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DON SECTION, BLOOR STREET VIADUCT, TORONTO

SOME NOTES ON THE PRELIMINARY WORK ATTENDING THE WHOLE PROJECT—FOUNDATION TESTS—FEATURES OF DESIGN OF DON RIVER SECTION.

THE rapid development during recent years of the northeastern section of the city of Toronto has produced an acute need for better transportation facilities across the Don river. While the business and residential sections of the city lie almost entirely west of this river and the ravines adjacent to it, annexation and development has resulted in a large and increasing population which is served by two thoroughfares; *viz.*, the Queen St. bridge, accommodating practically all downtown traffic over the Don, and the Gerrard St. bridge. These thoroughfares are both relatively near the waterfront, and necessitate considerable deviation of traffic that rightly belongs to the northern portion of the city, together with an excessive congestion at busy periods of the day, along the present avenues of communication.

With the development of the Danforth Avenue section of the city and the establishment of a civic car line to convey traffic between the extreme eastern section of the city and the bank of the river (where communication with the business section of the city is effected by transfer to a south-bound car service) it became more and more obvious that a viaduct to span the Don river and Rosedale ravine, thereby affording direct transport to and from Bloor Street and the central portion of the city, was required, to dispense with the handicap which had so long prevailed both to freight and passenger traffic.

During the summer of 1912 the Department of Works of the city, under the direction of Commissioner of Works R. C. Harris, made a thorough survey of the best available route, taking all necessary levels, cross-sections, etc., to enable the Department to prepare plans and specifications for the proposed viaduct. In addition to information regarding the physical condition of the site, it was necessary to collect and arrange a great deal of information relative to the growing demand of city traffic, both surface and underground. In January, 1913, a by-law was passed by the ratepayers authorizing the sum of $2,500,000 to be expended on the enterprise. Since that time the investigations have been carried on to the most minute detail and have just recently been completed. At the present time tenders for the Don section of the viaduct are under consideration, and it is probable that tenders will be solicited for the Rosedale section in a short time.

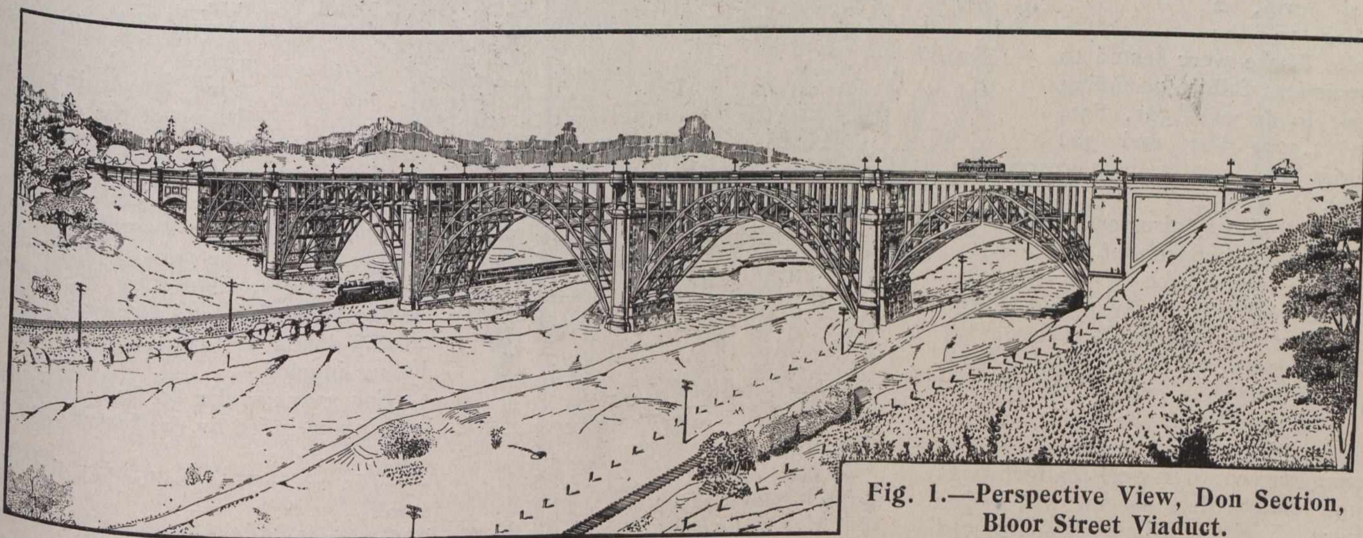


Fig. 1.—Perspective View, Don Section, Bloor Street Viaduct.

The surveys for the whole of the viaduct consist in general of its alignment, together with that of the adjacent streets and properties likely to be affected; the taking of levels for a distance of 100 ft. from the centre line on either side, at 10-ft. intervals, the results therefrom giving cross-sections for every 10 ft. between Sherbourne Street on the west and Broadview Avenue on the east side of the site. These cross-sections were necessarily very extensive at certain places, particularly between Sherbourne Street and Edgedale Road, in the Rosedale Valley between Parliament Street and Castle Frank Road, and also on the east side of the Don Valley. To facilitate measurements during the process of construction, permanent monuments were set and their location and elevation carefully determined.

In addition to the topographical work, extensive subsurface exploration was necessary. This included about 3,400 ft. of wash-boring and core-boring. Samples were carefully taken, labeled and preserved for reference. The rock found at varying depths consists of a shale.

Owing to the high unit stresses which the main piers of the proposed structure will impose on the shale, tests were made to determine as accurately as possible its safe carrying capacity. As the cores obtained by the use of the diamond drill were too small for compression tests, samples were selected from the quarry of the Don Valley Brick Works, in comparatively close proximity to the site. Care was taken to select the softest pieces obtainable and of the same character as the softest shale encountered in the boring operations. On account of the nature of this shale it was impossible to obtain good specimens.

Six test blocks, however, were obtained, of approximately cubical form, 2 inches to the side. These were tested to destruction, failure occurring under loads of 1,381, 831, 535, 1,500, 862 and 362 pounds per square inch respectively.

To acquire a fairer estimate of the carrying capacity of this material in place, the waterworks sections and the railway and bridge section of the city's Department of Works co-operated in making two loading tests on similar shale exposed in an excavation at the main pumping station. These tests were of the following nature: A steel platform was constructed with a bearing 8⅛ inches square. Weighed pig iron was placed upon it until the desired loading was obtained. On account of the settlements being small, special measuring devices were used and the total settlement checked by means of the level and target rod. In the first test a settlement of .45 inches was recorded under a unit pressure of 986 lbs. per square inch. Careful examination of the rock after the removal of the platform was made and the shale was found to be crushed only to such a degree as to have lost its characteristic structure for a depth of about 3 inches, while the shale immediately surrounding the loaded area showed no sign of injury.

In the second loading test a unit pressure of 402 lbs. per square inch was imposed, resulting in a settlement of .08 inches. Examination after the test showed that its effect on the texture of the shale could scarcely be observed.

The design of the Don section of the viaduct shown in Fig. 1 is based upon a steel structure with approaches and piers of reinforced concrete. It is a three-hinged, four-ribbed arch construction of five spans with footings carried down to rock foundation. The floor system is of concrete slabs supported on steel. The whole structure is 1,618 feet in length with a height of 130 feet above water level. The river span is 281½ feet, with a span of 240 feet, on either side, and on the outer side of these again, spans of 158 feet. The western approach will include a span of 80 feet. The specifications call for 26,175 cu. yds. and 3,050 cu. yds. of excavation for the east and west approaches respectively, and 20,000 cu. yds. for the piers. About 5,500 tons of structural steel and 43,000 cu. yds. of concrete will be required. As will be noted in the cross-section (Fig. 3) the design provides for a 20-ft. roadway on either side of car tracks, placed 11 ft. 11 in. c. to c. On either side, also, is a cantilevered sidewalk 10 ft. 9 in. in width, making a total width of 86 ft. Provision is made for the installation of a lower deck to connect with a future system of underground railways. A 42-in. water main will also be carried on either side under the main floor structure.

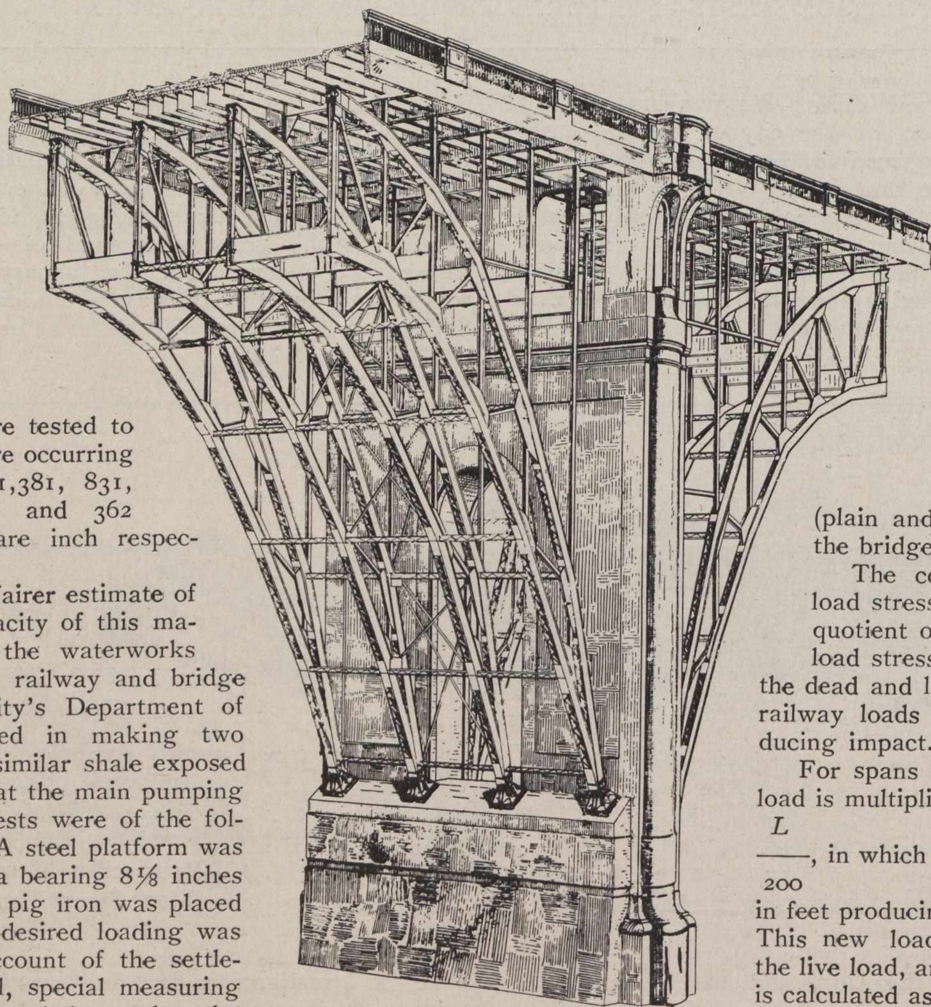


Fig. 2.—Perspective View of Pier "D."

The following are among the assumptions governing the design of the concrete (plain and reinforced) portions of the bridge.

The combined dead and live load stresses are increased by the quotient of the square of the live load stress, divided by the sum of the dead and live load stresses. Only railway loads are considered as producing impact.

For spans under 80 feet, the live load is multiplied by the factor $1.40 - \frac{L}{200}$, in which L is the loaded distance in feet producing the maximum stress. This new loading is then considered the live load, and the impact allowance is calculated as above.

The rails and ballast are assumed to distribute each wheel load uniformly over a length of 5 feet. The load on each track is assumed to be distributed over a width equal to the length of ties plus one foot.

In calculating bending stresses produced in the slab by the 20-ton truck, each wheel load is assumed to be distributed over a square, each side of which is equal to 9 inches, plus the effective depth of the slab. In calculating punching shear produced in the slab by the 20-ton truck, the area of contact is considered as a square 9 inches to the side.

The length of span for reinforced concrete subjected to bending shall, in general, be considered to be the distance centre to centre of supports.

All slabs are considered, unless otherwise shown on the drawings, to be partially continuous and shall have reinforcing in the upper portions at the supports. In all such cases the maximum positive bending moment in each individual span is taken as eight-tenths of that which would be produced in the same span resting freely on two supports, and the negative bending moment over intermediate supports is taken as ten-twelfths of the maximum positive bending moment in an adjacent span.

For beams and slabs the straight-line formula has been used, based on the following assumptions:

(*a*) All tensile stresses are considered to be resisted entirely by the steel reinforcing.

(*b*) There are no initial stresses in the beams.

(*c*) All shearing strain is cared for and there is no slipping between concrete and steel.

(*d*) The modulus of elasticity of concrete in compression is constant up to the limit of the allowable working stress.

(*e*) A section, plane before bending, remains plane after bending; that is, the stress on any fibre is directly proportional to its distance from the neutral axis.

Diagonal tension existing simultaneously with the maximum bending moment is considered as provided for by the concrete without web reinforcement, when the quotient of the vertical shear and the area between the centre of steel and centre of compression in the concrete does not exceed 50 lbs. per square inch.

Punching is assumed to be resisted by an area of concrete equal to the perimeter of the area of contact multiplied by the effective depth of the slab, and shall be considered as provided for by the concrete alone when the shear on this area does not exceed 100 lbs. per square inch.

The following are assumed working stresses in pounds per square inch:—

Tension in steel reinforcement	15,000
Compression in extreme fibres in bending ...	500
Modulus of elasticity of concrete	1,500,000
Modulus of elasticity of steel	30,000,000
Compression on 1:2:4 concrete under bearing plates and pad stones	400
Compression on 1:2½:5 concrete in body of pier	350
Compression on 1:3:5 concrete in caissons...	300
Bond between deformed bars and concrete....	100

The following assumptions are among those governing the structural steel designing:—

The steelwork is arranged to provide for the future traffic on the lower level, the clearance being 17 ft. 3 in. in height and 14 ft. 6 in. in width for each of two tracks. The top corners are bevelled 3 ft. 9 in. to a side, and the base has a width of 11 ft. 6 in. at rail level. Clearance is also provided for installation of two 42-in. water mains.

For purposes of dead load stress computation the weights of the different substances are assumed as follows:—

Concrete (plain or reinforced)	150 lbs. per cu ft.
Steel, as ordinarily listed per lin. ft.	
Broken stone ballast	100 lbs. per cu. ft.
Timber ties	54 lbs. per cu. ft.
4-inch wood block paving and ½-inch sand cushion	25 lbs. per sq. ft.
Rammed sand or gravel	125 lbs. per cu. ft.
Loose sand and earth	100 lbs. per cu. ft.

The floor system and posts are designed to carry on each upper deck track two 50-ton electric cars, producing live loads of 25,000 lbs. per axle (4 per car), the spacing in feet being 5 ft. 6 in.: 20 ft.: 5 ft. 6 in.:: 13 ft.:: 5 ft. 6 in.: 20 ft.: 5 ft. 6 in.

The arches and foundations are designed for a uniform load of 1,600 pounds per lineal foot of electric railway track.

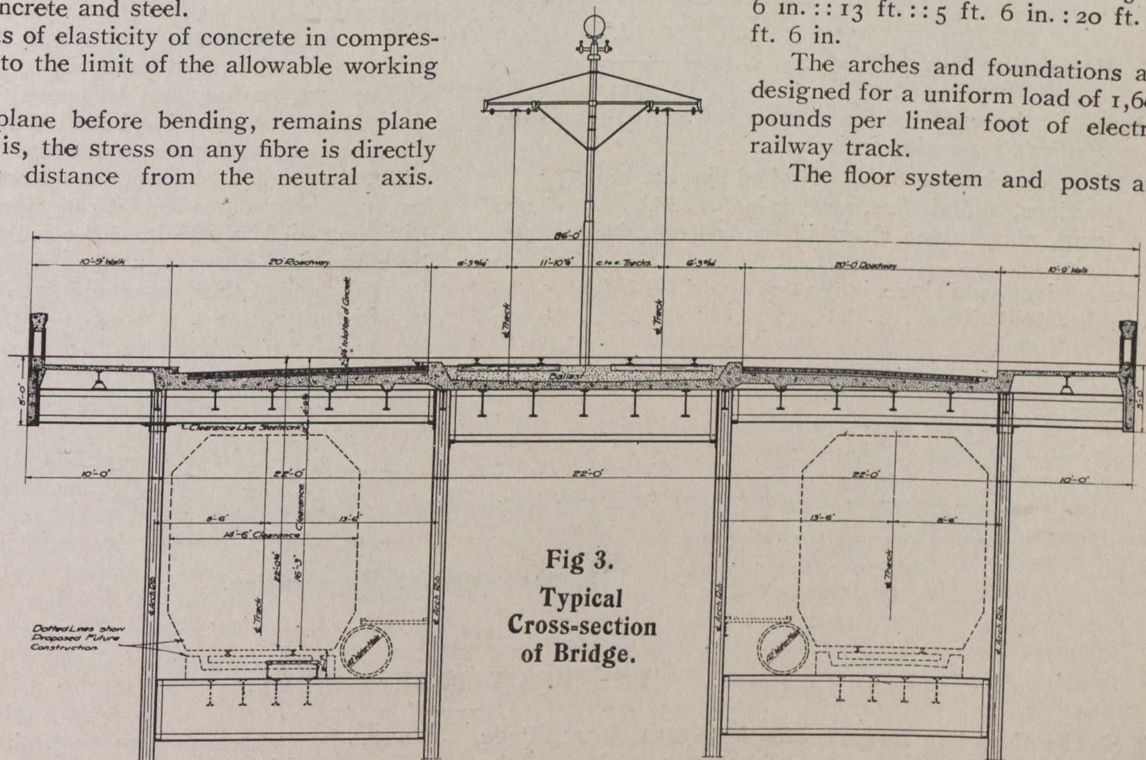


Fig 3. Typical Cross-section of Bridge.

The floor system and posts are designed for greatest roadway stresses produced by either of the following:—

(1) A uniform load of 135 lbs. per square foot on the area remaining after deducting a strip 22 ft. wide for tracks.

(2) A 20-ton truck producing loads of 12,000 and 28,000 lbs. on front and rear axles respectively, axles being spaced 12 ft. apart and wheels 5 ft. c. to c.

The arches and foundations are designed for a uniform load of 80 pounds per square foot for spans of 200 feet or over, and $80 + \frac{200-S}{5}$ pounds per square foot for spans under 200 feet. (S = span in feet.)

The slab, stringers, and posts for the sidewalk are designed for a uniform load of 100 pounds per square foot and the arches and foundations for a uniform load of 80 pounds per square foot.

The bridge is designed for a wind pressure of 50 pounds per square foot on the unloaded structure. For the upper deck the wind pressure is assumed to act on a vertical surface, ten feet in height from bottom of stringers upward. For the lower deck it is assumed to act on a vertical surface four feet in height taken twice.

For the truss members and posts it is assumed to act on twice the exposed area of one rib.

Each part of the structure shall be so proportioned that the maximum condition of stress in pounds per square inch shall not exceed the following:

Axial tension on net section of rolled plates and shapes 16,000

Axial compression on gross section of rolled plates and shapes:—

For flat or fixed ends, $16{,}000 \div \left(1 + \frac{L^2}{18{,}000\, r^2}\right)$

For one flat and one pin end, $16{,}000 \div \left(1 + \frac{L^2}{12{,}000\, r^2}\right)$

For pins at both ends, $16{,}000 \div \left(1 + \frac{L^2}{9{,}000\, r^2}\right)$

where L is the length of the member in inches and r is the least radius of gyration in inches.

Bending, on extreme fibres of rolled shapes, built sections, and girders, net section 16,000

Shearing, shop-driven rivets in reamed or drilled holes 10,000

Power-driven field rivets in reamed or drilled holes 9,000

All other field rivets 8,000

Lathe-turned bolts in reamed or drilled holes ... 8,000

Webs of girders, gross area 10,000

Bearing on diameter of rivets, twice the shearing value given above.

Bearing on pins 22,000

No compression member is to have a length exceeding 45 times its least width, nor an unsupported length in any direction exceeding 100 times its least radius of gyration about an axis perpendicular to that direction, excepting wind bracing and lateral struts, which may have an unsupported length of 120 times the least radius of gyration.

The preliminary work has been done, and the bridge designed, by the staff of the Department of Works, City of Toronto, assisted as regards architectural features of piers, approaches, and handrail, by Mr. Edmund Burke, Toronto, in the capacity of consulting architect. Considerable controversy has been created in connection with the proposed development as to the material, steel or concrete, that should be used, the nature of the soil structure having a very important bearing upon the question. The City Council has permitted the submission of tenders for both steel and concrete, and, as already announced in this journal, four of the former and five of the latter are under consideration.

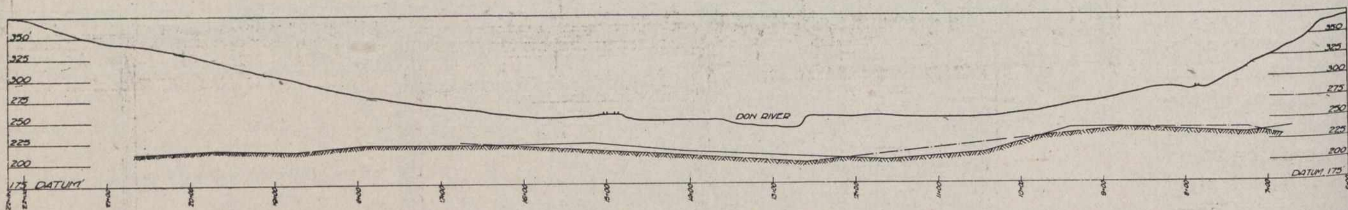


Fig. 4.—Profile of Don Section.

THE PITOT TUBE THEORY.

In *The Canadian Engineer* for May 28th, 1914, Page 784, a paper appeared entitled "Remarks on the Theory of the Pitot Tube," by N. W. Akimoff. The following discussion of the paper has recently appeared in the Journal of the American Water Works Association. The writer is Mr. J. W. Le Doux:

There has been recently a large amount of discussion of the apparatus known as "Pitot tube," the points of greatest interest being the shape and arrangement of the openings; the methods of calibration; the influence of disturbing factors; the formula of flow, particularly as to the term "g" representing the acceleration of gravity, and the constancy of the coefficient throughout the range of the velocity.

In regard to the first it would seem to the writer that as any particular form requires calibration, that which is the simplest and easiest to handle, offers no material obstruction to the flowing water and produces the highest deflection of head for a given velocity should be the most satisfactory.

It has been held that the results are different if a tube is moved in still water from what they are if the tube is stationary and the water moves. It is hard to see how this can be so, providing the conditions are alike in each case; for instance: if a long column of water of the same uniform cross-section be used for each determination. If a Pitot tube be made to advance at uniform speed through the centre of a canal of uniform cross-section, the coefficient thus determined should be the same as if the Pitot tube were stationary in the same relative position and the column of water advanced at the same velocity. If, however, the coefficient were determined under the first of these conditions and afterwards placed in a circular pipe under pressure, it is conceivable that the coefficient would be different, although if moving and still water determinations could be made for the pipe itself, the results might be the same.

The influence of disturbing factors, such as the proximity of fittings or variation in the shape of the conduit or pipe, can never be allowed for in advance, and the proper thing to do is to avoid them as far as possible.

The formula of a Pitot tube, as well as that of the flow through all orifices or contractions in a pipe, is almost universally recognized to be that of a parabola, which is the simplest formula of a conic section, there being but two terms and two variables, one of these being in the first power and the other in the second. The first variable is the head or pressure, and the second the velocity, or quantity flowing. The parabola formula can be placed in the form of $v^2 = c\,h$, in which h is the head, v the velocity, c a constant.

If this formula is true and c is a true constant, it is only necessary to obtain the value of h and v experimentally which will determine c by calculation, and when this is once found it is good for all other values.

As the formula is one of bodies moving under the action of gravity, it is evident that the constant is influenced by the term "g"; that, however, need not concern us as long as we have to determine the constant anyway by experimental methods, and it is very important that this determination be made under such conditions as will obtain in subsequent practical use.

RAILWAY CONSTRUCTION IN SASKATCHEWAN.

In the annual report of the Saskatchewan Department of Railways the whole railway situation in the province is thoroughly canvassed, and the report contains much information, interesting as well as instructive.

The growth of operating railway mileage annually in Saskatchewan compared with the other provinces of the Dominion is shown in the following table in the report:—

Province.	1909. Increase.	1910. Increase.	1911. Increase.	1912. Increase.	1913. Increase.
Saskatchewan	550	301	189	633	897
Ontario	296	1	92	224	454
Quebec	89	132	87	1	103
Manitoba	94	16	245	54	473
Alberta	...	167	6	403	315
British Columbia	63	36	10	13	96

The following further statement of mileage of steel laid in Saskatchewan is furnished to indicate the history of railway construction in the province:—

	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.
C.P.R.	1,090.1	1,181.4	1,235.85	1,528.84	1,650.39	1,819.14	2,080.18	2,271.38	2,479.34
C.N.R.	461.87	604.28	854.51	1,004.78	1,143.91	1,383.60	1,683.27	1,750.19	2,060.16
G.T.P.R.	....	....	154.08	260.67	465.15	531.75	635.75	873.09	1,087.36
Total	1,551.97	1,785.68	2,244.44	2,794.29	3,259.45	3,734.49	4,399.20	4,894.66	5,626.86

The following reference is made in the report to the effect of railway development in the province in the past and to the desire of the Government to see progress in the construction of branch lines maintained in the future:—

"The question of railway development in the province, despite the progress already made, remains one of paramount importance. The rapid development of the country impresses a realization of the need of railways. There are many rich and fruitful districts being retarded and vast regions remaining unopened and unproductive awaiting railway facilities. This lack of adequate means of transportation is the problem which has to be faced and which presses for solution. The population agriculturally employed is concerned in securing two things more than anything else, viz.: markets and transportation facilities to bring together the producers and consumers. That this is a matter of vital concern is plainly seen, for without markets and railways the industry of the farmer and the yield of the soil does not render him the best returns, the prices being generally determined by the facility and cost with which the produce can be placed on the market. For want of communication a great portion of the products of interior points possess little commercial value, but to which transportation facilities would give high commercial value. Increased rail transportation is necessary also to unite the different settlements which are now scattered and should be consolidated by providing means for social as well as commercial intercourse. The effect of railway development in the past touching the prosperity and well-being of the people has been perfectly obvious and appreciable, although not capable of being expressed in language or figures, and from this viewpoint it is earnestly to be desired that it will be possible for the era of railway expansion to continue, especially in view of the swelling immigration and development of the province."

A SIMPLE TYPE OF SECTION FOR MOVING A SHOVEL OVERLAND.

A. L. Van Dyke, of Woodstock, N.B., has given a description of a method, which he has used with much success, for moving a 70-ton shovel across country. Mr. Van Dyke states in the "Excavating Engineer" that when a shovel is to be moved for any distance it is most important to build sections instead of using rails, ties, and bridles.

Three 33-ft. sections are sufficient. Sixty-pound rails have been found suitable. These have not been found too light for the service. The rails are spiked to ties, of 3 by 6-in. hard pine, spaced about 8 in. apart. Beneath the rails, 3 by 12 or 16-in. hard pine planks are spiked to the bottom of the ties. To serve as runners, 1 by 3 or 4-in. strips are nailed beneath the planks.

In order to make the sections stiff, blocks should be put under the rails between the ties and spiked fast on top of the planks. The rails should be allowed to stick out from 4 to 6 in. over each end of the section, in order to provide clearance for easy connections. In making connections with the sections, use straps similar to those used with the ordinary 6-ft. sections, but instead of using a bolt and nut, use a spike with a key slot ¾ by ⅛ in. and a wedge-shaped key. This will prove simpler and more effective than bolts and nuts, as the threads are constantly being knocked off. To both ends of the fourth or fifth ties on each end of the section, fasten a ½ by 3-in. strap bent in a V shape.

Use two teams, one to pull the sections back from the rear of the shovel 6 or 8 ft., and the other to haul them around and in front of the shovel. Eight men with bars are sufficient to throw the section over in line, so connections can be made. Two others should be used to pull out and put in the bolts. In this manner, a mile to a mile and a half may be made in 10 hours without unduly driving the men. With 80-lb. rails, bridles, and ties, the work is very strenuous, and as a rule the men are exhausted by noon, consequently cutting down the progress in the afternoon. A turn can be made easily by using a 6-ft. section between the two long sections. Another advantage of the long section is that a shovel is not as liable to get off the track as is the case with ties and bridles. And even if this does happen it may be pulled on again easily by fastening a chain around one or two of the ties and the other end to the propelling chain. Jacks have rarely to be used.

COMPARATOR BUILDING OF THE DOMINION LAND SURVEY.

FOR some years the need has been keenly felt of proper facilities to test subsidiary standard tapes for the Dominion Land Surveyors. By the Dominion Land Surveys Act, the Surveyor-General is required to provide the surveyors with subsidiary standards tested and certified by him as correct. In order that these tapes might be properly tested and re-tested from time to time it was necessary to erect a building equipped with the most up-to-date apparatus for this purpose.

Building.—The building was of necessity of special design as it was of extreme importance that the temperature inside the building should vary as little as possible with any variation of outside temperature. It consists of two rooms, one a small room used as office and vestibule, and the other used for the testing. The inside dimensions of the main room are 150 feet long by 10 feet 6 inches wide with 12-foot ceiling. The walls are approximately 4 feet thick and consist of five thicknesses of brick, a 1-inch air space, sheeting, tar paper, 18 inches of shavings, 1 inch sheeting, 4 inch air space, tar paper and finally double sheeting. Between the ceiling and roof is a layer of shavings 4 ft. thick and beneath the floor a layer 2 ft. in thickness, under this cinders to a depth of 5 ft. to the solid rock. The only openings besides the door are two air intakes, one at each end of the room, and four ventilators in the ceiling. The air intakes (which are at the base of the wall) are arranged so that the quantity of air admitted can be regulated and during the tests can be completely shut off. Supported from the ceiling at each end of the room is an electric blower fan (shown in Figs. 2 and 3), used to circulate the air and so insure a uniform temperature throughout. The ceiling ventilators can be closed completely or opened any desired amount for ventilation. The exit into the outer room is of special construction, consisting of two doors with a 4-ft. air space between. The outer door is of the ordinary type, whilst the inner one is an insulating air-tight door of the refrigerator design.

In order to protect the apparatus from frost and moisture and also to raise the temperature to near standard temperature (62° F.) during the colder periods of the year an electric heating system was installed. Of necessity any system adopted must heat the testing room as uniformly as possible. A large number of small special heaters were used, placed around the walls near the floor. A double heater was also placed in each air intake in order to head the fresh air admitted. The heaters are of the three-heat type, giving low, medium and high heat. They may be controlled closely from a Vermont marble switchboard, the arrangement being designed so that different circuits may be regulated as to heat generated. The heaters with the conduit wiring may be noticed just above the floor in Figs. 2 and 3.

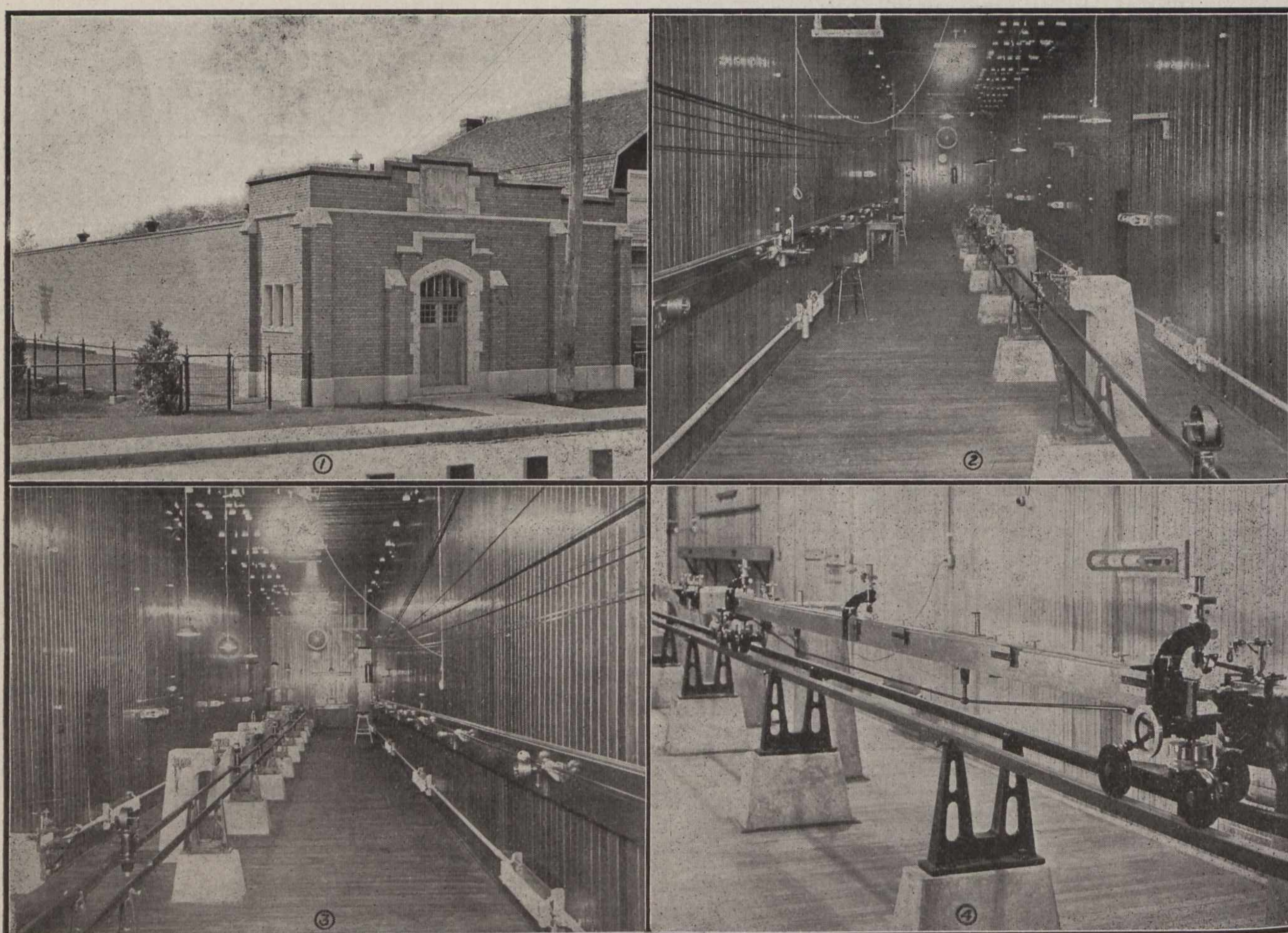


Fig. 1.—Exterior, Comparator Building; Figs. 2 (and 3).—Interior of Tape-testing Room, Looking North (and South); Fig. 4.—Meter Invar Bar in Position for Reading.

Apparatus.—Generally speaking, the existing bases for standardization of wires and tapes are of two types:

1st, The permanent bench marks of microscopic construction (*e.g.*, Russian bases at St. Petersburg); 2nd, the permanent bench marks consisting of lines traced on the edge of a series of polished surfaces (*e.g.*, bases of International Bureau and of the National Physical Laboratory). After careful consideration of the two systems it was decided to adopt the second one.

The apparatus installed was made by the Societe Genevoise pour la Construction d'instruments de physique Geneva. The general arrangement may be seen from Figs 2 and 3, the views being taken from the centre of the room looking towards the ends. The bench marks are permanently fixed to cement pillars. These pillars are isolated from the floor and extend down to solid rock. The bench marks are placed at 0^m, 4^m, 8^m, 10^m, 12^m, 50 ft., 16^m, 20^m, 66 ft., 24^m, 28^m, 30^m, 100 ft., and 32^m.

The distance between bench marks is determined by means of a standard invar bar 4 metres in length, standardized at the International Bureau of Weights and Measures at Paris. The bar is supported on a carriage which rolls over rails laid throughout the length of the base. This carriage, shown in Fig. 4, consists of two three-wheeled trucks supporting attachments for regulating vertical and horizontal movements. By this means the graduations on the bar and the bench marks may be brought very close together and the lines on the bar and bench marks sighted simultaneously by means of microscopes mounted on the carriage. Small two-candle power electric lamps are mounted on the piers to illuminate the graduations. The bar is protected by cases which rest on the support of the bar, the cases are notched at proper intervals to allow bringing the bar close to the bench mark and to uncover that portion of the bar in use.

The temperature of the bar is taken by means of two thermometers inside the case and read through openings in the latter. Suspended at equal intervals along the walls of the room and lying horizontally in cage guards are twelve delicate thermometers graduated to 0.1° C., it being possible to estimate to 0.01° C. By means of these thermometers an accurate determination of the room temperature may be obtained.

The rails which provide the runway for the carriage are supported every two metres by cast iron supports, these in turn being supported by cement piers isolated from the floor and carried down to solid rock. The iron supports are of U form to allow the tapes and wires to sag freely and to be freely manipulated. The supports used for suspending the tapes may be placed at any point along the runway and may be firmly clamped to the rails by means of two thumb-screws. The cord or wire which is fastened to the tape passes over a grooved pulley on the support and is attached to a weight to give the desired tension. The pulley is mounted on ball bearings and may be adjusted vertically or horizontally in order to bring the tape to the correct position. Intermediate supports which can be placed at any desired interval consist of pulleys mounted on ball bearings and are also adjustable.

As far as is known, only one set of apparatus exactly similar to that of the Dominion Government exists, this being one belonging to the Servian Government.

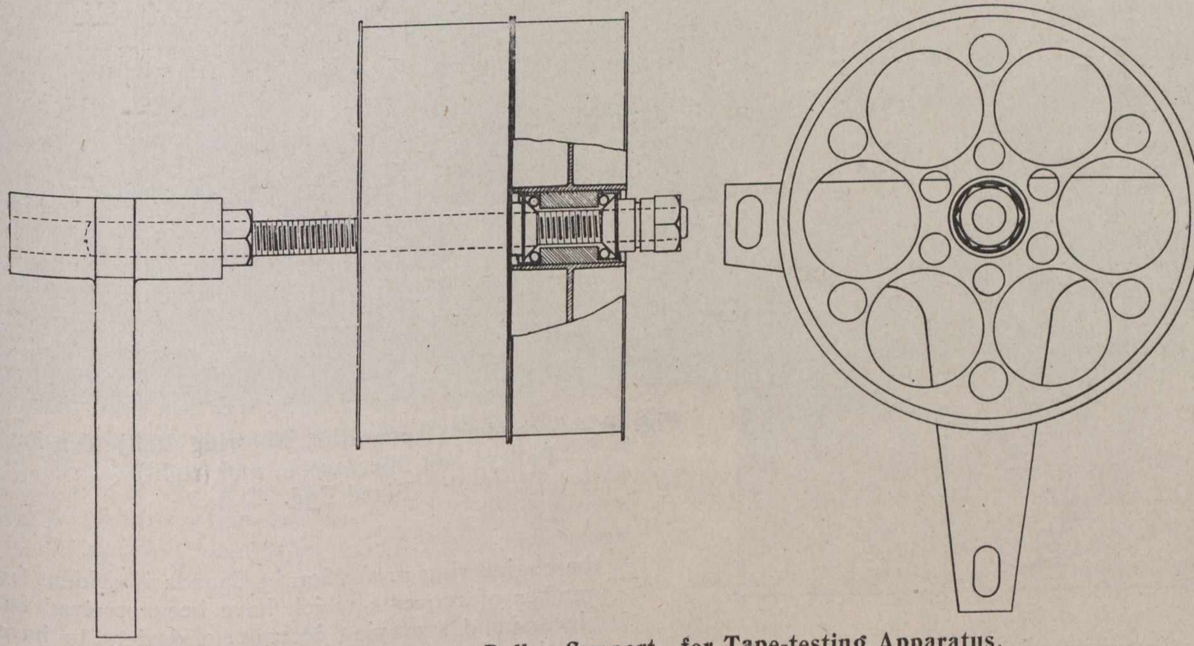


Fig. 5.—Intermediate Pulley Support for Tape-testing Apparatus.

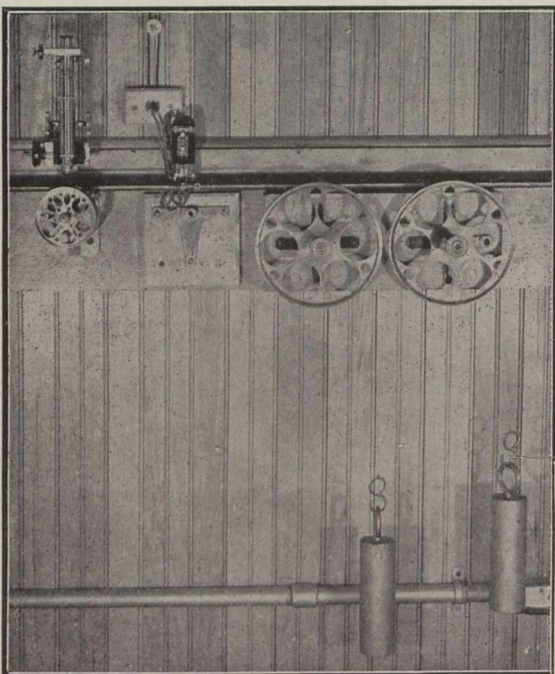
The foregoing apparatus is used only to test the laboratory standards or when this method is specially requested by an engineer desiring to have tapes standardized. As previously mentioned, it is of extreme importance that the temperature of the room be as close to standard temperature as possible and also that the exact temperature be determined, as shown in the following example. If, during the comparison of a 100-ft. tape with the bench marks (the spacing of which does not appreciably alter with small variation of temperature), an error of 1/5° F. was made in determining the true temperature of the tape it would cause an error of .000124 ft. in the results due to dilation of the tape. The coefficient of dilation used is C = .0000062, which is an average value, but as this value has been found to vary with different tapes it is important that the temperatures during the test be kept as near as possible to the standard temperature (62° F.) at which the certificate is issued. If the tape is tested at 72° F., a variation of 10° F. from standard temperature, an error of .0000005 in the coefficient of dilation would cause an error of .0005 ft. in reducing the results to standard temperature.

In order that small changes of temperature might be neglected and that subsidiary standards be tested quickly and accurately, Dr. Deville, the Surveyor-General of Dominion Lands, decided to design a secondary apparatus, shown attached to wall on left and right of Figs. 2 and 3 respectively. This apparatus is so constructed that the tape to be tested is suspended on a series of delicate pulleys, side by side with one of the laboratory standards. The pulleys (Fig. 5) are in pairs mounted on the same shaft and the set supporting one tape may turn independently of the set under the other. Microscopes are provided to make the comparison and as the length of the laboratory standard is known to a high degree of accuracy, very accurate determinations may be made.

The construction and method of using this apparatus enables determinations to be made directly for standard temperature. The only possible sources of error in comparisons of this kind would be due to: (1) Variation of temperature; (2) differential sag of tape and standard; (3) friction in the pulleys altering the applied tension. Due consideration was given to these points in the design of the apparatus. Any slight change in temperature affects both tapes to the same degree and may, therefore, be neglected. As the different tapes undergoing test are not all of the same weight per unit length as the standards there is a considerable variation in the sag of the two tapes, very often as much as ¼ in. with 66-ft. tapes supported only at the ends. This difference would cause an error of 0.00082 ft. in the final results unless a correction be applied. To overcome the necessity of using such a correction for varying weights of tapes the intermediate pulleys are used and spaced at such intervals that the alteration in length due to the difference in sag of the two tapes is so small that it may be neglected. After a series of careful determinations, the total friction of one set of pulleys for testing a 66-ft. tape, including end supports, proved to be but .014 lbs. This variation, when testing a 66-ft. tape under 10 lbs. tension, would affect the comparison of the length by less than 2 in 10,000,000.

The method of suspension is so delicate that it was necessary in order to keep the tapes steady during a reading, that the weights be attached to but one end, shown in Fig. 4. The wires imparting the tensions to the tape and standard by means of the attached weights are supported on separate pulleys mounted on ball bearings. The other end of the laboratory standard is fastened to a fixed point and the corresponding end of the tape is attached to a screw in such a way that the tape can be moved lengthwise to enable the various readings to be taken at different parts of the scale (Fig. 7). Horizontal adjustment is also provided to accommodate tapes of varying widths. A steel rod supported by ball bearings extends from one end of the apparatus to the other and when turned it imparts a motion to the adjusting screw by means of small gears. By this means the tapes may be set at any desired reading at any position along the tape-testing apparatus.

During the period in which the apparatus has been in use the results and accuracy obtained are all that could be desired. That a building of this nature is needed for the engineering profession in Canada is evident from the number of requests which have been received from engineers and surveying instrument dealers to have commercial measures verified. Although the building has been in operation but a short time, one hundred and fifty-three tapes have been tested for outside parties at their request.



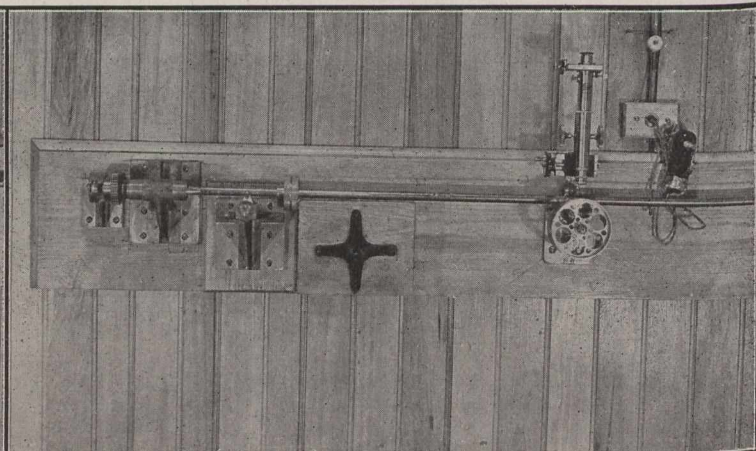


Fig. 6.—Secondary Apparatus, Showing (left) Tension Pulleys and Microscope, and (right) Fixed End.

HUDSON BAY RAILWAY.

The plant engaged on grading and bridge work, track laying and ballasting, for the Dominion Government Railway to Hudson Bay, consists of 3 steam shovels at Pas, and 2 at mileage 110; 13 locomotives; 100 Hart convertible cars and numerous box and flat cars, in addition to 2 passenger cars being operated as far as mileage 110. It is expected to have complete by the end of the year, track laying to the Manitou rapids of Nelson River, and grading from the Manitou Falls to within 110 miles of Port Nelson. Also the foundation work for a large bridge to be built at Manitou rapids, is to be finished this year. In connection with the terminals work in progress at Pas and at Port Nelson, two tracks have been laid at Pas, one from the roundhouse at Eighth Street, and another from the C.N.R., connecting with the bridge across the Saskatchewan River. Eight tracks are to be laid in the yards at once in such a manner that six additional tracks may be added as required. Though the complete details of track laying in the yards has not yet been worked out, it is expected to lay between six and eight miles of track in the yards during the summer. The work in progress at Port Nelson is of a more preliminary character.

SAFETY IN USE OF GRINDING WHEELS.*

Flanges should be of same size, and recessed out from centre, about 1/16 inch deep, for a distance leaving a flat bearing surface near rim of about 1/16 diameter of flange. A compressible washer of blotting paper or rubber, slightly larger than flanges, should be used between flanges and wheel.

Inner flange should be keyed or shrunk on spindle. Accidents have been caused by heavy pieces of work rubbing against a loose inside flange and the brake action caused nut to crawl, and enough pressure was set up by flanges to crush wheel. There should be no dirt between flanges and wheels. Sometimes a wheel breaks because wheel and spindle fit too tight.

It is not necessary to draw the nut up very tight; only enough to firmly grip the wheel between flanges. It has been calculated that on a 1½-inch machine with 8-inch flanges, a man with a 2-foot wrench can easily exert a crushing pressure between wheel and flanges of 3,600 pounds, or over 1½ tons.

If bearings become badly worn, there will be excessive vibration, causing wheel to run out of balance. If bearings are not properly oiled, the spindles run hot and heat is conducted to lead bushing in grinding wheel, and breakage may occur due to expansion of bushing.

Speed recommended by wheel manufacturer should not be exceeded. Under ordinary conditions, wheels will safely stand an overspeed represented by the testing speed. However, wheels may get damaged after being tested, and it is not possible to tell whether a wheel is damaged or not by looking at it. Tapping a wheel a light blow with a small hammer will usually tell if it is damaged, for if the wheel is perfect it will give out a clear ring, but if it is cracked it will have a dead sound.

When there are cone pulleys on a machine, sometimes a loose belt will automatically shift to the small cone pulley, and cause the wheel to run faster than it should. A belt-locking device is a good thing to use on a machine which has cone pulleys.

Most revolving cutters are made of chilled iron and break very easily. A hood on a dresser will catch most of the broken pieces.

Protection hoods provide greater safety than do safety flanges. Protection offered by any given taper decreases with decreased diameter of wheel. To provide equal safety on all sizes of wheels would require, therefore, a graduated difference in taper. A hood with adjustable tongue furnishes equal protection for a wide range in diameter of wheels. A hood adjustable to base of grinding machine also serves same purpose.

Cost of operating a given grinding machine is of importance. Adjustable hoods have the better of the argument, for as the wheel wears, protection flanges must be changed frequently. Such change involves the removal and remounting of the two flanges and wheel; whereas with hood, the change would involve merely setscrew adjustment.

To provide adequate protection for large wheels, the thickness of flanges should be increased beyond those of any flange now on market. This adds momentum to the revolving spindle, which, in turn, would require greater rigidity and strength than is found in the majority of present day grinding machines.

*From paper by R. G. Williams, of Worcester, Mass., presented at Chicago convention of American Foundrymen's Association.

Laws in almost every country and state require removal of dust from dry grinding. This requires a hood, and if a hood is used, it might just as well be strong enough to offer protection in case of accident. A proper hood offers complete protection. Where a hood would interfere with proper use of wheel, a tapered wheel mounted between flanges of a corresponding taper affords the next best method of protection.

PATENTS OF GERMAN AND AUSTRIAN INVENTION.

As provision has been made for the voidance or suspension of patents owned by German or Austrian patentees, a list has been prepared of such patents issued during the month of June, 1914. Those pertaining to engineering and allied industries appear below. A later issue will contain a compilation of such patents issued during the month of July to patentees in these countries.

1. 155947, June 2, 1914, projectile.
2. 155958, June 2, 1914, ball bearing.
3. 155959, June 2, 1914, ball bearing.
6. 156006, June 2, 1914, electric soldering.
7. 156015, June 2, 1914, process of butt-welding rails.
9. 156030, June 2, 1914, firearm.
10. 156066, June 9, 1914, igniter for shells, mines, etc.
11. 156116, June 9, 1914, surface for controlling electrically operated mechanism.
13. 156152, June 9, 1914, piston.
14. 156168, June 9, 1914, pump.
17. 156192, June 9, 1914, glazed mortar coating.
18. 156211, June 16, 1914, steel production.
19. 156212, June 16, 1914, telephone station.
22. 156220, June 16, 1914, apparatus for cooling superheater pipes.
23. 156245, June 16, 1914, cartridge magazine for firearms. Hungary.
26. 156376, June 23, 1914, filter.
27. 156378, June 23, 1914, nitrogen production.
30. 156440, June 23, 1914, electric switch for lamps.
32. 156452, June 23, 1914, wireless telegraphy system.
34. 156498, June 23, 1914, mitering machine.
35. 156506, June 30, 1914, crimping machine.
38. 156537, June 30, 1914, electrolysis of alkali of Halogenes.
39. 156543, June 30, 1914, motor plough mechanism.
40. 156621, June 30, 1914, sound transmitting machine.
41. 156628, June 30, 1914, process of and apparatus for making hollow building blocks.
42. 156630, June 30, 1914, mower and harvester mechanism.
43. 156640, June 30, 1914, cement reinforcement.
44. 156642, June 30, 1914, machine for gauging railway tracks.

Anyone interested may, on payment of a fee of $10 to the Commissioner of Patents, make application to have any one of these patents set aside or suspended. It will be necessary for the applicant to show that he intends to manufacture the invention, and that it is in the interests of Canada, or part of Canada, or of a particular trade, that he should be permitted to manufacture the patented invention. It is within the discretion of the Commissioner, then, to void or suspend the patent.

We are indebted to Messrs. Ridout and Maybee, Toronto, solicitors of home and foreign patents, for the above list.

EFFECT OF ELECTROLYSIS ON THE COMPRESSIVE STRENGTH OF CEMENT AND CONCRETE.

THIS is the subject of a paper read recently at a meeting of the American Institute of Electrical Engineers by C. E. Magnussen and B. Izhuroff, enlarging upon a previous paper entitled "The Electrolytic Corrosion of Reinforced Concrete," presented in 1911. In the earlier paper it was stated that the results obtained were not entirely conclusive, as the experiments were of only 30 days' duration. The series dealt with in the present paper continued for several months and the conclusions corroborate the results reported in the former paper. For the current density covered by the experiments, the current was found to produce no change in the compressive strength of concrete tubes, from which it is deducted that the failures of reinforced concrete due to electrolysis are due entirely to the forces produced by the increase of volume when iron is changed to iron oxide, and not by any direct action of the current upon the concrete.

This series of experiment was begun in September, 1912. Exceeding care was taken to keep the cubes moist. By tightly wrapping them with rubber and friction tape practically all electrical leakage was eliminated, so that all of the current in each circuit was made to pass through the cubes in series.

The tensile strength of the cement used complied with the specifications for standard Portland cement, as given by the American Society for Testing Materials. Chemical analysis and physical test data for this cement are given in Table I.

TABLE I.

Chemical analysis and physical test of the cement.

SiO_2		21 %
AlO_3		7 %
Fe_2O_3		2 %
CaO		66.5%
MgO		1 %
SO_4		0.5%
Na_2O and K_2O		2 %
Specific gravity		3.12%
Fineness:—		
Weight of sample	50.0 gr.	
Aver. of 3 sample	retained on 200 mesh..7.9 gr.,	14 %
	" " 100 " ..0.29 "	0.58%
	" " 50 " ..0.02 "	0.04%
Normal consistency 400 gr. cement	88 gr. water	21.6%
Penetration		10.5%
Tensile Strength:—		
Aver. of 3 sample	24 hours	108 lb.
	7 days	499 "
	28 days	717 "

The data from a chemical analysis and specific resistance are given in Table II. for the "fresh water" used.

TABLE II.

	Mg. per l.
Nitrics	0.0
Nitrates	0.0
Free ammonia—a trace	
Albumenoid ammonia	0.0
Free oxygen	0.8
Chlorine	3.5
Total solid	41.0
Fixed solid	21.0

Electrical conductivity per cm^3	at 20° C.	at 30° C.
Cedar River water	20,100 ohms.	15,600 ohms.
Fifth normal NaCl solution	54.4 "	45.4 "

The "salt water" used was a 3 per cent. NaCl solution in the above water.

Natural sand, screened to pass a sieve having 20 meshes per linear inch and retained on a sieve having 30 meshes, was used.

The gravel was screened to pass a sieve having 4 meshes per linear inch, and retained on a sieve having 8 meshes.

Two hundred and forty 2-inch (5-cm.) cubes were made as follows:

(*a*) Sixty cubes of cement with "fresh water."
(*b*) Thirty-six cubes of mortar with "fresh water." Ratio of cement to sand, 1 : 3.
(*c*) Twenty-four cubes of concrete with "fresh water." Ratio of cement : sand : gravel = 1 : 1 : 1.
(*d*) Sixty cubes of cement in "salt water."
(*e*) Sixty cubes of concrete in "salt water." Ratio of cement : sand : gravel = 1 : 1 : 1.

The cubes were made in accord with the specifications of the Committee on Uniform Testing of Cement, American Society of Civil Engineers.

Six bronze molds were used and six cubes were made at a time, and in the tables this is termed a "set." In making the cubes due care was taken to secure uniform conditions. The consistency was adjusted to give a reading of ten on the scale of a Vicat needle. The cubes were kept in the molds under cover of a damp cloth, to keep the air moist for 24 to 28 hours. At removal from the molds each was numbered, and then immersed in water "fresh" for groups (*a*), and (*b*), and (*c*), and "salt" for (*d*) and (*e*), where they were kept for forty to sixty days.

Four cubes from each set were then placed in the electric circuit; No. 1 nearest the anode, next No. 2 and No. 3 with No. 4 nearest the cathode. The remaining two cubes, No. 5 and No. 6, were kept in the water as control. As the four cubes in the electric circuit were kept moist throughout the experiment the only factor affecting cubes No. 1-4 more than No. 5-6 would be the electric current passing through the former.

The arrangement of the cubes and the wiring are shown in Fig. 2. At each end an iron plate was placed, extending a little beyond the surface of the cubes, and having a copper wire soldered to one edge for electrical connection. A glass plate and a rubber strip were placed outside the iron for insulation and the whole secured by a wooden clamp. By means of this clamp pressure could be applied so as to give a fairly good contact between the iron plates and the cubes, and also to bring the four cubes into close contact. The sets were wrapped tightly with rubber tape, and this secured by friction tape. In order to keep the cubes moist small openings were made through the tape on top of the cubes. These openings were covered by inverted test tubes, full of water, salt or fresh according to which had been used in making the cubes. See Fig. 1. Absorbent cotton was placed under the test tubes and in this way the water could slowly seep through the cotton and keep the cubes moist. A storage battery of 60 cells in series with a lamp bank was connected to the iron plates. The voltage was applied continuously.

The currents in the circuits were characteristically irregular. The iron plates corroded at the anode ends of all the sets. In the salt water sets the corrosion was much more rapid than with the fresh water cubes. The cotton under the test tubes near the anode became saturated with the iron oxide. In the salt water sets the discoloring appeared in a few hours, while with the fresh water three or four days were required. In set No. 7 the cotton was colored a greenish blue or Fe_3O_4, while all of the rest showed the red color of Fe_2O_3.

No odor was noticeable from the fresh water cubes. The chemical reactions probably consist simply of a decomposition of water and the formation of iron oxide.

$$3\,H_2O \longrightarrow 6\,H + 3\,O$$
$$3\,O + 2\,Fe \longrightarrow Fe_2O_3$$

No tests were made to determine a possible migration of sulphates and other salts.

An odor of chlorine accompanied the reactions in the salt water sets. The following equations give the main reactions:

$$4\,NaCl \longrightarrow 4\,Na + 4\,Cl$$
$$4\,Cl + 2\,H_2O \longrightarrow 3\,H\,Cl + H\,ClO + O$$
$$H\,Cl\,O \longrightarrow H\,Cl + O$$
$$2\,Fe + 3O \longrightarrow Fe_2\,O_3$$
$$Fe_2O_3 + 6\,H\,Cl \longrightarrow 2\,Fe\,Cl_3 + 3\,H_2O$$

The chlorine odor indicates the presence of hydrochloric acid and this may cause a secondary reaction that might affect the crushing strength of the cubes.

Testing Cubes.—Finally, the cubes in the electric circuit and the controlling cubes were tested for their compressive strength, using a Riehle 60,000-lb. testing machine. All cubes were tested under as nearly identical conditions as possible, using the same machine and at the same speed. One half of the tested cubes was crushed in the direction of the flow of the current, and the other

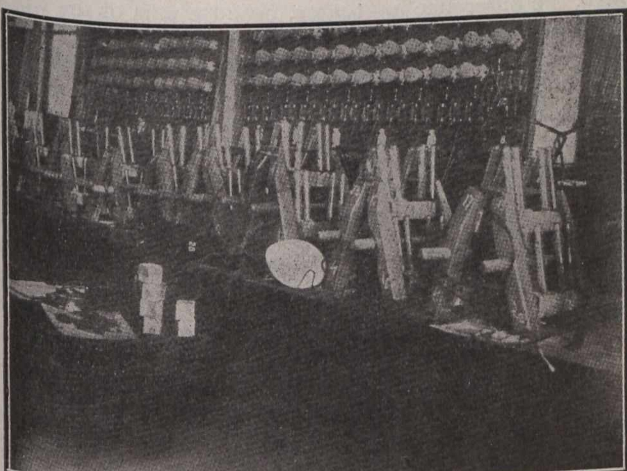


Fig. 1.—Arrangement of Test Apparatus.

half was tested in direction perpendicular to the flow of the current. (Fig. 3). One half of the control cubes was crushed in the direction of the open ends of the bronze mold and the other half in the direction of the sides of the mold.

Summary.—(*a*) The compressive strength of fresh water cement cubes was not affective by an average current density of 1.2 milliamperes per square inch (0.17 milliampere per cm²) applied for 310 days.

(*b*) The compressive strength of fresh water concrete cubes was not affected by an average current density of 1.8 milliamperes per square inch (0.26 milliampere per cm²) applied for 225 days.

(*c*) The compressive strength of salt water cement cubes was probably not affected by an average current density of 10.2 milliamperes per square inch (1.4 milliampere per cm²) applied for 113 days.

(*d*) The compressive strength of salt water concrete cubes was not affected by an average current density of 13.8 milliamperes per square inch (1.9 milliampere per cm²) applied for 110 days.

For (*a*), (*b*), (*d*) the average values for the cubes treated with the electric current were 1, 2, 3.0 and 2.5 per cent. respectively stronger than the corresponding control cubes. For group (*c*) the cubes in the electric circuit were 14 per cent. weaker than the control. An examination of the crushing strengths shows that the ap-

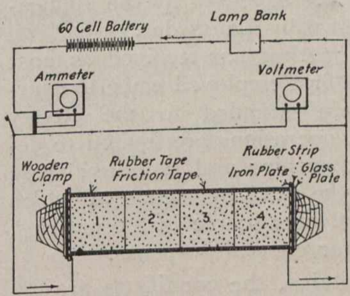


Fig. 2.

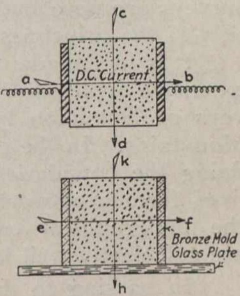


Fig. 3.

parent decrease is most likely due to a chance selection of too many of the stronger cubes for the control. If any action were due to the current the liberated chlorine would be the most likely agent. Since the chlorine is liberated at the positive pole it would appear at cube No. 1. In sets No. 22 and No. 23, the cube No. 1 was weakest, but in sets No. 27 and No. 29, cube No. 1 was strongest. Moreover, cube No. 1 in set No. 29 was the strongest in the whole series and hence not likely to have been weakened by the current. The series shows less uniformity in strength than the cubes in either (*a*), (*b*) or (*c*).

Averaging the averages for the four groups, the strength of the cubes Nos. 1, 2, 3 and 4 was only 1.8 per cent. less than the control cubes Nos. 5 and 6; and this difference is well within the errors of the experiment.

Summarizing the results, we find that for the current density covered by the experiments the current produces no change in the compressive strength of the cubes. This is in accord with the preliminary observations in the earlier paper (A.I.E.E. Trans. XXX., p. 2067).

Within the limits of current density for which these conclusions apply, it follows that failures in reinforced concrete due to electrolysis are due entirely to the forces produced by increase in volume when the iron is changed into iron oxide and not by any direct action of the electric current upon the strength of the concrete.

Messrs. Hering and Fuller, consulting engineers, of New York, made a periodical inspection of the filtration plant under construction at Montreal last week. It is reported that the proposed extension, which the Board of Control intends to carry out next year, was also under consideration.

A new process of manufacturing white lead is being tried out in the United States, and is being watched with interest by Canadian paint manufacturers and engineers who have occasion to specify lead paints. It is called the Euston Process, and is followed by the Euston Process Co., Scranton, Pa. Mr. Euston claims his lead has great uniformity, smoothness, tenacity and opacity; that it is non-checking, adhesive and durable. The particular advantage of this process seems to be the rapidity with which the lead can be manufactured compared with older methods.

PHOTOGRAPHIC SURVEYING.

THE photographic method of surveying is sometimes known by the names phototography and topophotography. The principle is to measure by means of perspectives, usually photography. The conception of this method is due to Laussedat (Austria). His first experiments, according to Dr. Deville's book on the subject, were made in 1849, the perspectives being drawn with a camera lucida. Shortly after, he substituted photography for the camera lucida. Wherever photographic surveys are now made, they are executed by the application of the principles laid down by Laussedat.

It is in Canada that the method has received its most extensive application; it was first employed when the surveys of Dominion lands were extended to the Rocky Mountains. In the prairies, operations are limited to defining the boundaries of townships and sections; these lines form a network over the land by means of which the topographical features, always scarce in the prairies, are sufficiently well located for general purposes.

In passing to the mountains, the conditions are entirely different. The topographical features are well marked and numerous; the survey of the section lines is always difficult, often impossible, and in most cases useless. The proper administration of the country required a tolerably accurate map, and means had to be found to execute it rapidly and at a moderate cost. The ordinary methods of topographical surveying were too slow and expensive for the purpose; rapid surveys, based on triangulations and sketches, were tried and proved ineffectual; then photography was resorted to.

Up to 1892, the photographic surveys were confined to the Rocky Mountains, in the vicinity of the Canadian Railway; at the end of that year, they covered about 2,000 square miles. In the same year, an International Boundary Commission was appointed to examine the country along the boundary between Canada and the United States territory of Alaska. The Canadian Commissioner, Mr. W. F. King, decided to carry out his share of the work by photography. In 1893 and 1894, his parties surveyed about 14,000 square miles.

Irrigation surveys were commenced in the southwesterly part of the North-west Territories, where the rainfall is not quite sufficient for agricultural purposes. In addition to the gauging of streams, the establishment of bench marks, etc., it is necessary to ascertain the catchment areas and to define the sites best adapted for reservoirs. For this purpose photography has again been resorted to in the foot hills and on the eastern slope of the mountains. It has, in this case, a peculiar advantage. Whether or not a site is a favorable one for a reservoir cannot be known until the plan has been partly plotted. It must be possible to bring water to the proposed place and to run it off; the capacity must also be adequate. If favorable, a detailed survey of the site is required. With the ordinary surveying instruments, a preliminary survey has to be made; if, after plotting it, the site is found favorable, the topographer has to go over the ground a second time to make a detailed survey. Or, the whole of the work may be executed at once, with the contingency that the detailed survey may turn out useless. With the camera, the plan may be plotted so far, and so far only, as required; the photographs which furnish a general plan can be made to give all the detail wanted without going again into the field. Whether the site is a good one or not, there is no labor wasted.

Notwithstanding the many publications on photographic surveying, the great advantages assigned to it and the numerous experimental surveys executed, it has not yet come into general use; in many quarters there is still an adverse feeling against it. There is such a fascinating simplicity about the method that it is at first difficult to understand the reasons which prevent its adoption. Can anything more convenient be conceived than a method which enables a topographer to gather rapidly on the ground the material for his maps and to construct them afterwards at leisure in his office?

Dr. Deville in his book says: "Assuming that the plane table can be used in the field whenever the weather is fair enough for the camera, which is not always the case, also that the topographer can plot and draw in the field as quickly as in the office, where he has every convenience at hand, the same survey by the plane table would require the same length of time at actual work or four days. To this we must add four days lost on account of the weather, or eight days altogether.

"The cost of our parties in the field is $20.50 per diem; at office work the only expense is the salary of the topographer, $5.00 per diem. Summing up, we find the comparative cost as follows:

Plane Table—	
8 days in the field, at $20.50 per diem	$164.00
Camera—	
2 days in the field, at $20.50 per diem	$ 41.00
3 days in the office, at $5.00 per diem	15.00
	$56.00

"This shows that the plane table survey would cost at least three times as much as the camera survey. In reality, the difference is greater, because part of the work, as well on the ground as in the office, is executed by the assistant, an arrangement which cannot very well be made with the plane table. The figures above are derived from our practice; with more views or more detailed plotting, the difference in cost would be still more in favor of the camera.

"If we analyse the causes of the superiority of the camera, we find that a very small portion of the topographer's time is spent in surveying operations. Nearly the whole of it is devoted to travelling for the purpose of seeing the country and he can map all that he, or rather his camera, can see. His work consists of two distinct parts; on the ground he simply collects data, and, with the exception of a few angles, does not waste any of his time in plotting or making measurements. This is left for the office, where the only expenses are the salaries of the surveyor and assistant. In the next place, the party consisting of an assistant and two men is, if not smaller, at least as small and inexpensive as for any other kind of survey. One man is sufficient to carry our camera and tripod almost anywhere, while an ordinary plane table, if it could be taken where our camera has been, could not be carried there by any single man.

"It is objected that plotting from photographs is more laborious than plotting on the plane table. There is, indeed, a slight additional labor; against this may be set off the fact that no useless line is ever drawn, as when, on the plane table, a point is sighted upon which cannot be recognized from the next station. The greater convenience of working in an office, instead of in the open air, turns the scale in favor of the camera. But photography has an overwhelming advantage in the numerous processes which the laws of perspective place at the disposal of the topographer. The plane table cannot compete with the perspectometer or the perspectograph.

"Another objection is, that points cannot be so easily identified on photographs, nor the forms of the surface so truly represented, as when the topographer has the ground under his eyes. This is a mistaken idea; there is no difficulty whatever in identifying any number of points on moderately good photographs, and, moreover, the topographer does not need, as with the plane table, to trust to his memory in order to recognize them. The undulations of the ground are, it is true, less distinct on the photographs, but this is more than compensated by the advantage of having, side by side, views of the same place from several stations."

Surveying Cameras.—The number of instruments devised or proposed for photographic surveying is considerable. They are divided into three classes:—

(1) Ordinary cameras.
(2) Surveying cameras or "photogrammeters."
(3) Photo-theodolites.

Ordinary cameras must be provided with a level; the relative positions of the plate and lens must be invariable, and when adjusted, the plate must be exactly vertical.

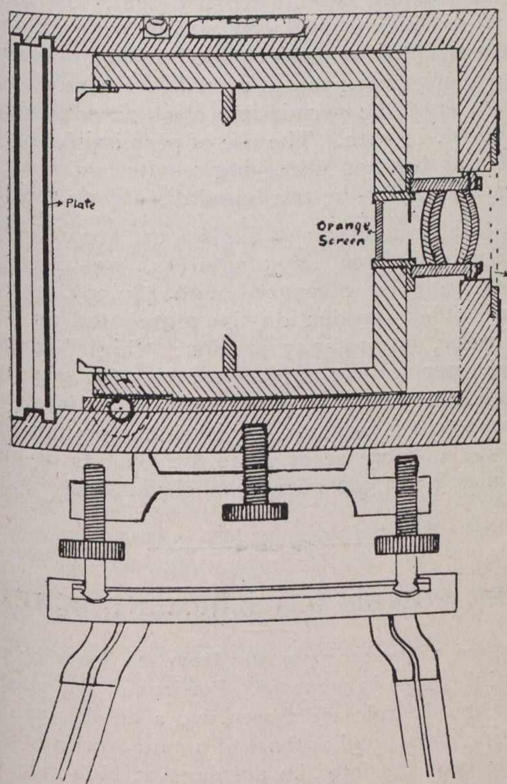


Fig. 1.—Sectional View of the Deville Surveying Camera.

The horizon is determined by two zenith distances of well-defined objects as far apart as possible. The principal points are ascertained from the azimuths of at least three points. It is expedient to make these determinations for every photograph. See specimens of plotting Figs. 2 and 3 (Wheeler).

The employment of ordinary cameras for surveying is not recommended. The present Surveyor-General, Dr. Deville, has invented a camera suitable for this work. A section of this camera is shown in Fig. 1. There are, however, many patterns of surveying cameras, one of the earliest is Meydenbauer's. It is a camera with tapering bellows set on a horizontal circle; it moves on a vertical axis.

Canadian Equipment.—The equipment of a party on the Canadian Surveys consists of a transit theodolite and two cameras. The transit theodolite and its tripod are carried by the surveyor, and a camera without the tripod by one of the men who always accompanies the surveyor. The assistant has his own camera with a tripod.

The transit is one of the ordinary patterns used by surveyors. It has three inch circles and reads to minutes. The tripod is a short one, specially designed for mountain work. It is three feet four inches long and has sliding legs, the joint being perfectly stiff. The surveyor observes

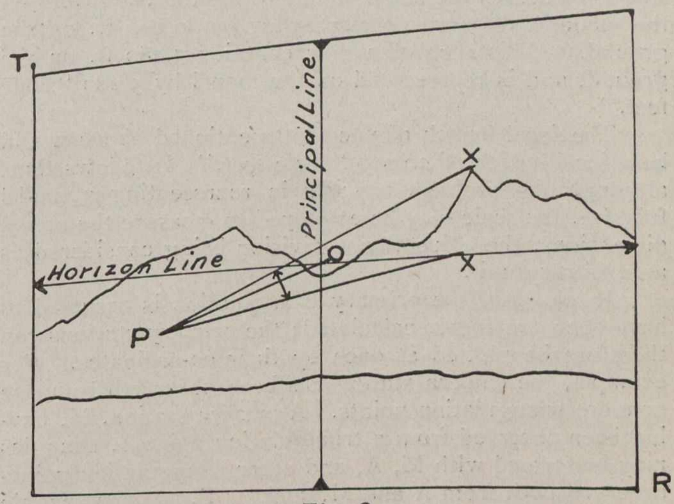


Fig. 2.

either in a sitting or kneeling position. For the purpose of packing, the head of the tripod is taken off and put in the transit box; when folded, the legs are twenty inches long and are placed under the box of the transit, as shown in frontispiece. The heavy parts of the instrument are made of aluminum; the whole, including tripod

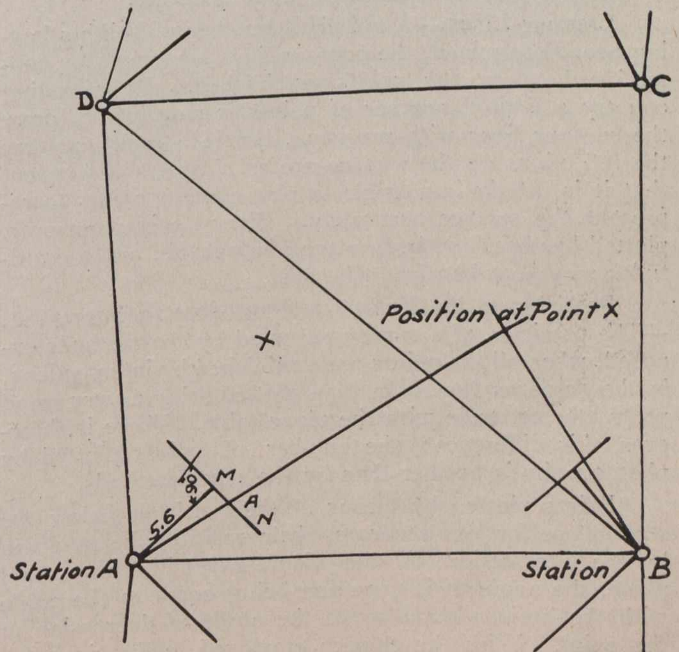


Fig. 3.—Specimens of Photographic Plotting (Wheeler).

and case, and also the camera base, weighs fourteen pounds and eight ounces.

Plotting the Survey.—The minutes of Canadian surveys are plotted on a scale of 1/20,000. They are afterwards reduced for publication to 1/10,000. The equidistance is 100 feet.

The angles measured are equal to those on the ground, for any triangle ABC of the ground is represented on the model by a similar triangle *a b c*. The altazimuth set in *a* gives between *b* and *c* the same angle as it would between B and C, if set at A.

Thus, if the plan be required on a scale of 1/20,000, the model is assumed to have been reduced to that scale, and the problem consists in making a plan full size by means of angles and photographs obtained on the model.

No change being made to the camera, the focal length preserves the same value; if one foot, it covers on the model a distance corresponding to 20,000 ft. on the ground. A distance of a mile contains 5,280 ft. on the ground, and is represented on the model by 5,280 "scale feet."

The focal length of one foot mentioned above would be a focal length of 20,000 "scale feet." It follows that, although the problem consists in representing a model full size, the scale may be employed to measure the actual dimensions, the value of one division being considered as an arbitrary unit.

In plotting, the primary triangulation is assumed to have been previously calculated; the primary stations can therefore be plotted at once by their co-ordinates. For example, the camera station has been observed from one or more triangulation points. A camera station, M, having been observed from a triangulation point A, triangles may be formed with M, A, and other triangulation points observed both from A and M, such as B. In the triangle MAB, the angles at M and A have been observed, and $B = 180° — (A + M)$. Similar calculations made for other triangulation points give the directions of the station as seen from these points; the plotting is done as if the station had been observed from every such point.

From the foregoing it is evident that the surveyor should endeavor to obtain at least one direction from a triangulation point on every camera station; the plotting is less laborious and the result more accurate.

Contour Lines.—A sufficient number of heights having been determined, the contour lines are drawn by estimation between the points established. In a rolling country a limited number of points is sufficient to draw the contour lines with precision, but in a rocky country the reflections on the surface are so abrupt and frequent that it is utterly impossible to plot enough points to represent the surface accurately. Every point, however, plotted has been marked on the photograph, and the altitudes may be taken from the plan.

Precision of the Method of Photographic Surveying.—The precision of a survey executed by the methods exposed, when all the points are established by intersections, is the same as that of a plan plotted with a very good protractor or made with the plane table. There is, however, this difference: the number of points plotted by photography is greater than by the other methods.

Points plotted by means of their altitude below the station are far less accurate, their positions being given by the intersection of the visual ray with the ground plane, the angle of intersection being equal to the angle with the horizon plane or to the angle of depression of the point. With the camera employed, embracing 60°, this angle is always less than 30°; even that is seldom obtained in practice, a declivity of 30° being almost a precipice. Therefore, the intersection is always a poor one and the uncertainty becomes considerable with points near the horizon.

With perspective instruments, doing mechanically the same construction, the results are still less precise, being affected by the instrumental errors.

On the other hand, it must not be forgotten that when these methods are employed, the ordinary topographer would fall back on sketching; the results furnished by topography are therefore indefinitely more precise.

UNITED STATES PRODUCTION OF EXPLOSIVES.

As explosives are essential to mining, and the use of improved types of explosives lessens the dangers of mining, the U.S. Bureau of Mines undertook the compilation of information showing the total amount of explosives manufactured and used in that country, its first report dealing with the year 1912. It now issues the second technical paper relating solely to the production of explosives. It is expected that similar publications will be compiled annually, and that with the co-operation of the manufacturers these statements will be published within a few weeks after the end of each year.

The figures show that in 1902 only 11,300 pounds of permissible explosives was used in coal mining, whereas in 1913 the quantity so used was 21,804,285 pounds. The quantity of permissible explosives used in the United States is larger than in a number of other countries. In 1912 it represented about five per cent. of the total quantity of explosives produced, and in 1913 six per cent. The total amount of explosives used for the production of coal in 1913 was 209,352,938 pounds, of which about ten per cent. was of the permissible class as compared with eight per cent. in 1912. The use of permissible explosives in coal mining has had gratifying results, and few, if any, serious accidents can be attributed directly to their use.

The total production of explosives, according to the figures received from manufacturers, was 463,514,881 pounds in 1913, as compared with 489,393,131 pounds for 1912. This production is segregated as follows: Black powder, 194,146,747 pounds; "high" explosives other than permissible explosives, 241,682,364 pounds; and permissible explosives, 27,685,770 pounds. These figures represent a decrease of 36,146,622 pounds of black powder and an increase of 7,212,872 pounds of high explosives and 3,055,500 pounds of permissible explosives.

NOVEL POWER DEVELOPMENT SCHEME.

A method of producing power from sea water by the rise and fall of the tides is proposed. Portions of the coast where high tides are the rule are chosen and a number of clefts in the cliffs are constructed or those of nature especially adapted. The water runs far into the openings at high tide and by means of pipes is trapped into a huge reservoir. Where the tide falls hundreds of gallons of water are thus left behind. Being on a high level it is then a comparatively simple matter to drop this water by means of pipes to a level many feet below and utilize the power thus obtained by the usual water jets acting on specially constructed wheels.

The latest statistics regarding the development of wireless telegraphy in the German Empire are up to the beginning of 1913. At the beginning of that year there were 23 coast stations and 376 ship stations. Of the coast stations, 12 were open to general traffic, 10 with limitations, and 1 for official use. Of the ship stations, 237 were for public, 134 for official, and 5 for private traffic. The number of wireless telegrams sent from the shore to the ships in 1912 was only 5,312; in the contrary direction, 14,893. Between ships 7,242 telegrams were exchanged. This makes a total traffic in telegrams of 27,447. Receipts for the year totalled 250,000 marks. In these figures the German Protectorates are included.

THE MAKING OF SOUND STEEL INGOTS.*

By Bradley Stoughton, Ph.B.,
Consulting Metallurgical Engineer, New York, N.Y.

THE metallurgist of to-day bears almost the same relation to steel as a doctor does to his patient. Where formerly a simple examination and a small number of tests completed a diagnosis, to-day the physician investigates the physical life history of the patient, together with some matters in the physical life of his parents and grandparents. The metallurgist also is not now content with the condition of the steel as revealed by mechanical and physical test, but wants to be informed as to its life history during manufacture, and as to the quality of pig iron from which it was made and the conditions prevailing during the conversion and during the the manufacture of the pig iron itself.

It is comparatively easy to tell by the usual tests whether the structure and composition of steel attain a given standard or quality, but certain dangerous defects, which may be inherent in the metal, will often escape the customary inspection, and may be difficult to discover even by such extraordinary investigations as sulphur-prints, microscopic examination, hardness tests, shock tests, etc., unless these are carried on at such an extensive scale as to destroy the steel for service. Defects of this character are generally classified under the head of unsoundness, and the chief ones may be described as follows:—

1. Presence of blow-holes;
2. Presence of combined and occluded oxides;
3. Presence of an unwelded shrinkage cavity; and
4. Excessive segregation.

The most effective means of preventing these elements of unsoundness is the exercise of great care and watchfulness during the manufacture of the steel, and also during the manufacture of the iron from which the steel was made, because it now seems to be removed practically beyond controversy that certain unfavorable conditions during the smelting of iron ores in blast furnaces will produce a grade of pig iron which, during the ordinary process of manufacture, will be converted into an unsatisfactory grade of steel. It is not our purpose to discuss this matter at length in this paper, but the literature on cast iron during the years 1913 and 1914 will afford ample proof of the accuracy of this statement. Fortunately, careful and expert inspection of the manufacturing process, and suitable testing of the product, are sufficient to prevent steel of this undesirable quality going into service.

Expert care and inspection during the manufacture and rolling of steel is also the best safeguard for preventing unsound metal from any of the other causes mentioned above going into the service of the consumer. Steel that is dangerously filled with blow-holes, or which is badly segregated, will give some indications of this condition during the ingot-forming or rolling stages. The presence of a residual unwelded shrinkage cavity can usually be prevented by proper inspection during cropping, although this is not an infallible safeguard. Oxide inclosures result from improper conditions of manufacture during the conversion of ingot-forming stages, such as: too late addition of ore to the open-hearth furnace; improper composition of the final open-hearth slag; insufficient fluidity of metal; wildness; excessive or improper addition of deoxidizers in the melt, etc.

The subject of prevention of oxide inclusion has received a good deal of attention from several eminent investigators during the past two years, and a number of remedies have been suggested. The most effective means which has been extensively applied during manufacture is the addition to the liquid bath of steel of properly proportioned quantities of titanium alloy.

Segregation does not occur to a dangerous extent when the phosphorus and sulphur are reduced to reasonable limits, provided the steel is properly deoxidized before teeming; is not wild in the moulds, and is poured in ingots not exceeding 5 to 10 tons each in weight. The larger the ingot, the smaller should be the proportion of sulphur and phosphorus in the steel, and ingots of very massive sections should not be used, unless the central core is to be drilled out and discarded, as is the case in the manufacture of large guns, for example.

The presence of blow-holes is not dangerous in low-carbon steels, except in certain situations, the causes for which are now well understood and can be eliminated. In medium and high carbon steel, the presence of blow-holes will always be indicated by the action of the liquid metal in the moulds, and suitable care in manufacture forbids such material going further in the manufacturing process. The careful steel-maker sends it at once to the scrap pile.

The prevention or elimination of the shrinkage cavity in steel ingots and castings without prohibitive expense, or equally prohibitive complication in manufacture, has taxed to the utmost the ingenuity of metallurgists, and many hundreds of thousands of dollars have been spent in experiments and investigations of numerous schemes and inventions. For many years the compression of the ingot during the process of solidification, in order to reduce the size of its outer envelope and thus compensate for the shrinkage taking place during solidification, has been practised at steel works where steel of the highest quality is made. The expense of this compression process, consisting of interest on investment, complication in the process of manufacture, and cost of operation, is not wholly compensated for by the lesser proportions of the ingot which has to be converted into scrap. The compression during solidification is also claimed to improve the strength of the metal, and this claim, although not granted by all metallurgists, has some practical evidence in its favor.

An English and an American investigator have used the compression process for elimination of the pipe in a way which aims to eliminate interference with the manufacturing process and interest on the investment, by taking the steel ingot before it has completely solidified and reducing its section in an ordinary pair of blooming rolls; then returning it to the heating furnace until entirely solidified, and subsequently completing the rolling operation in the usual way. Other recent investigators have aimed to accomplish a reduction in the cost of treating the steel by substituting some other method for the compression process, but none of these newer inventions secures the elimination of the shrinkage cavity, but only its reduction to a smaller size or a greater concentration at the top of the ingot, with consequent smaller proportion of cropped-off metal being necessitated.

Sir Robert Hadfield burns charcoal on top of the steel ingots in a special mould with a sand top, so as to delay the cooling of this portion of the metal and consequently draw the shrinkage cavity to that point.

*From a paper read before the Mining and Metallurgical Section of the Franklin Institute.

Emil Gathmann, by a very ingenious method of casting ingots with the smaller end down and then stripping them without excessive inconvenience, as well as by distributing the metal in his ingot moulds, also produces a more rapid cooling of the lower parts of the ingot than of the top, and thereby concentrates the cavity in the upper portion.

The Goldschmidt process involves heating the metal in the top of the ingot by the well-known thermit reaction, or else by creating a stirring reaction in the ingot by means of a can of thermit through which, it is claimed, blow-holes, pipes, and segregation are all reduced.

Each of these cavity-reducing processes has been tried on a commercial scale long enough to prove its advantage under a given set of conditions. It is probable, however, that, in the production of very large quantities of steel, cropping off as much of the ingot as is necessary to remove the shrinkage cavity is cheaper than introducing a complication into the process of manufacture, and that careful inspection is an adequate safeguard for avoiding the dangerous defect in finished steel known as an unwelded pipe in the great majority of cases.

FOURTH AMERICAN ROAD CONGRESS.

Final arrangements for the Fourth American Road Congress, to meet in Atlanta, Georgia, during the week of November 9-14, are nearing completion. All indications point to a record-breaking attendance and exceptionally strong program, while the demand for exhibit space on the part of manufacturers will far exceed the supply of space available.

The Construction and Maintenance Section program as now made up is as follows:

Drainage Structures.—By W. F. Atkinson, state highway engineer of Louisiana. Discussion opened by S. D. Foster, chief engineer, State Highway Department of Pennsylvania.

System in Road Management.—By C. J. Bennett, Highway Commissioner of Connecticut. Discussion opened by Paul D. Sargent, state highway engineer of Maine.

Maintenance Methods and Relation to Traffic.—By George W. Cooley, state engineer of Minnesota. Discussion opened by H. R. Carter, state highway engineer of Arkansas.

Convict Labor.—By George P. Coleman, state highway commissioner of Virginia. Discussion opened by J. E. Maloney, state engineer of Colorado.

Rights of Way.—By Austin B. Fletcher, highway engineer of California. Discussion opened by W. S. Gearhart, state engineer of Kansas.

Surfaces for Light Volume Mixed Traffic.—By S. Percy Hooker, state superintendent of highways of New Hampshire. Discussion opened by Frank F. Rogers, state highway commissioner of Michigan.

Efficiency in Highway Organization, Centralization of Purchases.—By E. A. Stevens, state highway commissioner of New Jersey. Discussion opened by John S. Gillespie, Road Commissioner of Allegheny County, Pennsylvania.

State Control of Road Work as a Policy.—By A. N. Johnson, former state highway engineer of Illinois. Discussion opened by T. H. MacDonald, state highway engineer of Iowa.

Engineering Supervision of Road Construction.—By W. S. Keller, state highway engineer of Alabama. Discussion opened by R. C. Terrell, state highway commissioner of Kentucky.

Economics.—By J. E. Pennybacker, chief, Division of Economics, U.S. Office of Public Roads.

Educational Field for Highway Departments.—By Dr. Jos. Hyde Pratt, state geologist of North Carolina. Discussion opened by Col. Sidney Suggs, state highway commissioner of Oklahoma.

Heavy Traffic Roads.—By Henry G. Shirley, chief engineer, State Roads Commission of Maryland. Discussion opened by W. A. Hansell, superintendent of public roads, Fulton County, Georgia.

Grades and Excavation.—By A. D. Williams, chief road engineer of West Virginia. Discussion opened by Wm. R. Roy, state highway commissioner of Washington.

Problems of Street Construction and Maintenance.—By Charles E. Bolling, city engineer, Richmond, Virginia. Discussion opened by F. L. Ford, city engineer, New Haven, Conn.

Road Binders and Palliatives.—By chief engineer, Rhode Island State Roads Commission. Discussion opened by Chas. W. Campbell, city engineer, St. Joseph, Mo.

Possible Lines of Improvement in Contract Highway Work.—By John J. Ryan, secretary, New York State Road Builders' Association. Discussion opened by L. D. Smoot, city engineer, Jacksonville, Florida.

The elaborate exhibit of the U.S. Office of Public Roads, which is being prepared for the Panama-Pacific Exposition, will be shown intact at the Road Congress and will include not only exact models of every known type of road, and the historical development of road building from the earliest times, but will also comprise special models showing road location, the beautifying of the roadside, and mountain road construction as exemplified in the splendid Swiss roads. The New York State exhibit will include at least one example of model work, which it is claimed will prove one of the most impressive exhibits at the Congress. A number of other states will have interesting exhibits in the form of models, maps and materials.

Information about the program and the Congress in general may be obtained from I. S. Pennybacker, Executive Secretary, and concerning exhibits from Charles P. Light, Business Manager, Colorado Building, Washington, D.C. The general officers of the Congress are as follows: Austin B. Fletcher, State Highway Engineer of California, president; Edward M. Bigelow, State Highway Commissioner of Pennsylvania, vice-president; W. E. Atkinson, State Highway Engineer of Louisiana, 2nd vice-president; A. N. Johnson, Former State Highway Engineer of Illinois, 3rd vice-president; C. A. Magrath, Chairman, Ontario, Canada, Highway Commission, 4th vice-president; Lee McClung, treasurer, former treasurer of the United States; John N. Carlisle, State Commissioner of Highways of New York, Chairman, Committee on Program; the Executive Committee comprises in addition to President Fletcher, George C. Diehl, Chairman, Good Roads Board, American Automobile Association; Logan Waller Page, President, American Highway Association and Director, U.S. Office of Public Roads; Richard H. Edmonds, editor of the Manufacturers' Record, and A. G. Batchelder, Chairman, Executive Committee, American Automobile Association.

Editorial

THE TORONTO-OSHAWA ROAD.

The construction of roads and the relief for the unemployed are phrases that accompany each other in the minds of the general public to such an extent nowadays as to be safely ranked as synonymous. From all parts of the Dominion we learn that there is talk of certain highway improvements in order to provide employment for the out-of-works. No doubt as the severity of winter sets in many Canadian towns and cities will regret that their good intentions did not materialize more substantially. It is a fact, nevertheless, that a great deal of time has been spent in promoting such enterprises and in overcoming quibles of one kind and another, that have resulted. It is now over two months, for instance, since the Hamilton-Toronto highway was quoted as being an assured fact and that little remained but to place the laborers at work. No work has been provided, however, and the approach of November is a stern reminder that the season for such work is practically at an end. Insofar as the unemployed are concerned, the municipalities interested can depend but little upon the proposed highway as an immediate work-providing channel, and they must therefore look elsewhere, to remedy the condition of the dinner-pail.

The regrettable delay in the above instance is more or less typical of similar delays elsewhere. It appears that, in the majority of cases the cause for dalliance has been the same—the opposition which some town or city council puts in the way, owing to a small detail or two being apart from its liking. Thomas A. Edison, the inventor, speaking last week at Chatham, Ont., in commenting upon the large numbers of unemployed, strongly endorsed the suggestion of the governmental building of trunk roads through the country. Besides affording employment during the period of industrial paralysis, brought on by the war, the roads thus built would be of inestimable value to the communities through which they would pass. Mr. Edison's advice, we are afraid, has fallen upon already well-informed ears. What the country needs most is a practical working out of a system whereby a proposal of this kind, so undoubtedly of great need in more ways than one, may be got under way before the season for the undertaking is over.

While the Toronto-Hamilton highway scheme is still impaled on the barbs of opposition to technicalities, with evidence of little or no progress this fall, there is an abundance of interest associated with the proposal of a permanent highway east from Toronto to Oshawa. A municipal deputation has been to the government asking for an immediate survey, an estimate of the cost, with a suggested assessment on each municipality. A 16-ft. concrete road with 4-ft. gravel shoulders is mentioned, and an alternative estimate for a macadamized road is asked. Although the Premier held out no immediate hope, as the present time is fraught by a number of difficulties in the way of raising money, he approved of the scheme on behalf of the government and stated that upon the realization of relief, which is expected early in the shape of a Federal grant for provincial highways, the matter would be proceeded with.

Further, the new Minister of Public Works assured the municipalities that the Department of Highways would make an immediate survey of the route and would shortly provide them with plans and estimates.

DEVELOPMENTS IN ELECTRIC TRACTION.

The entrance of electric power into the domain of the steam locomotive began in the early nineties with small trains in passenger service. Chicago, in 1893, where motor cars were used as electric locomotives, initiated in America the permanent invasion of the extensive steam service on elevated lines.

The earlier applications of electric power to regular steam railway service were in most cases for service in tunnels and railway terminals, with the object of eliminating the smoke and gases common to the use of steam locomotives. The Baltimore & Ohio Tunnel which commenced operation in 1895 was the first instance of electrification as applied to heavy traffic, and the first electric locomotives to successfully initiate the struggle for supremacy with steam locomotives under main line requirements.

"The electrification of main line service," states Mr. W. B. Potter, chief engineer, railway and traction department, General Electric Company, in the General Electric Review, "is no longer an experiment. The heaviest traffic can be successfully handled, and therefore there remains only the question of whether it will pay. As a rule, excepting the expense incident to the initial investment, the cost of operation with electric power will be less than with steam, and often this saving will show a handsome return on the investment. There are many instances, such as tunnels and terminals, where other considerations than the financial showing are of paramount importance. Even in such instances there are often local conditions where the value of property will be enhanced, or where territory necessary to steam service can be made available for other purposes and therefore remunerative.

"The possibility of handling heavier, or even equal trains at higher speeds is becoming better recognized as a means of increasing the tonnage over a given route, and so provide for an increasing traffic more economically than by the construction of additional lines under steam operation."

Electric locomotives for heavy traffic must be so constructed as to withstand the severe shocks and strains which occur in the handling of trains, and to facilitate inspection and maintenance the electrical and other equipment should be conveniently located. Much attention has been given to the development of different general types, and many varieties of electric locomotives differing both in mechanical design and electrical equipment have been built and tested.

Variations in the mechanical construction are influenced largely by different methods of transmitting the power from the electric motor to the driving wheels. The motor car and steam locomotive have both served as models, with innumerable variations in which their characteristics have been differently combined and in many cases with indifferent success. Geared or gearless motors mounted on the driving axle, or in special cases a combination of gearing and parallel rods, each with reference to its fitness for the particular purpose, are the most promising methods of drive. Guiding trucks will undoubtedly be used in high-speed service and doubtless at slower speeds with very heavy locomotives where the weight distribution on the track may be of importance.

The character of electrical equipment, considering the larger power required in main line service, is influenced by the problem of electric transmission to the locomotive and the collection of current from the conduction circuit. As the amount of current varies inversely as the voltage, the transmission and collection are therefore made easier at higher potentials. The development of equipment suitable for higher voltages has received much attention, and there are at present a number of important railway electrifications of this character on which alternating or direct current is used. The respective merits of alternating or direct current involve many details of which a very few are of general interest as influencing the trend of commercial development. As between the different systems the indications point strongly, however, toward the more general adoption of direct current for main line electrification and heavy railway service generally.

STANDARDS FOR THE TURBIDITY OF WATER.

In a paper read before the Illinois Waterworks Association by Francis D. West, chemist in charge of the Torresdale Laboratory, Philadelphia Bureau of Water, the author, in commenting upon the preparation of turbidity standards, regards the principle of correcting a standard determined by weight by the use of a field method as most unsatisfactory. No two laboratories nor any two persons in the same laboratory working independently in the preparation of silica standards, following the procedure outlined, will make standards exactly alike.

A field method is never accurate and the description of what is "An observation in the middle of the day, in the open air, but not in the sunlight, etc.," is a source of many possible interpretations. The amount of light, the size, shape and color of the vessel, the fineness of the material, to say nothing of the personal equation, all influence the results.

What is needed is a definite procedure by which standards can be duplicated from time to time by different chemists without variation.

Such a method has been in use in the laboratories of this bureau since 1901. It involves the use of diatomaceous earth, prepared as follows:

"Wash with water to remove soluble salts; dry and ignite to remove organic matter; treat and warm with dilute hydrochloric acid; wash until free from acid and dry thoroughly. Grind in agate mortar, sifting through 200 mesh sieve and dry in desiccator."

Take a weighed amount of finely ground material, about two grains, suspend in 500 c.c. of distilled water, shaking vigorously from time to time for two or three hours. Suspend for ten hours, decant supernatent liquid. Dry and weigh residue. The difference equals the amount in suspension. Dilute to standard and use as stock.

I have found that standards made in this way from different stocks do not differ perceptibly. All material that remains suspended for ten hours appears to be of the same degree of fineness.

We add a small amount of a saturated solution of mercuric chloride and make standards as follows: Use quart bottles of a high grade of white glass free from air bubbles. The standards are 0, 0.5, 1, 2, 3, 4, 5, 7, 9, 11, 14, 17, 20, 23, 26 parts per million silica. For readings above 26, we use a special nessler jar with a ground glass stopper. We seal these standards. The 100 c.c. standards are 26, 32, 38, 44, 50, 65, 80, 95, 120, 150, 180. For turbidities above 180, dilutions are made with clear water.

During 1913, we made over 24,000 tests with these standards. We have standards made in 1907 still in use. These have been checked from time to time and have not been found to change. We would not recommend using standards over six months without checking.

This method, while it is ideal for the preparation of standards which can always be duplicated, involves considerable labor in the preparation of the diatomaceous earth. The introduction of Fuller's earth seems to be a step in the right direction. I believe this was first brought out by Dr. E. C. Levy, of Richmond, Va., in a paper before the Laboratory Section of the American Public Health Association, although in the report for 1912, he is not given credit for it. The idea, of course, is to do away with the tedious grinding and to obtain a standard which resembles more closely the turbidity of water caused by clay.

Working, then, with two objects in view, of having a definite weight and a definite degree of fineness (obtained by suspension for a definite period) we have experimented with Fuller's earth and have prepared standards which check exactly with our standards made with diatomaceous earth. Our method follows:

If a 200 mesh sieve is not obtainable take about 20 grams of Fuller's earth; if a sieve can be obtained, take about 5 grams of the sifted material (weighing is not necessary). Place in a gallon bottle and add about a quart of distilled water, shake thoroughly, as above, and suspend for ten hours. Decant and determine the weight of the material remaining in suspension by filtering 100-200 c.c. through a weighed Gooch crucible. Dry and weigh.

It will probably be necessary to coagulate the material by the use of a known weight of hydrate of alumina or a solution of alum. In this latter case, the water should be alkaline to precipitate the alum.

The total weight will be the weight of the material in solution plus the weight of the hydrate of alumina.

We know then the degree of fineness as we have suspended for a definite period and we have a known weight. From this suspension we can make our stock for use in preparing our standards.

I do not know just how long the standards will keep, as the period elapsing since their preparation is relatively short compared with our other standards, but in any case it is a simple matter to prepare new ones.

PROGRESS ON HARLEM RIVER TUNNEL.

The sinking of the fifth and last section of the tunnel under the Harlem River, New York City, which is to be a part of the Lexington Avenue subway, has been completed. The tunnel is being built by submerging massive sections of steel tubes which, when connected in position, will be surrounded by concrete and form the bore of the completed tunnel. The procedure is similar to that followed in building the Michigan Central tunnel under the Detroit River at Detroit. The final section, now placed in position, is 250 ft. long. The other four sections are 220 ft. long. The sections are constructed on dry land, and the whole structure is floated into the river by its own bouyancy. Water is then let into the tubes, which are gradually sunk into place, two large floats being used to support the tubes as they are being lowered.

ENGINEERS' LIBRARY

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CONTENTS.

BOOK REVIEWS.

Modern Tunneling, With Special Reference to Mine and Water Supply Tunnels. By David W. Brunton and John A. Davis. Published by John Wiley & Sons, New York; Canadian selling agents, Renouf Publishing Co., Montreal. First edition, 1914. 450 pp.; 80 illustrations; 6x9 ins.; cloth. Price, $3.50 net.

This book will be found of exceeding value by those who have been on the lookout for practical information concerning tunneling methods, particularly in the United States. It is confined chiefly to problems of tunneling for drainage, transportation or development, but it also includes those for water power, irrigation or domestic purposes, in which the essential features are very like those of mine tunnels. It should be stated that the book pertains almost entirely to excavation in solid rock and does not refer to soft ground, subaqueous or railroad tunneling.

Following the introduction are chapters on history of tunneling; modern mining and water tunnels; choice of power for tunnel work; air compressors; ventilation; surface equipment; rock-drilling machines; haulage; incidental underground equipment; drilling methods; blasting; methods of mucking; timbering; safety; cost of tunnel work; bibliography. The authors devote little space to the history of tunneling or to old-time methods. They enter at once upon the work of presenting up-to-date information, such as is desired by tunnel engineers who generally feel that up-to-date methods and equipment that are proving safe, efficient and economical are not as widely known as they should be.

Of great interest are the chapters devoted to a discussion of the various types of machinery, plant methods, etc. The advantages and disadvantages of many different varieties of equipment are voiced; tables are presented and the whole treated in such an exhaustive and complete manner as to leave little to be desired on the part of the reader. A chapter on "safety" supplies a very needful part of a book on this subject. The authors have treated it in a practical way that should meet with approval. The chapter on cost of tunnel work gives some excellent data covering the more important tunnels of the United States. This data has already appeared in *The Canadian Engineer* (issues of Sept. 24, Oct. 1, and Oct. 8, 1914). It had been previously collected by the authors for the U.S. Bureau of Mines. (It is in justice to the Bureau to state that the material in the book under discussion is very considerably the same matter as had already appeared in Bulletin No. 57 of the U.S. Bureau of Mines, under the same title, written, of course, by the same engineers.) The bibliography occupies 60 pages, although it has been "selected," as stated by the authors.

The Science and Practice of Management. By A. Hamilton Church. Published by the Engineering Magazine Co., New York. First edition, 1914. 535 pp.; illustrated; 5x7 in.; cloth. Price, $2.00.

For one who is searching for a scientific treatment of the fundamental principles and elements underlying scientific management, this volume will be found to go a long way toward analyzing and classifying the existing forms with which they are more or less familiar. The author has endeavored, according to his introductory notes, to ascertain the fundamental facts of production, not from the viewpoint of cost but from the viewpoint of management. One is accordingly impressed with his success in formulating such fundamental facts and regulative principles as may be hereafter developed into a true science of management.

The first part of the volume has to do with the science of management and Part II. with practical organization of the organic function. There are five appendices dealing with the labor question; the expense burden in relation to piecework and premium; the same in relation to bonus; the planning department; some axioms of administrations.

The reader will find the author's classification one by which the information on the subject of management may be scientifically analyzed, properly grouped and, as a result, made more useful.

Strength of Materials. By H. E. Murdock, M.E., C.E. Published by John Wiley & Sons., Inc., New York; Canadian selling agents, Renouf Publishing Co., Montreal. Second edition, 1914. 352 pp; numerous illustrations; 5x7 in.; cloth. Price, $2.00 net.

The first edition of this book was reviewed in *The Canadian Engineer* for Nov. 30, 1911. It is essentially a book for engineering students and has been written with the aim of making intelligible the fundamental principles of the strength of materials without the aid of the calculus. The book is replete with illustrated examples and problems. The subject is proceeded with in the following way: Materials of construction; direct stresses and applications of them; riveted joints; beams, external flexural forces and internal flexural stresses; stresses in such structures as chimneys, dams, walls and piers; graphic integration; deflection of beams; elastic curve; same determined by the algebraic method; secondary stresses; columns and struts; torsion; repeated stresses resilience, hysteresis impact; reinforced concrete beams;

reinforced concrete columns; centroids and moments of inertia of areas, (the latter as an appendix). The book concludes with numerous tables usually found in works on this subject.

Hydraulics. By Louis A. Martin, Jr., Professor of Mechanics, Stevens Institute of Technology. Published by John Wiley & Sons, Inc., New York City; Canadian selling agents, Renouf Publishing Co., Montreal, P.Q. First edition, 1914. 223+12 pages; 114 illustrations; size, 5x7½ in.; cloth. Price, $1.50 net.

This work appears as Volume 5, of a set of books by the same author, devoted to mechanics. The previous volumes cover statics; kinematics and kinetics; mechanics of materials; applied statics. In his preface the author states that he has sought to produce a text book which will encourage the student to think and not to memorize, to do and not simply to accept something already done for him. The fundamental principles underlying hydraulics are systematically developed and arranged, with special attention to those underlying the theory and design of impulse wheels and turbines.

The first part of the book is devoted to liquids at rest, and takes up the pressure and the force exerted by a liquid, applications, and floating bodies. Liquids in motion are dealt with in the remaining nine chapters of the book, the work being arranged as follows: The free surface of liquids moving with acceleration; the flow of liquids; flow through orifices, weirs and pipes; force exerted by moving liquids; axial-flow and radial-flow impulse water wheels; turbines.

A feature to be admired in the work is the care that has been given to the selection of exercises and examples. There is an abundance of material in this section of the book to make it of absorbing interest to the student.

Concrete Roads and Pavements. By E. S. Hanson. Published by the Cement Era Publishing Co., Chicago. Revised edition, 1914. 338 pp.; 5x7½ in.; illustrated; bound in cloth. Price, $1.50. The first edition of this book was reviewed in *The Canadian Engineer* for August 28, 1914.

The present volume shows one-third increase in size by the addition of seven chapters. The author has made many revisions in the older portion of the work, bringing it up-to-date in every detail. The introduction of new subjects, such as how to promote the construction of concrete roads; the economic methods of handling materials; experimental work, etc., give the book a tone of usefulness that will enhance its value considerably to the road engineer. Other subjects which were treated only briefly in the first edition of the book have been expanded into full chapters. Some new matter has been added to Chapter I., showing the advantages of concrete as a road material, and after this is a chapter discussing the various types of concrete roadways. Following this, the various steps in the construction of concrete roads and pavements are taken up in separate chapters, these covering the preparation of the sub-grade, the selection of materials, economic methods of handling materials, mixing and placing the concrete, finishing and curing. The chapter on joints has been brought fully down to date, while the chapters descriptive of work done in various localities have been considerably augmented by the addition of descriptions of recent work accomplished.

To the appendices appearing in the first edition there has been added the specifications of the American Concrete Institute. The list of specifications now includes, in addition to the above, specifications for Wayne County, Mason City, Illinois Highway Commission, Blome Granitoid and Granocrete pavements, Bitustone, Dolarway, Hassamite, Vibrolithic, bridges and culverts, sidewalks, curb and gutter.

The expansion of the book is well worth the notice, even of those already familiar with the first edition.

The Calculus. By John Graham, B.A., B.E. Published by E. and F. N. Spon, Limited, 57 Haymarket, S.W. Fourth edition. Cloth; 5x7 in.; 355 pages; 116 illustrations. Price, $1.25 net.

This volume is an elementary treatise on the calculus for engineering students. It covers the differential and integral calculus and the solution of differential equations. The book is very complete with numerous examples and problems worked out.

Hydraulics. By W. M. Wallace, Wh.Sc. Published by the Technical Publishing Company, Limited, 55 Chancery Lane, London, W.C. Cloth; 5x7 ins.; 276 pages. Price, $1.00 net.

This little volume is intended to supply the wants of the practical engineer and the student. In the first two chapters, hydrostatic principles and hydraulic machines are dealt with; the flow of water in pipes and through orifices is covered in Chapters III. and IV. Chapter V. deals with the impact of water on surfaces; Chapter VI. with centrifugal head, while Chapters VII., VIII. and IX. deal with the water turbine, the centrifugal pump and the turbine pump. The titles of the other chapters are: Chapter X., Loss of Energy Due to Shock; Chapter XI., Pumps; Chapter XII., Measuring the Flow of Water; Chapter XIII., Channel Fow; Chapter XIV., Fluid Friction; Chapter XV., Vibration and Rolling; Chapter XVI., Hydraulic Problems. This is a valuable little reference book for the engineer in practice, and a good text book for the student.

Hand Book of Construction Plant: Its Cost and Efficiency. By Richard T. Dana, M.Am.Soc.C.E. Published by Myron C. Clark Publishing Company, Chicago. 702 pp.; numerous illustrations; size, 4½x7 ins.; limp leather. First edition. Price, $5.00 net.

The object of this book is to furnish contractors with information in ready reference form concerning the cost, capacity, operating expenses and adaptability of equipment most generally required. Much well-arranged information is given that is invaluable to an inexperienced contractor, and that would undoubtedly be of considerable interest even to a man of broad experience. The book is especially useful to a contractor who has kept but little cost data or who is not in close touch with the costs, merits and sources of supply of equipment.

The usefulness of the volume to Canadian contractors, however, is hampered by the fact that only United States, and no English or Canadian equipment, is discussed, and the lists given of prices, makes and kinds cover only United States firms. While a vast amount of excellent equipment is bought in the United States every year by Canadian contractors, it is obvious that no Canadian contractor could afford to make any purchase without giving due consideration to the competitive merits and prices of Canadian and English goods. The book is not simply compiled from the Canadian standpoint, but will no doubt meet with a very good sale in the field which it is intended to cover.

PUBLICATIONS RECEIVED.

Philadelphia Public Works.—Annual Report (1913) of the Director, Department of Public Works, city of Philadelphia.

Timber and Soil Conditions of Southern Manitoba.—By L. G. Tilt, B.Sc.F., Forestry Branch, Department of the Interior, Canada. 36 pp.; illustrated.

Kewagama Lake Map-Area, Quebec.—By M. E. Wilson, Memoir 39, Geological Survey, Department of Canada. 140 pp.; numerous plates and illustrations.

Magnetic Occurrences near Calabogie, Renfrew County, Ontario.—By E. Lindeman, Mines Branch, Department of Mines, Ottawa, describing location, history, geology, ore deposits, etc.

Farmer as a Manufacturer.—By A. T. Stuart, B.A., assistant chemist, Department of Agriculture, Experimental Farms. An outline of some basic principles in agricultural chemistry. 16 pp.; 6 x 9 in.

Pollution of Des Plaines River.—Report of the sanitary district of Chicago. 55 pp.; 6 x 9 in.; illustrated. It outlines investigations of conditions along the river in new territory annexed by the city in 1913.

Moose Mountain Iron-Bearing District, Ontario.—By E. Lindeman, Mines Branch, Department of Mines. 32 pp., describing location, general historical and geological features, character of ore and commercial possibilities.

The Archæan Geology of Rainy Lake Restudied.—By A. G. Lawson, Geological Survey, Department of Mines. Published as Memoir 40. 115 pp.; 6 x 9 in.; plates and illustrations. A report upon investigations in Northwestern Ontario in 1911.

Gold Fields of Nova Scotia.—By W. Malcolm, Geological Survey Branch, Department of Mines. 330 pp.; 52 plates, 24 figures and 2 maps. It is a compilation of data, the result of field investigations and studies of Mr. E. R. Faribault.

Resuscitation from Mine Gases.—Technical Paper No. 77, United States Bureau of Mines, report of committee. 36 pp.; illustrated. It outlines manual and mechanical methods of artificial respiration, experiments with commercial devices, etc.

The Humidity of Mine Air, with special reference to coal mines in Illinois. By R. Y. Williams, United States Bureau of Mines (Bulletin 83). It is devoted to a resume of mine humidity investigations, methods of humidification, conclusions and suggestions.

A Study of the Oxidization of Coal.—By H. C. Porter and O. C. Ralston, United States Bureau of Mines. 30 pp.; 6 x 9 in. Rate of oxidization of different coals compared and factors affecting described. Experiments to determine nature of oxidization reactions outlined.

Valuation of Ohio Public Utilities.—Report of a joint committee of the Public Utilities Commission. 42 pp.; 6 x 9 in.; price, 50 cents. It outlines the committee's formulation of principles as applied to "Reproductive cost new, less depreciation," method of valuing public utilities.

Topographical Surveys Branch.—Annual report for 1913 of this Branch, Department of the Interior, Ottawa. 226 pp.; 6 x 9 in.; 17 maps and profiles; numerous illustrations. It contains the report of the Surveyor-General, various schedules, lists and statements, and the reports of surveyors.

Timber Conditions in Alberta.—A report on the timber conditions of Little Smoky River Valley and adjacent territory. By J. A. Doucet, Forestry Branch, Department of the Interior. 52 pp.; illustrated. It outlines general conditions, report on the country by blocks, fire protection, and the proposed forest reserve.

Telephone Systems.—The Ontario Telephone Act and Amendment thereto. Extract from report of Ontario Railway and Municipal Board for 1913. Specifications for construction of telephone systems. Forms of petition, by-laws, etc. 60 pp. Copies on application to the Ontario Railway and Municipal Board, Legislative Buildings, Toronto.

The Double-Curve Motive in Northeastern Algonkian Art.—By Frank G. Speck, Geological Survey, Department of Mines, Ottawa. It contains very interesting information respecting the occurrences of the motive among the tribes south and north of the St. Lawrence and in adjacent areas westward. There are 18 plates and 25 figures of note.

Forests, Waterways and Water-Powers.—Report of the select standing committee, Ontario Legislature. 28 pp.; 6 x 9 in. The committee's report has appended to it: (1) Conservation of natural resources in British Columbia (7 pages); Sir Richard McBride. (2) Work of the Provincial Forestry Department in British Columbia (11 pages); H. R. McMillan.

Irrigation.—Annual report for the year 1913 of the Department of the Interior. 172 pp.; numerous illustrations. It contains reports on the districts of Calgary and Maple Creek; on special inspection; on the South Saskatchewan and St. Mary River diversion projects; stream measurements; Bow River flood discharge and floods in the North Saskatchewan drainage basin.

Thermal Properties of Steam.—By G. A. Goodenough. Bulletin No. 75, Engineering Experiment Station, University of Illinois, Urbana, Ill. 69 pp.; 6 x 9 in.; illustrated. It presents a critical discussion of the experimental investigations, an outline of the thermodynamic relations that must be satisfied, and the development of a general theory of superheated and saturated steam.

Lode Mining in Yukon.—An investigation of quartz deposits in the Klondike Division, by T. A. MacLean, M.E., Mines Branch, Department of Mines, Canada. 222 pp., with 6 maps, 36 sketches and 40 photographs; size, 6 x 9 in. The report deals with the quartz deposits in the mining districts of Duncal Creek, Conrad and Dawson, with a view to describing their gold contents and reporting upon their economic value.

Water Measurement in Open Channels.—A description by C. R. Weidner, C.E., of the diaphragm method for the measurement of water in open channels of uniform cross-section. Issued as Bulletin No. 672 of the Engineering Experiment Station, University of Wisconsin, Madison, Wis.; price, 25 cents. 72 pp.; size, 6 x 9 in.; 6 plates; 30 figures. Describes the apparatus in various European stations, giving results of tests, etc.

Port Directory of the Principal Canadian Ports and Harbors, 1913-14.—Department of Marine and Fisheries, Ottawa. 305 pp.; fully illustrated; 6 x 9 in.; bound in cloth. The volume contains, in addition to the above, data respecting a large number of minor ports, wharves, depth of water, facilities for loading, etc.; also descriptions of types of aids to navigation in Canadian coastal and inland waters, navigable distances of many rivers in the north-west of Canada, and general information for mariners.

The Copper Smelting Industries of Canada.—By A. W. G. Wilson, Ph.D., chief of the Metal Mines Division, Department of Mines, Canada. 184 pp.; 6 x 9 in.; 43 plates, 4 maps and 39 illustrations. The report takes up the various smelters by provinces in Chapter 1. Following it are chapters devoted to the Canadian Copper Co., the Mond Nickel Co., Limited, the Consolidated Mining and Smelting Co. of Canada, Limited, Granby Consolidated Mining, Smelting and Power Co., British Columbia Copper Co., Tyee Copper Co., miscellaneous summaries and statistics of copper production.

CATALOGUES RECEIVED.

The World's Greatest Asphalt Plant.—The Barber Asphalt Paving Co., Philadelphia, issues a 16-page illustrated description of their plant at Maurer, N.J.

Tubular Steel Tripods.—A leaflet describing the Morris folding tubular steel tripod, issued by the Herbert Morris Crane and Hoist Co., Limited, Toronto.

Jeffrey Limestone Pulverizer.—Bulletin No. 132, of the Jeffrey Manufacturing Co., Columbus, Ohio. Describes the swing hammer pulverizer, type "D," with diagrams. 8 pp.

Synchronous Converters.—Bulletin issued by the Canadian General Electric Co., listing the ratings of standard lines of converters for various frequencies, voltages and capacities.

Morris Hand Overhead Travelling Crane.—A 4-page leaflet, issued by the Herbert Morris Crane and Hoist Co., describing a new type designed to run on the lower flange of two parallel I-beams.

Sprague Electric Monorail Cranes.—48 pp.; fully illustrated, describing the function and various types and capacities of these cranes. Issued by the Canadian General Electric Co., Limited, Toronto.

Speed Regulation.—A 4-page leaflet describing a new invention called the Douglas Speed Regulator, of interest to engineers and manufacturers. Issued by J. A. Douglas, 626 McMillan Avenue, Winnipeg, Man.

Westinghouse Turbo-Alternators.—A 40-page profusely illustrated description of various types. It traces the development of the steam turbine, of reaction and impulse turbines, and of variations in modern designs.

Temperature Control Apparatus.—A booklet descriptive of the Grundy System of automatic temperature control. Also information about heating and ventilating by electricity. Issued by A. Schonfield and Co., Glasgow.

Lackawanna Plate Sheet Piling.—Bulletin No. 107, outlining a new section just brought out by the Lackawanna Steel Co., for whom H. A. Drury Co., Limited, Montreal, are Canadian representatives. 4 pp.; illustrated.

Heavy Traffic Centres.—A descriptive publication of the Westinghouse Electric and Manufacturing Co., giving a number of interesting and instructive illustrations showing operating conditions in many large traffic centres.

Electrical Equipment for Oil Wells.—A 24-page bulletin, well illustrated and containing some instructive information on the use of electrical apparatus in the oil fields. Issued by Canadian General Electric Co., Limited, Toronto.

Drawing Tables, etc.—A 48-page catalogue, issued by Economy Drawing Table Co., Toledo, Ohio. Drawing tables, filing cases and specials for engineers, architects, contractors, manufacturers, schools, etc., are described.

Piston Rings.—A small 8-page booklet, published by the Burd High Compression Ring Co., Rockford, Ill. Reprinting an article by H. S. Whiting on "How the Efficiency of a Motor Car is Dependent upon Gas-Tight Ring Joints."

Steam Engines for Direct Connection to Electric Generators.—16 pages, describing the Chandler and Taylor engines, simple, tandem and cross compound. Issued by Canadian Allis-Chalmers, Limited, Toronto, agents for Canada.

Train Operation.—A collection of illustrations, with brief notes, showing some of the advantages of multiple-unit trains for city, suburban and interurban service. 16 pp.; 8½ x 11 in.; illustrated. Issued by the Westinghouse Electric and Manufacturing Co., East Pittsburgh.

Despatchers' Selective Signalling System.—A leaflet from the general railway signal company, Rochester, N.Y., describing a new system by means of which the despatcher can control train-order signals and take-siding signals located at various stations, and determine the indication displayed by each.

Horsfall Destructors.—A 50-page catalogue, issued by the New Destructor Co., Limited, Pershore, England, describing the features of this type of destructor and a number of the plants now in operation. Other equipment for destructor plants, such as crushing and screening plant, tin-baling machines, etc.

Marshall Traction Engines and Road Rollers.—A fully illustrated 44-page catalogue, issued by Marshall, Sons and Co., Limited, Gainsborough, England (Canadian office, Saskatoon, Sask.) It describes different sizes of traction engines and road locomotives, single and compound; road rollers, scarifiers, trailer wagons, etc.

MILITARY PROMOTION FOR C. H. MITCHELL, C.E.

Word has been received from the military authorities at Ottawa of the appointment of Major Charles H. Mitchell, of Toronto, to the important position of General Staff Officer on the Headquarters Staff of the First Contingent, and also of his promotion to the rank of Lieut.-Colonel. This appointment is one of the highest given to any militia officer in Canada. Lieut.-Colonel Mitchell is deserving of this distinction, and military men in Toronto assert that he is perhaps the best qualified Canadian officer for the position.

Lieut.-Colonel Mitchell is perhaps better known generally throughout the Dominion as "C. H. Mitchell, C.E.," of the firm of C. H. and P. H. Mitchell, Consulting Engineers, Toronto. His experience in engineering has been wide, but his activities have been chiefly in hydro-electric and hydraulic work. For the past four years he has been consulting engineer for the Dominion Government on water-power matters, particularly in Western Canada.

Lieut.-Colonel Mitchell is a member of the Board of Governors of the University of Toronto, from which university he graduated in 1892. He has also taken an active part in the advancement and improvement of the city of Toronto, and for many years has been on the Executive of the Toronto Civic Guild, of which organization he is now the President.

ST. JOHN VALLEY RAILWAY, N.B.

The Canadian Pacific and the Intercolonial have patched up their differences relative to facilities for entering the St. John Valley Railway into Fredericton. The railway will enter from the south by double-tracking the C.P.R. from Victoria Mills to the Intercolonial "Y"; thence by their own tracks. The Quebec and St. John Construction Co. may do their own double-tracking on this work or may sub-let it. As soon as this connection has been completed operation of the Valley Railway will be commenced between Fredericton and Gagetown.

It is stated in a recent communication from Fairville, N.S., that the installation of a 12-inch water main along the Sand Cove Road has been completed as far as the Fairville plateau; that concrete sidewalk has been completed for some distance cut the Manawagonish Road; and that progress on the new Government bridge over the Reversible Falls is favorable. Of the bridge construction, the granite piers which are being erected on the east side have been completed. The trestle which was built from the C.P.R. track and crosses tne road overhead has been finished and the crane for hoisting the steel into position has been placed on the cliff overlooking the falls, the steel construction now being in progress.

Coast to Coast

London, Ont.—The proposed new municipal sewage disposal plant for the east end of the city has been under consideration last week and a number of suitable sites inspected.

Hamilton, Ont.—A start was made last week on the concrete foundation of the first building of the new plant of the Proctor-Gamble Co. and excavation is progressing for the other buildings. About 150 men are at work and the contractors are rushing things before cold weather sets in.

Amherst, N.S.—The Canada Car and Foundry Co. have a large number of cars of various types under construction in the passenger department. For the past few months from 350 to 500 men have been employed, and it is probable that this number will be increased from time to time during the winter.

Hamilton, Ont.—Hamilton authorities, thinking the expenditure of $328,000 for a bridge, 1,600 ft. in length, in connection with the Toronto-Hamilton highway, to be too great, have asked the Hamilton Bridge Works for plans and estimates of a bridge about 1,000 ft. in length. The purpose of this bridge is to do away completely with the Valley Inn Hill.

Moose Jaw, Sask.—Mr. Geo. D. Mackie, engineer-commissioner, owing to the shortage of the Caron water supply, due to exceptionally dry weather having reduced the flow from the infiltration galleries, recommends the use of Snowdy Springs water, which will require the use of a filter to be installed at South Hill. If the scheme is carried out it will provide the city with an additional supply of 200,000 gallons.

Kirkland Lake, Ont.—During the past week two new plants have been started in the Kirkland Lake section of Northern Ontario. At the Lake Shore Gold Mines a 3-drill air-compressor has just been installed and operations have commenced on a shaft, already sunk by hand-drill to a depth of 40 ft. A station will be established and drifting started at the 100-ft. level. The other plant is that of the Kirkland Lake Gold Fields, and will operate five drills. It is run by two boilers of 110 h.p. Sinking has been started and will be carried to 100 ft. on the continuation of the Teck-Hughes main vein, picked up some months ago on the McKane property (worked by the company) under heavy overburden.

Summerside, P.E.I.—In addition to completing that portion of the 1913 programme of steel and concrete bridge construction which had to be left unfinished, the provincial department of public works has built a number of other bridges this year. Of last year's work the most important is the big bridge over the Cardigan River. This structure comprises two steel spans of 280 feet in length, clear of the approaches. The bridge has a concrete roadway and a 4-foot sidewalk, the width of the bridgeway being about 16 feet. This bridge was commenced last fall, and at present the entire superstructure, including the concrete roadway, has been completed; while the construction of the approaches is now under way. It is expected that it will be opened for traffic in the course of another month. A concrete culvert bridge was also erected near Cardigan this year. At Wigginton's a 35-foot steel bridge has been erected in the place of the previously existing wooden one. Fortune bridge of two 120-foot steel spans has been completed, this permanent structure also replacing a wooden bridge. A Mink River, a 100-foot steel span bridge has been erected; near Crapaud another 35-foot steel bridge; while one with 25-foot steel spans is in course of erection at Ahearn's, Tignish.

PERSONAL.

A. T. ENLOW, sales manager of the Pedlar People, Limited, Oshawa, Ont., has resigned.

A. I. DAVIS, B.A.Sc., has been appointed mining engineer for the United States Gypsum Co. at Fort Dodge, Iowa. Mr. Davis is a graduate in mining of the University of Toronto.

W. N. ASHPLANT, city engineer of London, Ont., has applied for service in the second Canadian contingent. Mr. Ashplant is a South African veteran and a lieutenant in the 17th Fusiliers, London.

GEO. W. COBURN, district engineer for the Canadian Pacific Railway Co. at Souris, Man., has been transferred to Brandon, Man., where he will serve in the same capacity. Mr. Coburn has been with the C.P.R. since 1896.

Prof. GEO. A. GUESS, of the Department of Metallurgy, University of Toronto, is at present in Anyox, B.C., where he has been engaged for a short time in a consulting capacity by the Granby Co. in connection with their new smelter.

E. MAERKER, A.Sc., of Toronto, has accepted a position with the Winnipeg River Power Co., at Winnipeg, and assumes his duties next week. Mr. Maerker was previously designing engineer with the Toronto Power Co. on high-tension transmission work.

Hon. T. CHASE CASGRAIN, K.C., chairman of the Canadian section of the International Joint Commission, has been appointed Postmaster-General for Canada. His successor on the Commission will likely be appointed forthwith, as the Commission meets in Detroit on November 10th.

F. N. SMITH, resident engineer of construction, Canadian Northern Pacific Railway, Henningsville, B.C., and D. R. WEBER, assistant superintendent, Grant Smith and Co. and McDonnell, Limited, Revelstoke, B.C., have recently attained associate membership in the American Society of Civil Engineers.

OBITUARY.

Hon. COLIN H. CAMPBELL, formerly Minister of Public Works for the Province of Manitoba, died at his home in Winnipeg on October 24th after an illness of about 2 years.

TORONTO BRANCH, CANADIAN SOCIETY OF CIVIL ENGINEERS.

On Wednesday, Oct. 28th, the Toronto Branch of the Canadian Society of Civil Engineers met at the Engineers' Club to hear an address on "Naval Architecture," delivered by Prof. J. R. Cockburn, of the University of Toronto. The meeting was largely attended. Mr. Cockburn also illustrated by a number of slides the various types of vessels employed by the British Admiralty.

On Saturday, Oct. 31st, members of the Branch, accompanied by members of the University of Toronto Engineering Society, will take a trip over the new Welland Ship Canal work. Sections 1, 2 and 3 present many important and instructive engineering features that will be of special interest to the visitors, who will be shown over the work by Mr. J. L. Weller, chief engineer of the canal, and his engineering staff.

In order to see all the work under construction open street cars will be hauled over the track on the west bank of the canal. Arrangements also provide for inspecting the harbor work at Port Weller. Luncheon will be served in one of the construction camps. In the evening the ladies of St. Catharines will provide a dinner, the proceeds of which will go to the Patriotic Fund.

The library committee of the Branch has announced the addition since the last annual meeting of a considerable number of valuable series of transactions, proceedings, journals and reports as well as some 80 engineering treatises and text books. These new books comprise the most recent works on bridge engineering, cement and concrete, ceramics, chemical engineering, electrical engineering, foundations, heating and ventilating, highway engineering, hydraulics, mechanical engineering, metallurgy, railway engineering, sanitary engineering, steam engineering, structural engineering and water supplies. The usefulness of the periodic literature in the library has also been considerably increased. The committee consists of Messrs. W. A. Hare, A. L. Mudge and Prof. C. R. Young, chairman.

HIGHWAY STUDY AT COLUMBIA.

The non-resident lecturers in the graduate course in Highway Engineering at Columbia University appointed for the 1914-1915 session are as follows: John A. Bensel, New York State Engineer; Edward D. Boyer, Cement and Concrete Expert, the Atlas Portland Cement Company; Sumner R. Church, Manager, Research Department, Barrett Manufacturing Company; William H. Connell, Chief, Bureau of Highways and Street Cleaning, Philadelphia; W. W. Crosby, Chief Engineer, Maryland Geological and Economic Survey, and Consulting Engineer; Charles Henry Davis, President, National Highways Association; Arthur W. Dean, Chief Engineer, Massachusetts Highway Commission; John H. Delaney, Commissioner, New York State Department of Efficiency and Economy; A. W. Dow, Chemical and Consulting Paving Engineer; H. W. Durham, Chief Engineer of Highways, Borough of Manhattan, New York; C. N. Forrest, Chief Chemist, Barber Asphalt Paving Company; Walter H. Fulweiler, Chief Chemist, United Gas Improvement Company; D. L. Hough, President, the United Engineering and Contracting Company; William A. Howell, Engineer of Streets and Highways, Newark; Arthur N. Johnson, Highway Engineer, Bureau of Municipal Research, New York; Nelson P. Lewis, Chief Engineer, Board of Estimate and Apportionment, New York; Philip P. Sharples, Chief Chemist, Barrett Manufacturing Company; Francis P. Smith, Chemical and Consulting Paving Engineer; Albert Sommer, Consulting Chemist; George W. Tillson, Consulting Engineer to the President of the Borough of Brooklyn, New York; and George Warren, President, Warren Brothers Company.

G.T.R. MASTER MECHANICS.

The following Grand Trunk staff changes have been announced: J. Markey is appointed master mechanic of Ontario lines with headquarters at Toronto, and J. R. Donnelley is named as assistant master mechanic of Ontario lines with headquarters at Allandale, the title of master mechanic of the northern division being abolished. T. McHattie is appointed master mechanic of eastern lines with headquarters at Montreal, and the title of master mechanic of the Ottawa division is abolished. W. H. Sample is appointed master mechanic of western lines with headquarters in Battle Creek, Mich.

CANADIAN ENGINEERS AT THE FRONT.

In addition to the list of graduates and undergraduates of the University of Toronto who are now in England with the first Canadian expeditionary force there should be added the names of Messrs. P. J. McCuaig, '09; H. N. Klotz, '09, and W. J. Baird, '10.

We announced Mr. H. F. H. Hertzberg, chief engineer of the Canadian Bridge Co., Walkerville, as a member of the contingent. As many of our readers are aware, this should have read, "Mr. H. F. H. Hertzberg, engineer of the Trussed Concrete Steel Co. of Canada, Walkerville, Ont."

THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

On Thursday, Oct. 22nd, a largely attended meeting of the Canadian Society of Civil Engineers was held in the Society's headquarters, 176 Mansfield Street, Montreal, Walter J. Francis, C.E., presiding. A paper, illustrated by slides, and entitled "The System of Unit Construction in the Concrete Power House at Cedars, P.Q.", was read by Mr. J. E. Conzelman, chief engineer of the Unit Construction Co., Montreal. The speaker dealt in detail with the use of reinforced concrete in the construction of large industrial and similar buildings. The application of the "unit construction" to the power house of the Cedars Rapids Manufacturing and Power Co., as described by Mr. Conzelman, aroused a good deal of discussion and was of great interest.

Another paper, entitled "Mushroom Construction," by Mr. C. A. P. Turner, had to be postponed until a later meeting as the discussion following the first paper occupied the greater part of the meeting.

CHANGE OF ADDRESS.

The Ottawa Branch of the Canadian Society of Civil Engineers has changed the address of its headquarters from 177 Sparks Street to 128 Queen Street, Ottawa.

COMING MEETINGS.

NORTHWESTERN ROAD CONGRESS.—Annual Convention, to be held at Milwaukee, Wis., October 28th to 31st. Secretary, J. P. Keenan, Milwaukee.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Charles Carroll Brown, Secretary, Indianapolis, Ind. Meets at Somerset Hotel, Boston, Mass., October 21st, 22nd and 23rd.

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.

WASHINGTON STATE GOOD ROADS ASSOCIATION.—Convention to be held at Spokane, Wash., November 18th, 19th, and 20th. Secretary, M. D. Lechey, Alaska Building, Seattle, Wash.

ANNUAL MEETING, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The annual meeting of the American Society of Mechanical Engineers will be held in New York, December 1st to 4th, 1914. Secretary, Calvin W. Rice, 29 West 39th Street, New York.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Eleventh Annual Convention; fifth 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 Street, New York, N.Y.

EIGHTH CHICAGO CEMENT SHOW.—To be held in the Coliseum, Chicago, Ill., from February 10th to 17th, 1915. Cement Products Exhibition Co., J. P. Beck, General Manager, 208 La Salle Street, Chicago.