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The Canadian Engineer

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PROVENCHER BRIDGE, ST. BONIFACE, MAN.

GENERAL DESCRIPTION OF DOUBLE-LEAF BASCULE BRIDGE TO BE ERECTED OVER THE RED RIVER BETWEEN ST. BONIFACE AND WINNIPEG.

TENDERS have been called for the supply and erection of the superstructure for a bridge to cross the Red River between Provencher Avenue, St. Boniface, and Water Street, Winnipeg. The superstructure is to be a double-leaf, Strauss trunnion, bascule bridge, spanning a 105-foot channel on a 60° skew. The bascule span is to consist of two through girder-spans, the main trunnions of which are supported on two trunnion posts for each girder. The construction further includes two towers, in addition to reinforced concrete counter weights, supported from the tail ends of the girders and maintained in a horizontal position during the operation of the bridge by means of structural steel counter weight lengths.

The live load uplift is taken by supports in the front and by supports in the rear connected to the approach spans.

The machinery for the operation of the bridge embraces trains of gears operated by electric motors and actuating operating pinions, one for each girder, engaging segmental cast iron racks bolted to the tail ends of the girders. The motive power is to consist of 4 electric motors for general operation of the bridge and additional motor for the operation of the centre locks. They are to be series wound and of the enclosed railway type. Each motor is to be furnished with a brake held in the set position by a spring strong enough to overcome about 135 per cent. normal motor torque and to be released by enclosed solenoids and held automatically in release. The equipment is also provided with a hand-brake. The control of the leaf motors and of the centre lock motor will be quickly interlocked with each other in such a way that it will be impossible for the operators to start the leaf operating motors until the locks have actually been released; also in closing it will be impossible for the operator to close the locks until the bridge has been completely closed. This interlocking is accomplished, not by mechanically locking levers, but by preventing the operator to get current into his motors until the preceding motion has actually been performed. An automatic cut-off will throw the circuit-brakers out on the operating motor circuits and set their brakes when the bridge reaches nearly its open or its closed positions. The electrical equipment is so designed that each leaf can be operated from its adjacent operator's house. The centre lock mechanism is to be operated from one of these also.

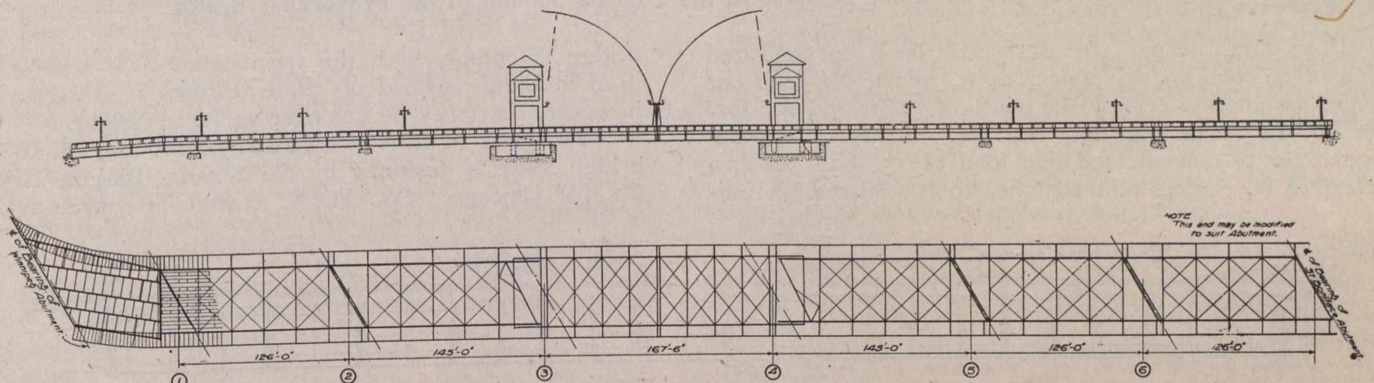


Fig. 1.—General Diagram of Proposed Bridge Over the Red River, Between Winnipeg and St. Boniface.

Reinforced concrete counter weights will be used, and, as stated, will be connected to the tail ends of the bascule girders. Each will be in the form of a monolithic concrete block, with recesses for additional material for adjustment, and will be supported on a structural steel frame. The concrete mix will be 1 of Portland cement: 8 of sand and crushed stone, and will weigh about 148 lbs. per cubic foot. Altogether there will be about 2,338 cu. yds. of concrete, including reinforcement in the counter weights.

The bridge floor will have a clear width of roadway of 44 ft. between the main girders. Two sidewalks, each 19 ft. in width, will be carried on steel brackets outside of the main girders. The bridge will be provided with two lines of car tracks, spaced 11 ft. 9 in. from centre to centre of the tracks, and it will provide head room to suit the trolley wires being placed 18 ft. from the top of the rails. The dead load will thus consist of the weight of the steel in the girders, floor system, handrails, laterals, etc., the weight of concrete in sidewalks and floor and the weight of pavement, rails, etc. The main girders are proportioned to carry the following loads:—

Portion of span in ft.	Lbs. per cu. ft. in each car track.	Lbs. per sq. ft. of remaining floor, including walks.
100	1,800	100
110	1,740	98
120	1,680	96
130	1,620	94

the reinforcement to consist of plain, round rods placed at right angles to the centre line of the bridge. The floor mix will be 1:2:4. The surface will be crowned 3 in. from sides to centre. The specifications call for a cement and sand cushion ½ in. thick with a 3½ in. creosoted wood block pavement or an alternative No. 1, sheet asphalt on the fixed spans, this to have a 2-in. surface on a 1½ in. binder.

It has recently been announced that alternative tenders will be considered on other designs for this

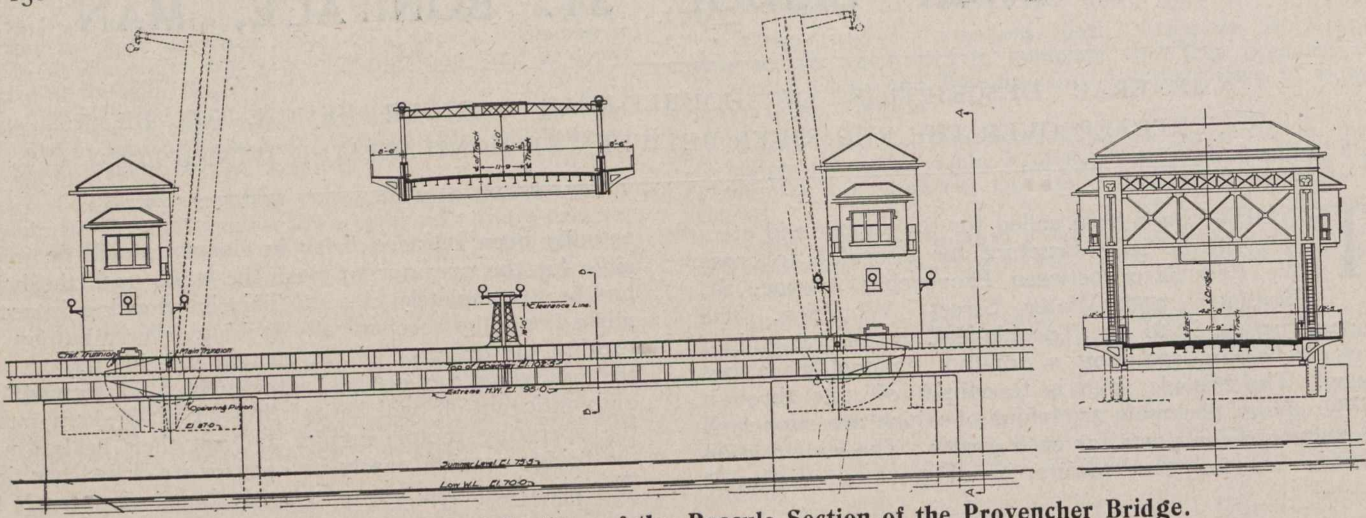


Fig. 2.—Elevation and Sections of the Bascule Section of the Provencher Bridge.

The floor beams are designed for a concentrated load of 30 tons on two axles, 14 ft. apart, for each car track, assumed to occupy the width of 11 ft. and 100 lbs. per sq. ft. remaining floor surface. Stringers are designed for a concentrated live load of 15 tons on two axles, 14 ft. centres and 16 tons, 10 ft. centres. A uniform load of 100 lbs. per sq. ft. is the basis of the sidewalk stringer and bracket design, while the floor slab on roadway is proportioned to support a concentrated load of 3 tons per foot in width of the slab.

Specifications consider the reinforced concrete floor and floor beams to have a sufficient bracing for wind load. A temperature variation of 150° F. is provided for, and the traction load is estimated at 20 per cent. of the greatest live load on any part of the structure. The impact load is taken as a percentage of the live load, equal to $\frac{10,000}{L+150}$ where L is the length and feet of portion of span covered by the live load when the member considered receives its maximum stress.

The floor of the bridge will be of reinforced concrete, 6 in. in thickness, and supported on steel stringers,

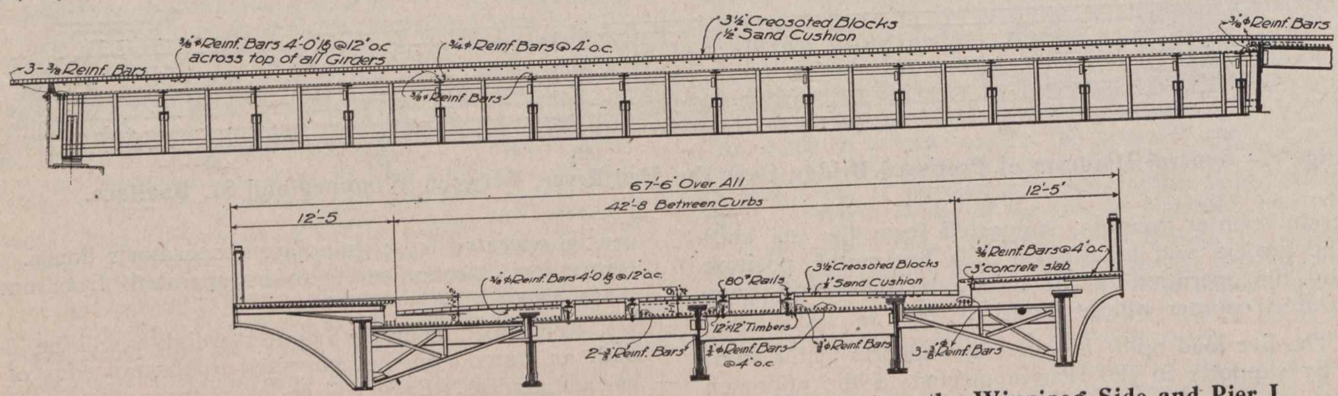


Fig. 3.—Longitudinal and Cross-sections of Span Between Abutment on the Winnipeg Side and Pier I.

bridge to comply with the specifications. If trusses are used in them instead of plate girders it is necessary, however, that they be not over 14 ft. in height.

The work is to be completed by Nov. 1st, 1915. The bridge itself is designed by the Strauss Bascule Bridge Co., of Chicago. Col. H. N. Ruttan is consulting engineer of the work. M. P. Blair, city engineer of St. Boniface, will supervise its erection.

SEVENTH CONGRESS OF THE INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

The Seventh Congress of the International Association for Testing Materials will be held under the patronage of H.M. the Czar of Russia, in St. Petersburg, from August 12th to 17th, 1915. Four days will be devoted to the discussion of the most important problems on testing materials. After the Congress extensive excursions in the interior of Russia have been arranged.

The president of the Association is N. Belelubsky, St. Petersburg; vice-presidents, A. Martens, Berlin; A. Mesnager, Paris; G. C. Lloyd, London; R. W. Hunt, Chicago, and general secretary, E. Reitler, Vienna.

TYPES OF FLOORS FOR LIGHT HIGHWAY BRIDGES.

In the latest annual report of the Illinois State Highway Commission the question of floors for steel highway bridges is reported upon. The suggestions given concerning them are given below:

The largest item of expense in connection with the upkeep of steel bridges not having concrete or other permanent floors, is that of floor maintenance. Until a few years ago, the floor almost universally specified for country highway bridges consisted of white or burr oak plank, from 2½ to 3 inches in thickness. When first-class material could be obtained at a cost of $25 per thousand feet board measure, such floors proved to be fairly economical if not subjected to heavy traffic. But now it is almost impossible to obtain at any price a good quality of white or burr oak bridge plank.

The lightest concrete floor that can be designed to carry modern traffic with safety weighs 40 pounds or more per square foot, and in order to protect such a floor from excessive wear and to distribute concentrated loads sufficiently so that they will not produce local failure, a wearing surface of gravel, macadam or brick weighing a minimum of 50 pounds per square foot is necessary.

Steel bridges carrying plank floors are rarely, if ever, designed to carry more than the dead weight of the bridge itself, which includes about 12 pounds per square foot for the floor, and a live load of 100 pounds per square foot, provided by law.

To place a concrete floor on a steel bridge, designed to carry a plank floor, would impose, therefore, an additional dead load on the structure amounting to the difference between 90 pounds per square foot, the weight of the concrete floor and wearing surface, and 12 pounds per square foot, the weight of a plank floor, or about 78 pounds per square foot.

The proposed floor must weigh but little more than the floor for which the structure was designed; it must not be unduly expensive, and it must be as durable as possible.

The material which best meets these requirements seems to be timber treated with creosote oil to prevent decay. All woods treated with creosote oil seem to resist decay equally well. Any wood may, therefore, be used which is susceptible to the creosote treatment and which will resist the wear coming upon it.

For existing wood floor steel bridges, located in or near cities, which carry a considerable amount of traffic, it is recommended that a creosote wood block pavement be laid on creosoted pine sub-plank. Such a floor weighs about 30 pounds per square foot. This is about 18 pounds per square foot in excess of the floor weight a majority of wood floor steel bridges are designed to carry. However, as this type of floor is very much smoother and stiffer than the ordinary plank floor, the reduction of vibration due to heavy moving loads is greatly decreased. This is a factor of safety which will balance somewhat the greater dead weight of the structure. However, a careful investigation of the strength of the bridge should be made before a floor of this character is laid.

At present prices for material this type of floor can be laid for about four times the cost of a 3-inch plank floor. If proper materials and workmanship are used, there is little question but that such a floor will last 12 years or more, possibly 25 or 30 years.

For existing bridges in good condition and of proper design, located on roads at some distance from a city, carrying a moderate amount of traffic, a floor consisting of 3-inch creosoted sub-plank on which is placed a wearing surface about three-quarters of an inch thick of fine gravel or stone chips flushed with heavy asphaltic filler will be found serviceable and economical. Such a floor, if properly constructed, will present a smooth, elastic surface which will reduce vibration. A floor of this character weighs but a few pounds per square foot more than a 3-inch oak plank floor and is far more durable. The wearing surface will probably require renewal at intervals of from 2 to 6 years, depending upon traffic conditions. As the wearing surface may readily be renewed by day labor, at a cost of about 50 cents per square yard, the item of maintenance is small compared with the cost of maintaining an untreated plank floor. There is no reason why a floor of this character should not last as long as a creosoted block floor, providing the sub-plank is kept protected from wear by a properly maintained wearing surface.

For existing country highway bridges, in good repair and of sufficient strength, where traffic is light and little wear comes upon the floor, creosoted oak plank with no special wearing surface can often be used. Red oak can be used to advantage for this purpose, as it is readily susceptible to treatment with creosote oil, wears less than a softer wood and will probably last as long, as far as decay is concerned, as any other creosoted timber.

In this connection it is worthy to note that the rate of wear on an ordinary plank floor greatly increases with the age of the plank, owing to the softening of the wood as decay advances. As the creosote treatment protects the plank from decay, a floor of this character will wear better than a floor of untreated material, as the wood remains hard and resistant until decay sets in.

In the light of the above discussion it is, therefore, well to hold in mind the following points:

1. Old steel bridges are rarely, if ever, strong enough to carry with safety a concrete floor.

2. For existing steel bridges in good condition and of satisfactory design, located in cities or elsewhere where traffic is heavy and ordinary plank floors rapidly wear out, it will be found economical to refloor with creosoted sub-plank and creosoted blocks.

3. For existing steel bridges in good repair and of satisfactory design, carrying moderate traffic, but yet where wear is of considerable importance, it will be found economical to use creosoted plank with a bituminous wearing surface.

4. For existing steel bridges in locations where an ordinary plank floor rots rather than wears out, a creosoted plank floor with no special wearing surface will be found economical.

If a proper selection of floor is made, and the material used is subjected to rigid specifications and inspection, this floor should in most cases outlast the steel bridge on which it is placed.

A proposal is on foot to build a bridge across the harbor of North Sydney, Australia, in conjunction with a new underground railway system. This bridge will be the third largest in the world as regards length of span, and the first as regards headway for shipping. The specification provides that it shall consist of nickel-steel cantilevers supporting centre girders, also of nickel steel. The shore arms of the cantilevers will be some 500 ft. long, and the cantilever arms 520 ft. long, the length of the centre girder being 560 ft. The approaches to the bridge will consist of steel arch spans of the three-hinged spandrel braced type.

THE METHODS AND WORK OF THE EMSCHER-GENOSSENSCHAFT.

By Prof. P. Gillespie, C.E., University of Toronto.

THE Emscher River is a tributary of the Rhine, the confluence being 12 miles below Essen, famous as the headquarters of the Krupp steel industries. The stream has an average discharge at its mouth of 300 cubic feet per second, a volume equivalent to one-seventh of that of the Canadian Trent at low water. It drains an area of 300 square miles which supports a population upwards of 2,000,000 people; so that the number of persons to the square mile is over 6,600. If the entire population of Canada were placed on the province of Prince Edward Island, the congestion would be less than half that obtaining in the Emscher valley. Predominatingly industrial is the district owing to the prevalence of coal deposits and mines and the stimulus which these give to the manufacture of iron, steel and steel products. The larger centres are Oberhausen, Essen, Gelsenkirchen, Bochum, Recklinghausen and Dortmund. The seriousness and complexity of the problems involved in the satisfactory drainage of such a district will readily be appreciated, but here, as elsewhere, the situation seems to have developed both the men and the method.

In 1906 an act of parliament passed by the Prussian government created the so-called Emschergenossenschaft or Emscher Federation and conferred upon it wide powers and much authority. On this board are represented the government, the municipalities, the mines, the industries and the farmers. Its work comprises the regulation of the Emscher River and its tributaries and the design and construction of bridges, sewers and sewage disposal works. It has authority to levy rates for these undertakings and to that end, to make assessments in which the responsibility for nuisance and the benefit to be derived from its amelioration are the determining factors in the award. Dr. Karl Imhoff is the chief engineer of the sewage division of the federation's work, and it was under his direction that the work of perfecting that type of clarification tank which bears his name and which has come to be regarded as the feature of the Emscher method of sewage treatment, was carried out. The Emscher Federation is a splendid example of effective organization and efficient management and is successfully executing a work which could not have been carried out by independent effort except at enormous waste of energy and money. It has expert service to apply to the solution of each individual problem; it eliminates the too-often costly experimenting of the novice; it secures economy; avoids unnecessary duplication, and is a happy compromise between public and private control. So pronounced are its advantages that one often wonders whether some of its methods and organization could not with great advantage be copied in this country. If our Provincial government with much acceptance can supply our municipalities with electrical energy, why can it not at least design our sewage disposal works? The latter undoubtedly touch the well-being of the community in at least as vital a way as the former.

The Emscher River is not generally a source of public water supply. In consequence the necessity for carrying the purification of sewage to the limit of excellence there, does not exist. In all cases, except in the upper reaches of the valley, the sedimentation of the sewage in Imhoff tanks combined with the subsequent treatment of the sludge constitutes practically the whole process. This makes for economy and simplicity of method and represents the general practice of the Board.

The first of the large Emscher plants was constructed at Recklinghausen in 1907. The Emscher year-book for the fiscal year ending March 31, 1913, states that at the time of its publication there were 19 separate plants within the jurisdiction of the Emschergenossenschaft comprising 123 Emscher tanks and serving in the aggregate 870,000 people. During the year then closing four urban communities, aggregating in population 210,000, had been supplied with clarification plants. This involved the construction of 34 Imhoff tanks exclusive of the doubling of the capacity of the old plant at Essen-Nordwest, also completed during the year. Mr. Leslie Frank, now with the Baltimore Sewerage Commission, who spent last year as a member of Dr. Imhoff's staff in Essen, states that in the German Empire there are probably 100 plants using the system. It has thus been tried out for seven years on a scale of great magnitude in Germany and so successful has it proved that a federation similar in its organization to the Emschergenossenschaft has recently been formed for the watershed of the Rhur, adjacent to the Emscher valley. This stream is another tributary of the Rhine with a flow ten times that of the Emscher and a drainage area six times as large. Of this, Dr. Imhoff is the chief engineer. Construction was begun there a year ago.

A visit to the works under Dr. Imhoff's care confirms all that has been said from time to time regarding the results which are attained there. The Imhoff tank is primarily a device for the inoffensive treatment of sludge and it is to that device that the visitor's attention is naturally directed. An attendant opens one of the sludge valves allowing the liquid sludge to escape. In color it is always black. Although its water content is less than that of fresh sludge by 20%, it is more mobile than the latter and flows freely. Its odor is that of hot asphalt or scorched rubber. So distinctive is this, that by the smell, properly rotted sludge may be readily identified. The smell of sour milk so characteristic of insufficiently decomposed sludge is here entirely absent. Especially noticeable is the rapidity with which the sludge separates from its water. This is one of the most important, and from the engineer's standpoint, one of the most fortunate of its characteristics. On the sludge-drying bed the sludge floats to the top and the water sinks to the bottom and drains away through the sand or cinder layers below. It is interesting to observe that while the sludge-drying area is in Germany ⅓ sq. ft. per inhabitant, in Birmingham it is 2 sq. ft.

The visitor's attention is attracted to the active and constant ebullition taking place in the gas vents to the digestion chambers. The liquor there is inky black and the escape of gas is most vigorous though not offensive to the sense of smell. It is commonly stated that this gas is roughly ¾ methane and ¼ carbonic acid gas, but the writer has not seen any analyses that could be considered the results of precise work, though doubtless such are available. Over one of the rectangular vents at the plant at Essen-Nord, a metallic hood terminating in a gas-pipe has been erected. The escaping gas, if ignited, will burn continuously. This plant, by the way, is the largest controlled by the Emscher Board, serving as it does a population approximately three-eighths that of Toronto. The sewage is a mixture of domestic and industrial since the Krupp steel works and other large industries are located there. There are eighteen Emscher tanks in all, twelve of the longitudinal flow and six of the radial flow type. There is no offensive odor. In the immediate neighborhood are the plant of the Rhenish Westphalian Electrical Company and the dwellings of the workmen. Some of our municipal authorities will be interested in the fact that the per capita charges for interest, sinking fund, administration and maintenance are less than five cents per annum.

Some doubts have been expressed as to the likelihood of Emscher tanks working efficiently in this latitude because of the much lower temperature. These misgivings, in the view of the writer, are without much foundation. In the first place, let it be remembered, the temperature of sewage does not fluctuate markedly in response to temperature changes in the atmosphere. The reason for this is obvious, particularly where the community is sewered on the separate system. The sewers are buried in earth whose temperature is nearly constant. Furthermore, the opportunities for fluctuation of temperature in the decomposing chamber of an Emscher tank are very much less than in an ordinary sedimentation or septic tank. The decaying process in the former takes place under 25 feet of nearly stagnant water and into this digestion chamber almost no fresh sewage is permitted to enter. It is interesting to observe, moreover, that there is less than 5 deg. F. difference between the mean annual temperatures of Toronto and Essen, Germany. In the second place, it must not be forgotten that the activity of sludge decomposition depends upon many influences other than temperature, as the experiments of Guth and Spillner in 1911 have shown. In this series, observations were made on the manner in which decay of organic substances takes place in sewage tanks of various types. At thirteen different stations, all of them within a triangle determined by Hamburg, Essen and Leipzig, and representing every possible kind of sewage, parallel tests were made. The average temperatures over a period of eight weeks are reported as varying from 48 deg. F. in the sewage disposal plant at Harzburg, to 71 deg. F. in the Emscher tank in the sewage disposal plant in Essen-Nordwest. On the whole, the most complete digestion took place at a station in Hamburg, where the temperature was about 60 deg. F. Of the 13 tank temperatures, four were higher than this one. In the third place, observation shows that at the plants of two adjacent communities sewage temperatures at the same time may sometimes differ very much more than the fluctuations of either between summer and winter seasons. To minimize this latter variation in this country, it will often be advisable to provide covers.

That the dried sludge has some manurial value is evidenced by the fact that farmers are willing to take it at a small price for use on the land. At Recklinghausen it brings 12 cents per cart load; at Erfurt (not in the Emscher district) it sells at 7½ cents per cubic yard. On the sludge dumps about the Emscher plants, it is a common sight to see luxuriant vegetation. In contrast with this is the appearance of the dried sludge banks at Birmingham which support not a single blade of grass. The presence of copper and other metallic salts in considerable quantities in the sewage of the latter place is thought by some to be the explanation.

It is significant that the supposed failures of the Imhoff system are not in the Emscher valley. Indeed, some of the alleged failures elsewhere investigated by the writer, were found to be working excellently. The skilled supervision received from the operating staff of the Emschergenossenschaft assists materially in bringing to a satisfactory working state the plants under its control. Probably the lack of it elsewhere explains why satisfactory working conditions are so long deferred in a few other plants. The writer found one Imhoff tank installation in central Germany which produced a good inoffensive sludge for the first time three years after being put into operation. Needless to say, the plant was not under the supervision, directly or indirectly, of the staff of the Emschergenossenschaft.

Of the Imhoff tank, several modifications and adaptations have come into being. One of these is exploited by the holders of the Kremer patents, the Sewage Purification Company of Berlin, who have adapted their fat-arresting device to the double-story tank of the Imhoff type and who claim to have installed over 50 large purification plants for towns, communities and institutions. Another is the Städtereinigung und Ingenieurbau A. G., of Wiesbaden and Berlin, selling under the cryptographic commercial designation of "Stiag." A somewhat similar state of affairs exists on this side of the water.

In the United States some 25 cities, towns and institutions have constructed Imhoff tanks. Rochester, N.Y., one of the latest, is planning for 20 tanks to serve a population of 400,000. In Canada, a few have been or are being built. In England, outside of Dr. Travis' hydrolytic tanks at Norwich, Hampton and Luton, not one known to the writer has been or is being constructed. Dr. Fowler, of Manchester, and Mr. J. D. Watson, of Birmingham, have constructed experimental tanks of the Emscher type at the sewage disposal works of those cities. With typical conservatism, the Britisher prefers to wait until he is absolutely sure of his ground.

The writer regards the Imhoff tank as representing the most significant advance made in the art of sewage purification during the past ten years. This not because of small initial cost or ease of construction, neither of which it probably possesses, nor because in the general case it constitutes a method of sewage treatment complete in itself, for it does not, except in special cases like the Emscher valley, but because it affords an undoubted solution to that most troublesome phase of sewage treatment—the disposal of sewage. To anyone who has encountered the penetrating stench emanating from putrefying sewage as it exists at many plants, the extra cost will be justified. Moreover, the favorable representations made by visitors to the German plants regarding this odor question have not, in the opinion of the writer, been exaggerated.

What the future has for the art of sewage treatment it is impossible to say, but since, at the hands of specially trained investigators in Europe and America, the problem is receiving much attention, it cannot be believed that a finality has been reached. But even if no improvement upon existing processes were to be realized, the methods of to-day are producing results which, in the main, are satisfactory, and which are available to all our cities and towns at moderate cost.

A feature of the prospectus just issued by the Lucky Strike Oil and Gas Company, Limited, of Calgary, Alta., is the fact that the company proposes drilling for oil and petroleum gas at or near Aldersyde, close to a well that is now producing petroleum gas at a depth of only 280 feet. The company will drill a number of wells until a flow of 4,000,000 feet of gas is obtained. Bessemer condensers will be installed for the purpose of extracting the gasoline, and at the low estimate of 25 cents per gallon, it is anticipated that the revenue of the company from this source alone will amount to $1,000 daily.

CRITICAL LOADS FOR IDEAL LONG COLUMNS.*

By Arthur Morley.

(Concluded from last week.)

EXAMPLE IV. :—

As a nearer approximation to a practical shape, take a column of uniform type of section, but the linear cross-sectional dimensions varying uniformly from the fixed to the free end at which they are half those at the fixed end —e.g., a conical pillar—

$$I = I_1 \frac{(l + x)^4}{16\, l^4} \quad . \quad . \quad . \quad (31)$$

Assuming the curve (2) the successive approximations to P are $\frac{E\, I_1}{l^2}$ multiplied by 3/2, 15/14, 147/142, etc., or 1.5, 1.071, 1.035, etc., respectively.

If we assume as a starting point

$$y = y_0 \quad . \quad . \quad . \quad (32)$$

which, as a second approximation, yields the curve taken under the action of the couple ($P\, y_0$) at the free end of the corresponding cantilever—viz.—

$$y = y_0 \left(\frac{l^2}{2(l + x)^2} + \frac{x}{2\, l} - 1\right) \quad . \quad (33)$$

the successive approximations for P are $\frac{E\, I_1}{l^2}$ multiplied by ¾, 30/31, 31/32, etc., or 0.75, 0.96774, 0.96875, etc. The limit is evidently approached very quickly, and it may be taken as very near to $0.97 \frac{E\, I_1}{l^2}$. In any case it has been reduced to the range between 1.035 and 0.97 times $\frac{E\, I_1}{l^2}$.

Economy of Material.—If A_1 is the cross-sectional area at the fixed end, the volume of the column in Example IV. is $\frac{7}{8} \times \frac{1}{3} A_1 \times 2\, l = \frac{7}{12} . A_1\, l.$. A column of uniform cross-section and the same volume has a moment of inertia of cross-section equal to $(\frac{7}{12})^2 \times I$, and its critical load is $\frac{\pi^2}{4 l^2} . E \times (\frac{7}{12})^2 I_1 = 0.84 \frac{E\, I_1}{l^2}$, or some 13 per cent. less than that of the tapered column. On the other hand, considering the more tapered column of Example III., its volume is ½ $A_1 l$. A uniform column of equal volume would have a critical load of $\frac{\pi^2}{4 l^2} E \times \frac{1}{4} I_1 = 0.616 \frac{E\, I_1}{l^2}$, or nearly 2½ times that of the tapered column (which is ¼ $\frac{E\, I_1}{l^2}$).

Curve Approximations.—The statement has been made that the exact shape of the curve is not important. But it has been shown in the foregoing that while the difference in end-loaded cantilever and column curves is not so great in columns of constant moment of inertia as to give a bad approximation, the case may be very different

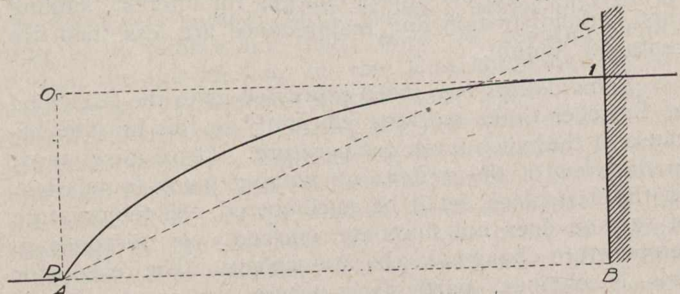


Fig. 2.

with tapering columns. It may be worth stating the point from simple principles as follows:—

1. It is clear from the bending moment diagrams, say, A1 B and A C B, Fig. 2, which for equal values of y_0 must have equal moments about o, that the curvature will be greater for the column than for the cantilever, for the bending moments are increased in greater proportion where their values are smaller—i.e., towards the free end.

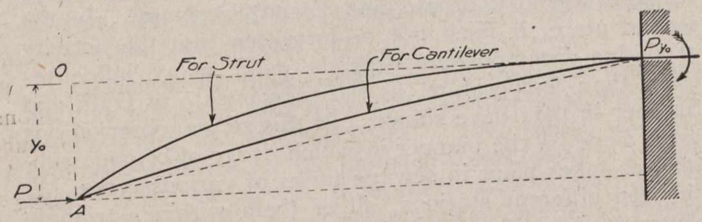


Fig. 3.

2. This is particularly the case with tapering columns, for here I decreases:—

$$\left(\frac{d^2 y}{d x^2} = \frac{M}{E\, I}\right).$$

3. For the displacement method—

$$y_0 = \int_0^l \frac{M\, x}{E\, I} d\, x = \frac{P}{E} \int_0^l \frac{(y_0 - y)\, x}{I} d\, x,$$

or

$$P = E\, y_0 \div \int_0^l \frac{(y_0 - y)\, x}{I} d\, x.$$

For any curve flatter than the true one

$$\int_0^l \frac{(y_0 - y)\, x}{I} d\, x$$

is underestimated, and therefore P is overestimated.

4. By the method by energy, for a curve flatter than the true one (see Fig. 3), the strain energy is underestimated, but the axial component of the movement of P is underestimated in a greater proportion; hence, from the equation P = (strain energy) ÷ (axial movement of P), P is overestimated.

Note on the Initial Choice of a Curve.—By choosing a straight line or the second approximation to which it leads—viz., the curve of an end loaded cantilever—a curve flatter than the true curve is ensured and the true critical load is approached from above. By starting from a constant deflection or the curve of a cantilever acted on by a couple at its free end to which it leads, a curve of exaggerated curvature is secured and the true critical load is approached from below. If the limit is approached

*Reproduced from April 24th issue of Engineering (London).

slowly, the use of both alternatives, when possible, may be recommended.

An alternative method of obtaining a starting point corresponding to the second approximation is to assume that the curve is of the form

$$y = y\left(A + B\frac{x}{l} + C\frac{x^2}{l^2} + D\frac{x^3}{l^3}\right) \quad . \quad (34)$$

the number of constants being equal to the number of known conditions and powers of x higher than the third vanishing when $\frac{d^4 y}{d x^4} = 0$ for all values of x. If the coefficients A, B, C, etc., are made to comply with as many of the known end conditions as possible, the resulting approximations for the curve and for the critical load will be closer than those from a curve complying with fewer of these conditions.

Thus, in Example I., for $x = 0$, $y = y_0$; therefore $A = 1$. Also $\frac{d^2 y}{d x^2} = 0$; hence $C = 0$. And for $x = l$, $y = 0$, and $\frac{d y}{d x} = 0$; hence $B = -3/2$, $D = 1/2$, from which (34) reduces to equation (7). The resulting coefficient for P—viz., 2.5—is nearer the true value, although not safer, than if we neglect the condition $\frac{d^2 y}{d x^2} = 0$, which from the general form

$$y = y_0\left(A + B\frac{x}{l} + C\frac{x^2}{l^2}\right) \quad . \quad (35)$$

yields the form (17) and a coefficient 2.4. Similarly, in Example III., in which $\frac{d^2 y}{d x^2}$ is not necessarily zero, the form (2), which corresponds to $A = 1$, $B = -1$, $C = 0$ in (35) gives coefficients 1, ½, 2/5, 5/14, etc., while the nearer form $A = 1$, $B = -3/2$, $C = 1/2$, resulting from the three conditions $y = y_0$ for $x = 0$ and $\frac{d y}{d x} = 0 = y$ for $x = l$ gives the nearer coefficients ⅔, 6/13, 26/67, 134/381, which, however, approach the same limit, but in a manner somewhat less simple to compute arithmetically.

The United States Bureau of Mines has undertaken to construct, in co-operation with the mining industry and the manufacturers of mining machinery, a mine beneath the floor of the Palace of Mines and Metallurgy at the Panama-Pacific Exposition. The financial and operative success of the mine is assured through exhibits whereby typical metal and coal mining operations will be reproduced by full size working places in which mining machinery will be installed and operated. The walls of the mine will be covered with either ore or coal typical of the mine illustrated.

The American Society of Engineers, Architects and Constructors was incorporated in New Jersey in May last, in the interests of civil engineering, architecture, engineering and building construction, and the arts allied thereto. Its board of trustees consists of Messrs. J. W. Howard, C.E., O. R. Parry, J. A. Yates, C.E., C. F. Dingman, W. P. Comstock, A.B., J. R. Draney and T. H. Boorman, C.E. At the election of officers Major S. S. Hatfield, C.E., became president and Mr. T. H. Boorman, C.E., secretary. We note among the associates of the society the names of Messrs. E. Belanger, C.E., Montreal, and D. D. Barry, Government engineer, Ottawa.

MOTOR BUS TRAFFIC—ITS DEVELOPMENT AND CHARACTERISTICS.

At the recent National Conference on City Planning, held in Toronto, Mr. John A. McCollum, assistant engineer, Board of Estimate and Apportionment, New York City, read a paper on the use of the motor bus by municipalities, and outlined many important points in connection with it in the solution of transportation problems. The following is, in part, Mr. McCollum's paper:—

The date of the first appearance of the horse-drawn omnibus in London is not definitely known, but it is certain that corporations owning and operating such vehicles were in existence as early as 1855, and during the year 1862 more than 42,000,000 passengers were carried by the 600 vehicles of one company alone. The maximum number of horse-drawn vehicles was reached in 1901. In this year 3,736 were licensed. Subsequent to that time the number gradually decreased until a few months ago, when the last horse-drawn omnibus was removed from the streets of London.

The new era began in 1901, when 10 motor buses were licensed by the police. No large increase in numbers took place, however, until 1905, when 241 vehicles were licensed. From that time down to the present, the numbers increased by leaps and bounds. There are at present in London more than 3,000 motor-driven buses, which have entirely supplanted the horse-drawn vehicles. These have a seating capacity of 34 passengers each; operate on regular schedules; move with an average speed somewhat in excess of the surface railway cars, and carry with regularity and dispatch, at a rate of fare exceeding by only 20 per cent. that of the street railways, an aggregate of 676,000,000 passengers per annum, a total greater than the number of cash fares and transfers collected on all the street surface railways of the Boroughs of Manhattan and the Bronx in the city of New York. This seems miraculous when we consider the short period within which motor-driven vehicles have been developed and adapted to this severe use.

The operating efficiency of the motor bus in London may be well illustrated by the fact that during seven continuous months of the year 1913 about 2,200 motor buses ran an average of 117 miles each per day, or an aggregate of 55,000,000 bus miles, with a loss of schedule mileage equal to only 0.12 of one per cent. of the total. This probably exceeds the efficiency of many street railway systems. In Paris there are more than 1,000 vehicles of a type unlike those in London, operating under different conditions, but performing nevertheless an efficient passenger service. New motor bus routes are being established daily in European cities.

There are two characteristics of the motor bus which distinguish it from every other public transportation facility. The first is flexibility; that is, flexibility of vehicle movement and flexibility of route. Because of this feature the vehicle responds quickly to operating requirements and to traffic conditions; e.g., passengers may enter or leave buses at the side of the roadway without risk or danger of crossing dense vehicular traffic; delays to other motor cars do not result from breakdown either of a motor bus or any other vehicle, and daily or less frequent changes of route may be made to comply with traffic conditions. All of these are advantages not to be found in any car confined to rails.

The second distinguishing characteristic is its independence of extraneous equipment, such as expensive and delicate power generating and distributing systems or expensive track equipment. The railway investment must, in a large measure, increase in the same ratio as the length of the track, while the motor bus investment grows only in proportion to the number of vehicles employed or, what is the same thing, in proportion to the daily vehicle mileage.

The importance of this feature is shown by the comparison of the capitalization of the street railways in the Boroughs of Manhattan and the Bronx and the municipally owned and operated surface railways in London with the largest omnibus undertaking in that city. The number of passengers carried in the year 1912 by the London railway was about the same as the number carried by its omnibus system. In Manhattan and the Bronx the total number of passengers paying cash fares and presenting transfers exceeded by about 20 per cent. the number carried by the London omnibus system. The aggregate lengths of route operated were about 148 miles by London railways, about 230 miles by Manhattan and the Bronx railways and more than 300 miles by the London motor buses. Yet at the close of 1912 the London railway investment, less the accumulated sinking funds, was $53,000,000; the Manhattan and the Bronx railways' capital was $190,000,000, with an appraised property value of $166,000,000; while the amount of capital employed by the omnibus company, as evidenced by its outstanding securities, was only $15,500,000, including an increase during the year of $5,000,000 for the purpose of supplying funds for additional facilities, the benefit of which will accrue in subsequent years.

Thus we find that the London railway investment is about 3½ times that of the omnibus. The capitalization of the street railways in Manhattan and the Bronx is more than 12 times and their appraised value is almost 9 times as great as the capital used for London omnibuses. Five per cent. profit upon the capital of the railways of Manhattan and the Bronx would equal more than 13c. for each car mile operated. The following general comparisons may be made between the operating expense of the largest existing motor bus undertakings and that of the street railways:

In London, where the operation is skillfully managed, where the pavements are kept in excellent repair and where the improvement in the type and construction of vehicle has been most rapid, we find that the bare operating cost is relatively low. It is less than 15 cents per bus mile and probably does not exceed by more than 10 to 15% the cost per car mile of the municipally owned surface railways. The excess cost is, however, more than offset by the lower interest charges on motor bus operation, and the total cost per bus mile probably is less than the cost per car mile. The relative seating capacity of vehicles used in this comparison is 34 for the motor bus and 78 for the surface car. This ratio of seating capacity brings the total cost per motor bus seat mile greater than that of the car seat mile. In Paris, where a much heavier vehicle of about the same capacity is operated on pavements less smooth, the cost per mile is considerably greater than in London.

Many conditions abroad bearing on the cost of operation differ from those in America; e.g., the comparatively low cost of labor in England, particularly, mechanical labor, of which so much is required in motor omnibus operations.

The depreciation of the motor bus is much more rapid than that of the street railway car and other railway equipment and requires provision for replacement funds at a greater rate. The total amount of depreciation may not exceed that of the railway, although the rate is higher, because the value to which the rate is applied is much less. In London the life of motor bus equipment is estimated to be from five to six years, and in New York depreciation funds are provided sufficient to replace the vehicles after three years' use. Probably the average life of motor buses constructed abroad when efficiently maintained is much longer than five years, but the mechanical improvement in type and construction has been thus far so rapid that the vehicles become obsolete before they are worn out.

Street pavement is to the motor bus what the steel railway track is to the railway car, but unlike the railway track it is provided at public expense. Its preservation, therefore, is one of the problems which will confront the authorities if large numbers of heavy motor buses are to be operated, particularly in suburban districts, where the pavements are usually less permanent than in city streets with dense vehicular traffic.

The capacity—hence to some degree the weight—of the motor bus is an extremely important consideration from the standpoint of economy, for the cost of operation per vehicle does not increase at the same rate as the number of persons which it may carry. Therefore, where the volume of traffic is sufficient, a larger vehicle is more desirable. Speed and rapid acceleration up to certain limits are also essential for passenger service. In consequence, reduction of weight per unit capacity or other improvements in design must be depended upon to keep down road repair cost rather than reduction of speed in motor bus operation.

Motor buses operated in London, Paris and New York vary in weight from 219 pounds to 365 pounds for each passenger which the vehicle is capable of carrying. The lightest vehicle is used in London and weighs about 3¾ tons unloaded. This is the maximum weight permitted by the police for a public service vehicle. It is possible to obtain American-made single-deck buses, 24-passenger seating capacity, that probably do not exceed in weight the maximum per passenger capacity authorized in London. Whether those vehicles will prove successful in the severe trials of motor bus work is yet to be proven.

There is a great need for a careful research into the whole problem of mechanical traction on roads, particularly the effect of vehicle weight and speed upon the cost of road maintenance. If it is shown that the motor bus is particularly destructive to roads, the operators should pay something toward road maintenance.

BREAKWATER CONSTRUCTION AT VICTORIA.

In connection with the construction of a breakwater in the outer harbor at Victoria, B.C., a 7,000-ton floating dry dock, owned by the Seattle Construction and Dry Dock Co. and leased to Grant, Smith & Co., will be used. Upon it concrete piers will be built, the dry dock being allowed to sink as the construction of the piers progresses. When they have been completed, they will be held in suspension by cranes while the dry dock is being removed, after which they will be properly seated in position.

There are in all 54 of these caissons to be built in connection with the contract, two of them being constructed at a time upon the dry dock. Each will have a weight of approximately 3,500 tons.

The water level is regulated by means of water-tight compartments in the bottom and sides of the dry dock.

The Dominion Government will shortly spend $200,000 in establishing an astronomical observatory near Victoria. This station will be equipped with a 72-in. reflecting telescope, said to be the largest of its kind in existence.

POINTS IN ROAD DESIGN.

At the First Canadian and International Good Roads Congress, held in Montreal in May last (see *The Canadian Engineer*, May 28, 1914), the subject of road design was dealt with by Mr. Robt. A. Meeker, State Highway Engineer for New Jersey. Mr. Meeker touched upon the essential factors: width, alignment, grade and drainage, in the following way:

Width.—The first point to be considered in designing a road is its width. It may be generally stated as axiomatic that the width of roads should be in multiples of eight, this being the width that should be allowed for each vehicle using the road. A road 8 ft. wide might more properly be termed a lane leading to one building or a small group. The next in importance should be 16 ft. in width, in order that two vehicles might have sufficient width in which to pass. The third width, or 24 ft., would permit of two vehicles passing while the third was standing along the side of the road—or two loads of hay or other bulky material to pass. The fourth width, or 32 ft., permits two vehicles to stand along the sides and leaves sufficient space for two other vehicles, moving in opposite directions, to pass each other in safety. These widths refer to the traveled carriageway alone, no allowance whatever being made for the accommodation of pedestrians, nor for any drainage structures.

In order to obtain a roadway of sufficient width to accommodate travel passing in both directions, 24 ft. may well be taken as the minimum allowable, and if there is the prospect of an increase of traffic in the near future, a proper addition to the width of the surface, necessary for the accommodation of the traffic, should be provided for in the original design. It is almost impossible to properly grade and drain a road of less than 24 ft., and the wider the roadway the more easily it is drained, and also maintained, due to the fact that the traffic is distributed over a greater area, and that the surface is more freely exposed to the drying action of the wind and sun, thereby preventing the formation of mud and ruts.

Alignment.—The second problem is that of the location of the line. On a new road this is determined by certain well-defined principles. First, the beginning and ending points should be connected by the most direct line; second, the grades should be kept as low as possible; third, for economy's sake, the line should be so located as to reduce the amount of grading to the minimum, likewise the number and size of the bridges.

The factors governing the departure from a straight line are many. In crossing a ridge we seek the lowest point in the summit, in order to avoid expensive cutting or the alternative of steep grades; in following a valley we keep well up on the hillside, to avoid bridging ravines and small water courses; if we encounter a swamp or pond we can frequently, by swinging the line, save the expense of a heavy fill; a stream may be avoided by diverting the line, thus saving the cost of bridges.

On an old road another set of problems has to be solved; these are chiefly those of expediency. Though a straight line between the termini may not only be the best but also the cheapest, the claims of intermediate communities may be so strong that the line must be diverted from its best course to satisfy the wants of the communities to be served. But through it all, in spite of all of these warring factors, the engineer must never lose sight of the straight level line between two points as his ideal. By keeping this constantly before his mind's eye the results that may be achieved will often surprise even the author.

Grade.—The grade, or the angle which the axis of the road makes with a horizontal line, is the most important economic feature in road design, for upon it depends the amount of material a horse can draw over the road. The results of experiments made both in England and France prove that a horse can haul twice as heavy a load up a 2 per cent. grade as he can up a 6 per cent. grade. That being so, the value of a road for heavy traffic, having a maximum grade of 6 per cent., is only one-half of that having a maximum of 2 per cent. This fact is often lost sight of in designing new grades, the object of many road officials being to build as many miles of road as possible for a given amount of money, the first cost, and not the ultimate value of the road to the community, being the basis upon which the improvement is made. This cutting down of hills and the filling of valleys or reduction of gradients is no new idea, for Isaiah wrote, over 2,000 years ago, his idea of a perfect highway as follows: "Every valley shall be exalted and every mountain and hill shall be made low; and the crooked shall be made straight, and the rough places plain."

Drainage.—Having laid out your road as straight as possible, and having reduced your grades as much as your funds will permit, the next important problem is is that of drainage. This is of two kinds—surface and subsurface. Surface drainage is both transverse and longitudinal. Every road must be so planned that the water which falls upon its surface will not remain upon or along it. The first object is attained by giving the road a proper crown or cross-section, so that the water may be conveyed quickly to the gutters on the sides. This crown should have the form of the arc of a circle, drawn through three points—the centre of the road and the gutter on either side. The elevation of these points should be in the following ratio: For earth roads a fall of 1 in. per foot from the centre to the gutters; for waterbound macadam, ¾ in. per foot, and for bituminous concrete ½ in. per foot. This form of cross-section permits of the fullest use of the road, and at the same time conveys the water to the gutters without washing the sides or shoulders of the road. The longitudinal surface drainage is taken care of by the gutters, which must be carefully trimmed to conform to the grade of road, all holes being carefully filled and all humps cut off. In fact, the gutters must be as carefully graded as the centre of the road. Proper inlets to bridges crossing the road should always be constructed if the bridge is as wide as the carriageway. In some soils these precautions are not sufficient, and we are then compelled to lay underdrains. These should be placed about 3 ft. inside of the gutter line, for two reasons: First, to intercept the subsurface water before it reaches the middle of the road, and second, to prevent erosion in case the gutters are gullied. The object of underdrains is to cut off the subsurface water before it can get beneath the traveled road; therefore their place is on one or both sides of the paved way.

The second-hand railway equipment business of Jas. T. Gardner, deceased, Chicago, will continue under the name of Jas. T. Gardner, Inc., with the following officers:—M. Gardner, pres.; R. H. Gardner, vice-pres.; A. V. Talbot, sec.; and A. M. Talbot, treas.

Victoria, B.C., has commenced work on the excavation of the ten-mile trench in which the steel pressure pipe for the Sooke Lake waterworks system will be laid from Humpback Reservoir to the city. This work will be rushed ahead in order that no delay may be encountered when the Burrard Engineering Company of Vancouver, to which has been let the contract for the fabrication and laying of the pipe, starts delivering the pipe lengths.

THE FIRST RAILROAD IN AMERICA.

THE pressing need for additional and enlarged transportation facilities to meet the growing demand occasioned by the phenomenal growth of business in all of its departments and branches, presents itself as an issue and problem of far-reaching importance. Apart from this living issue, which is now in process of argument and investigation, it is interesting to review briefly the origin of railroads in America.

In this connection Mr. W. P. Maher, writing in "Railway and Locomotive Engineering," has presented a few statistics and data concerning the origin of railroads in the United States, as given below:

The first railroad constructed in the United States was the Quincy railroad (1826). It was three miles in length and was built to transport granite from the quarry at Quincy to the Neponset River, close to Boston harbor. This railroad was laid upon granite ties eight feet apart. The cars were drawn by horses and the usual load was ten tons. The schedule of this railroad was three miles an hour.

The Baltimore & Ohio Railroad is credited with being the first railroad constructed in the United States operated as "a steam railroad." This is erroneous. As a matter of fact the first railroad planned and constructed in the United States to have for its motive power steam engines was the Charleston & Hamburg Railroad, in the State of South Carolina, connecting the port of Charleston, S.C., with the town of Hamburg, S.C., located on the Savannah River, opposite Augusta, Ga., the distance between Charleston and Hamburg being 136 miles.

On December 6, 1827, the city council of Charleston called a public meeting of citizens. After varied discussion towards the means and ends of constructing a line of railway to run from Charleston to Hamburg, on December 19, the legislature passed an act, chartering the South Carolina Canal and Railroad Company. The directors realized the great importance of employing an engineer having special ability in construction work. They began to look around for a suitable person and engaged the services of Horatio Allen. He immediately proceeded to acquaint himself with the details of affairs as they existed and in two months he presented a report to the company embodying the cost of transportation by horse power and by locomotive power.

In March, 1830, E. L. Miller, a native of Charleston, who had been present at the opening of the Liverpool & Manchester Railroad and who had studied closely Stephenson's engine on that line, offered to construct a locomotive after his own plan. The offer was accepted and Mr. Miller proceeded to West Point, N.Y., and built the engine at the West Point foundry. The engine arrived at Charleston the latter part of October and was placed on the road November 2. It was named "The Best Friend." It made its trial trips December 14 and 15, 1830. In speed and power it exceeded the most sanguine expectations. It pulled six cars with 50 passengers at the rate of 20 miles per hour and with the empty cars it made from 30 to 35 miles an hour.

The engine was regularly used in carrying materials over the line, and also was used in between times to carry excursion parties. "The Best Friend" was the first American built locomotive and the road upon which it ran was the first American railroad to employ steam locomotive power. The engineer who had the honor to operate it was a native of Charleston named Nicholas W. Darrell. Through the carelessness, or perhaps due more to inexperience, the negro fireman gave the engine an overdose of steam and on June 17, 1831, "The Best Friend" exploded.

About this time the chief engineer, Allen, designed an eight-wheel locomotive which he had constructed at the West Point foundry. This locomotive was put on the line in January, 1832. It was named "South Carolina." It was a very powerful machine, and was the first eight-wheel locomotive in the world.

On November 7, 1832, the road was completed and opened for traffic between Charleston and Branchville, a distance of 61 miles. On November 2, 1833, the entire line from Charleston to Hamburg was finished and begun its operations of common carrier. It was the longest line of railroad in the world to be operated solely by steam locomotive power.

In summarizing some of the distinctive features of priority that the Charleston & Hamburg Railroad can claim over its competitors, it may be mentioned: It was the first railroad constructed in the United States, built and planned to be operated by steam locomotive power. Constructing and operating on its road the first American-built locomotive. Having for its first chief engineer the man who ran the first locomotive in America.

We learn that in February, 1835, the splendid locomotive "Edgefield" was making its regular schedule, pulling five passenger cars the distance of 136 miles in seven hours and 20 minutes; that the railroad owned 12 engines, 20 passenger cars and 135 freight cars, and that regular schedules were operated—both freight and passenger, and that depots had been built along the line about 10 to 15 miles apart.

This is, in brief, a historical summary of the first steam railroad built in the United States. This line is now a part of the Southern Railway system.

NOTABLE ITALIAN WATER SUPPLY.

With the completion of the Croce di Monaco tunnel through the Eastern Apennines, which was accomplished recently, the last engineering difficulty in the way of finishing the Pugliese aqueduct has been removed. This aqueduct, which was begun in October, 1899, and will, it is hoped, be completed this autumn, is said to be the greatest hydraulic work of its kind ever undertaken.

By diverting the River Sele, which at present flows into the Tyrrhenian Sea below the Gulf of Naples, its waters are carried through the main range of the Apennines to the Adriatic coast of Italy and delivered to the three arid provinces of Puglia. The aqueduct begins at Caposele, 1,358 feet above sea level, and the main waterway running to the eastern slope of the mountains at Venosa is 132½ miles long, of which 60 miles are cut through the rocky mountains.

At Venosa the supply is divided into three, one branch running to Foggia, another to Bari, and the third to Lecce, in the very heel of Italy. These three main conduits have a total length of 1,000 miles. The distribution among the principal towns and communes has necessitated the laying of 500 miles of piping. One hundred and fifty-two reservoirs, each containing 150,000 cubic metres of water, have been constructed at various points. Two and a-half million people will be benefited by the scheme, and 84,000 small land owners will obtain water for the irrigation of their holdings.

The total cost of the undertaking, which has employed 10,000 for 15 years, has exceeded £6,000,000.

Pine and fir piles that have been in service for 43 years in a railway trestle in Great Salt Lake have, upon inspection, been found perfectly sound, due to thorough impregnation with salt.

The Province of British Columbia has an area of 395,000 sq. mi. and a coast line of 7,000 mi. It has 15,000,000 acres of standing timber. There were 2,250 mi. of railway in operation last year, with 2,304 mi. under construction.

WATER STERILIZATION BY ULTRA-VIOLET RAYS.

A PAPER which is being presented by M. von Recklinghausen at the 31st annual convention of the American Institute of Electrical Engineers in Detroit on June 26th, is based upon the sterilization of water by ultra-violet rays of the mercury-vapor quartz lamp. It refers to the historical development of mercury lamp water sterilizers and the development of pistol lamps for large sterilizing units. The sterilization of water is a field that has developed for the application of electricity during the past five years. The experimental work has been done chiefly in France and with it M. von Recklinghausen has been prominently identified. His paper deals particularly with the work done by him in collaboration with Messrs. Henri and Helbonner at the physiological laboratory of the Sorbonne University. A considerable portion of it is devoted to a study of the economical use of ultra-violet rays for this purpose and the best temperature to be employed in the luminous part of the lamp. The measurement of ultra-violet power, based on physical, chemical and bacteriological reactions is explained and these reactions are compared.

It is found best to choose as a unit some value of the particular effect of the rays which concerns the work in hand, and of the four different methods of examining the power of the ultra-violet spectrum the bactericidal or abiotic action is found well suited in the sterilization of water. However, in choosing a unit of bactericidal reaction it was found that cultures of microbes vary so much with age and other conditions that it was impossible to get sufficiently constant results upon which to base a unit reaction. It has been necessary, therefore, to determine the sensibility of the reactive material; i.e., the germ culture on hand, by exposing samples of it to the light of a lamp which has been standardized. This has led to the creation of a laboratory standard lamp to be operated so that it will always produce the same amount of ultra-violet rays. The experimental method of procedure consisted in taking a drop of the culture, exposing it at a definite distance from the lamp, counting the seconds necessary to render them motionless and comparing the

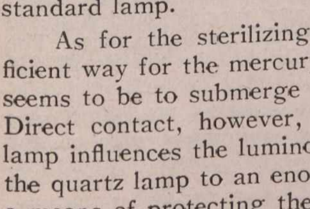


Fig. 1.

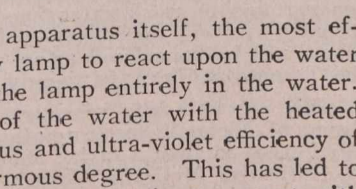


Fig. 2.

figures thus obtained with figures obtained under the standard lamp.

As for the sterilizing apparatus itself, the most efficient way for the mercury lamp to react upon the water seems to be to submerge the lamp entirely in the water. Direct contact, however, of the water with the heated lamp influences the luminous and ultra-violet efficiency of the quartz lamp to an enormous degree. This has led to a means of protecting the lamp from direct contact with the water by fusing over the former a wide quartz jacket. This system has been adopted with modern apparatus. Difficulties arose in the manufacture of such jacketed lamps, however, resulting in the construction of what are known as pistol lamps. Another method is to let the water circulate in such a way around the lamp that it will not come into contact with it, receiving, nevertheless, all the rays emitted by it. Again, where it is more a question of convenience and less a question of efficiency the simplest method is to place the lamp above the water as close as possible to its surface, but reflectors placed above such lamps have a low efficiency in the reflection of ultra-violet rays.

Water bacteria are killed in as short a time as 1/20th of a second at a distance of 1 to 2 centimeters from the powerful ultra-violet ray lamps. Water being practically as transparent to the rays as air itself, if a germ floats in the water it will be annihilated by getting into the illuminated zone, the condition for this being that no suspended matter is contained in the water which would form a shield for the germ.

Water for this sterilization has, therefore, in most cases to be filtered before being submitted to the sterilizing action of the rays. However, even very good filters will allow some microscopic matter to pass. It is much more effective, as shown by experiments, to stir up such water while it is going through the illuminated zone so as to turn over and over any particles which otherwise might allow microbes to pass by under cover. Baffle arrangements are built in for this purpose of stirring up the water. For the same reason, also, it is best to pass the water through several illuminating zones, which can easily be done by leading the water several times towards the same source of light, or by passing it successively under several sources of light.

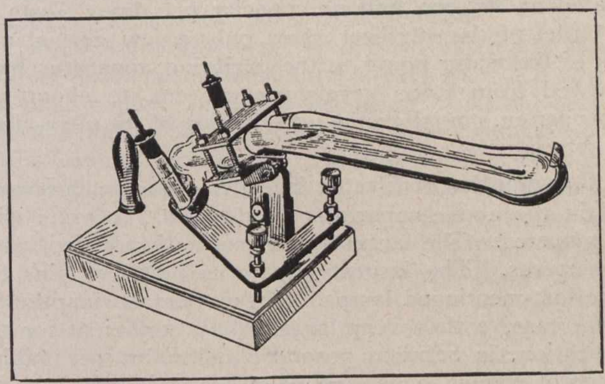


Fig. 3.

Typical Installations.—The largest unit ever built was set up about two years ago in the city of Luneville, France, to sterilize the city water supply. It consists of a flume into the sides of which ten 500-volt pistol lamp equipments are inserted. These equipments consist of metal boxes for the starting of the lamps (the latest types of them contain also the rheostats). The boxes are equipped on the inside with a stuffing box arrangement holding the quartz protective tube which protrudes into the water. The lamps are lit in the starting boxes and then their luminous parts are inserted into the protective tubes, so that the light emitted from the lamp enters the water.

The raw water fed into this plant comes from the Meurthe River and contains sometimes as high as 60,000 germs per cu. cm. It is clarified by a series of roughing filters and one filter. After this it is physically in fairly good condition, being very poor in suspended matter, but having from time to time fairly deep color (up to 45 U.S. standard) in solution. The germ contents are sometimes as high as 1,000 per cu. cm. in this water. It is then passed through the sterilizing unit described above, coming under the influence of the light from one to two minutes altogether, according to the number of lamps running. This number (sometimes only 4) depends on the physical condition of the water, which is easily observed. The bacteriological tests of the water when leaving the sterilizer rarely show more than 10 germs per cu. cm., and are often zero. Bacterium coli is always eliminated. Not only are the bacteriological tests satisfactory; the health of the community has improved considerably. Typhoid used to cause from 70 to 160 deaths annually; it is now practically eliminated, there being no cases at all this year.

Another typical installation was made in New York lately for the purification of the water of a swimming pool, which is naturally exposed to continuous pollution from the bathers. The water in this case is circulated continually through a filter to take out suspended matter and then it passes through the ultra-violet ray sterilizer. This apparatus is similar to the Luneville unit except for its size, as it contains only two 220-volt pistol lamps. It is rated at 175,000 gallons capacity per day. Tests at the outlet of the sterilizer show only a few germs, and tests of the water going to the purifying apparatus have improved from 6,000 germs per cu. cm. to about 350 germs per cu. cm. since the introduction of the ultra-violet ray apparatus.

Consumption of Electric Energy.—The smallest lamp used in the above apparatus operates at 110 volts with two amperes. The largest made so far is for 500 volts, 2.5 amperes. The largest apparatus built contains ten of the last-mentioned lamps. The power consumption in such a case, with a very large safety coefficient for the sterilization, is between 50 and 130 kw.-hr. per million gallons of water. This amount of power is evidently not very great but it will always do something to smooth out the load curve of a power station, as, in most cases, such

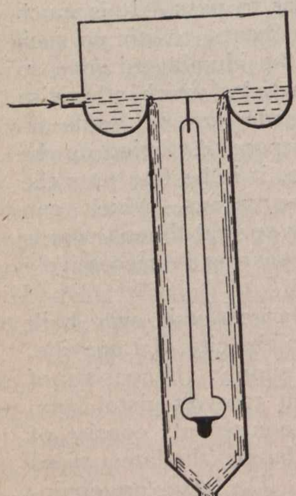


Fig. 4.

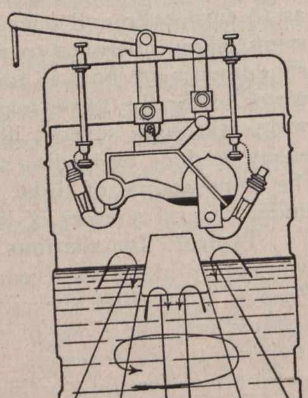


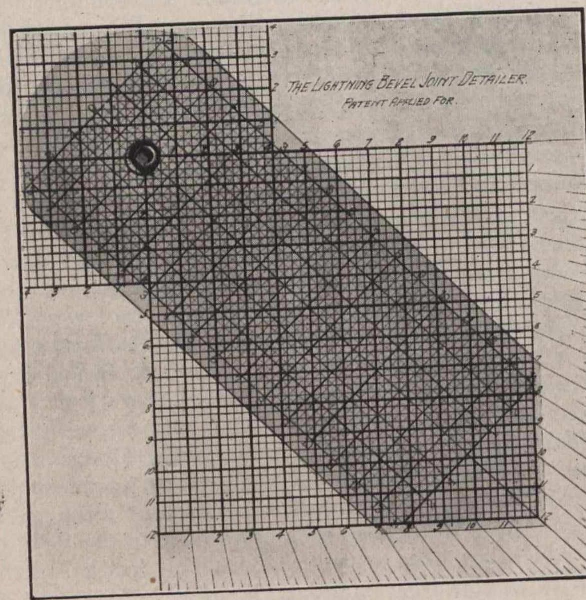
Fig. 5.

apparatus will be operated continuously. Many installations of this kind have been made in Europe for both small and large waterworks, and they are operating very successfully. Their simplicity and rapidity of action are highly satisfactory.

The accompanying illustrations from M. von Recklinghausen's paper, convey an idea of the nature of the apparatus and its use. Fig. 1 shows the entirely submerged lamp used in the experiments of Courmont and Nogier, and Fig. 2 shows the position of the quartz jacket used to prevent contact of water with the light-giving portion of the lamp. Fig. 3 is an illustration of the so-called pistol lamp, which allows all the light to enter the water, at the same time providing a removable lamp. Figs. 4 and 5 show several methods of circulating the water so as to be thoroughly penetrated by the ultra-violet rays, although not coming into contact with the lamp.

NEW BEVEL JOINT DETAILER.

A useful and ingenious little instrument for the detailing of bevelled joints in structural steel work has been designed by W. J. Donley and B. H. Williamson of the Canadian Allis-Chalmers. Limited. Toronto. It is extremely simple in operation, promises to be a great time saver and is at the same time very accurate. It does away with the necessity of making detail layouts to a great extent and has a large field of usefulness to both checkers and detailers.



The accompanying illustration gives a fair idea of the general appearance of the device. It is called the Lightning bevel joint detailer. It is 9 in. square and consists of a back of white celluloid and a movable arm of transparent celluloid, both of which are graduated to half-size scale. The instrument has been thoroughly tried out on the detailing of truss member joints, lateral and partial connections and various other classes of work. It has been found so satisfactory in every case that patents will be applied for and the instrument put on the market.

The Ontario Railway and Municipal Board appointed some little time ago a board of experts to investigate the traffic conditions in Toronto with regard to the street railway system and to make some recommendations for the improvement of the same. A report has been submitted recommending improvement to the extent of an estimated expenditure of $2,950,000. Of this amount $2,160,000 covers additional cars, 180 2-car trains being recommended; $250,000 pertains to track extensions and specials, and $540,000 includes power machinery transmission equipment. The report will be considered at an early date by the Board and the Toronto Railway Co. jointly.

The contract was recently awarded to Messrs. Naylor Bros., of Victoria, for a reinforced concrete bridge of the trestle type to span a ravine about 280 ft. in width and 75 ft. in depth over McCartney Creek, B.C. The new bridge will be located about 4 miles east of the city of North Vancouver, on the Keith Road, which is forming part of the Marine Drive trunk road scheme for the north shore of Burrard Inlet, inaugurated by the District Council in 1911. The bridge will have a 24-ft. roadway, with provision for sidewalks, water mains, etc. The contractors' price was $17,800. The work is well in hand, and the date set forth for completion is July 22nd. It is being built for the Corporation of North Vancouver.

THE FRENCH SYSTEM OF ROAD MAINTENANCE.

At the recent Good Roads Congress in Montreal and elsewhere frequent references have been made to the systematic organization of forces which has attended the construction and maintenance of roads in France. The superiority and completeness of the French road system has world-wide recognition. The technical and administrative organizations in charge of road development in that country are looked upon throughout America as being of the most efficient, and it is generally maintained that such is an evidence of the advantages arising from a systematic organization properly trained and properly equipped for such work.

This French road system was described by Mr. Jean de Pulligny, chief engineer, bridges and roads, and director of the "Mission Francaise d'Ingenieurs aux Etats-Unis," New York City, in a discussion on road construction and maintenance before the American Society of Civil Engineers last year, and appearing in the Proceedings of the Society for September, 1913. From it the following synopsis is given:

The national main highways which connect Paris with the large cities and the frontiers are constructed and maintained by the central government. These main highways (Routes Nationales) were built more than 100 years ago, when scarcely any roads were to be found in other countries, for military purposes and for carrying the royal mail. Their total length is about 24,000 miles, and the annual appropriation for their reconstruction and maintenance is $6,500,000. Since the completion of railways the national main highways are not considered as having as much importance as the other roads of the country, which amount to 339,500 miles in length, and require an annual expenditure of $37,400,000. These roads include mainly Chemins Vicinaux de Grande Communication, connecting the cities and villages, and the less important Chemins Vicinaux Ordinaires, which connect farms with the next village or the nearest city. The Chemins Ruraux are roads connecting one farm with another or connecting farms with more important roads.

Technical Organization.—France, which has a gross area of 207,000 square miles, is divided into 86 territorial units called Departments, having an average area of about 24,000 square miles. The 86 Departments (plus Belfort territory) are divided into 275 Arrondissements and the 275 Arrondissements are composed of 2,325 Cantons, which are divided into 36,222 Communes. Each Department is a political unit, and is a unit for several public services. It has a governor appointed by the central government, called a Prefet, and an elective body called the Conseil Général. It has also certain revenues produced by taxes, the appropriation of which is decided by the Conseil Général.

All the road system of Chemins Vicinaux is managed by the Prefet, and the expenditure is voted by the Conseil Général, the central government having practically nothing to do with it. The Prefet, of course, does not manage the road system himself, but through a centralized body of competent technical men. In about half the Departments the work has been entrusted by the Conseils Généraux to the body of government engineers—Ingenieurs des Ponts et Chaussées—to which the writer has the honor to belong. These roads comprise only a small part of their work. They also have in charge the national main highways and the various civil engineering works which are administered by the French government, including all the inland navigation works, canals and canalized rivers, all the ports, docks, harbors, sea shores and lighthouses, and the close inspection maintained by the French government over the railroads, with reference to safety, regularity and rates, and also to secure a proper maintenance of the railroad property which is only entrusted to the railroad companies for a definite period, at the expiration of which such property will be returned to the government.

In the other half of the Departments (exactly forty-six) special technical bodies have been organized, which are, of course, quite outside of politics. They include a chief road engineer, residing at the capital of the Department, near the Prefet, and having charge of all the Chemins Vicinaux of the Department.

Each Department is divided into three or four political districts headed by a Sous Prefet, and called an Arrondissement. In each capital of each district there resides a district road engineer, who is under the orders of the chief road engineer and has charge of all the Chemins Vicinaux of the Arrondissement.

Each Arrondissement is divided into eight or nine judicial districts, named Cantons, each of which also has its small capital, in which resides an assistant road engineer who has charge of all Chemins Vicinaux included in the Canton. He is under the orders of the district road engineer. Finally, all roads in a Canton are divided into sections, each having an average length of 4 miles, and on each of these sections the celebrated French Cantonnier, or road patrolman, works constantly with his pickaxe, shovel, shrub and wheelbarrow. These Cantonniers are under the orders of the assistant road engineer. A few of them have shorter sections and they look after the work of their neighbors, as foremen (Chefs Cantonniers). The Cantonniers are simple laborers, generally of agricultural training, and are not required to have any special knowledge in order to enter the service. They are only expected to be of respectable behavior, to be able to read and write, and to be steady and trustworthy workers.

It is evident that every square yard of French roads is under the permanent care of a patrolman, of a chief patrolman, of an assistant road engineer, of a district road engineer, and of a chief road engineer. All these men form a hierarchy, with a Prefet as the head. Any complaint by the people, or their representatives, to the Prefet is properly attended to. All members of the road service, from the patrolman to the chief engineer, work under a civil service law. When they have once entered the service they can only be dismissed in case of serious misbehavior. They are promoted at regular intervals, with better pay, and when they retire, after thirty years' work, they get an old age pension. Most of the patrolmen lack sufficient knowledge to become assistant engineers. The latter are recruited by public competitive examinations, taking place every two or three years, from among young men who have studied, by themselves or in school, the necessary subjects, such as the elements of mathematics, surveying, drafting, designing, and road construction and maintenance. The boys employed as helpers for drafting, designing and surveying in the offices of road engineers also generally undergo these public examinations. Their practical experience serves them well, and most of them succeed. The district engineers are generally chosen from among the most able and experienced of the assistant engineers who have had many years of service. The chief engineer for the whole Department may have been previously a district engineer, but it is not obligatory. In some cases he was formerly a civil engineer, a graduate from one of the principal schools, an architect, or an Ingenieur des Ponts et Chaussées.

Table I. shows the number of chief, district and assistant road engineers in each of the 46 Departments where a special road service has been organized.

Table I.—Number of Engineers, Etc., on French Roads in Departments Having a Special Road Service.

Departments.	Chief road engineers.	District road engineers.	Assistant road engineers.	Field and office graduate assistants.
Ain	1	5	41	46
Aisne	1	6	55	7
Hautes Alpes	1	4	22	8
Ardennes	1	5	32	6
Ariège	1	4	22	11
Aude	1	4	49	16
Calvados	1	6	34	26
Cher	1	2	21	9
Corrèze	1	2	33	7
Creuse	1	4	27	3
Dordogne	1	5	42	21
Doubs	1	5	26	11
Eure	1	7	44	12
Gard	1	4	36	10
Haute Garonne	1	5	48	16
Gironde	1	10	48	48
Hérault	1	5	49	15
Ille-et-Vilaine	1	7	37	16
Indre-et-Loire	1	3	25	15
Isère	1	7	52	30
Jura	1	5	36	10
Landes	1	4	25	9
Lozère	1	2	19	12
Manche	1	6	51	14
Haute Marne	1	4	33	3
Meuse	1	4	39	14
Morbihan	1	6	25	10
Nièvre	1	3	30	9
Nord	1	8	53	28
Orne	1	5	36	15
Puy-de-Dôme	1	5	53	..
Pyrénées-Orientales	1	2	25	6
Haut Rhin	1	..	5	3
Rhône	1	3	32	29
Haute Saône	1	3	34	4
Sarthe	1	5	34	13
Seine-et-Oise	1	7	51	17
Seine-Inférieure	1	5	50	29
Deux Sèvres	1	4	31	12
Somme	1	6	45	15
Tarn	1	5	28	18
Tarn-et-Garonne	1	2	20	13
Vendée	1	8	26	6
Vienne	1	6	32	15
Vosges	1	6	34	6
Yonne	1	6	42	6

Salaries.—As examples, statements will be given concerning the salaries of the road engineers and assistants in two Departments: In Seine-et-Marne (population = 358,325; area = 2,300 sq. mi.) the service is entrusted to the Ingenieurs des Ponts et Chaussées; in Seine-et-Oise (population = 707,325; area = 2,170 sq. mi.) there is a special service of departmental road engineers.

Department of Seine-et-Marne (Road Service Entrusted to the Government Civil Engineers).—The body of government civil engineers (Ponts et Chaussées) was created on February 1st, 1716, and the Ecole des Ponts et Chaussées, for the education of such engineers, was founded in 1750.

The classes and salaries in the body of the Ponts et Chaussées are as follows:—

	Annual salary, according to seniority.
Inspecteur Général	$2,900 to $3,400
Ingénieur en Chef	1,900 to 2,300
Ingénieur Ordinaire	965 to 1,350

In addition to their government work, these engineers are allowed to work for departments, cities, chambers of commerce, etc. From this and from other supplements given by the state itself nearly all engineers earn at least $200 yearly. Many earn more, and the supplements of a few equal or exceed their salary.

The state salaries of their assistants are as follows:

Conducteurs (assistant engineers), $425 to $965 per annum, according to seniority.

Commis (office and field graduate assistants), $280 to $675 per annum, according to seniority.

After 30 years of employment, all engineers and assistants are granted an old-age pension of about one-half of the highest salary they have obtained. Besides their state salary and supplements, the engineers and their assistants receive the following fees for their department road service:

Ponts et Chaussées:	Annual fee.
Chief engineer	$1,150
District engineer	575
	According to seniority.
Conducteurs (assistant engineers)	$123 to $192
Office assistants: Head clerks	210 to 385
Typewriters and field and office assistants	50 to 150

The patrolmen are special for the departmental road service. Their monthly salary is as follows, according to seniority:

Chief patrolman	$25 to $27
Patrolman	19 to 21

When these officials are ordered to travel outside the limits of the city in which they reside they receive traveling expenses.

During 1912 the total salaries, traveling and sundry expenses for the road officials, including patrolmen, in the Department of Seine-et-Marne, amounted to $28,000.

Department of Seine-et-Oise (Special Departmental Road Service).—The salaries and old-age pensions after 30 years' service are as follows:

	Annual salary.	Annual pension after 30 years' service.
Agent voyer en chef (chief road engineer)	$1,920	$1,440
District engineer	$960 to 1,100	825
Assistant engineer	480 to 850	640
Office and field graduate assistants	280 to 575	430
	Monthly salary.	
Chief patrolman	$22 to $25	$121
Patrolman	16.50 to 19	100

Many employees also receive various supplements for the high cost of living in certain cities, help to large families, extra work, traveling expenses, etc.

The total of these expenses for the office staff in the Department during 1911 was $10,400. The total expense for patrolmen and chief patrolmen, including all sundry expenses, was $72,500.

These two Departments are near Paris, where the cost of living and all salaries are high. In many other Departments, the salaries would be smaller by 10 per cent., and, in a few, by 25 per cent.

The total expense for the Chemins Vicinaux of all classes during 1910 amounted to $37,500,000, as follows:

Regular maintenance	$26,355,000
General repairs	2,100,000
Building new roads	4,420,000
Land acquisitions	890,000
Sundry expenses	335,000
Salaries and general expenses	3,400,000
Total	$37,500,000

Administration and Financial Organization.—The engineers of the road service not only build new roads and maintain existing ones, but take an important part in the administrative and financial working of the road system.

The assistant engineers walk nearly all day on the roads of their district, or they may ride on a bicycle, in a carriage, or in an automobile. They constantly meet the elected mayors of the small towns, and they know all the needs of the people. Knowing also approximately the available resources for the coming year, they prepare for each township and for each road of their district a scheme for maintenance expenses and for the building of new roads. They send their reports to the district engineer who sums them up and makes any changes he deems necessary.

Table II.—Mileage of Chemins Vicinaux.

Condition.	De Grande Commun-ication. Miles.	D'Inter-et Commun. Miles.	Ordin-aires. Miles.	Totals. Miles.
Accepted and regularly maintained	107,000	47,200	178,000	332,200
Under construction	287	302	6,700	7,289
Only designed	970	1,770	53,500	56,240
Total	108,257	49,272	238,200	395,729

All the district engineers forward their reports to the chief engineer, who designs a general scheme for the maintenance and building of new roads in the whole Department. Each town or village has its small elective body, which is called to deliberate on the road work and on the expense in which it is concerned. A bill for this scheme is then discussed by the Department's Legislature in its annual session, and may undergo some changes. The appropriation is finally voted, and the works are then carried out with no more intervention on the part of the political representatives, the road engineers acting only under the authority of the Prefet. The expense is levied on the town or village as a public tax, even if the people do not approve of it.

The Chemins Vicinaux, thus taken care of by the Department, are the Chemins de Grand Communication which connect two or more towns or villages. In such cases it is admitted that the maintenance of the roads must not be entrusted to the townships, because one town might do its share of the work and suffer because the other town would not do the same; therefore, the money is provided by the town taxes, but the direction of the work is assumed by the Department.

The construction of new Chemins de Grande Communication is undertaken by the Department for the same reason, but, in this case, there is an important difference as to the origin of the funds. Instead of providing all the money from municipal revenues, the town only give a part of it, and the remainder is appropriated by the department from its share of certain taxes, the amount of which is divided between the Central State, the department and the towns. The sharing of the expense between the town and the department is provided in accord with definite rules, in which both the needs of the township and its resources are considered.

The total revenue produced by certain taxes is supposed to be an index of the comparative wealth of the townships, and the area of their district is considered as a measure of their needs for roads. The revenue being divided by the area, the quotient is considered as an index number by which the townships are classified, and, for a certain index number, they may receive a definite percentage of help from the department, as high as 85 per cent. for a very poor township with a very wide area needing very long roads.

A similar classification is made in the Departments on the same double basis of wealth and area, and an annual appropriation from the Central Government's fund is divided between the departments as a National aid for the construction of their roads. This appropriation amounted to only $2,000,000 in 1910. It has been larger in certain other years.

Such is the technical, administrative, and financial system, and it has worked satisfactorily in France for nearly a century. It only applies to the Chemins Vicinaux de Grande Communication which concern two or more towns or villages.

As for the Chemins Vicinaux Ordinaries, Chemins Ruraux, and Rues (streets) which concern only one town or village, the mayors are free to build and maintain these roads out of the municipal funds, as they wish. In fact, all the villages and small towns voluntarily entrust their road work to the assistant road engineer whom they see daily, and he does it for a small fee. If a town is more important, and if it has a few municipal works of sewerage, water, gas, or electricity, to be looked after besides the road work, a special engineer is appointed who takes care of the whole. If a city is still more important, one or more municipal engineering services are organized. The municipal engineering services of the city of Paris are extremely complete, and their organization is most remarkable, from every point of view.

A few words may be devoted to two other divisions made by the laws of the past in reference to the French roads, namely, the Routes Departmentales and the Chemins d'Interet Commun, which are nothing more than types of Chemins de Grande Communication.

The difference in names carries a few changes in the rules governing the management of these roads and the corresponding funds. These changes are not direct toward simplicity. For many years the tendency in all departments has been to have only one class of roads, the Chemins de Grande Communication. No more Chemins d'Interet Commun are created, and every year some Routes Departmentales are dropped from the official lists, and are afterward considered as Chemins de Grande Communication. The length of the Routes Departmentales has decreased from 29,500 miles, in 1869, to 8,100 at the present time.

On January 1st, 1911, the 395,729 miles of Chemins Vicinaux were distributed as shown in Table II.

As previously stated, there are also 8,100 miles of Routes Departmentales and 24,000 miles of Routes Nationales, forming a grand total of 428,000 miles of roads of all classes.

The building and maintenance expenses of the Chemins Vicinaux have varied according to time and place, but the figures in Table III. give an idea of what they usually cost. The lengths considered include only the roads accepted or under construction.

For comparison the figures relating to the Routes Nationales have been reproduced, and also some for the Routes Departmentales.

The total length of French roads is nearly 372,000 miles, and their total cost may be considered roughly as more than $1,500,000,000. The difference between these 372,000 miles and the total of 428,000 previously given, results from the omission from Table III. of the 56,240 miles which have only been designed. There are also about 155,000 miles of farm roads, with or without ditches, metaled roadway, and maintenance.

The annual maintenance of the 372,000 miles of regular roads requires nearly $45,500,000, the share of the Central Government being $6,500,000 and that of the 86 Departments nearly $39,000,000. This shows a contribution of about one dollar per head of population.

Table III.—Usual Cost of French Roads.

		Av. Width, in yards.		Approximate cost of: Building.			Annual maintenance.		
Classes.	Total length, in miles.	Ditches included.	Ditches excluded	Total expense.	Per mile	Per square yard, ditches included.	Total expense.	Per mile.	Per square yard, ditches excluded.
Routes Nationales	23,800	20	15½	$ 300,000,000	$12,600	$0.36	$ 6,500,000	$270	$0.0099
Routes Departmentales ...	8,100	14	11	63,000,000	7,750	0.32	1,500,000	185	0.0095
Chemins Vicinaux de Grande Communication	107,300	10¾	8½	665,000,000	6,200	0.33	16,900,000	157	0.0105
D'Interet Commun	47,500	10	7½	178,000,000	3,750	0.21	6,000,000	126	0.0095
Ordinaires	184,700	9	6½	457,000,000	2,470	0.16	14,500,000	78	0.0068
Totals	371,700	....	....	$1,663,000,000	....	....	$45,400,000	....	......

PRIME MOVERS.

In the proceedings of the American Institute of Electrical Engineers appears a paper, entitled "The Present Status of Prime Movers," to be read on June 25th at the 31st annual convention of the Institute in Detroit. This paper, by H. G. Stott, R. J. S. Pigott and W. S. Gorsuch, deals with the present status of heat engines and hydrographic turbines in commercial use at the present time for the conversion of the energy found in fuel and water into mechanical power for the production of electric energy. The paper compares the various types as to relative importance, capacity, efficiency, weight, cost and economy. The prime movers are divided as follows: (1) reciprocating steam engine, (2) steam turbine, (3) gas engine, (4) oil engine, (5) hydrographic turbine. Each is dealt with separately and illustrated by curves showing the above characteristics. At the conclusion of the paper a section devoted to finance and economics also contains a number of curves, which show the investment and fuel costs of the different heat engine units, on the basis of percentage of normal full-load rating of machines.

FIRE DAMAGE TO STEEL BRIDGES.

Serious damage to several steel viaducts in the lumber district of Cleveland, Ohio, was due to a fire which swept over approximately 15 acres, destroying about 15,000,000 ft. of lumber. These two viaducts, in their condition as a result of the conflagration, have provided a subject of interesting discussion for engineers. One of them, the Central Viaduct, built for the city in 1887-88, is 2,835 ft. in length, and consists of pin-connected Pratt deck trusses, with a through steel truss river span. Under it ran a railway viaduct, built in 1905-06. It is about 3,000 ft. long, and consists of a roller lift, a through plate-girder, and several deck plate-girders.

As a result of the fire about 500 ft. of the latter viaduct was seriously affected. The foundation piers were badly disintegrated and many of the steel members distorted and buckled, although no part of it fell.

The Central Viaduct received more serious injury, in that about 270 ft. of it at a point where it was approximately 90 ft. above the ground, broke away and fell across the railway viaduct.

The Waterworks Department of the City of London, Ont., has a total of 2,115 water meters now in use, 451 of which were installed during 1913 and 376 in 1912.

The city of Toronto will shortly submit to its ratepayers a by-law to permit the acquiring of $300,000 for the purpose of purchasing motor buses to serve outlying districts. Full and detailed information regarding the proposal is now being acquired prior to placing the matter before the people.

The new Lake Shore line of the C.P.R. will be in readiness for passenger traffic on June 29. A freight business is being tentatively carried on. This new line will give practically a new route between Montreal and Toronto, and will greatly facilitate in handling the traffic, passenger and freight, which passes through this territory. The work was commenced about two years ago, and entailed a cost of nearly twelve millions of dollars.

A report from New York shows that the unfilled tonnage of the United States Steel Corporation on May 31 totalled 3,998,160 tons, a decrease of 278,908 tons over April.

The Pitt Meadows Oil Company, Vancouver, B.C., whose properties are about 25 miles from Vancouver, has secured oil leases on land in that district totalling 1,920 acres, and has also taken over a well formerly owned by a Vancouver syndicate, comprising, among others, W. I. Paterson, Dr. Robert Telford and T. F. Paterson.

The city of Calgary has under construction this year about 150,000 sq. yds. of asphaltic concrete pavement, about 3,000 sq. yds. of stone block, and about 800 sq. yds. of vitrified brick. These figures are in addition to those which were published in *The Canadian Engineer* for May 21st, 1914, which issue contained a summary of the present season's paving work throughout Canada.

Editorial

GRADE SEPARATION IN HAMILTON.

As a result of the recent decision of the Supreme Court that the Board of Railway Commissioners had not the power by virtue of the Railway Act to order the Toronto, Hamilton and Buffalo Railway to unite with the Grand Trunk Railway and the proposed Canadian Northern Railway to use a common right-of-way and union station in the city of Hamilton, the question of grade separation at once presents itself.

For several years an agitation has been on foot in Hamilton against the present location of the T. H. & B. in the southern and residential section of the city. A common right-of-way scheme was presented to the railways by the city, the G.T.R. and C.N.R. signifying their willingness to consider it, but the T. H. & B. refusing to do so. Then the city went ahead with the preparation of plans and estimates for diverting the latter's track, and applied to the Railway Commission for an order. The question as to whether the Board had power to order the T. H. & B. to remove its tracks from Hunter Street, was subsequently taken to the Supreme Court for a decision. According to it, the Board of Railway Commissioners has not the power, on an application from the city, to make an order directing the T. H. & B. to divert its line from its present location to some other location.

Failing in this, matters stand largely as outlined in *The Canadian Engineer* for September 4th, 1913. Doubtless the depression plan will be taken up forthwith. A plan developed by the city, provides for depressing the tracks of the T. H. & B. at an estimated cost of $1,200,000, in addition to $310,000 land damages. Another depression plan, prepared by Westinghouse, Church, Kerr and Company, and submitted by the railway company, entails an estimated cost of $2,940,000, exclusive of land damages. The same company estimates the cost of elevating the tracks at $760,000. In view, however, of the fact that a portion of the present line is already depressed at the western entrance into the city, a depression scheme will, in all probability, be given early consideration.

PRESERVING ENGINEERING LITERATURE.

The value to the engineer of a library of technical information is so universally recognized in all the branches of the profession that none can contest the arguments in favor of the establishment of such by the individual or the organization of which he forms a part. Everyone is aware that accurate information is as essential to the success of engineering work as a compass is to navigation. In its investigation, design and construction, there must be no empiricism or loose approximations. As one writer has said, information is as necessary a tool in engineering enterprises as the mallet and chisel are in the work of an artisan. Besides, through the medium of print one acquires a knowledge of what others are doing and how—as valuable an asset in a profession as in a competitive business.

With the close of the half year, some weekly engineering journals complete another addition to their standardized volumes, and the thought is in order of immediately binding them for preservation and for facilitating reference when occasion requires. The practice of preserving copies for the purpose of having them bound at the end of the half year is one which should be encouraged and its importance emphasized. Requests from readers for back copies to complete volumes are frequent, and it is regrettable that occasionally these requests cannot be complied with owing to the particular issues being out of print. The result is that the volume is either left unbound or bound in an incomplete state. The wisdom of having a place for each journal and of keeping every copy in its place is evident. Now is the time to begin.

It is not the best thing to do to clip articles from journals for the purpose of filing them. While space on the book-shelf may be saved, and articles on like subjects may be kept together in a single file, it is, in the long run, a waste of time, besides destroying the value of the copy itself. In cases of miscellaneous periodicals which contain, only occasionally, articles of value to the engineer, such a procedure may be advisable, but for the regular engineering and technical journals it is an inefficient method.

One cannot foretell whether articles that are thereby being destroyed, will not attain equal or greater value at some future time than those that are being preserved. No one is so proficient in prophecy as to clearly define what should or need not be clipped for future use. One's range of interests is apt to expand or change entirely as time goes on.

Taking it for granted, therefore, that an engineering journal is not to be read like a newspaper and carelessly thrown aside, there are several important points to keep in mind: When the weekly copy arrives, look it over carefully; examine the index page; clip it (and it only), as suggested in our issue of June 4th. Then place the copy with the previous issues, returning it there whenever it is taken from its place and referred to. When July 1st or January 1st comes round, call in the bookbinder.

HIGHWAY ENGINEERING IN GREAT BRITAIN.

With the advent of mechanically propelled traffic, which has multiplied at a great rate in England during the last ten years, and the discovery that such traffic is highly destructive to road surfaces, especially to those made in waterbound macadam, a serious problem has arisen as to what is an economical form of road paving which is suitable for carrying the new form of traffic. For it is admitted by all English road engineers that waterbound macadam is incapable of withstanding heavy motor propelled traffic, while for light motor traffic it is not economical. On rural main roads its life may, however, be extended by sealing the surface against attritive and weather action by coating it with tar or some tar compounds which have been introduced by commercial firms. Each year, therefore, in most highway districts in England the area of waterbound macadam roads which is protected by a surface dressing of tar is extended and—it is safe to prophecy—that within a measurable number of years waterbound macadam will have disappeared from main roads in England.

RUN-OFF FROM SEWERED AREAS.

In May, 1907, the sanitary section of the Boston Society of Civil Engineers appointed a committee to investigate the above subject. The committee submitted a preliminary report early in 1908, designed particularly to describe the apparatus needed for the gauging of rainfall and run-off. This report offered many valuable suggestions for engineers contemplating the establishment of such apparatus. It has been followed by four progress reports bringing out the difficulties of maintaining gauging stations and of properly interpreting the results of gaugings. It has finally transpired that the committee has brought together all of the gaugings which it has been able to secure and has made such interpretation of the results as is practicable. This final report has been published in the June, 1914, Journal of the Society. It is divided into three main parts: methods of measuring precipitation; methods of measuring run-off, and results of measurements of rainfall and run-off, showing relation between precipitation and flow in sewers.

Methods of Measuring Precipitation.—The automatic or recording rain gauge is the only type which is of use in studies of this character, not only because it is essential that records be taken at the time storms occur, whether that be during the night or at other times when observers might not be on duty, but also and especially because it is the rate of rainfall, rather than total quantity, in which we are interested in studies of this kind. This point is so fully recognized that it is not necessary to do more than refer to it at this time.

A point not always recognized in connection with automatic rain gauges is the great importance of a good clock movement which can be closely and accurately regulated. In comparing the records of several rain gauges or the records of rain gauges with those of sewer gauges, the question of time is one of much importance. The correct time of starting a new gauge sheet and of removing the sheet from the gauge should always be distinctly marked upon the chart. With this information available, it may be possible to adjust the error so as to tell moderately closely the time of occurrence of a storm and the time occupied in travel of the storm.

With all commercial rain gauges on the market, the only method of estimating the time is by noting the position of the pen upon the chart. It is seldom possible to estimate the time closer than five minutes, and frequently it is difficult to estimate it closer than fifteen minutes. It is, therefore, a difficult matter to regulate the clock, or to compare the time indicated by two or more gauges. This would be greatly simplified if all gauges of this type were furnished with clock dials and hands, in addition to the ordinary regulator, so that it might be possible to adjust the clock to the correct time and to keep the clocks of several gauges properly synchronized. In large and important works the possibility of electrical operation of the clocks, thus insuring their keeping proper time and being absolutely synchronized, is worthy of consideration.

The report then enumerates and describes the construction and methods of operation of the principal types of automatic rain gauges, including the Fergusson, Draper, Freiz, Queen, Richard, Marvin, Fitzgerald and Hellman.

Measurement of Run-off.—A measurement of the actual volume of storm water run-off in sewers is not usually practicable. Weirs installed in the sewers themselves are objectionable on the score of the head required and also because they cause a retardation of velocity and retention of sediment; it is also difficult to arrange weirs which shall give satisfactory results under wide variations of flow, and frequently with high velocities of approach. Venturi meters are expensive if furnished with recorders, which are indispensible in studies of storm flow; they have an insufficient range for measuring the wide fluctuations which are likely to occur; and as they must usually be set in inverted siphons in order to register properly, their installation in sewers already built involves some difficulties. Current meters for continuously recording the flow of sewage are not ordinarily practicable on account of the foreign material in the sewage, which is likely to clog the meter, or otherwise derange it. As a result, gaugings, so-called, of storm-water flows in sewers, have almost invariably been made by recording the level of the sewage flowing and computing the quantity of flow, using Kutter's formula, usually with an assumed coefficient of roughness. In order to compute the flowing in the sewer from observations of this kind, it is necessary to know the cross-section of the flowing stream, the slope, and the coefficient of roughness. The former can be readily computed from the known or measured cross-section of the sewer, having given the elevation of the surface of the sewage, which is easily obtained from a record of the water level or flow gauge. In most observations of this character, the hydraulic slope has been assumed as parallel to the invert of the sewer, and a coefficient of roughness, n in Kutter's formula, has been assumed. In many cases these assumptions have probably been wide of the truth.

With regard to the hydraulic grade, the following comments by W. W. Horner, principal assistant engineer, Sewer Department, St. Louis, in a discussion of a paper by S. A. Greeley, in "Journal of the Western Society of Engineers" for September, 1913, are pertinent:

". . . It has been noted that there are marked differences between the grade of the sewer and the water surface grade. For example, in a 9-ft. sewer for one rain a depth of flow, at one point, of 4½ ft. was observed; 1,000 ft. downstream the depth was less than 4 ft. though several tributaries entered between, while 500 ft. farther downstream, the depth was over 5 ft. Similar variations have been noted in other rains. The sewer is uniform as to grade, size and condition. The most reasonable explanation of these differences is that the flow at the upper and lower gauges is distributed, in the case of the upper gauge, by a curve 200 ft. upstream, and of the lower by a 3-ft. lateral, discharging into the main sewer nearly at right angles, 100 ft. above the gauge. In both cases the velocities would be materially reduced from that computed by Kutter's formula. In another case, a sharp reverse curve and small local obstruction has been found to create a back pressure above of over 10 ft., although the sewer below was only slightly overcharged."

Other observers have had similar experiences. It is, therefore, evident that the use of the grade of the sewer as representing the hydraulic grade may result in serious errors in computing the actual flow in the sewer. It is obvious that correctly to compute this slope two or more water level indicators are necessary, and these must be exactly synchronized so that the true hydraulic slope corresponding to the depth at any time can be properly computed. The use of maximum flow gauges, indicating merely the maximum height reached by the flood wave at any point, for the purpose of determining the hydraulic slope, is not to be commended, although such gauges serve as a valuable check upon the readings of the automatic gauges. The crest of the flood wave progressing downstream leaves its record on each of these gauges, but it is obvious that the hydraulic slope is not the slope between the highest point reached at one gauge and the highest point reached at the succeeding gauge, since the crest of the flood was not at both of these points at the same time.

Wide errors may also be introduced into the estimate of flow by incorrect assumption of the value of the coefficient. It is only necessary to call attention to the fact that the values of n in Kutter's formula for the classes of sewers ordinarily gauged may range from 0.009 to 0.017 in order to realize that assumptions of this coefficient may be far from the truth. These two values, as it happens, have been found by velocity measurements at Pawtucket and Philadelphia to apply to the particular cases referred to; but it is evident that the assumption of such coefficients without experimental determination may introduce serious errors, possibly as much as 50 per cent. Obviously, this method of estimating flow can only be correctly employed when the coefficient is experimentally determined for the sewer under consideration. Either the coefficient of roughness n in Kutter's formula, or the coefficient C in the Hazen-Williams formula, may be determined and employed in the estimation of flow. It is not thought best to use the Chezy formula directly, since the coefficient in this formula would not be constant for varying depths in the sewer and the resulting changes in the hydraulic radius.

In the study of run-off at Pawtucket the following investigations were made in an endeavor to find the value for n in the Kutter formula for the sewer under investigation. The diameter of the sewer was too small to permit of the use of current meters when measuring storm flows. It is seldom that a depth greater than one foot is reached in this sewer, and most of the observations had to do with much lesser depths.

Because of these conditions, floats were tried between manholes 447 ft. apart. The surface slope of the discharge corresponded with the slope of the sewer, as nearly as it was practical to measure the depth of flow, and the slope of the sewer, .006, was therefore adopted for the value of s.

The floats used were pieces of wood three inches in diameter and two inches long, and the time taken for the passage of these between manholes was recorded by observers. About 170 observations were recorded, during storms occurring between February, 1905, and February, 1906, and from these data ninety-one velocities were figured for various depths of flow between 0.16 and 1.1 ft. These velocities have been plotted and a curve drawn which corresponds very closely to the curve of Kutter's formula when using a value for n of .0085.

As the velocity measured was the surface velocity, and therefore, for the shallow depths observed, was very nearly a maximum, it is fair to assume a somewhat lower figure for the average velocity. Mr. Fteley, in his measurements of the flow in the Sudbury River Conduit, found the average velocity there to be about 88 per cent. of the maximum velocity, and a velocity curve *cd*, representing 88 per cent. of the observed velocity has been drawn.

This curve lies between the curves of the Kutter formula drawn with values for n of .010 and .009, but very close to the former curve. It is identical with the velocity curve of the Hazen and Williams formula when giving a value of 150 to c in that formula, $V = cr^{0.63}\ s^{0.54}\ 0.001^{-0.04}$.

With respect to this latter formula, it may be said that c has a range of 145 to 152 when compared with the experiments of Darcy and Bazin in semi-circular conduits of 4.1 ft. diameter, with a surface of pure cement.

The following quotation is taken from W. G. Taylor's description of a new main intercepting sewer at Waterbury, Conn.: "Observations upon the sewage flow in the main carrier, at depths up to the springing line, have shown that the value of n in Kutter's formula when applied to the sewer flow is not greater than 0.010." The sewer for which these values were obtained was of reinforced concrete of horseshoe shape, 5 ft. 6 in. x 4 ft. 5 in. Great care was used in churning the deposited concrete, and the interior and exterior surfaces are reported as being "very smooth."

Types of Recording Gauges.—Leaving Venturi and current meters out of consideration, practically the only type of automatic gauge applicable to gauging storm water flows in sewers is a gauge of the water level recorder type. All of the gauges available for this purpose may be divided into two general classes—float gauges and pneumatic pressure gauges. Either class is equally applicable to keeping a continuous record of the head of water over a weir in case it is practicable to use a weir for accurate measurements of flow.

In order to secure proper registration with any type of gauge, it is practically essential to install the float or pressure chamber in a separate manhole connected with the sewer, rather than in the sewer itself. This adds materially to the cost of installing the gauge and keeping records of sewer flow, but it has not been found practicable to obtain trustworthy records by means of a gauge installed directly in the sewer itself.

In the float gauge a float contained within a pipe or other suitable guide is connected with a recording apparatus through the medium of a cord, chain, tape or by a solid rod or tube.

The report then presents descriptions of various recording gauges including the Hydro-Chronograph, Freiz's improved water stage register, Builders' iron water level register, pneumatic pressure and diaphragm gauges, and Sandborn's flow recorder.

Installation of Automatic Sewer Gauge.—A reliable automatic record of the depth of the storm flow in the sewer is of equal importance with the record of the rate of precipitation, but is even more difficult to obtain. So many difficulties beset the installation of an accessible recording device that it has been very hard to obtain the co-operation of municipal engineers in this work. In sewers less than four feet in diameter and in any sewer where the normal dry-weather flow is of very shallow depth, the installation of a recording device in the sewer itself is apt to produce such an obstruction to the flow as will set up artificial conditions, which make a record of the correct depth of flow impossible.

It is therefore much better to construct an auxiliary manhole, independent of the sewer, for the special purpose of installing the recording mechanism. In this manhole a float chamber can be constructed and connected with the main sewer by a small pipe, or pipes, and these need be the only connection with the sewer. Under such a construction it will be possible to visit and inspect the recording mechanism without the inconvenience attendant upon a descent into a regular manhole which is a part of the sewer itself. It will still have the disagreeable feature, however, of being below ground and accessible only through an opening in the street surface. A much better location for the recording device is at the edge of the curb and above the level of the sidewalk. This can be accomplished through a construction similar to a police signal box, and the chart will thus be made readily accessible. The only criticism of such a method of installation lies in the necessity of providing some method of accurately checking the chart record with the depth of flow.

Particular care should be taken in connecting the gauging chamber or float chamber with the sewer, to see that the connecting pipe is normal to the direction of flow, and does not project into the sewer. If this precaution is not observed, the recorded heights will be in error—too high if the connecting pipe is directed upstream or against the current, and too low if in the reverse direction. The precautions taken should be the same as in installing a piezometer connection to a water pipe.

It is highly necessary that recording devices be regularly inspected in order that they may be sure to be in operation when most needed, and the more accessible and convenient it is possible to make their location, the more careful attention will they receive. Maximum rates of precipitation and the attendant depth of flow in the sewer are of infrequent occurrence, and it is very essential that the recording device be in operation whenever such a discharge takes place.

Maximum Flow Gauges.—Practically the only information to be obtained from a maximum flow gauge is the greatest height reached by the flood wave at the point of observation since the last recorded measurement. Ordinarily the records thus obtained are of little value, but they may occasionally serve as a valuable check upon the records of an automatic gauge which may be out of order and fail to indicate the highest point reached by the flood. It is, therefore, advisable to install such maximum flow gauges at all points where automatic water level recorders are installed.

In the earlier observations of run-off in sewers, the maximum gauges consisted merely of whitewashed laths set firmly in position in manholes, the expectation being that the highest point reached by the sewage would be clearly indicated on the whitewash. In some cases this simple type of gauge has proven satisfactory, although in many cases the whitewash has peeled off about the height to which the sewage reached, and in other cases, for some unexplained reason, the maximum height could not be distinguished upon the gauge. The most satisfactory type thus far devised consists of a rod to which are firmly fastened a number of small vials having their mouths set at uniform distances apart, usually one-tenth or two-tenths of a foot, the whole being properly protected from the flowing current by a shield or perforated tube. On examining this rod, it is evident that the sewage must have been as high as the highest vial which is found to be filled with water. Inverting the rod and emptying the vials is all that is necessary to prepare the gauge for use. This type of gauge is best located in a manhole, with the bottom of the gauge slightly above the normal dry-weather flow. In some cases, gauges of this type have not proved satisfactory where high velocities have obtained—such as 8 ft. per second.

Actual Measurements of Storm-water Flow.—The report contains, in tabular form, all available records of storm-water flows in sewers, including not only those which have been made in co-operation with the committee and submitted to it for publication, but all other published records of storm sewer gaugings which have come to its attention. It gives also a detailed description of apparatus and methods used in a study of rainfall and run-off at Pawtucket, R.I.

Rate of Precipitation Causing Maximum Flow.—It is of the greatest importance in arriving at a correct conclusion that the maximum rate of flow in the sewer be compared with the rainfall which actually caused this run-off. It is, therefore, particularly important that the time required for concentration of run-off at the gauging point, under the conditions existing at the time when the gauging was made, be accurately known.

It is evident that if the time required for the concentration of the run-off at the gauging point is thirty minutes, the run-off factor obtained by comparing the maximum rate of run-off with the rate of rainfall which obtained for a period of five minutes, or with the average rate which obtained for a period of sixty minutes, would be considerably in error, unless the rate were uniform in the latter case. In such comparisons it is evident that the actual time of concentration existing for the particular gauging is the figure desired—not the computed time of concentration for maximum velocities of flow, which may be widely different from those existing. If the sewers are but partly filled and the velocity of flow is less than the maximum velocity, it is evident that the time of concentration will be considerably greater than the time computed upon the basis of maximum velocities.

Another point requiring careful consideration is the interpretation of the run-off from storms of less total duration, or having a downpour of less total duration, than the time of concentration for the drainage system gauged. This is particularly true in the case of large areas for which the time of concentration is considerable. It is not often that storms occur of sufficient uniform intensity to produce a noticeable "flood wave," and lasting from thirty to sixty or ninety minutes. Accordingly, storms which give significant information relating to drainage areas for which the time of concentration exceeds thirty minutes are of rare occurrence, and records of value for such systems are obtainable only after a number of years of observation. Much valuable information could be obtained in shorter periods of time if sub-districts, for which the time of concentration would be short, were gauged. The committee spent a large amount of time in endeavoring to obtain significant information from storms in which the period of downpour was of less duration than the time of concentration of the district gauged, but had been forced to the conclusion that, with present knowledge, no information of value can be obtained from such records. It seems impossible to estimate the area actually yielding storm water from a shower of less duration than the time of concentration. Take, for instance, the case of a heavy downpour lasting ten minutes upon a drainage area for which the time of concentration is thirty minutes. If the entire rainstorm lasts but ten minutes, it is evident that the maximum rate of run-off represents the discharge from but a portion of the drainage area. Whether this is the portion lying nearest the outlet or some other part of the drainage area, it would be impossible to tell without a very large amount of information. If the storm included a heavy downpour of ten minutes' duration, followed by a drizzle of indefinite duration, the maximum run-off would probably occur when a section of the drainage area at a distance from the gauging point was contributing at the maximum rate, while portions nearer the gauging point were contributing the run-off corresponding to the lighter rainfall which followed the downpour. It is therefore impossible to say what the true contributing drainage area to the maximum run-off amounted to, or what is the proper rate of precipitation with which that run-off should be compared.

The report concluded with a description of the sewer districts gauged, together with data relating to the location and type of rain gauge, method of gauging flow, etc.

The committee expressed itself of the opinion that more will be accomplished by a larger number of gaugings of small drainage areas than by attempts to gauge areas of larger extent. With the smaller drainage areas the time of concentration will be less and there will be a much larger number of storms in which there can be little doubt that the maximum rate of rainfall continued at a uniform rate for a sufficient period to produce the maximum observed run-off, and accordingly, the resulting computed coefficient of run-off will be more nearly correct. In such cases, also, the difference between the computed time of concentration under conditions of maximum velocity through the sewer, and the time of concentration actually existing for any particular observation, will be slight. Moreover, in small districts, the main channels will not be large and the effect upon the results of storage in the sewers themselves will not be great.

It is not intended to minimize the value of careful gaugings of the medium-sized and larger drainage areas. Such measurements are of great value and it is to be hoped that they will be continued. Measurements of discharge from areas of 200 to 500 acres are perhaps likely to be of most general applicability, and should be encouraged whenever it is possible to make an extended series of gaugings. Where, however, the means are seriously limited and the probability of continuing gaugings over a long period is not great, it is believed wiser to carry out measurements upon smaller districts from which results can be obtained in a shorter period of time. It is very much to be desired that measurements of the flow from subdistricts, which together make up a large district, whether or not the entire district is also gauged as a whole, should be undertaken as extensively as possible.

Information relating to inlet time or time required from the beginning of the rain to the moment when the flow is established at the storm water inlet is also of importance, and little or no accurate information is to be had upon this subject.

The personnel of the committee was as follows: George A. Carpenter, chairman; Harrison P. Eddy, secretary; William S. Johnson, Hector J. Hughes, Lewis M. Hastings, Arthur T. Safford, George C. Whipple, Harold K. Barrows.

MONTREAL IRON AND STEEL SITUATION.

In iron and steel circles it is declared that the foundries are not working more than 10 per cent. to 20 per cent. as many hours as they worked formerly. The larger industries, such as the railway shops, car and locomotive works, are almost closed down. The repair shops of one sort and another seem to be about half occupied, and foundries engaged on staple lines—such, for instance, as stoves, furnaces, etc., are apparently working about 75 per cent. of capacity. On the whole, the demand for iron has fallen off to a minimum.

The trade is keeping a close watch on developments on the other side of the line where the steel companies seem to have been meeting a rather better demand lately, and where the orders placed show a considerable increase in volume, although it is understood that this increase was largely the result of a shading in price in the Pittsburg district. Around Buffalo, prices appear to be holding firm.

The opinion in the trade is that little or no improvement is in sight. The only consolation is that consumption is undoubtedly greater than production, and the result must sooner or later be that new supplies will have to be purchased.

Montreal, June 23rd, 1914.

OIL PRODUCTION IN CANADA.

In view of the publicity given to the oil area in the vicinity of Calgary, and the numerous companies formed since the discovery, a partial list of which has been given in recent issues of *The Canadian Engineer*, the following government return is especially interesting.

The production of crude petroleum in Canada was still confined during 1913 to the old established fields in Ontario with a few barrels pumped from gas wells in New Brunswick.

The annual output has been steadily declining during the past six years, and shows a further falling off in quantity produced in 1913, although owing to the higher price obtained for oil a larger total value is shown than for 1912.

A bounty of one and a half cents per imperial gallon is paid upon the production of crude petroleum, the Bounty Act being administered and payments made by the department of trade and commerce. According to the records of this department the total output of petroleum in 1913 was 228,080 barrels or 7,982,798 gallons on which a bounty of $119,741.97 was paid. The total value of the production at the average price for the year $1.782 per barrel was $406,439.

The production in 1912 was 243,336 barrels or 8,516,762 gallons valued at $345,050, or an average value of $1.418 per barrel. The average price per barrel at Petrolia during 1913 increased from a minimum on January 1 of $1.65 to $1.75 on April 16, $1.84 November 6, and $1.89 on December 22.

The production in Ontario as furnished by the supervisor of petroleum bounties was in 1913 as follows in barrels:—Lambton, 155,747; Tilbury, 26,824; Bothwell, 34,349; Dutton, 4,610; Onondaga, 4,172, and Belle River, 464, or a total of 226,166 barrels. In 1912 the production by districts was: Lambton, 150,272; Tilbury, 44,727; Bothwell, 34,486; Dutton, 4,335, and Onondaga, 7,115, or a total of 240,935 barrels.

The production in New Brunswick in 1913 was 2,111 barrels as against 2,679 barrels in 1912 and 2,461 barrels in 1911.

Exports entered as crude mineral oil in 1913 were 3,650 gallons valued at $379 and refined oil 24,273 gallons valued at $3,188. There was also an export of naphtha and gasoline of 17,875 gallons valued at $4,284.

The total value of the imports of petroleum and petroleum products in 1913, states Mr. J. McLeish, in his annual report, amounted to $13,339,326 as against a value of $11,978,053 in 1912. The imports have been increasing rapidly during the past few years.

Crude oil is being extensively used as fuel on the Pacific Coast in both steamships and locomotives, and the wide use of the gasoline motor has created a big demand for gasoline. The total imports of petroleum oils, crude and refined, in 1913 were 222,779,293 gallons, valued at $13,230,429 in addition to 1,628,837 pounds of wax and candles valued at $108,897. The oil imports included crude oil 162,062,201 gallons, valued at $5,250,835; refined and illuminating oils 19,393,627 gallons valued at $1,386,440; gasoline 29,525,170 gallons valued at $4,822,941; lubricating oils 6,789,451 gallons valued at $1,172,986, and other petroleum products 5,008,844 gallons valued at $597,227.

The total imports in 1912 were 186,787,484 gallons of petroleum oils crude and refined valued at $11,858,533 in addition to 2,144,006 pounds of paraffin wax and candles valued at $119,520. The oil imports included: crude oil, 120,082,405 gallons, valued at $3,996,842; refined and illuminating oils, 14,748,218 gallons valued at $1,012,735; gasoline, 40,904,598 gallons valued at $5,347,767; lubricating oils, 6,763,800 gallons valued at $1,077,712, and other petroleum products 4,288,463 gallons valued at $423,477.

There was an increased importation in 1913 of all classes of oil with the exception of gasoline, the increases being most pronounced in crude oil and refined illuminating oil.

There was comparatively little change in the production of natural gas in Ontario, but a large increase in the production in New Brunswick and in Alberta. The total production in 1913 was approximately 20,345 million feet valued at $3,338,314, of which 828 million feet valued at $174,006 was from New Brunswick; 12,487 million feet valued at $2,092,400 from Ontario and 7,030 million feet valued at $1,071,908 from Alberta.

The production in 1912 was reported as 15,287 million feet valued at $2,362,700, and included 174 million feet from New Brunswick valued at $36,549; 12,529 million feet from Ontario valued at $2,036,245 and 2,584 million feet from Alberta valued at $289,906.

ENGINEERS' LIBRARY

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer.

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BOOK REVIEWS.

Poor's Manual of Public Utilities for 1914.—Published by Poor's Railroad Manual Company, 535 Pearl Street, New York. Second Annual Number. 2172 pages of text; 6 x 9 ins.

This important financial reference work contains 248 pages more than the first edition. About 400 new statements and 300 new comparative tables have been added. Bond descriptions have been amplified, and in the majority of them information is given showing whether or not interest is payable without deduction for the normal United States income tax.

A valuable new feature is the re-arrangement of the street railways. The old arrangement of presenting statements by States has been dropped in order that street railways in public utility systems may appear in connection with the statements of the respective holding companies.

The manual is the only one devoted entirely to the public service corporations. It gives the same service to the public utilities that Poor's Manual of Railroads has given to the railroads for nearly half a century.

The Electric Furnace.—By Alfred Stansfield, D.Sc., Professor of Metallurgy, McGill University. Published by McGraw-Hill Book Company, New York. 415 pages; 155 illustrations; 6 x 9 ins.; cloth. Price, $4.00. Reviewed by T. R. Loudon, Assistant Professor of Ferro-Metallurgy, University of Toronto.

This book is an enlargement of the well-known first edition, published in book form in 1907 after portions had appeared as serial articles in *The Canadian Engineer.*

As stated in the introduction, it has been the author's endeavor to trace the evolution of the electric furnace and to set forth the outstanding facts relative to the theory and practice in design and operation of the present-day furnace. The author is to be congratulated on the clearness with which this has been accomplished. The work is, of course, very largely a compilation of theory, the references being quite numerous and varied.

There are fifteen chapters as follows: History, Description and Classification of Electric Furnaces; Efficiency of Electric and other Furnaces and Relative Cost of Electrical and Fuel Heat; Construction and Design; Operation; Laboratory Furnace; Production of Pig Iron; Production of Steel from Metallic Ingredients; Production of Steel from Ore; Ferro Alloys; Graphite and Carbides; Zinc and other Metals; Miscellaneous Uses; Electrolysis and Electrolytic Processes; Future Developments. The above list is abbreviated in some cases.

Chapter IV. on Construction and Design gives a good description of the various refractories used in furnace construction. The description is necessarily brief, but is well written, which is not always the case in most descriptions of refractories. A number of details of construction are given, but in this respect there is rather a lack, the discussion having the appearance of being too theoretical.

The chapter on Operation has also the objection of being theoretical. The term "operation" obviously refers to the practical. Such sections as voltages required for electric furnaces and current density in furnaces would be more in keeping in the chapter on Design.

Chapter VII. deals with the production of pig iron.

A great deal of space is taken up in discussing the results obtained in the Sault Ste. Marie experiments and the European Commission's report. The familiar results of the Swedish furnaces and the furnaces at Herault, California, are also given.

Chapter VIII., dealing with the various forms of steel furnaces, gives descriptions of the well-known types. Chapter IX. discusses the making of steel from iron ore, dwelling at length on experiments carried on by the author himself in the so-called Evans Stansfield furnace. It is worthy of note that the only practical furnace in Canada has been omitted; that is, the Moffatt-Irving furnace, which has been in operation for some time making steel from ore.

The author has gone very thoroughly into the question of zinc smelting.

The book is a valuable compendium of references on articles scattered throughout the technical literature of the day.

Designing and Detailing of Simple Steel Structures.—By Clyde T. Morris, C.E., Professor of Structural Engineering, Ohio State University. Published by McGraw-Hill Book Company, Inc., New York City. Third edition; 260 pages; 94 illustrations; cloth; 6 x 9 ins. Price, $2.25.

This book has been carefully revised and reset, portions of it having been practically re-written since the publication of the first edition in 1909. Those who are familiar with the previous works will note a change in the order of the chapters and an increase in volume The chapters, as they occur, are as follows: Designing and Estimating; Riveting; Mill Buildings; Plate Girder Bridges; Pin-connected Bridges; Highway Bridges, Manufacture; and an appendix containing the general specifications for steel railway bridges (1911) of Ohio State Highway Department.

The book will be found valuable as an elementary treatise upon design, and students in engineering colleges and technical schools have in it a work adapted to their needs and to the limited time which they generally have in which to refer to the subject. The text contains numerical examples which add materially to the descriptive matter and the carefully-arranged exposition of theory.

The Coöperation of Science and Industry.—By S. Roy Illingworth. Published by Chas. Griffin & Company, Limited, Strand, London, England. 91 pages; 3½ x 5 ins.; leather. Price, 30 cents net.

In this little work Mr. Illingworth has urged a closer relation between industrial establishments and applied science. The problem has been viewed from an impartial standpoint, commencing with the long and tedious period prior to the 18th century, through which the gradual evolution of industrial enterprises experienced comparatively unappreciable change compared with the momentum which the same and similar industries have gained since the development of industrial research in the 18th century. The author refers to the work of the scientist in the cultivation of the by-products of coal as an example of what may be accomplished when applied science is permitted to unite with industry in the promotion of efficiency and of new commercial enterprises.

The Englishman, regarded as the pioneer of industry, is pronounced delinquent and too prone to disregard processes as unremunerative or useless rather than to recognize the value of the application of science thereto. The present industrial position of Germany is presented as an example of the results which might be expected from a judicious intermingling of the two.

Taken altogether, the book presents some forceful arguments in favor of more scientific methods in the establishments of the British manufacturer, and its application should not be considered limited to any country or to any industry.

Engineering Manual.—Published by the American Electric Railway Engineering Association, New York City. Size, 6 x 9 ins.; cloth binder. Price, $3.00; binders, $1.00.

This Engineering Manual for 1914 is a compilation of the standards and recommendations adopted by the Association, and covers practically the entire field of electric engineering. Miscellaneous methods and practices are outlined therein which include, as well, all definitely approved recommendations other than those of the Association itself. It is in the form of a loose-leaf binder, and includes 82 sections, which are fully illustrated with diagrams and working drawings. The Manual, which is free to members of the Association, has been put into loose-leaf form in order that the standards and recommendations may keep pace with such additions and alterations as are made at the yearly conventions of the associations.

The volume possesses a very complete index of the material contained therein, and covers also references to related subjects as to their location in the proceedings of the Association. Being revised each year and containing a complete collection of information of the most practical value to electric railway men, the volume will be found of great use.

The Job, The Man, The Boss.—By Dr. K. H. M. Blackford and Arthur Newcomb. Published by Doubleday, Page & Company, New York, 1914. 226 pages, 23 half-tone illustrations. Price, $1.60. Reviewed by Geo. S. Hodgins, Assistant Engineer (Mechanical Department), National Transcontinental Railway.

In a quite remarkable book dealing with the engaging or hiring of men, the authors show that each man bears about with him in his speech, behavior and actions the indelible record of his tastes, faculties and aptitudes. It is the business of the Employment Bureau, wherever established, in factory, mill, bank or railway repair shop, to view with the trained eye of science each applicant for work; and with what amounts to almost complete knowledge of his past, revealed by his build, his words, his movements and his health, to predict his future actions, and to "fit" him in his place.

With this kind of knowledge, and knowing the requirements of each job, the employment department picks out the best available man and places him where he ought to be, and where he will find his work congenial. Here he will do his best work and please himself and be a source of profit and satisfaction to his employer.

The book is not only a valuable contribution to the whole science of selecting men, but is a practical work that well might be in the hands of any intelligent foreman or gang-boss who handles applicants where the "hire-and-fire" system still prevails. A railway roundhouse, a small machine shop, or even a special laborers' squad, would feel the benefits of the system here outlined.

It is pleasant reading, easily understood, and the matter, once taken in, sticks in the mind for ready reference and for use. The chapters on "Analyzing the Man," beginning with "heredity and environment," are simply fascinating. The "nine physical variables" are defined and explained, how they came into being, what they mean, what they still stand for, and why they are evidence of character and aptitude. This kind of knowledge may easily prevent a boss from shoving a square peg into a round hole

All men bear about in face and frame and gait and word, certain evidences of character. They cannot conceal them if they would, and the majority do not know they have them, but they betray their likes and prejudices, their aptitudes and abilities, in many curious ways, like Achilles, concealed among the daughters of Lycomodes, who, unthinking, stretched forth his hand to grasp the sword as it clanged down upon the floor from amid the costly fabrics, and thus revealed himself to the astute Ulysses, who had brought the gorgeous raiment, ostensibly to charm the maidens, and to gain their father's smile.

The book is written in a kindly, optimistic spirit that looks for the dawn of a brighter day for all. There is no trace of idle dreaming; it is the clear and helpful statement of undoubted scientific fact.

A Treatise on the Inspection of Concrete Construction.—By Jerome Cochran, B.S., C.E., M.C.E. Published by Myron C. Clark Publishing Company, Chicago. 595 pages; 26 illustrations; 6 x 9 ins.; cloth. Price, $4.00. Reviewed by C. S. L. Hertzberg, of James, Loudon and Hertzberg, Consulting Engineers, Toronto.

This book is a very elaborate and comprehensive treatise on all phases of concrete work. It is intended, primarily, for the use of inspectors on concrete construction, but it is a work which will be found very useful to engineers, architects, contractors, and, in fact, anyone who is in any way interested in concrete work.

The introduction deals, at some length, with the necessity of good inspection, and outlines, in a brief way, the duties, necessary qualifications and responsibilities of the inspector, together with a few hints as to the best way of dealing with contractors, etc.

A rather complete treatise on cement and aggregates is given in Chapters I. and II., together with methods of testing and standard requirements.

Chapters III. and IV. deal with the inspection of mixing operations and form work.

In Chapters V., VI. and VII. the inspection of reinforcing steel, pouring of concrete and concrete finishes are fully treated. The remainder of the book deals, in detail, with the inspection of particular types of concrete construction.

It is seldom one meets with a book so thorough in its attention to important details, and the author's complete familiarity with concrete construction in all its numerous forms has resulted in the production of a particularly useful book.

In the chapter on the proportioning of concrete a 1:2:4 mix is referred to (when speaking of the aggregate collectively) as a 1:6 mix. The meaning is made quite clear in the sentence which follows, and there should be no reason for any misinterpretation. However, this method of referring to proportions has led to errors being made when the aggregate was composed of unscreened, pit-run gravel, and a mixture of one of cement to six of gravel has been substituted for the specified 1:2:4 mix. A number of engineers are now referring to the combined aggregate equivalent of a 1:2:4 concrete as a 1:4 concrete.

Engineering Geology.—By Heinrich Ries, Ph.D., and Thos. L. Watson, Professors of Economic Geology in Cornell and Virginia Universities, respectively. Published by John Wiley and Sons, New York (Canadian Selling Agents, Renouf Publishing Company, Montreal). 672+26 pages; 400 illustrations; cloth; 6 x 9 ins. Price, $4.00 net. Reviewed by J. Keele, Geological Survey of Canada.

It has long been the opinion of those who have given consideration to the subject, that a course in applied geology is better suited to the needs of students in engineering than a portion of the abstract course in this science for arts students which they usually receive. The limited time at the disposal of the engineering student does not allow of going very far into the study of general geology; hence, as a rule, he is not very much interested in it, and promptly forgets the little he learns at college. It would seem, therefore, that the application of the principles of geology to the problems of engineering might be the best method of securing his attention.

This is the object of Messrs. Ries and Watson in their book, entitled "Engineering Geology." The authors are geologists of wide experience, both in teaching and field work, and, moreover, have given special attention to the part geology has played in all modern engineering achievement. Therefore, they are well qualified to select and put in order those aspects of geology that some time or other will surely enter into the practice of general engineering. Beginning with the common rock-forming minerals which leads to rocks in general and a description of their structural features, we have in the first three chapters as much as any engineer wants to know on these subjects. The importance of certain structural features, such as faulting and folding, with their influence on tunnels, aqueducts or foundations, are emphasized in separate sections. Defects in the earth's crust sometimes have a disagreeable manner of asserting themselves to the unwary engineer.

Four chapters are devoted to the work of water, both above and below the surface of the earth. The relation of wave action and shore currents to coasts and harbors, the destructive and constructive work of stream erosion, the effect of superficial deposits and bed-rock structure upon underground water, and the conditions that lead to pollution of water supply are all very fully explained and illustrated by sections and diagrams. The manner in which the subject of the work of water is presented deserves attention. Physiography is that branch of geology which deals with land forms and the causes, mainly erosional, that produce them. It may be reckoned as a purely cultural subject, like Greek, when regarded from the theoretic point of view. The authors of "Engineering Geology" dispense with an intricate discussion on the genesis of land forms, but by practical applications of the results of the forces at work indicate how these forms were produced.

An important part of the work of modern engineering is concerned with controlling, distributing, and conserving water supplies. Enormous sums of money are spent on these undertakings. Therefore, a thorough knowledge of all the influences that may affect these undertakings is an essential portion of an engineer's equipment.

Although rocks, clays and soils enter largely into the industrial life, and social welfare of our country, intimate knowledge of these materials is rare, and important problems regarding their utilization are still unsolved. The chapter on rock weathering and formation of soils in this volume forms an introduction to the relation between geology and structural materials. These include building stone, limes, cements, plaster, clays and clay products. In addition to a brief account of occurrence of these materials in nature, a surprisingly large amount of the technology of them is condensed within a small compass.

The coal series, petroleum and natural gas, are very fully treated in the space allotted to them. A chapter on the origin, nature and occurrence of the principal metallic ore deposits concludes the volume.

Although this book is written mainly for the use of civil engineers, mining engineers will also find much useful matter in it. It is essentially a work on geology for the technical man.

A list of works of reference at the end of each chapter is a valuable feature of the book. It is also very fully illustrated with half-tone reproductions of photographs, and numerous line drawings of an explanatory nature.

Foundations of Bridges and Buildings.—By Henry S. Jacoby, Professor of Bridge Engineering, Cornell University, and Roland P. Davis, Professor of Structural and Hydraulic Engineering, West Virginia University. New York: McGraw-Hill Book Company, Inc. Cloth; xvi.+603 pages; 295 text figures and full-page illustrations; 6 x 9 ins. Price, $5.00 net. Reviewed by C. R. Young, C.E., Assistant Professor of Structural Engineering, University of Toronto.

Heretofore the engineer or student who found occasion to consult the literature of foundations was unable to turn to any comprehensive modern treatise on the subject. It is true that books in English on foundations have been available for some time, but none which could truly be said to cover the field fully, logically and in a manner suited to the needs both of the engineer and of the engineer-to-be. Professors Jacoby and Davis have admirably supplied this need in the present volume.

A cursory examination of the book is sufficient to impress the reader with the vast amount of labor involved in assembling and compressing within 600 odd pages the information presented to him. Perhaps there will be some who would wish that their own special methods or contrivances had received fuller consideration, but it is difficult to see how this could be done without disturbing the admirable balance preserved by the authors throughout.

A feature indicating the authoritative character of the book, if anything further than the standing of the authors themselves were needed, is the inclusion of a chapter on "Pneumatic Caisson Practice" by the well-known expert on deep foundations, T. Kennard Thomson, C.E., D.Sc., Consulting Engineer, of New York City.

Of the nineteen chapters, the first five are devoted to the subject of bearing and sheet piles. This is justified by the authors on the ground that young engineers are more likely to obtain their early experience with pile foundations than with any other class of foundation construction. Special effort has been made to present the subject-matter relating to piles so as to meet the requirements of students without experience. Chapter I. is devoted to Timber Piles and Drivers, Chapter II. to Driving Timber Piles, and Chapter III. to Bearing Power of Piles. In describing the use of the water jet, no mention is made of a practice that has found favor in Canada, viz., loosening up the material into which the piles are to be driven by a water jet and then, after the jet is withdrawn, driving the pile before the material has had a chance to settle down firmly again. Concrete piles, treated in Chapter IV., receive special consideration in the matter of driving and bearing power, apart from the general discussion of these subjects in Chapters II. and III. Metal and Sheet piles are covered in Chapter V.

In Chapters VI. to XI., inclusive, the various constructions and methods adopted for placing foundations under water are given detailed treatment. The subjects considered are: Cofferdams, Box and Open Caissons, Pneumatic Caissons for Bridges, Pneumatic Caissons for Buildings and Pier Foundations in Open Wells.

Three chapters on piers and abutments are incorporated in the work for the reason that courses in masonry construction and foundations are frequently combined in engineering colleges.

An excellent chapter on spread foundations is included, numerical examples, both in steel grillages and reinforced concrete footings being worked out. In the footnote to Table 153 a, on page 461, the pressure on the earth in pounds per square foot is erroneously stated to be due to "dead, live, and dead plus live load." Reference to the table itself shows that this should be "dead, dead plus ½ live load and dead plus live load."

Two useful chapters are those on Underpinning Buildings and Explorations and Unit Loads. Logical, up-to-date treatments of these subjects in text-books have up to the present been lacking.

Chapter XVIII., by Dr. T. Kennard Thomson, concludes the text proper.

One of the most valuable features of the book is the extensive list of references to engineering literature contained in Chapter XIX. From this the student or engineer can carry his investigation of the subject to the limit of detail desired.

It is a pleasure to turn over the pages of a book exhibiting the evidences of authority and care in presentation characterizing the present volume. No engineer having to do with foundations can afford to be without a copy, and perhaps when the full merit of the work is realized none will care to undertake an unfamiliar piece of work without consulting it.

Modern Business.—Edited by Joseph French Johnson, Dean, New York University School of Commerce, Accounts and Finance. Published by the Alexander Hamilton Institute, New York. Canadian office, C.P.R. Building, Toronto.

This is a series of eighteen treatises, published in twelve volumes, forming the basis of a modern business course and service. While it does not touch upon engineering in all its departments, there are many sections from which the engineer may derive much instruction and benefit, as will be recognized from the following synopsis of the subjects included:—

Volume I., Applied Economics, by James Mavor, Professor of Political Economy, University of Toronto; Volume II., Organization and Management, by Lee Galloway, of New York University; Volume III., Selling, by Ralph Starr Butler, of University of Wisconsin; Credits, by Lee Galloway, of New York University, revised by W. W. Swanson, of Queen's University, Kingston; Traffic, by Hon. S. J. McLean, Member of Board of Railway Commissioners for Canada; Volume IV., Advertising, by Lee Galloway, of New York University; Correspondence, by George B. Hotchkiss, of New York University; Volume V., Accounting Practice, by Leo Greendlinger, of New York University, revised by E. W. Wright, of the Toronto Bar; Volume VI., Corporation Finance, by W. H. Lough, formerly of New York University, revised by Fred. W. Field, Managing Editor, *Monetary Times*, Toronto; Volume VII., Money and Banking, by Joseph French Johnson, of New York University, and Earl Dean Howard, of Northwestern University; Volume VIII., Banking Practice, by E. L. Stewart-Patterson, of the Canadian Bank of Commerce; Foreign Exchange, by Franklin Escher, Editor of "Investments," New York City, revised by E. L. Stewart-Patterson, of the Canadian Bank of Commerce; Volume IX., Investment and Speculation, by Thomas Conway, Jr., of University of Pennsylvania, revised by Fred. W. Field; Volume X., Insurance, by Edward R. Hardy, of the New York Fire Insurance Exchange, revised by Fred. W. Field; Real Estate, by Walter Linder, of the Title Guarantee and Trust Company, of New York City, revised by E. W. Wright, of the Toronto Bar; Volume XI., Auditing, by Seymour Walton, C.P.A., of Chicago, revised by E. W. Wright, of the Toronto Bar; Cost Accounts, by Stephen W. Gilman, of University of Wisconsin: Volume XII., Commercial Law, by W. S. Johnson, of the Montreal Bar.

The series as a whole is a complete and logical digest of the principles and practices of present-day business, and is a most valuable contribution to business literature. It has been entirely re-written for Canadian use, and should prove an important factor in improving business methods. Four of the treatises, those dealing with the conditions that are quite different in Canada from what they are in the United States, are entirely new. We refer to the treatises on applied economics, railway traffic, banking practice and commercial law. In the first, Professor Mavor, so well known among Canadian economists, has exhibited a wonderful knowledge of business conditions in Canada, and his work abounds in concrete information that is of great value to anyone interested in the economic problems of the country. It is as well a general introduction to the whole series, and touches upon almost all of the questions raised in the subsequent volumes. In the treatise on traffic Hon. J. S. McLean, of the Dominion Board of Railway Commissioners, has presented a complete and able discussion of the factors which govern freight rates in this country. The treatise is divided into 10 chapters devoted to the following phases of the subject: Canadian Transportation; Freight Classification; Freight Rates; Freight Rates in Practice; Phases of Rates and Tariff; Passenger Rates; Practical Phases of Railway Business; Express Service; Inland Water Transportation; Foreign Trade and Ocean Transportation. There has been so much partisan controversy in this field that it is a relief to find the subject treated with such marked impartiality. The work will undoubtedly be influential in bringing about a reasonable and mutually satisfactory agreement as to the traffic problems which exist.

Another volume that should prove of interest and value is devoted to "Organization and Management." This book, by Lee Galloway, the author of "Economics of Dock Management," has been pronounced the most comprehensive text on this subject that has so far appeared. At any rate, in the opinion of the reviewer, a knowledge of the principles which are set forth in this volume is a necessary part of the equipment of every present-day executive. It is on a subject, moreover, that is engaging the attention of progressive business men throughout the world.

There is a volume devoted to corporation finance which is an exposition of the principles and methods covering the promotion, organization and management of modern corporations. The information contained therein is largely drawn from the experience of the big industrial and railroad companies, whose methods are well developed and worthy of study and imitation by the management of smaller corporations. The book on accounting practice is a comprehensive statement of accounting principles and methods illustrated by modern forms and problems. Chapters on capital and revenue, on depreciation and other reserves, render it a valuable book for the man in engineering and contracting from a business standpoint.

One often hears assertions respecting the value of the study of English in an engineering training. Engineers are frequently placed at a disadvantage, particularly young engineers, when called upon to make a report upon a certain problem, or a progress report as construction work goes on. Similarly, a lack of fluency in the expression of thought is to be found occasionally in an engineer's correspondence. Written expression of thought requires more care and consideration on the part of the writer than verbal expression, and those who have little writing to do are frequently at a loss to properly convey upon paper the intended meaning as they could readily do by word of mouth. One of the subjects which is given a careful study is in connection with correspondence. It takes up in a masterful way the art and its problems, the principles of construction and the essential points connected with letters of various kinds.

In the same volume is contained a treatise on advertising which the manufacturer and the salesman will find of exceeding value in his work.

In all, they should appeal strongly to mature business men who wish to supplement their practical experiences by getting into touch with the ideas and experiences of other successful business men, and to young men who are just getting well started in business, and who need, above everything else, to get a grasp on the principles which underlie modern business practice.

The whole series of texts is claimed by the publishers to be but a single feature of a complete modern business course and service which aims to make available for business men of Canada a fund of information that they cannot get out of their own experiences. The books have been well edited and bound in a durable flexible backing.

Steel Bridge Designing.—By Melville B. Wells, C.E., Associate Professor of Bridge and Structural Engineering, Armour Institute of Technology. Cloth; 6¼ x 9¼ ins.; 260 pages; 43 illustrations; 26 pages. Published by Myron C. Clark Publishing Company, Chicago. Price, $2.50 net.

This book is intended primarily for use in engineering colleges and also as a reference book in the drafting-rooms of bridge works. To the instructor, the student, and the man in the drawing office it can be well recommended.

The first three chapters treat the subject of bridge designing in a general way, Chap. 1 dealing with engineers' work and contracts; Chap. 2, bridge manufacture, and Chap. 3, rivets. The next six chapters relate to actual design, Chap. 4 containing the design of a 50-ft. roof truss, Chap. 5 discussing types and details of highway bridges, and so on, each chapter giving the detailed numerical computations of the example under consideration.

Chapter 11 has to do with shop drawings, their general considerations, arrangement, markings, dimensions, etc.

The subject of Strength of Materials is dealt with to the extent of 30 pages in Chap. 12. Sections of it are devoted to: centre of gravity, moment of inertia, radius of gyration, flexure and deflection of beams, shear, column formulas, latticing, combined stresses, pins and rollers, deflection of a truss, bending moment on plate girder webs, average unit stress, formulas and notation. The chapter gives briefly the derivations of the principal formulas used in bridge designing, with examples of their applications when such examples in other parts of the book are not referred to. With respect to its insertion, the author states: "The student is assumed to know the methods of calculating stresses, also to have studied the subject of strength of materials. In designing, however, it is often desirable to refer to a volume on mechanics or strength of materials. Such a volume is not always accessible, and the tendency is for students to fall into the dangerous practice of using formulas blindly, not knowing their derivations and correct applications."

Chap. 13 presents a bibliography of supplementary reading on the various subjects treated in the text, and should prove of great service to the reader. The closing chapter contains the general specifications for steel railway bridges adopted by the American Railway Engineering Association in 1910.

There are twenty-six folding plates of shop and general drawings, from which have been taken the examples used throughout the text. There are other good illustrations throughout the book, while its typography, press-work and binding are all very commendable.

PUBLICATIONS RECEIVED.

Annual Report of the International Harvester Corporation to December 31st, 1913.

Town of Oshawa, Auditor's Report for 1913.—Containing detailed statement, receipts and expenditures, assets and liabilities, and report of water commissioners.

Problems of the Petroleum Industry.—By Irving C. Allen, United States Department of Mines. Information derived from conferences at Pittsburg in 1913.

Wheaton District, Yukon Territory.—A 150-page bulletin listed as Memoir No. 31, Geological Survey Branch, Department of Mines, Canada. Prepared by D. D. Cairns.

Fires in Lake Superior Iron Mines.—By Edwin Higgins, of the United States Bureau of Mines. A 34-page illustrated pamphlet dealing with mine fires and their prevention.

Town Planning Act.—First draft of the Town Planning Act prepared by the Commission of Conservation, Canada, for discussion at the 6th annual conference on city planning.

International Conference of Mine-Experiment Stations.—Compiled by Geo. S. Rice as Bulletin No. 82, United States Bureau of Mines, concerning Pittsburg Conference, September, 1912.

Water Commissioners of London, Ont.—(35th Annual Report, 1913), of the city of London waterworks, electrical and parks department. H. J. Glaubitz, general manager. 124 pages; illustrated.

Mines Sign-Boards.—Technical paper No. 67, United States Bureau of Mines, dealing with the use of sign-boards in mines for various purposes and containing recommendations for universal symbols.

Efficient Use of Cars.—Booklet issued by the Westinghouse Electric and Manufacturing Company containing suggestions received from operating railway men on the efficient use of cars and cost of stops.

American Highway Association and American Automobile Association Proceedings of the 3rd American Road Congress, held in Detroit, September, 1913. 312 pages; 6 x 9 ins. Price, $1.00, postpaid.

Cedars Rapids Manufacturing and Power Company.—Third Progress Report (May, 1914), on the construction of the Cedars Rapids hydro-electric development on the St. Lawrence River. 28 pages; illustrated.

Climate of British Columbia.—Tables of rain and snowfall and temperature; altitude of places, lakes and mountains. Second edition of Bulletin No. 27, Bureau of Provincial Information, British Columbia.

American Road Builders' Association.—Proceedings of the 10th annual convention, held at Philadelphia, December, 1913, including reports of executive committee, secretary-treasurer, etc. 320 pages; 6 x 9 ins. Price, $2.00.

Test of a Jet Pump.—By L. R. Balch, C.E., University of Wisconsin. Issued as Bulletin No. 596, engineering series. It presents a description of apparatus, methods of experiments and results and conclusions. Price, 25 cents.

Physical and Chemical Properties of the Petroleums of California.—Technical paper No. 74, United States Bureau of Mines, dealing with the collection, physical and chemical examination of samples and the results therefrom. 34 pages; 6 x 9 ins.

City Plan for Greater Berlin, Ont.—Prepared by Chas. W. Leavitt, New York City. 22 x 30 ins., locating streets, parks, railway lines, etc., through the commercial and residential districts. Also an industrial map of the city of Berlin, 13 x 15 ins.

International Waterways Commission, Canada.—Compiled reports (1905-13), It is a computation of all memoranda reports issued by the Canadian and American sections of the Commission during this period. 1224 pages; 6 x 9 ins.; containing numerous maps and drawings.

A Test of an 8-foot Flash Wheel.—Bulletin No. 598, University of Wisconsin. Prepared by L. R. Balch, C.E., research assistant in hydraulic engineering. It deals with experimental tests, methods, computations, discussion and conclusions. 58 pages; 6 x 9 ins.; illustrated.

Manitoba Public Utilities Commission.—Second Annual Report for the year ending November 30th, 1913. It includes applications, proceedings, orders, etc., together with Mr. R. M. Feustel's report, dated September 15th, 1913, on the Winnipeg street railway service. 182 pages; 6 x 9 ins.

St. Hilaire (Belœil) and Rougemont Mountains, P.Q.—By J. J. O'Neill. Published by Geological Survey, Department of Mines, Canada, as Memoir No. 43. It deals with the physiography, petrology, etc., of these mountains and of the strata in the neighborhood of each. 108 pages; 6 x 9 ins.

The Effect of the Soot in Smoke on Vegetation.—Bulletin No. 7, of the smoke investigation of the Mellon Institute of Industrial Research and School of Specific Industries, University of Pittsburg. An investigation begun in March, 1912, and continued through a year and a half by J. F. Clevenger, M.A. 26 pages; illustrated; 6 x 9 ins.

Infiltration and Leakage in Sewers.—A 64-page booklet published by the Union Clay Products Company, New Brunswick, N.J., containing discussion on the subject by leading authorities as found in proceedings of various societies and other publications. It contains specifications and directions for using a joint compound manufactured by the publishers.

American Wood Preservers' Association.—Proceedings of 10th annual meeting, held at New Orleans, La., Jan. 20, 21 and 22, 1914. 498 pages; 6 x 9 ins.; illustrated. The volume contains an account of the convention, papers presented, constitution of the Association, list of members, and statistical information respecting the use of preservatives during 1913.

Investigation of Flow through Large, Submerged Tubes.—Bulletin No. 629, Engineering Series, University of Wisconsin, Part 3, of experiments with submerged draft tubes. By Geo. J. Davis, Jr., C.E., and L. R. Balch, C.E. A description is given of the apparatus used, methods of experimentation and computation and general discussion of results. 57 pages; illustrated.

Geological Notes and Map of Sheep River Gas and Oil Field, Alberta.—Memoir No. 52, Geological Survey, Department of Mines, Canada. Prepared by D. B. Dowling. It contains a description of the geological formations, occurrences of gas and oil in the general region, oil-bearing horizons in various States, and notes on the origin of oil and gas. 26 pages; illustrated.

The Cement Gun and Its Work.—Reprint of a paper read before the Western Society of Engineers, Chicago, by Carl Weber, descriptive of the cement gun, a machine for "shooting" a coating of cement mortar upon construction surfaces, such as concrete, brick, tile, wood and steel work, by the aid of compressed air. Distributed by the Gun-Crete Company, McCormick Building, Chicago.

Investigation of Hydraulic Curve Resistance Experiments with 3-inch Pipe.—Bulletin of the University of Wisconsin, No. 578. Prepared by L. R. Balch, C.E., research assistant in hydraulic engineering under direction of Prof. Geo. J. Davis, Jr., and Prof. Daniel W. Mead. It describes the apparatus used, methods of experiment, computation of results and theoretical consideration of loss of head in bends. 52 pages; 6 x 9 ins. Price, 25 cents.

Safety and Efficiency in Mine Tunnelling.—By D. W. Brunton and J. A. Davis, United States Bureau of Mines Bulletin No. 57. 270 pages; illustrated; 6 x 9 ins. The bulletin deals with various phases of tunnelling operations, describes surface and underground equipment, tunnel construction methods, cost and history of tunnelling. A section is devoted to the cause and prevention of tunnel accidents.

Siphon Spillway Automatic Crest for Dams.—A 16-page booklet issued by the Hydraulic Specialties Company, Limited, Albany, N.Y., describing the two devices invented by Mr. G. F. Stickney for regulating the water level is a canal stream or reservoir and for providing for the disposal of surplus water in time of flood. These devices have been adopted on the New York State Barge Canal, in connection with which Mr. Stickney was a designing engineer.

Abstracts of Current Decisions on Mines and Mining.—By J. W. Thompson, United States Bureau of Mines. It treats of the following subjects: minerals and mineral lands; mining corporations; mining claims; mines and mining operations and statutes relating thereto; mining leases; mining properties; damages for injuries to miners; and operation of quarries. The information contained therein covers investigations made from March to December, 1913. 140 pages; 6 x 9 ins.

Sewer Flushing and Its Cost.—Published by Merritt Hydraulics Company, Philadelphia. 102 pages; 146 illustrations; 6 x 9 ins. This is the second edition of an interesting and useful book on sewer flushing, including a discussion of the cost of flushing at various intervals, ranging from every day to once or twice a week. It includes also a discussion on the design of flush tanks to secure reliability, to prevent water waste, and to secure any frequency of discharge. It has an appendix on sewage pumping and sewage disposal apparatus, and sewer jointing. The book contains the results of experiments and the statements of authorities regarding such important items as the conditions under which deposits will form in a sewer system and flushing will be needed, the amount of flushing water required, and the effectiveness of a flush wave. The reader is referred liberally to available literature in various books and reports and to the files of the leading engineering periodicals.

Engineer's Hand-Book.—A 581-page illustrated handbook of tables, charts and data on the application of centrifugal fans and fan system apparatus, including engines and motors, air-washers, hot blast heaters and systems of air distribution. Published by the Buffalo Forge Co., Buffalo, N.Y., and edited by W. H. Carrier, chief engineer. First edition; price, $3.00.

This book has very complete information for the engineer and the architect on the fundamental principles governing the selection and application of fans for various purposes. It is intended to be used as a guide for them with respect to the above appliances. It indicates that an effort has been made to so standardize the rules and data given that they may be used with any standard make of equipment. The book contains results of tests and research by the engineering staff of the company, much of which has been heretofore published in the proceedings of some of the engineering societies. The information which the book contains is complete and reliable.

CATALOGUES RECEIVED.

Air Compressors.—Four-page illustrated folder, issued by the Canadian Ingersoll-Rand Company, Limited, Montreal, descriptive of several types of convertible steam or belt-driven compressors.

Hydraulically and Electrically-Operated Valves.—Booklet No. 6 of the Rensselaer Valve Company, Troy, N.Y., illustrating various types and sizes, and also clutch attachments for power-operated valves.

Porcelain and Glass Insulators.—A 16-page illustrated bulletin of the Westinghouse Electric and Manufacturing Company descriptive of high-voltage porcelain pin-type and wall insulators and bushings.

Electric Hoists.—A handsomely compiled, 32-page illustrated catalogue describing Sprague electric hoists in capacities from ½ to 6 tons. Canadian General Electric Company, Limited, Toronto, selling agents.

Air-Compressors and Vacuum Pumps.—Eight-page illustrated pamphlet of the Merta Machine Company, Pittsburg, describing their automatic plate valve (Iversen patent) and its advantages; and also their vacuum pumps.

Push-Button Control for Industrial Plants.—An illustrated catalogue descriptive of push-button control as a safety device of importance for manufacturing plants, issued by the Canadian General Electric Company, Toronto.

Aztec Liquid Asphalt for oiling roads. A 28-page illustrated booklet issued by the United States Asphalt Refining Company, containing useful information pertinent to Aztec Asphalt, its source, preparation, qualities, methods of using, and reports of analyses and tests.

Valves and Hydrants.—Catalogue No. 5 and price list of the Kerr Engine Company, Walkerville, Ont., descriptive of brass angle check, globe, gate, radiator and swing check valves; also fire hydrants, flanges, floor stands, indicator posts water cranes, etc. 60 pages; fully illustrated.

Pile Hammers.—A 28-page illustrated booklet of the McKiernan-Terry Drill Company (Canadian agents, Canadian Allis-Chalmers, Limited, Toronto). It depicts the characteristic features of this type of light and heavy-duty hammers, and illustrates a wide variety of uses. Dimensions, prices, specifications, etc., are included.

Good Pavements and Roads in the South.—A handsomely illustrated 24-page booklet descriptive of highways in the Southern States that have been built with Trinidad and Bermudez Lake asphalts, and explanatory of essential features in the construction and maintenance of such roads. Issued by the Barber Asphalt Paving Company, Philadelphia, Pa.

Pneumatic Concrete Mixers.—A handsomely illustrated catalogue issued by the Pneumatic Concrete Placing Company of Canada, Montreal and descriptive of mixers and conveyors and of the operation of mixing and placing concrete by means of compressed air. Some interesting construction views are given of this machinery in use. The above company are Canadian agents for J. H. MacMichael, Chicago.

Centrifugal Pumps.—A 298-page illustrated catalogue of the DeLaval High Efficiency Centrifugal Pumps of single and multi-stage types for various capacities and heads. It is known as catalogue "B," and deals with their characteristics, design, manufacture, testing, selection and adaptation to various uses. It contains special chapters on speed-reducing gears and turbine-driven waterworks pumps. An interesting illustration is that of a 100,000,000-gal. centrifugal pump under test prior to installation in Pittsburg. Another cut illustrates a 16,000,000-gal. steam turbine-driven centrifugal pump, now being installed in Toronto, when under test.

The Industrial Harbor.—A 152-page illustrated booklet descriptive of cranes and transporting appliances of various kinds for the quick handling of goods in modern commercial harbors. Issued by the Demag-Duisburg Deutsche Maschinenfabrik A.G., Germany. Illustrations are given of various harbors throughout the world where there are in operation cranes of the electric travelling, revolving, electrically-driven locomotive, electrical slewing, tower-revolving, grab and portable steam, locomotive jib, electric stationary, semi and full portal, portable and slewing gantry, electrical dischargers, and various other types of cranes, etc. Coal and ore-unloading and transporting plants of various types are included.

PROPOSED AUTO-HIGHWAY IN ENGLAND.

A bill is to be brought before the British Parliament to secure approval for the construction of a highway exclusively confined to automobile traffic, which will be about 50 miles long and 150 feet wide. It is estimated that it will cost $25,000,000; and it is to be constructed by the London, Brighton, and South Coast Motor Road Syndicate Company, Limited. The roadbed proposed is of reinforced concrete with a bituminous surface. Brighton is selected as the southern terminal and Richmond as the entrance of the highway, which will be provided with 3 tracks—the first for fast traffic, the second for heavier vehicles, and the third for autocycles and cyclecars. Wherever the present main roads cross the new roads, bridges will be built; and interference with any other traffic will thus be avoided. According to the plans the entrance to the road at Richmond will be in the form of an ornamental stone arch and a rectangular building for garages, workshops and the sale of accessories. At various points on the road there will be grandstands and workshops. The stands will be for the observation of auto racing on certain specified days, and the workshops for hauling broken-down cars from the road and repairing them. At Brighton terminus there will be ornamental gardens and a bandstand.

The Wabamun Power and Coal Company, of Edmonton, Alta., is preparing to establish a thoroughly modern power plant on its property situated at Wabamun, and has delegated C. J. Grierson and J. Wilson, expert engineers, to visit all the power plants situated in the large cities of the Pacific Coast and middle west states in order to collect first hand information as to the best type of machinery to secure for installation, as well as the cost of the same. R. D. Fetherstonhaugh, mining expert, at present employed with the company, states that three copper and silver claims have been obtained by him for the company in the Omineca country, ore from which is yielding $100 worth of silver per ton. Mr. Fetherstonhaugh will also stake anthracite coal and other claims for the company in the Dunvegan district.

Coast to Coast

Wexford, Ont.—The bridge over the C.P.R. tracks near Wexford, known as the town line bridge, has been completed and opened for traffic.

Medicine Hat, Alta.—It is reported that the Medicine Hat Brick Co. has now in full operation its large plant at Medicine Hat. From 50,000 to 75,000 bricks are being manufactured daily.

Moncton, N.B.—City Engineer Edington, of Moncton, N.B., has submitted for the consideration of the civic board of works plans for street paving for 1914 involving an expenditure of $44,000.

Montreal, Que.—On the recommendation of the board of control, the Montreal city council has voted $294,634.31 to be used mostly in the construction of buildings in connection with various civic departments.

Sussex, N.B.—The new I.C.R. station at Sussex is practically complete and ready for occupation. Also the siding at the military grounds is being improved, and the loading platform is being extended considerably.

Victoria, B.C.—Actual work on the excavation of the 10 miles of trench necessary for the steel pressure pipe line for the Sooke Lake waterworks system between Humpback Reservoir and the city, has been commenced.

Hamilton, Ont.—Estimates have been prepared to be brought before the Wentworth County council amounting in all to approximately $100,000, of which the chief estimate is a road work appropriation amounting to $46,837.60.

Ottawa, Ont.—The Public Works Department of the Ottawa Government has commenced operations on undertakings consisting of harbor and river improvements, and of public buildings, which will aggregate an expenditure of $46,000,000.

Rosser, Man.—A satisfactory adjustment of disputed points has been arranged between the municipal council of Rosser, Man., and governmental authorities in charge of the good roads department; and active road construction in the Rosser district has recommenced.

Halifax, N.S.—It is reported from Halifax that contractors are organizing to commence the construction of a mile of seawall, forty feet high from the bottom and on two great piers, the whole of which construction work will cost $5,000,000.

Canora, Sask.—It has been announced that the present season will see the completion and operation of the new C.N.R. branch from Canora northward as far as Sturgis, a distance of 22 miles. Also two stations are expected to be constructed between these points.

Moose Jaw, Sask.—Engineer Commissioner Mackie has presented to the Moose Jaw city council a report on street grading done during the month of May, showing that 18,000 cubic yards of excavations have been completed at a cost of $46,000, which means an average of about 25 cents per cubic yard.

Halifax, N.S.—A news item from Halifax states that the civic authorities are at present taxed to the utmost to keep the works in progress up to date; that street, sewer, and sidewalk construction is proceeding rapidly, the Clerk of Works having paid out about $12,000 for the past fortnight's labor.

Vancouver, B.C.—The C.N.R. company has placed an order for 45,000 tons of steel rails for the completion of its lines in British Columbia. Five thousand have already been shipped from Sydney, C.B., to Port Mann, B.C.; 5,000 are to be shipped to the Vancouver Island line; 8,000 will be delivered to Kamloops; and 17,000, to the present end of steel, south of Yellowhead Pass.

Calgary, Alta.—Crude black petroleum has been struck at the well of the Monarch Oil Company on section 5, township 32, range 6, west of the fifth meridian, at a depth of 808 feet. The well is about 30 miles west and 6 miles south of the town of Olds, on the Calgary-Edmonton line of the C.P.R., while the Dingman well is about 65 miles southwest of Calgary. At the Dingman well, light oil was struck at a depth of 2,700 feet.

Vancouver, B.C.—An announcement has been made at Ottawa to the effect that the Dominion Government has selected as a site for the new $1,000,000 transfer elevator to be built at Vancouver, a point on the Government dock in Vancouver harbor; and that tenders will be called for the structure within a couple of months. Plans are to be prepared at once. It is expected that the cost will be between $750,000 and $1,000,000.

Winnipeg, Man.—The works and property committee of the Winnipeg city council has estimated that, during the season of 1914-1915 in Winnipeg, public works will cost about $106,900. Of this amount, $15,200 will be required for the maintenance and repair of bridges, $15,000 for street grading, $47,000 for sewer maintenance, $4,000 for sewer ventilation test, etc. The estimated expenditure during 1913 was $101,483; but the actual cost proved to be $116,665.44.

Medicine Hat, Alta.—It is reported from Medicine Hat that building operations totalling an expenditure of $1,500,000 are showing signs of preparation for construction in that city. Some of the structures are a brick and stone block being built by Thomas Mulligan, the enlargement of the present post-office building, the "News" building, a new technical high school, the enlarging of the mill property of the Lake of the Woods Milling Company, and the plant for the Maple Leaf Milling Company.

Victoria, B.C.—It is announced that the first contract to be completed in connection with the Sooke Lake waterworks scheme has just been executed by Messrs. Watson & Cousins, to whom the work of the construction of the telephone line from the lake to Humpback Reservoir, a distance of 27 miles, was let at a figure of $426 per mile. The telephone line is a double metallic circuit, and connects up numerous stations along the line of the pipe grade. Connection with the Humpback Reservoir end of the line will be made into the city.

Galt, Ont.—The Dominion Natural Gas Co. has experienced some difficulty in connection with the construction of the proposed purification plant for Tilbury gas. Delay was caused in the commencement of operations due to the fact that for a certain portion of the work only two firms on the continent were able to tender. It has now been finally decided to build the plant is 3 units, the first of which it is expected to have in operation in a month or six weeks. The other units will be completed within a month and two months, respectively, subsequent to the completion of the first unit.

Windsor, Ont.—It is said by Sir Adam Beck that the work on the Windsor-St. Thomas extension of the Ontario Hydro-Electric Commission's power line, has progressed sufficiently to warrant power being available by the end of July. The engineers are now preparing to make the connection with the local distributing stations at Windsor and Walkerville. For the low-tension line connecting Dresden, Tilbury, Wallaceburg, Strathroy, Lambeth, Embro, Plattsville, Priceville, Fergus, Elora and other places, orders have been placed for the material, some of which has been delivered.

Winnipeg, Man.—The following report on the output from the Winnipeg civic quarries for the month of May, 1914, and the corresponding month of last year, has been published. In 1914, from Stony Mountain, the output of crushed stone was 183 cars, containing 5,570 yards; in 1913, 319 cars and 9,732 yards. In 1914, from Bird's Hill, the output of gravel was 189 cars containing 5,370 yards; in 1913, 213 cars and 6,440 yards. In 1914, the sales to the city storekeeper were 4,575½ yards crushed stone, 3,419 yards gravel, 91 yards sand, and 34 yards granite, a total of 8,119½ yards. Last year the sales were: crushed stone, 9,416 yards; gravel, 6,427 yards; sand, 388 yards; granite, 39 yards.

Toronto, Ont.—The contracts which have just been let by the Hydro-Electric Power Commission of Ontario in connection with the development of power at Eugenia Falls, will involve an expenditure of $230,000. The work entailed is the construction of dams, canals and penstocks. Dam No. 1 will be a reinforced concrete structure 2,000 feet long, and varying in height from 40 to 50 feet; while Dam No. 2 will be similar, though not as large. Tenders are now being called for the necessary hydraulic and electrical equipment, which will be used to develop 4,000 horsepower; although the headworks, canals and storage reservoir of the undertaking contemplate an ultimate development of 8,000 horsepower.

Victoria, B.C.—The estimated cost of the work to be undertaken at Songhees Point, Victoria, B.C., and for which tenders are being called, is about $250,000. A retaining wall, approximately 2,000 feet long and 6 feet above high water mark, extending from Songhees Point to the proposed Johnson Street bridge, is to be constructed; and 13 acres of land must be reclaimed. The successful contractors will probably have the option of two alternative schemes in connection with the construction of the retaining wall. One will be by surrounding the site by a cofferdam for the construction of the concrete in the dry, while the other alternative may be by means of cribwork. Considerable dredging will have to be carried out, as it is proposed to have 20 feet of water outside the retaining wall at low tide.

Cobalt, Ont.—A report from Cobalt states that about 120 feet of the Dominion Government 400-foot dam at the foot of Lake Timiskaming, has fallen away; and the cause for this is as yet unfathomed. The portion of the dam affected includes 3 piers on the Quebec side of the dam in the deepest part of the channel, 60 feet of sluice gates and 60 feet of piers. This dam was erected at the foot of the lake at South Timiskaming, and has given considerable trouble previously to the engineers. The water in the lake is falling very fast; and it is estimated that ultimately it will fall ten feet in consequence of this break. This will mean that the new wharf at Ville Marie will not be approachable by boats. The new wharf at Paradis Bay will be in a similar position. The wharves at New Liskeard and Haileybury will be effected only in a minor degree, since there is much better harborage at these points.

Vancouver, B.C.—The mining committee of the Vancouver Board of Trade recently reported to the board in reference to the advisability of encouraging the establishment of an iron and steel industry in Vancouver. The committee stated that there are ample supplies of raw material in the form of magnetite ore on Texada, Nelson, Redonsda and other islands, and on the east and west coast of Vancouver Island. There are supplies of limonite ore at Quatsino, Barclay Sound, Green Lake, Chilliwack and other accessible points. Hematite ores are reported from Bella Coola, Bute Inlet and other points. Vancouver Island coal can be converted into suitable coke by the use of proper retort ovens; while there is plenty of limestone for fluxing to be had at nearby points. The committee also stated that pig iron could be produced at $12.53 a ton, and added that there is a market for $150,000 tons a year at $25 a ton. If local coal cannot be made into proper coke the government is willing to remit the tax on coal imported for coking. There are no known deposits of iron ore of commercial value on the Pacific coast south of British Columbia; but the copper ore shipped out of British Columbia in 1913 totalled 352,300 tons, valued at $3,035,540.

Vancouver, B.C.—Announcement is made to the effect that, between the Okanagan sections of the Kettle Valley Railway, rail connections are now in course of construction along the entire route from Midway to Hope, which are to be completed within the next 3 months. The completion of a 15-mile link between Carmi and Penticton will mean that the entire line from Midway to Osprey Lake will be ready for service. Along this section, it is stated that bridge building is proceeding rapidly south of Penticton; and steel has been laid to Osprey Lake from which point a section of line is being built to Penticton. All recent publications in connection with progress being made with all sections of the Kettle Valley road, as well as the section of the V.V. and E., which is to be used conjointly by the two roads, would indicate that rail connection between the boundary and Okanagan points and Merritt, will be completely established this autumn.

Fraser River, B.C.—The work which is provided for by the sum of $60,000 included in the supplementary estimates of the Dominion Government, is the removal of obstructions from the Fraser River, so as to construct a permanent passage for fish to their spawning grounds. Work has been in progress for some time at Hell Gate in the Fraser Canyon, where the river is only about 100 feet wide, and where last December the channel was made considerably narrower by a slide caused by the falling in of the C.N.R. tunnel just above Hell Gate. The contract for the dredging of the channel was given to the Pacific Dredging Company about three months ago; but another six months will be required to complete the work. Night and day shifts have been at work during the past months, and have been moving from 1,000 to 1,500 yards of heavy rock from the bottom of the river to a ledge on the C.P.R. side, 175 feet above water. The rock is being lifted and carried by an overhead cable way which carries a weight of up to 15 tons at each trip and moves 30 feet per second. It is stated that the type of carriage in use is the only one in Canada. It was made in Pittsburg, and carries either buckets full of small rock, or hooks on to 10 or 12-ton rocks. Mr. Stuart Cameron, vice-president of the company, has said that no less than 46 tons of dynamite are being used in the work.

Victoria, B.C.—Mr. J. S. MacLachlan, Government supervising engineer on the breakwater and pier contracts at Victoria, has announced that, during the month of May, 54,114 tons of rock were dumped at the Ogden Point breakwater site. This is a material advance on the amount accomplished in April; while it brings the total amount of rubble dumped since the breakwater contract was started up to 126,504 tons. The increase in May is attributed to the use of a dredge with a capacity of 500 tons. Also, during the month of May, 1,190 tons of granite blocks were laid on the rubble bed under the supervision of divers. Altogether, 1,000 cubic yards of material were excavated and levelled off on the foreshore area during May. This amount is considerably smaller than in previous months. At the site of the piers, during the past month, 7,036 tons of rip-rap were dumped; which material is to form the foundation of the concrete cribwork that is to be constructed on the big floating drydock now moored inside the Inner Harbor. The first shipment of steel is on its way overland to Victoria from the plant of Prior & Co., Nova Scotia; and cement is now under order from the Associated Cement Company, of Bamberton. The Grant Smith & McDonnell quarries at Esquimalt, whence much of the rubble for the contract will be secured, are being opened up; and it is expected that material will be shipped from that point this month.

PERSONAL.

JAS. L. TAYLOR, formerly road superintendent for the County of Wentworth, Ont., has gone to Parry Sound, to accept a similar position there.

A. G. HAULTAIN, for the Canadian Geological Survey, is making a survey of Lake Athabasca, which will serve as a base for all explorations and surveys in the surrounding region.

HANS DEMPWOLFF and TURT SEMMIER, two engineers of the Prussian State Railway System, have been spending several weeks in Canada on an inspection trip of Dominion lines.

THOS. R. LOUDON has been appointed assistant professor of ferro-metallurgy; A. T. LAING, assistant professor of applied mechanics; and A. W. McCONNELL, assistant professor of architecture, at the University of Toronto.

R. L. DOBBIN, B.A.Sc., has been appointed Waterworks Superintendent for the City of Peterborough, Ont. Mr. Dobson has been connected with water supply works in various capacities throughout Canada. A few years ago he was associated with the construction of the Moose Jaw supply line from Caron, Sask.

C. D. KAEDING, formerly assistant general manager of the Goldfield Consolidated, and recently assistant superintendent of mines for the Canadian Copper Co., has been appointed vice-president and general manager of the Dome Mines, Limited, South Porcupine, Ont., and has taken charge of the property, Mr. H. C. Meek, his predecessor, having recently resigned.

OBITUARY.

The Grand Trunk Railway System has suffered a loss through the recent death of Mr. M. M. Reynolds, its vice-president, who for many years had charge of the financial and accounting departments.

A prominent engineer in the person of Mr. Alex. Stewart, assistant chief engineer, Great Northern Railway, died in Seattle, a few days ago. Mr. Stewart was well known in Victoria and Vancouver. The reclamation work at False Creek, the dock on Burrard Inlet, and the other development work carried out by the G.N.R. in Vancouver was done under his supervision.

The death occurred recently in Victoria, B.C., of T. H. Parr, at the age of 66. He was born in England and came to Canada at an early age entering the engineering department of the City of Winnipeg. In 1890 he went to Victoria and engaged in private practice as civil engineer and surveyor. In 1892 he was appointed assistant city engineer of that city under Mr. E. A. Wilmot, and held office for many years. Of late he has not taken an active part in professional affairs.

Owing to the resignation of its secretary, Mr. W. H. Rosevear, the Western Canada Railway Club has, as acting secretary until the annual elections in September, Mr. Louis Kon, Immigration Agent, G.T.P. Ry., Winnipeg.

The 7th annual meeting of the Mine Inspectors' Institute of the United States was held in Pittsburg, a few weeks ago. A large number of delegates from Canada and also from Mexico, were in attendance.

REGINA ENGINEERING SOCIETY.

The personnel of the Regina Engineering Society executive for the present year is as follows:—President, H. S. Carpenter, Board of Highway Commissioners, Saskatchewan Government, Regina; first vice-president, L. A. Thornton, City Commissioner, Regina; second vice-president, R. O. Wynne-Roberts, Consulting Engineer, City Hall, Regina; secretary, J. M. Mackay, Superintendent of Waterworks, Regina; treasurer, R. N. Blackburn, Chief Boiler Inspector, Saskatchewan Government, Regina.

COMING MEETINGS.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Seventeenth Annual Meeting to be held in Atlantic City, N.J., June 30th to July 4th, 1914. Edgar Marburg, Secretary-Treasurer, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF ENGINEERING CONTRACTORS.—Summer convention to be held at Brighton Beach, N.Y., July 3rd and 4th, 1914. Secretary, J. R. Wemlinger, 11 Broadway, New York.

UNION OF CANADIAN MUNICIPALITIES.—Annual Convention to be held in Sherbrooke, Que., August 3rd, 4th and 5th, 1914. Hon. Secretary, W. D. Lighthall, Westmount, Que. Assistant-Secretary, G. S. Wilson, 402 Coristine Building, Montreal.

WESTERN CANADA IRRIGATION ASSOCIATION.—Eighth Annual Meeting to be held at Penticton, B.C., on August 17, 18 and 19. Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

AMERICAN PEAT SOCIETY.—Eight Annual Meeting will be held in Duluth, Minn., on August 20th, 21st and 22nd, 1914. Secretary-Treasurer, Julius Bordollo, 17 Battery Place, New York, N.Y.

CANADIAN FORESTRY ASSOCIATION.—Annual Convention to be held in Halifax, N.S., September 1st to 4th, 1914. Secretary, James Lawler, Journal Building, Ottawa.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Seventh Annual Meeting to be held at Quebec, September 21st and 22nd, 1914. Hon. Secretary, Alcide Chausse, 5 Beaver Hall Square, Montreal.

CONVENTION OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—To be held in Boston, Mass., on October 6th, 7th, 8th and 9th, 1914. C. C. Brown, Indianapolis, Ind., Secretary.

AMERICAN HIGHWAYS ASSOCIATION.—Fourth American Road Congress to be held in Atlanta, Ga., November 9th to 13th, 1914. I. S. Pennybacker, Executive Secretary, and Chas. P. Light, Business Manager, Colorado Building, Washington, D.C.

AMERICAN ROAD BUILDERS' ASSOCIATION.—11th Annual Convention; 5th American Good Roads Congress, and 6th Annual Exhibition of Machinery and Materials. International Amphitheatre, Chicago, Ill., December 14th to 18th, 1914. Secretary, E. L. Powers, 150 Nassau St., New York, N.Y.

The City of London, Ont., has 13,978 water services supplied by its Waterworks Department.

A large deposit of silica sand has just been discovered near Redcliff, Alta. Under test it withstands a temperature of 3,000° and possesses properties which indicate its suitability in clay products, iron works and rolling mills. The discovery has aroused considerable interest in Redcliff.

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.

21978—June 15—Directing that, within 60 days from date of this Order, C.P.R. install improved type automatic bell at crossing of main approach to Hospital for Insane, London, Ont.; 20 per cent. cost of installing bell be paid out of "Ry. Grade-Crossing Fund," remainder by Railway Company.

21979—June 13—Directing that, within 60 days from date of this Order, Pere Marquette R.R.Co., install improved type of automatic bell at crossing of Head St. (Longwoods Road), Chatham, Ont.; 20 per cent. cost installation be paid out of "Ry. Grade-Crossing Fund," remainder by P.M.R.R. All train movements on siding be flagged over by one of Company's yardmen.

21980—June 8—Approving agreement entered into between Bell Telephone Co. of Canada and King Telephone Co., Limited, dated May 28th, 1914.

21981—June 13—Establishing collection and delivery limits of Dominion Express Co., in town of Morse, Saskatchewan.

21982—June 12—Authorizing C.P.R. to open for traffic its line from Bassano to Empress, mileage 0.0 to 118.3; and from Empress, mileage 111.8, to mileage 110.8, Swift Current Northwest Branch, subject to and upon condition that trains operated over portion from mileage 0 to 75 be limited to speed not exceeding 20 miles an hour; from mileage 75 to 118.3, 18 miles an hour; and from mileage 110.8 to 111.8, 18 miles an hour.

21983—June 12—Approving location G.T.P. Branch Lines Co., station at Lorlie, Sask., Sec. 26-21-10, W. 2 M., Melville-Regina Branch; Station to be in accordance with Co.'s standard Structural Plan No. 1.

21984—June 13—Authorizing G.T.R. to construct siding into premises of Sarnia Bridge Co., Limited, from Sarnia Tunnel Station Yard.

21985—June 11—Authorizing Dominion Atlantic Ry. to construct siding to warehouse of W. H. Chase and Co., Avonport, Co. Kings, N.S.

21986—June 15—Authorizing Lake Erie and Northern Ry. to connect its tracks, temporarily, with siding of M.C.R.R. at Waterford, Ontario.

21987—June 15—Authorizing Esquimalt and Nanaimo Ry. to construct siding for Spragge and Company at mileage 1.35 west of Victoria, B.C.

21988—June 13—Authorizing C.N.O.R. to construct, temporarily, across public road between Lot 19, R. 1, and Lots 23 and 24, North Front A, by spur to Ballast Pit, Tp. Westmeath, subject to conditions contained in resolution.

21989—June 13—Authorizing C.P.R. to use Three (3) bridges—No. 30.8, near Kendry Station, Ont., No. 33.5, near Cavan Station, Ont., and No. 39.4, near Bethany Jct. Station, Ont.

21990—June 15—Amending Order No. 21915, dated June 1st, 1914, by striking out words "Campbellford, Lake Ontario and Western," in recital to Order, and substituting therefor words "Ontario and Quebec."

21991—June 15—Authorizing C.P.R. to re-construct Bridge No. 34.6 on Toronto Subdivision, Ont. Div., at Cavan, Ontario.

21992—June 8—Authorizing G.T.P. Ry. to construct Five (5) Bridges—across creek, mileage 151 east of Prince Rupert; across Shames River, mileage 79, Prince Rupert East; across Hardscrabble Creek, mileage 113.3, Prince Rupert East; across Creek at mileage 115.8 east of Prince Rupert; and across Sand Creek, mileage 115.1, Prince Rupert East, B.C.

21993—June 12—Authorizing C.N.O.R. to open for traffic Orillia Branch from junction with its main line at Udney to Atherley, Ont.; and rescinding Order No. 11308, dated July 28, 1910.

21994—June 16—Authorizing G.T.P. Ry. to construct spur in S.E. ¼ of Sec. 36-52-2, W. 5 M., mileage 823.64, Dist. North Alberta, Alta., for Alsip Brick and Supply Co., Limited.

21995—June 16—Authorizing G.T.R. to reconstruct bridge No. 301 across Indian River, mile post 105.80, near Thornbury, 14th Dist, of its line, Tp. Collingwood, Ontario.

21996—June 16—Amending Order No. 21114, dated December 30th, 1913,— 1. by inserting word "unopened" before word "highway," where same occurs in recital and operative part of Order. 2. By striking out words and figures, "the said crossings to be constructed in accordance with the Standard Regulations of the Board Affecting Highway Crossings, as amended May 4th, 1910."

21997—June 16—Amending Order No. 21496, dated March 17th, 1914, by inserting word "unopened" before word "highway" where it occurs in Order, and striking out words, "the said crossing to be constructed in accordance with Standard Regulations Affecting Highway Crossings, as amended May 4, 1910."

21998—June 16—Amending Order No. 21495, dated March 17th, 1914, by inserting word "unopened" before word "highway," where it occurs in Order; and striking out words, "the said crossing to be constructed in accordance with Standard Regulations of Board Affecting Highway Crossings, as amended May 4th, 1910."

21999—June 10—Authorizing C.P.R. to construct diversions in Secs. 19 and 29-7-27, W. 2 M., Sask., and construct Weyburn-Stirling Branch Line, at grade, across North and South Road Allowance between Secs. 19 and 30, and Secs. 20 and 29-7-27, W. 2 M., mileage 94.36; and rescinding Order No. 19746, dated July 4th, 1913.

22000—June 15—Directing that C.P.R. provide and construct highway crossing over its railway, Lot 5, Con. 2, Tp. Rayside, Ont.

22001—June 16—Authorizing Winnipeg River Ry. Co., to connect with C.P.R. at Lac Du Bonnet, Manitoba.

22002—June 19—Amending Order No. 21890, May 27th, 1914, by inserting after word and figures, "Sec. 3," in part 1 of recital to Order, word and figure, "Twp. 8;" and striking out figure "8," after word "Twp.," in said part 1, and 2nd paragraph of operative part of Order, and substituting figure "7."

22003—June 19—Amending Order No. 21891, May 27th, 1914, by striking out figures "512" in 2nd line of recital, and substituting therefor figures "312."

22004—June 16—Approving location C.N.R. through Twps. 18-20, R. 7, East of Principal Meridian, Man., mileage 48.56 to 62.72.

22005—June 10—Authorizing C.N.R. to construct across and divert road in S.E. ¼ Sec. 7-43-19, W. 4 M., Alberta.

22006—June 16—Authorizing C.N.R. to re-construct bridge across Red River, at Emerson, Man., subject to condition that Co., at own expense, construct guide pier or protection work should be called upon to do so at any future time by Dept. Public Works of Canada, in interests of navigation.

22007—June 8—Approving agreement entered into between Bell Telephone Co. and Municipal Corporation of Tp. Brooke, dated May 13th, 1914.

22008—June 16—Authorizing C.P.R. to construct stringer opening at Bridge No. 111.45, Hamilton and Goderich Sub. Div., at crossing of Wellington St., town of Goderich, Ontario.

22009—June 16—Authorizing G.T.R. to reconstruct Bridge No. 35, mile post 111.46, 30th Dist., Ottawa, Div., over South Indian River, near South Indian, Tp. Cambridge, Ontario.

22010—June 15—Directing that on and after date of this Order, Sarnia St. Ry. Co., bear and pay cost of maintaining and repairing diamond required to be installed at crossing of G.T.R. by Sarnia St. Ry.; rescinding Order No. 21825, May 14th, 1914, and this Order be without prejudice to rights of G.T.R. or Sarnia St. Ry. with reference to maintenance and repair under Order No. 138.