considerable quantities of both crude and of mill stock were held in manufacturers hands at the close of the year. Exports in 1910 were 71,485 tons valued at $2,108,632, as against 56,971 tons valued at $1,729,857 in 1909. Imports and manufactures of asbestos in 1910 were valued at $230,489, and in 1909, $196,742.

Shipments of chromite in 1910 were reported as 299 tons valued at $3,734, as compared with shipments of 2,470 tons valued at $26,604 in 1909.

The total sales of grain corundum in 1910 were 1,870 tons valued at $198,680, as compared with sales in 1909 of 1,491 tons valued at $162,492.

Shipment increased from 12,783 tons valued at $40,383 in 1909, to 15,809 tons valued at $47,667 in 1910. The exports are recorded as 10,834 tons valued at $35,234 in 1909, and 15,601 tons valued at $47,962 in 1910.

A small production of fluorspar was reported in 1910, of which two tons valued at $15 were shipped from the mine. About 7,461 tons of fluorspar were used during the year in steel plants.

Shipments of crude and milled graphite during 1910 totalled 1,392 tons valued at $74,087, as against 864 tons valued at $47,800 shipped in 1909. The production of artificial graphite in 1910 was reported as 1,221 tons, as compared with 257 tons in 1909.

Exports of plumbago in 1910 are reported as 788 tons valued at $53,008, and manufactures of plumbago valued at $66,658. Exports in 1909 were: Plumbago, 1,004 tons valued at $52,440, and manufactures of plumbago valued at $864. Imports of graphite in 1910 were valued at $112,853 and included. plumbago not ground, $4,867; blacklead, $10,048; plumbago ground and manufactures of, $45,042; and crucibles of clay or plumbago, $52,896. In 1909 the imports were valued at $94,392, including: plumbago not ground, $5,075. blacklead, $11,638. plumbago ground and manufactures of, $37,538; and crucibles of clay or plumbago, $40,141.

The production of grindstones, scythestones, and wood pulp-stones in 1910 was 3,973 tons valued at $47,196, as compared with 4,275 tons valued at $54,664 in 1909. The exports in 1910 included: stone for the manufacture of grindstones, 308 tons valued at $338; and manufactured grindstones valued at $23,164; the exports in 1909 were: stone for the manufacture of grindstones, 125 tons valued at $1,685, and manufactured grindstones valued at $13,942. The imports of abrasives in 1910 included: grindstones valued at $71,394; burrstones, $854; emery in bulk crushed or ground, $40,400; manufactures of emery, carborundum, etc., $92,890; pumice stone, $14,829. The 1909 imports comprised: grindstones valued at $69,554; burrstones, $2,001; emery in bulk crushed or ground, $29,752; manufactures of, $66,777, and pumice stone, $11,291.

The total shipments of gypsum crude and calcined in 1910 were 525,246 tons valued at $934,446, as compared with shipments of 473,129 tons valued at $809,632 in 1909. The tonnage of gypsum mined or quarried in 1910 was 548,019 tons, and the quantity calcined, 69,889 tons. In 1909, 493,086 tons of gypsum were mined and 63,670 tons calcined. The shipments in 1910 included: crude gypsum, 469,573 tons valued at $508,686; ground gypsum, 6,121 tons valued at $17,390, and calcined gypsum 49,552 tons valued at $408,370. In 1909 shipments comprised: crude gypsum, 423,474 tons valued at $457,038; ground gypsum, 8,814 tons valued at $26,159, and calcined gypsum, 40,841 tons valued at $326,435.

The exports of gypsum in 1910 were: 346,081 tons of crude gypsum valued at $416,725, and gypsum ground or calcined valued at $12,306. The 1909 exports were: 315,201 tons of crude gypsum valued at $372,286, and gypsum ground or calcined valued at $2,787.

The imports of gypsum in 1910 were valued at $169,798, including: crude gypsum, 12,271 tons valued at $21,073; ground gypsum, 6,690 tons valued at $13,242, and plaster of Paris, 19,045 tons valued at $135,483. The total value of imports in 1909 was $141,715, made up of: crude gypsum 3,958 tons, valued at $12,507; ground gypsum, 10,737 tons valued at $16,779, and plaster of Paris, 19,116 tons valued at $112,429.

Shipments of magnesite in 1910 were 323 tons valued at $2,160, and in 1909, 330 tons valued at $2,508.

The value of the mica production in 1910 as reported by mine operators was $190,385, as compared with $147,782 in 1909. The exports of mica in 1910 were 937,263 pounds valued at $330,903, as against 717,066 pounds valued at $256,834 in 1909.

Shipments of barytes in 1909 were 179 tons valued at $1,120, and no production was reported in 1910. The production of iron ochres in 1910 was 4,813 tons valued at $33,185, as compared with 3,940 tons valued at $28,093 in 1909.

The export of iron oxides in 1910 were 1,746 tons valued at $29,839, as against 658 tons valued at $7,956 in 1909. The imports in 1910 were: ochres and ochrey earth and raw siennas, 1,246 tons valued at $31,926; and oxides, dry fillers, fireproof umbers, and burnt siennas, 868 tons, valued at $23,467. The total imports in 1909 were valued at $39,497.

FERTILIZATION BY SEWAGE.

An investigation by Muntz and Massie in Paris, has shown that a permanent meadow yielding 4½ tons of hay per acre requires 120,000 cubic feet of sewage for phosphoric acid and 150,000 for potash; and that by irrigating with 150,000 to 175,000 cubic feet, given in eight or ten instalments during the growing season, the crops have sufficient for both water and nutritive material. Some land receives ten times this quantity.

COMPRESSION TEST FOR STONE BALLAST.

The committee on ballast of the American Railway Engineering Association has presented in its report for 1912 a compression test which the Office of Public Roads on the Department of Agriculture has agreed to make. The compression test is described in the report of the committee as follows:

A cylinder 2 in. in diameter and more than 2 in. long is drilled from the specimen of stone to be tested, by means of a diamond core drill, and sawed to a length of 2 in. by a band saw fed with emery. The specimen is finally faced off on each end by means of a power-driven grinding lap, on which water and emery are continuously fed.

The cylinder then has both ends embedded in plaster of paris, the bed being made as thin as possible and both ends being made parallel. The cylinder is next mounted on an Olsen test machine on a special bearing block between blotting papers, three thicknesses being placed at each end, between the cylinder and the steel-bearing faces of the machine. The load is then applied at a speed of 0.152 in. per minute, the machine being kept balanced during the application of the load.

The committee believes that with the former physical tests of stone for ballast and the compression test added, sufficient information will be given by which to compare the character of stone from various quarries from which it is proposed to obtain ballast.

The advantage of using approved physical tests of stone for ballast is pointed out to be the determination of the character of the stone and its fitness for ballast without the expense of opening quarries and of using the stone before it is known whether it will be suitable for ballast or not.