PAGES

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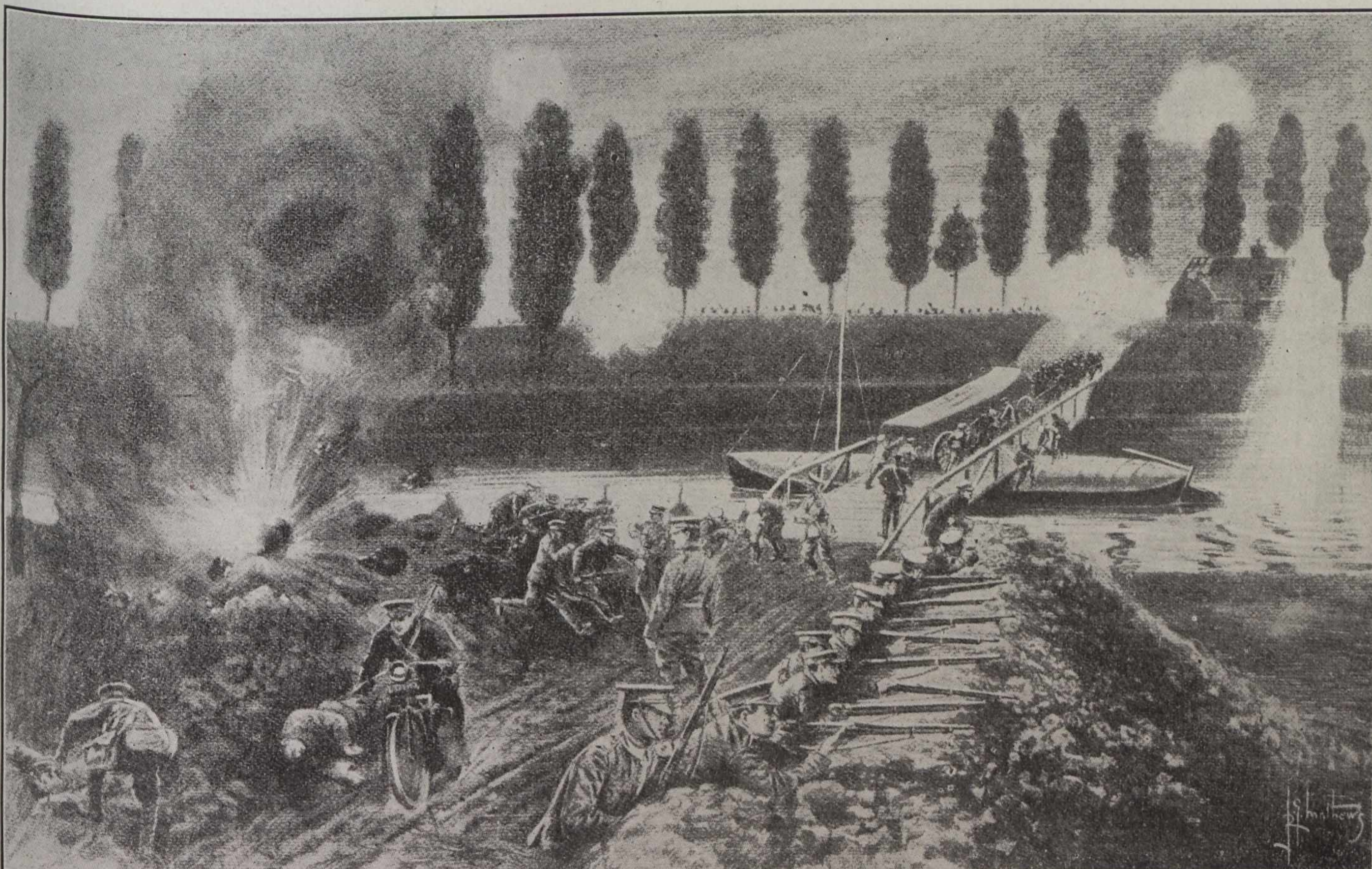
The Canadian Engineer

A weekly paper for engineers and engineering-contractors

THE CANADIAN ENGINEERS AT YPRES



WE are indebted to *The Graphic* of London for the accompanying reproduction of a sketch showing a company of the Canadian Engineers in action along the Yser Canal, close to Ypres. According to the source of information mentioned, the Germans, in their attempted advance to Calais, got to within half a mile of this spot. The Canadian Engineers prepared the four bridges near Ypres for demolition, and their pontoons had to be drawn across by men, as they could not get the horses to cross on account of the heavy shelling. The three men to be seen on the barge are placing an explosive charge under the direction of Lieutenant H. F. H. Hertzberg. He afterwards with thirty men advanced to a trench and held up a large number of Germans, thereby helping to save the bridge. He has been awarded the Military Cross. On the further bank of the canal the Engineers are making new trenches.

Lieutenant Hertzberg, a graduate in civil engineering of the University of Toronto, a junior member of the Canadian Society of Civil Engineers, and formerly chief engineer of the Trussed Concrete Steel Company of Canada, is a son of Mr. A. L. Hertzberg, division engineer at Toronto for the Canadian Pacific Railway.

CONCRETE DAM AND STEEL SECTOR WEIR, CALGARY

BOW RIVER IRRIGATION BLOCK OF THE CANADIAN PACIFIC RAILWAY, NOW EQUIPPED WITH NOVEL HEADWORKS TO MAIN CANAL, WESTERN SECTION.

By WM. WREN HAY, Jr.Mem.Can.Soc.C.E.

THE permanent headworks for the Canadian Pacific Railway Company's main canal for the western section of the irrigated lands have been completed and were in operation during the past season. The old timber headworks have been replaced by a concrete stop-log dam with an hydraulically operated steel sector weir designed to divert the river without backing the water into the city of Calgary. The western section comprises a total area of over one million acres, water being diverted from the Bow River at a point within the south-eastern limits of the city of Calgary.* The Bow River at this point has an ordinary discharge of from 1,500 to 25,000 second-feet during the spring and summer months.

*For a complete description of the Canadian Pacific Railway Bow River Irrigation Block the reader is referred to *The Canadian Engineer* for September 30th, 1915.

The section of the main canal varies from the maximum bed-width of 60 ft. at the headgates, with side slopes of 3 to 1, and 0.01 per cent. grade, to a bed-width of 44 ft., 2 to 1 side slopes, and a grade of 0.02 per cent., having a calculated discharge from $n = 0.025$, of 2,050 second-feet at full depth of 10 feet over a distance of 17 miles. The canal terminates at reservoir No. 1, from which three secondary canals take out. In order to supply the main canal with the full depth, it was necessary to construct a diverting weir, or dam, to raise the water surface to the desired elevation, which otherwise only occurs during extreme high water, and the new permanent headworks are designed to maintain the maximum depth of 10 feet required for the calculated discharge at all stages of the river, without creating a backwater which would flood the lower portions of the city of Calgary, one mile up-

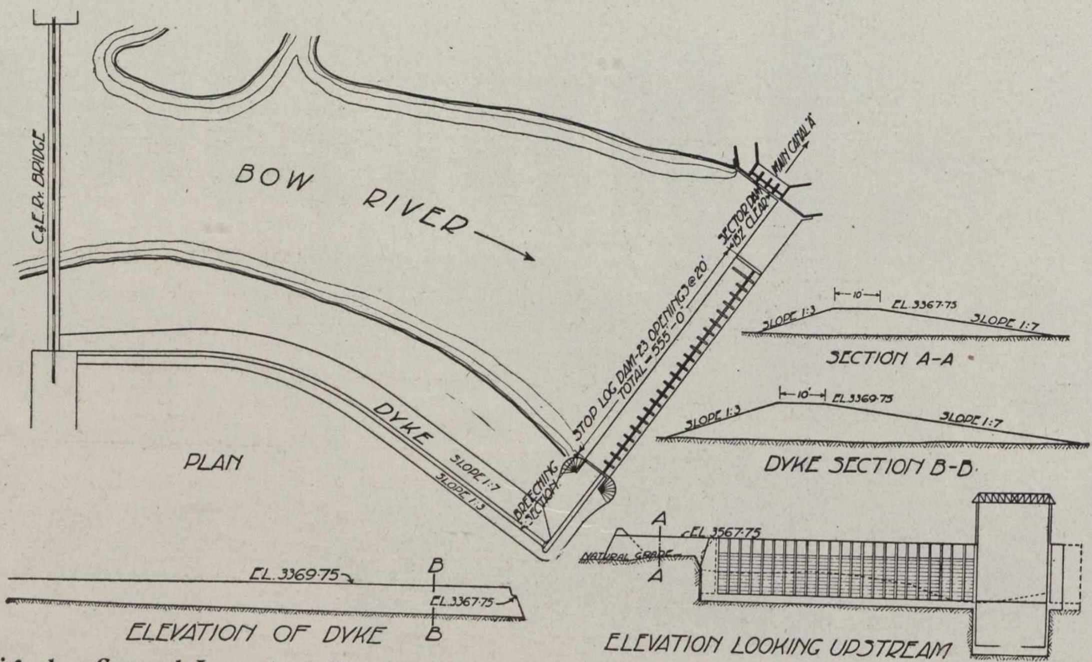


Fig. 1.—General Layout of Headworks on Bow River for the Main Canal, Western Section.

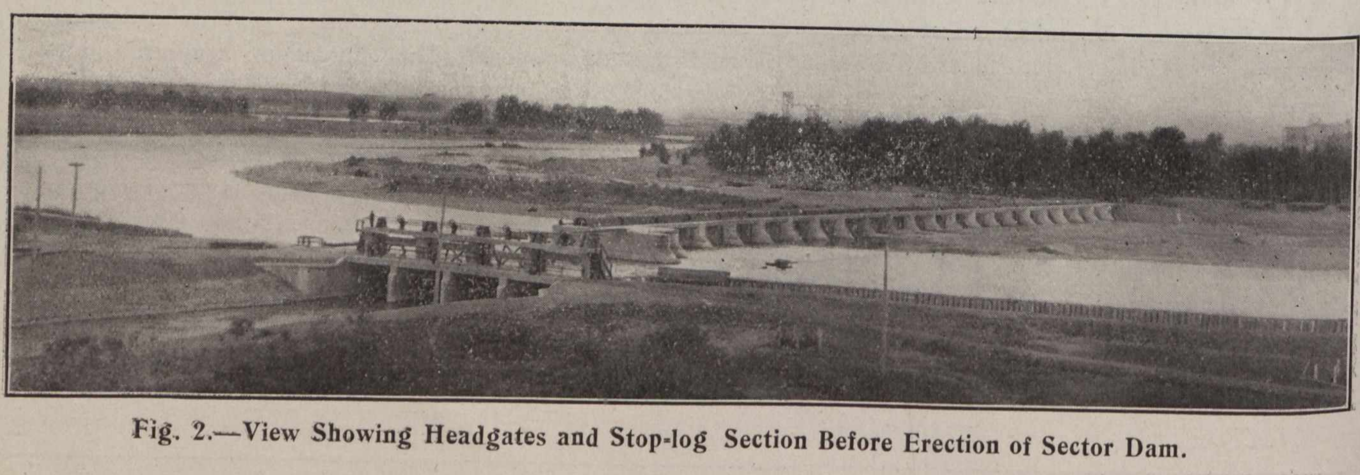


Fig. 2.—View Showing Headgates and Stop-log Section Before Erection of Sector Dam.

stream. The former headgates were of timber, with a pile and timber bulkhead extending 350 feet above and 1,400 feet below the structure. The Bow River at this point has a width of stream bed of about 500 feet and is maintained in its channel by high bluffs on the north, the south bank being low and subject to flooding at periods of extreme high water. The completed works consist of the concrete headgates for the canal, waterway for the weir structure, and a stop-log section across the river terminating in a dyke running up-stream along the south bank for a distance of 1,200 ft.

The headgates structure was completed during the winter of 1912-13 and consists of four sluiceways approximating 20 ft. 6 in. in width, having balanced steel Stoney gates operated by individual electric motors. A heavy scour mattress, 3 ft. 6 in. thick, acts as the foundation for the gates structure, and there are wing walls of the gravity type, running well back into the embankment upstream and connecting with the pier for the weir downstream. At the toe of the mattress there is a curtain of wooden sheet piling, and beneath the gates there is a core wall of heavy steel sheet piling. A reinforced concrete slab 10 ft. 6 in. wide and 15 ft. above the gate sills provides a crossing, the operating deck being 8 ft. 3 in. higher, and but 8 ft. 8½ in. wide. The gates consist of a skin-plate ⅜ in. thick, supported by 9-in. at 25-lb. I-beams, the skin-plate being 19 ft. 3 in. wide by 22 ft. 9 in. high. The gates have 5-inch diameter cast steel rollers operating on a 7-in. I-beam guide track and are lifted vertically by 5 h.p. motors operating through gear and pinion.

The dam consists of a structure approximately 707 feet long face to face of abutments, having a stop-log section of heavy concrete piers alternating with sluice openings with a length of 555 feet, and a moveable steel sector dam 152 feet long, together with a dyke and breeching section along the south bank of the river to a point well above any possible amplitude limit. The stop-log section consists of 23 openings 20 ft. wide, founded on a heavy scour mattress with sheet pile cut-off wall, and carrying a reinforced concrete deck upon which travels an electric winch for handling the stop-logs. The trolley winch travels on 50-lb. steel rails on the deck, with three electric motors for performing its functions of traction, traversing, and raising or lowering the stop-logs. The stop-logs are 12-in. by 18-in. timbers, 21 ft. 11 in. long, eleven logs to each section, with cast iron slots in each end for the needles of the winch.

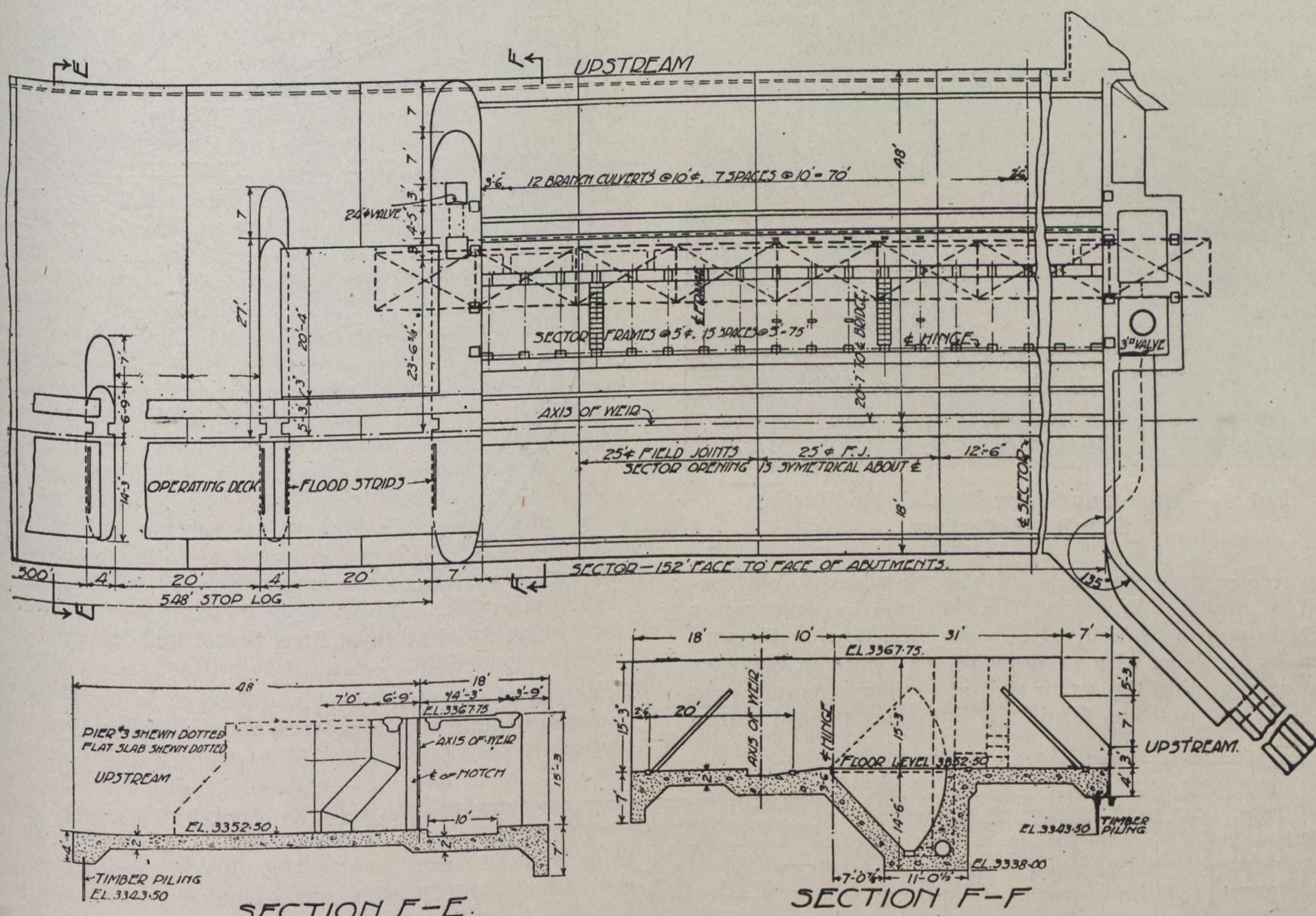


Fig. 3.—Layout Plan and Sections of Hydraulically Operated Sector Intake Weir.

At the north end of the stop-log section is a long pier, extending 47 ft. up-stream from the stop-log dam, forming the south abutment for the weir and containing the inlet valve for the sector well; the adjacent pier extends 34 ft. up-stream, all the other piers extending but 14 ft. up-stream. The north abutment of the weir, adjoining the headgates structure, contains the discharge well. All the concrete construction is heavy mass work, all walls and piers being of the gravity type. The steel sector dam has a total length of 152 ft. and consists of a trussed steel frame conforming to the sector of a circle having a radius of 15 ft. 5 in., with a central angle of 45 deg. The curved surface and top deck have riveted ⅜-in. watertight skin-plates. The steel dam consists of 50 frames spaced 5 ft. on centres, connected by the skin-plates, and braced. The open ends are sealed against the masonry by a timber, held in place by spring bolts, pressing against the concrete surfaces. When the waterway is clear, the structure rests in a well below the stream-bed. Above and below the dam the well is protected by a heavy concrete scour mattress with up-stream curtain wall of triple timber sheet piling.

To operate, stop-logs are placed in all sections, the head on the stop-log side of the longer valve pier becom-

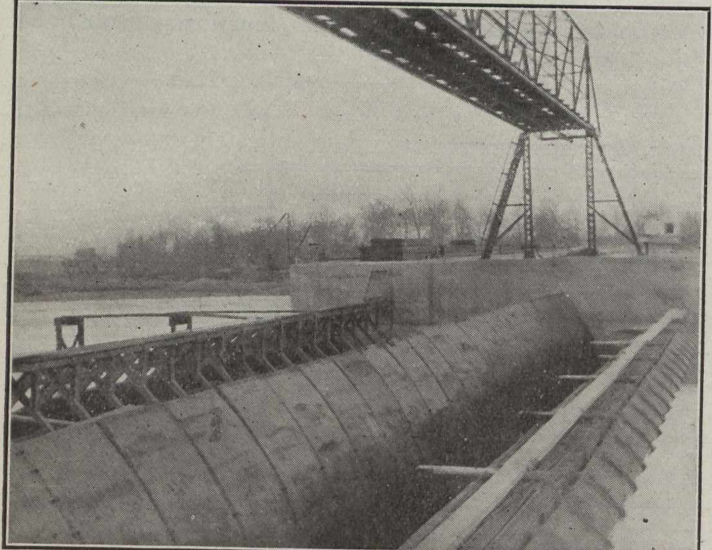


Fig. 4.—Automatic Sector Dam Under Erection, Showing Cofferdam.

ing greater than that across the sector when no obstruction is offered. Water is then admitted into the sector well through a 24-inch valve in the pier, flowing through a 24-inch culvert with 12 branches 12 inches in diameter and opening into the sector well at regular intervals. As soon as the well has filled, the difference in head across the pier causes an upward pressure on the watertight skin-plates, operating to lift the sector. By placing a suf-

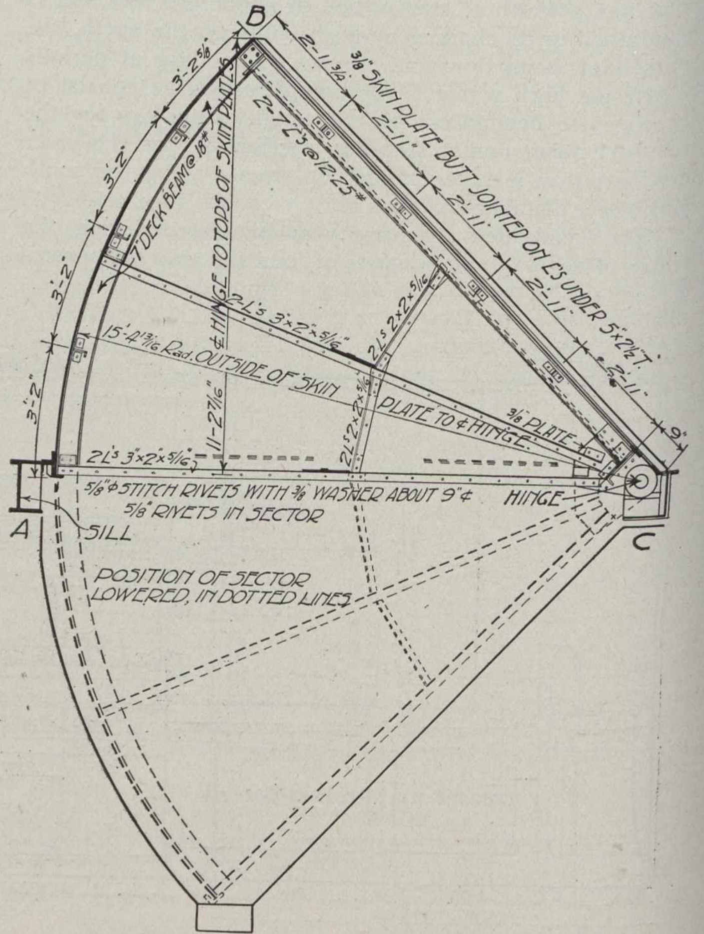


Fig. 5.—Design of Steel Sector and Hinge.

ficient height of stop-logs, the difference in head may be maintained until such a point as may be desired, up to the

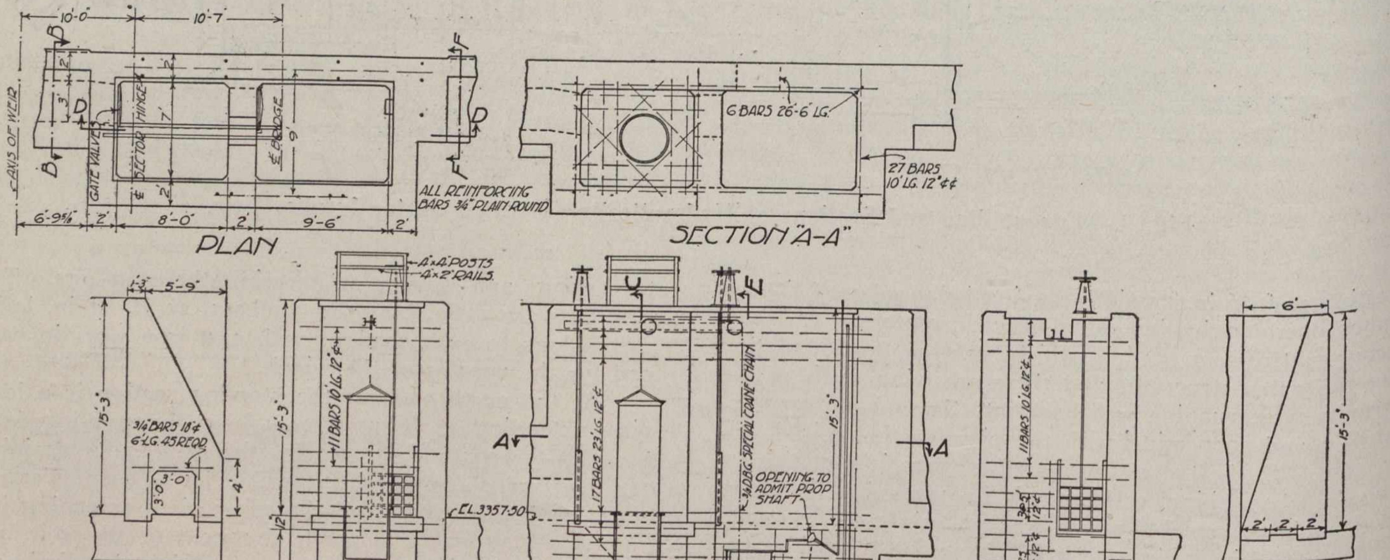


Fig. 6.—Details of Annular Weir Wells.

full lift of the sector, or about 11 ft. 2 in. The head on the inside of the sector is readily controlled through the discharge well in the north abutment. The water is discharged through a vertical weir tube operated by a hand wheel, controlling the discharge head, and hence the head on the sector. The annular weir consists of a cast iron tube 36 inches in diameter set below the river bed, supported through a reinforced concrete slab in a well formed in the abutment, and in which telescopes a second tube balanced by counterweight and operated by hand, through which the water must pass to escape from the well, the maximum escape head being equal to that necessary to raise the sector to its extreme elevation.

Construction was commenced in the fall of 1913, but actual progress did not begin until January, 1915. Excavation was then commenced, and concreting was in progress day and night from the middle of February until completion in May. About 18,000 sq. ft. of cellular cofferdam were built, enclosing the sector well and abutments, and later, portions of the stop-log section. In the sector well the excavation was in blue clay, almost bordering on rock, with occasional layers of sandstone 2 to 3 ft. thick. Because of the amount of water present and the low temperatures prevailing, it was necessary to handle practically the entire amount (about 10,000 cu. yds.) by hand, loading into stone skips which were removed by derricks and dumped into 1½ cu. yd. cars in dinky trains on a trestle to the bank. Concrete was placed from a switching track from a mixer plant located on the north bank. Three small Marsh-Capron mixers turned out about 2,500 cu. yds. of concrete per month. Erection of the steel sector was accomplished by setting up a wooden cofferdam around the sector well. Wooden sills were anchored to the scour mattress when concreted and held the toe of an A-frame upon which were placed 2-in. planks for the outside of the cofferdam. There is a steel footbridge over the sector dam, and this was erected first, and the frames for the sector proper were handled from this bridge.

The contractors for the dam were Janse Brothers, Boomer, Hughes & Crain, of Calgary, and the construction was under the immediate direction of Mr. A. M. Crain, Assoc.M.Am.Soc.C.E. The design was made by the Department of Natural Resources of the Canadian Pacific Railway, Mr. A. S. Dawson, chief engineer, and the entire work was carried out under the supervision of Mr. H. B. Muckleston, assistant chief engineer, Calgary, Alberta.

An untreated steel containing about 1½ per cent. manganese is claimed to be fully as tough, and is stronger than a nickel steel of about 3¼ per cent. nickel.

The Great Falls Power Co. and the Thompson Falls Power Co., subsidiaries of the Montana Power Co., have entered into contracts with the Chicago, Milwaukee and St. Paul Railway for the electrification of about 430 miles of its main transcontinental line from Harlowtown, Mont., to Avery, Idaho, and for electric power to operate the same. Under these contracts, which cover a period of 99 years, to go into effect on or before January 1, 1918, the railway company is bound to take and pay for 20,000 kw., about 26,500 h.p., and has taken an option on additional power to the extent of 30,000 kw., about 40,000 h.p., which option must be exercised one-half in five years and one-half in 10 years; but not less than one-half the amount under option must be taken. On August 11 water was let over the spillway of the dam which the Montana Power Co. has been building for the past three years for its hydro-electric plant at Big Falls on the Missouri River, 14 miles from Great Falls. The dam alone cost about $5,000,000.

TRACTION EQUIPMENT FOR ELECTRIFIED STEAM RAILWAYS.

The committee on heavy electric traction of the American Electric Railway Engineering Association, has compiled some very complete tables relating to the general types of electric locomotives in operation on railroads in America and abroad. They do not cover locomotives used on interurban lines or those used for switching in industrial plants, mining operations, etc., being limited entirely to the practice on electrified steam railroads and on lines acquired or owned by steam railroads. There are two, the first relating to American, and the second to foreign lines. They give under each railroad the number of locomotives in use, description of the service, system of traction and voltage, kind of contact conductor employed, wheel arrangement, total weight and weights of parts, horsepower rating, speed, type of drive and connection, and principal dimensions. Practically all the available systems are represented. An analysis of the tables indicates that of a total of 301 domestic locomotives listed 115, or 38 per cent., are used in connection with 600-volt d-c. third-rail operation, the remaining 186, or 62 per cent., being used in connection with some form of overhead trolley, and that of the locomotives using overhead trolley 72 per cent. are in connection with the alternating current system. It is noted that the foreign locomotives except those in England and France operate in connection with some form of overhead trolley.

These tables, to be presented in the report of the committee, at the convention of the Association in San Francisco, October 4-8, are accompanied by a very interesting study of the present trend of electric locomotive design. In regard to the electrical equipment, it is stated that the practice of using forced ventilation is becoming quite general especially where alternating current or high voltage direct current equipments are used. There is a distinct weight and cost economy resulting from the use of forced ventilation which more than justifies the provision and maintenance of the blowing apparatus. In the case of the Pennsylvania Terminal locomotives where forced ventilation is not used at present for the short haul, service provisions have been made for adding forced ventilation and thus materially increasing the motor capacity when required later on in connection with extensions. The later type New York Central locomotives are equipped with forced ventilated motors.

The most interesting features which develop from a study of electric locomotives is the design of the mechanical parts, especially the wheel arrangement and the method of drive. There is a great divergence of practice in regard to these features. Where locomotives are used for high speed operation leading and trailing wheels are provided by a majority of the roads and in some cases even where the speeds are low and where the line contains numerous track curves it has been thought advisable to provide trucks for leading the locomotives into and out of curves and to prevent oscillation and excessive side pressure on track rails. The majority of foreign locomotives use two-wheel trucks. The latest type of New York Central locomotive has the guiding trucks equipped with motors.

Method of Drive.—Probably the greatest amount of ingenuity and effort in developing the design of electric locomotives has been devoted to the question of type or method of connection between the motor shaft and the axles. A very considerable portion of the weight of the electrical equipment is in the motors and to carry these satisfactorily they should as far as possible be spring supported, either by mounting them on the main locomotive frames or on a separate system of springs. The relation, however, between the motor shaft and the axle must be definitely maintained and at the same time it is important to provide flexibility and cushioning of the motor weight.

There are four distinct types of connections between motor and driving wheels, namely:

(1) Motors mounted directly on the axles and connected either rigidly or by means of spring or quill connections to the driving wheels: Where the complete motors are mounted rigidly on the axles it is obviously impossible to carry the motors on springs. The New York Central locomotive motors are bi-polar and gearless, and the armatures only are mounted on the axles, the remainder of the motor being attached to and carried by the locomotive frames. The earlier New Haven locomotives had the motors mounted on quills with a relatively small amount of movement provided for in the spring drive.

(2) Motors geared to the axles either directly or through quills and driving springs: Until comparatively recently the usual practice has been to gear the motors directly to the axles and there are numerous examples such as the Baltimore and Ohio, Grand Trunk, Michigan Central, and others. The later New Haven locomotives are examples of the use of motors geared to quills and provided with flexible spring drive between quills and wheels. Where the motors are geared directly to the axles the motors are usually suspended at the same level as the axles and geared horizontally to them, part of the weight of the motor being carried on the locomotive frame which in turn is flexibly supported by the main locomotive springs. There is practically no flexibility transversely with this method of mounting. Where the motors are geared to quills around the driving axles the entire weight of the motors and gears is carried on springs but the amount of flexibility both vertically and horizontally is restricted by the relatively small clearances that are permissible with this arrangement.

(3) Motors geared to jackshafts which are in turn connected to the driving wheels by means of side rods: In this case the motors with gears and jackshafts are all mounted on the main frames and hence are spring supported and the connection between the jackshafts and drivers is effected by means of side rods with the maximum amount of flexibility and this arrangement provides the same freedom of movement as is permissible and customarily provided in steam locomotives. The Norfolk and Western locomotives are an example of this type of drive.

(4) Motors connected to jackshafts by means of main rods and drivers connected to jackshafts by means of side rods: This arrangement has the same advantages as to flexibility of mounting and spring cushioning of motor weights as in the case of (3) above. It has been used in the United States only for the Pennsylvania Terminal locomotives which are of the high-speed passenger type and, therefore, rod connections were used between motors and jackshafts in preference to gears.

It is claimed by the users of motors mounted above the axles and connected either by gears or rods that improved riding qualities are obtained due to the high centre of gravity of the locomotive as a whole, the tendency being for the heavier parts to roll on the springs and to reduce side pressure on the track rails. On the other hand, it is the opinion of those who use motors located on or near the axles, that the high centre of gravity is not necessary to give good riding qualities, provided the running gear is so designed as to avoid the setting up of an oscillatory tendency.

Axle Weight.—Another interesting feature of electric locomotive practice is the maximum weight per axle. On the domestic locomotives the weight per driving axle ranges from 30,000 lb. in the case of the New York Central to 55,000 lb. in the case of the Norfolk and Western, the majority of locomotives having a weight of between 40,000 and 50,000 lb. on driving axles. It is noted that this is considerably less than the axle weights used in steam locomotive practice where they range from 40,000 to 62,000 lb. and in some cases even as high as 68,000 lb. as in the case of the heaviest Pennsylvania engines.

Rigid Wheel Base.—Another feature of the mechanical design of electric locomotives is the length of rigid wheel base, which for domestic locomotives ranges from 6 ft. 6 in. to 13 ft. (excepting a few B. & O. engines). In the majority of recent electric locomotives the rigid wheel base does not exceed 8 ft. with the exception of the Norfolk and Western where the rigid wheel base is 11 ft. This compares with a maximum of 14 ft. for steam passenger engines and 17 ft. 6 in. for steam freight engines.

Locomotive Capacity.—Inasmuch as the source of power for the operation of electric locomotives is not on the locomotive itself but in the power house and lines connecting the power house with the locomotives, it is feasible to construct electric locomotives of almost unlimited power or capacity by providing a sufficient number of driving axles and motors. There is naturally a limit to the capacity which can be secured per axle on account of the limitations of track gauge and width and height of engines and on account of limitations in mechanical strength of materials used in the construction of the parts and restriction as to permissible weight per axle carried on the track. As an example of capacity may be cited the Norfolk and Western locomotive which consists of two units; two of these complete engines or four units will handle the same tonnage as three of the largest Mallet type of steam engines but at twice the speed.

It may be said that electric locomotives have been built and operated to perform every kind of railroad service, that is, high-speed and suburban passenger and road and yard freight up to and in excess of the maximum capacity for which steam locomotives have been built for similar service. It is, however, too early to attempt to standardize electric locomotives either electrically or mechanically.

Canadian manufacturers look upon the Russian market as one of great value. Comparatively few of our exports have gone to Russia in past years. The filling of war orders for that country by several important Canadian firms has awakened a remarkable interest in the Russian market. The directors of many of these firms have visited Russia and are of the opinion, with others, that after the war, Russia will probably undergo an active development such as has been the case in Canada during the past ten years. This development will call for considerable railroad construction, with the consequent demand for steel, locomotives, cars and general equipment. And that is only a typical example of general construction work.

UNIFORMITY IN HIGHWAY DATA

THE following extracts from a paper read at the recent Pan-American Road Congress at San Francisco, Cal., describe the method employed by the Commission of Highways of the State of New York. The author is Mr. H. E. Breed, First Deputy Highway Commissioner, and in his preliminary remarks he strongly emphasizes the necessity for uniformity in highway data. Continued neglect of this important branch of the work means waste of experience, energy and resources. The necessity for uniformity is obvious. Under the present system, many different highway departments are doing similar work without any basis for comparison. The records of one are unintelligible to others. Mistakes made in one department are duplicated by many another. Experiments are repeated, often with unsatisfactory or disastrous results, in a dozen different places. Every department, every engineer, has to learn largely through his own experience, and when this process involves the huge sums now being expended upon highways, it is entirely too costly. Were comparative statistics available, every department would be an experiment station; every experiment station an illumination to the whole field. The conscientious engineer, consulting such statistics upon the inception of any new work could determine, far more accurately than he can to-day, factors making for success or failure in it.

Granted the necessity of having a uniform system for keeping statistics and data, we must consider its scope. It should be broad and comprehensive enough to be of relative worth, without tying itself up into an agglomeration of red-taped detail. Simplicity should be its keynote and motive. It should be devised in such a way as to be intelligible to anyone without the department who came thither for information, and it should give to all employees within the department adequate knowledge of the work; its preliminaries, its progress and its results. In such a system, only approximate cost data could be sought, for varying local conditions would so change many items as to make them inconclusive.

The Commission of Highways of the State of New York, on July 15 had $14,000,000 worth of construction work going on, plus $1,325,000 worth of maintenance work. Its statistical problem, therefore, is large. For the purposes of this paper this problem has been considered in part under three heads: First, the treatment of maps; second, the tests and tabulation of stone and sand; and, third, the actual highway construction and maintenance data.

The Treatment of Maps.—The department has three different styles of maps: a large map of the state on a scale of five miles to the inch; 57 county maps on a scale of two miles to the inch; and additional county maps made from the U.S. Government geological sheets on a scale of approximately one mile to the inch. On the large state map projected state highways are shown by two green lines; projected county highways are shown by a single red line; state highways under construction are shown by a black dash line between two green lines; county highways under construction, by a black dash line over a red line; completed state highways by a solid black line and green border; and completed county highways by a plain black line. Finished, this shows the projected state highway system as prescribed by legislative enactment, and county highways as petitioned for and laid out by legislative enactment and county boards of supervisors. In addition to the information given on the large state map, the county maps show, too, the number of the contract, its length in miles, the year finished, and the type of construction. The topographical map of each county on the mile-to-the-inch scale gives the same information as the county map. Each topographical sheet is cut in six sections mounted on linen 3/8 in. apart so that they may be folded for pocket use. When on inspection tours these maps give the essential information at a glance.

(FRONT)

Division Sample No ....

STATE OF NEW YORK
COMMISSION OF HIGHWAYS

STONE, GRAVEL AND SAND
SAMPLE INFORMATION
BUREAU OF TESTS
Albany, N.Y.

.............................., N.Y.,...................., 191..

Gentlemen:

There has this day been shipped Division Sample No............of......................taken.............., 191..
SAMPLE taken by........ ....(1)......... .... from property of.......................
Village or City of..... ....Town of. ....County of.......................
Character of supply is (2)..... ....Its location by Index No. is Quad......Sec......Letter....No...
General classification of stone is (3)...............The available supply is (4)... ....
It has been used for (5) ....Course on Road Nos.......... .. ....The results of its use were
....

SAMPLE is submitted for use in (5).... .... { Culverts / Course of the (6)........................ Road
Pet. No........Road No.... ..Repair Contract No........Route No.... . Sec No ....County of..............
From Sta....to Sta. ..Haul to nearest point on road which is Sta....is....miles. Road extends from Sta....to Sta....
The kind of stone specified for use on this road for top course is (3)...........and for bottom course is (3).........
The type of construction of this road is.......................... ..... Binder to be used is..... ....
Remarks (7)..
....
....
....
....
....
SAMPLE is herewith recommended for use in the (5)...... ...course Signed ....
Engineer Division No........
SEE NOTES ON OTHER SIDE OF THIS FORM.

(BACK)

NOTES.

(1) Give title of person who took sample.

(2) State whether quarry, ledge, or field stone, or in case of sand or gravel whether bank or creek bed.

(3) State whether limestone, trap, syenite, etc., etc.

(4) State whether plentiful or limited. If limited give approximate estimate in cubic yards.

(5) State whether top, bottom or concrete.

(6) State name of road.

(7) Wherever information called for on this form cannot be given, draw a line in the following blank space. Wherever there is insufficient space for information in the form give the additional information under "Remarks," also any information regarding the accessibility of the quarry, character of haul, amount of stripping necessary or other information deemed advisable.

Fig. 1.

Tabulation of Stone and Sand.—The large amount of stone and sand that passes through the testing laboratory makes uniformity in the keeping of accurate data essential in order to avoid duplication of work and to preserve information that will increase economic construction and assist anyone engaged in the building of public highways. In order to handle the work expeditiously and to make it valuable to all the employees of the department, it has been necessary to make a number of comprehensive forms for the correlation of the results of the different tests.

With every specimen of stone submitted for test, the engineer sends with the sample definite information about the location and available supply, giving its exact location on the United States topographic sheet, as well as the character of rock or material in question, the type of construction for which the same is intended, and the results of any former use. In locating samples, we have found that the government method of locating by quadrangle is very helpful. By it, each quadrangle is divided into nine sections and these sections are numbered from one to nine inclusive, starting at the upper left hand corner and numbering across the sheet from west to east. Each section is then divided into equal spaces, lettered from A to V inclusive from west to east, and numbered from 1 to 32 inclusive from north to south, the numbers and letters serving as co-ordinates for the point in this section from which the samples were taken. As nearly as may be roughly determined, the maximum limit of error would be somewhere in the neighborhood of 800 ft., which is practically inappreciable for the work involved. Such an information slip (Fig. 1) accompanies every stone sample to the laboratory and also accompanies the report of test when the report is made on the specimen. The location of the source from which this sample was taken is then plotted on our office map which shows the highway system, as described above. These maps are very useful, especially in looking up sources of material when we again have construction work in the same vicinity. For all future requirements the record given for this material gives us a service test of the same.

Results of Stone Tests

STATE OF NEW YORK
COMMISSION OF HIGHWAYS
BUREAU OF TESTS
ALBANY

Filed Under ....

B. R. Sample No.......... Taken.......... 191.., by.......... Div. Sample No..........
From the property of ....
Village or City of .... Town of.......... County of..........
Location.......... Index No. ....
Character of Supply.......... Cubic yards available..........
Material has been used on Highways No.......... Results of use..........
General classification..........
Stone specified { Top course..........@..........per cu. yd..........
Stone specified { Bottom course..........@..........per cu. yd..........

RESULTS OF TESTS

Specific Gravity	Weight lbs. per Cubic Foot	Waterabsorbed lbs. per Cubic Foot	Abrasion		Hardness	Toughness	Weighted Value
			Per cent of Wear	French Co-efficient of Wear			

Type of Construction ....
Remarks: ....

Sample received..........191.. Tested..........191..., by.......... *Engr. in Charge Tests*
Sample......accepted for..........concrete..........191..., by..........
Sample......accepted for..........course..........191..., by..........

Fig. 2.

In our stone tests the following determinations are made: Gravity, absorption, coefficient of wear, hardness, and toughness. In order to have a figure which will enable one quickly to compare the relative values of two or more stones, we have a figure which we have designated as a weighted value. This is obtained as follows: To each of the items, abrasion, hardness and toughness, we affix a weight, giving 3 to the French coefficient of wear (abrasion) as being the most important; assigning 2 to the hardness test as being second in importance and reliability; while to the toughness the weight of 1 is given. These three weighted results are added together, giving the weighted value of the stone tested. All are tabulated on cards (Fig. 2) for the purpose with the other information mentioned above, as well as the location, owner, available supply, water, where used, etc. Furthermore, these tests are collated on one sheet for each county, listed under headings giving the character of the stone found in the county. The weighted value is placed on the map, it being of great aid when approving or disapproving stone for use from these different localities.

This information, of course, is not without its limitations. In many instances the chief in the office is unable to judge by the previous information that he has on hand of tests already made whether sufficient examination has been made on the ground. Often it has been found that a more comprehensive field survey will develop a supply of stone and sand which was not found upon first examination, thus cheapening, in many cases, cost of construction. And, too, the division by county is rather a rough determination, though it is considered fine enough for the work in hand, as we also take into account the geologic formation when taking action on the various tests.

The results of these tests are reported in duplicate to the division engineer in whose territory the sample was taken. This allows him to preserve in his files a copy of the same and also to transmit a copy to the engineer who is in actual charge of construction. By this means a two-fold purpose is attained, as the data are placed in the hands of the division engineer for his use and future reference, and serves as well to educate the engineer in charge of the work by familiarizing him with the various materials which he employs.

The test for sand is not quite so elaborate as that for stone, but as there is great variation in the supply obtained in many cases, we have provided kits for men in the field which enable them to check the loam determination and also to make some of the mesh analyses. With sands the following determinations are made: Per cent. of loam and its occurrence, that is, whether it occurs in free state or has a tendency to coat the grains; also the effect of washing upon the sand; percentage of voids by mesh analysis, using the following sieves: 1/4, No. 6, No. 20, No. 50, No. 100 and No. 200. The natural and washed sands are also made up into 2-in. cubes for compression tests, using a standard blend of cement. At the same time we make a compression specimen, using the same cement and a 20:30 Ottawa sand. The result obtained on the natural and washed sands at the end of seven and twenty-eight days is compared with results obtained on the specimen made, using the Ottawa sand as a standard, the requirements being that the natural sand, if it is to be used in any of our concrete pavements, shall show a compression at least equal to that of Ottawa sand. It must also be free from organic matter and reasonably free from loam, our specifications stating that 5 per cent. of loam will mean rejection. Sand used for other structures such as culverts, foundations, etc., must show a compression strength of at least 80 per cent. of that obtained with Ottawa sand.

This elaborate detail test of sand may appear to be useless work, but it has been proven by results obtained that in order to have successful concrete pavements the sand forming the matrix must be as carefully and judiciously selected as the cement that forms a part of the same. Our experience has been that many failures in this type of construction are entirely due to poor sand. Concrete, to withstand abrasion and tensile and compressive stresses, is only as strong as the matrix composing it. The inconsistency of present day practice is shown by testing the one important ingredient (cement) with a fine degree of precision, and trusting the other equally important ingredient (sand) to visual guesswork.

Highway Construction and Maintenance Data.—As this is one of the most important items for the consideration of uniformity, I shall endeavor to give a description of our system somewhat in detail, chiefly for the purpose of emphasizing the necessity for uniformity and for the keeping of this kind of statistics. Probably every municipality and state engaging in the improvement of highways and pavements has some form or other which covers this class of data, and some effort should be made to reduce the ultimate results to standardized units flexible enough to cover all constructive and maintenance matter and relative enough to permit an intelligible exchange of this data between different departments. These statistics are outlined with the idea of placing in the hands of the designing engineer a rough relative cost of the types of pavement, giving the kind of material used, the density of traffic carried, its growth invited by the improvement, and the life of the pavement, so that he can in the consideration of a new problem have always before him a service test of magnitude equal to that of the undertaking to be considered. This information should also be of equal value to the maintenance engineer as a record of the results gained from the expenditure of money from year to year on different types, giving him adequate data on which to formulate new kinds of treatment along lines giving the greatest satisfaction and to discard methods proven by use to be unreliable.

For the purpose of collating these data, the department has adopted three cards, one of which is designed to show all construction data, both general and specific, giving its information in such manner as will be available and intelligible to the general public as well as to the engineer.

General Data.—Under this heading are grouped such general features as Highway Number, Name of Highway, etc. In general, we have two classes of highways: State highways, built wholly by the state; and county highways, built by the state and county together, for which the state pays from 65 to 85 per cent. of the total cost. In order that they may be distinguished by their numbers, numbers from 1 to 5,000 are used to distinguish county highways, and 5,000 to 9,000 to distinguish state highways. Numbers above 9,000 are used for the purpose of designating roads originally constructed by a county or town for which the burden of maintenance has since been assumed by the state.

Our cards (Fig. 3) are indexed under their highway number and our files are arranged numerically. The name of the highway is generally taken from the city, village or other well-known point at each terminus of the road; as for example, Albany-Schenectady Highway. If too long for one contract, it is designated at Parts 1, 2, 3, etc.

Hwy. No. .... Name ...., ...Miles, ...County
Route.............. Sec..... .... Pet. Nos.....
C ntractor
Address
Eng. Est. ....Cont. Pr.
Eng. & Adv.______________Spec. Agr. ______________
Approp
State ....Eng. & Adv.______________
County ....Total
Corp...............................State
County
Prelim. Est. by ....Corp.

Towns	Miles	Type	Corpor.	Miles	Type

AGREEMENTS

Date	Plus	Minus
Total		

Date of Cont. .... Date of Acc. ....

Length in Feet	WIDTH: Pav.	WIDTH: Rd.	MATERIALS OF CONSTRUCTION: Foundation	Th.	Bottom	Th.	Top	Th.	Binder	Surfacing	Sq. Yds. of Pavement	Equiv. 16' Miles	COSTS: Per Sq. Yd. of Pavem't	Per Mile 16' Pavem't	Exc. per Mi. 26' R'dway	Other Items per Mi. Cont.	Total Cost pr Mile 16'-26'
Item Costs =																	
Final Est. by																	
Item Costs =																	

Sq. Yds. of Roadway.............. Cu. Yds. Total Excavation.............. Cu. Yds. Misc. Foundation..............
Miles Equiv. 26' Rd. .... Cu. Yds. per Mi. 26' R'dway.............. Cost per Mi. Misc. Found..............

Fig. 3.

This name system further serves to locate the highway and, therefore, appears on the card; the length in miles, the name of the county, the route and section number if a state highway, as well as the petition number if a county highway, and the length and type in each town and corporation are given to complete the location. The contractor's name and address are also given, as well as the amount of the engineer's estimate, the estimated engineering and advertising charges, and also the amount of the total appropriation with the respective subdivisions of this amount into state, county and corporation charges. The actual cost placed opposite to the foregoing shows at once how careful the engineers were estimating. Space has also been provided to show the amount spent in agreements, which is the term used for any extra work or change in type. Finally the date of the contract and the date of acceptance completes the general record. This card probably is of value only to the department, and is used most often by the deputy commissioners, the secretary, and the financial bureau.

Specific Data.—The main subdivisions under specific data are widths, materials and costs. Space is provided for three types of pavement, as we often have that number on one road; the length and width of pavement and roadway are shown for each type. Under Materials of Construction are given the kind and thickness of the foundation, of the bottom and top courses and of binder and surfacing used. Under foundation will appear such forms of construction as Telford, sub-base, etc. Binder will show water for waterbound; asphalt and tar for bituminous; grout for brick roads, etc. Surfacing includes wearing course and oil, tar or glutrin treatment, etc. Costs are figured on the per yard and per mile basis, using 16 ft. of pavement and 26 ft. of roadway as the standard in width. The reason for the adoption of these widths is that they are the most general type in use in New York. As the width of pavement many times varies from 12 to 50 ft. where the width of roadway varies from 24 to 50 ft., on account of improvements mainly in villages and cities, the necessity for the above standard for comparison is obvious. Both preliminary and final estimates are shown. The square yards of mileage in a 26-ft. roadway are given as a basis for computing cost of excavation. A total excavation in cubic yards and the number of cubic yards per mile of 26-ft. roadway are given to show whether the excavation was light or heavy. The number of cubic yards for miscellaneous foundation and its cost per mile are given to show the amounts of extra foundation course that are required owing to bad soil conditions. These specific data are of great value in properly forecasting future work and if a system for uniformity can be devised, much may be learned through them of benefit to others engaged in highway work.

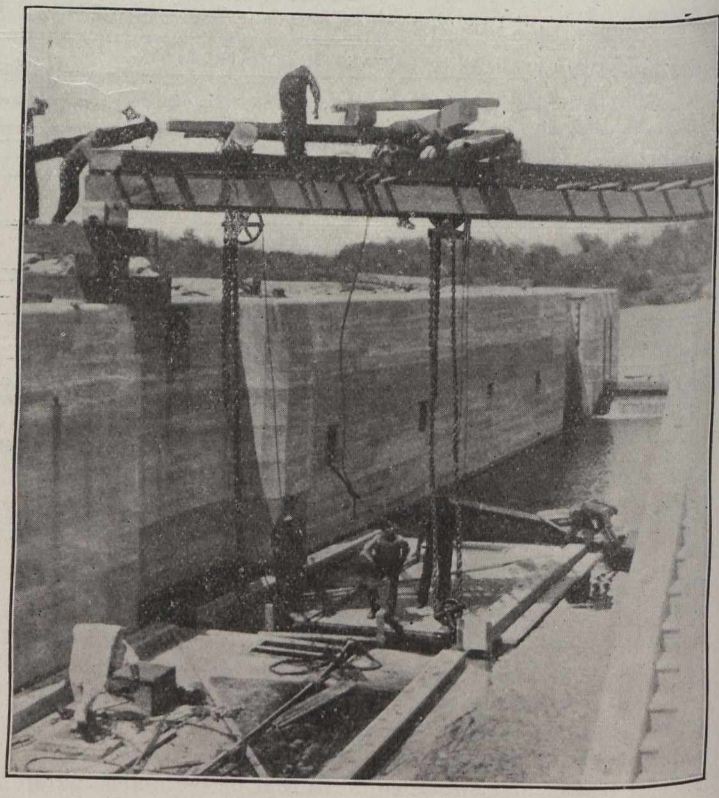
Data Sheets.—In order that the Commissioner, Deputy Commissioners, Division Engineers and other employees might have reliable data so as readily to compare different highways under the same and varying conditions both in regard to construction and maintenance, the material on the cards as outlined above has been collated and placed upon white print cloth sheets, according to the type of construction. A legend is placed at the top of the sheet by which the different classes and kinds of material as well as the name of the manufacturers can be distinguished. The data on these sheets is featured mainly in material unit cost per mile and maintenance per year. Each highway occupies one line and is indexed under its number and there is room for 26 highways on each sheet. Inasmuch as some highways are constructed of several different types, a column is provided for the total mileage; another is provided for the mileage of the type under consideration. Complete information such as kind and thickness of material entering into the different courses as well as the binder used, are shown by abbreviations appearing in the legend. A column is provided in which is recorded the unit cost per mile for the pavement only; another for all other items of construction cost lumped together; and a third for the total amount spent for engineering and advertising. These three items are summed up in a column which gives total cost per mile and the equivalent cost per mile of a 16-ft. pavement is computed and tabulated in order to give instant comparison between highways of the same or different types based on this standard of width. The costs per square yard of the entire pavement and of the top course are given, experience having shown that these items are the ones most often required. The cost of the bottom course can be readily obtained by a little calculation. The maintenance per year will be shown for the first and second years and also the total to date. The cost per mile per year and per square yard per year are given, the idea being to furnish unit costs that will allow a rapid comparison.

For better study of the traffic density we are having a traffic census taken each year and if necessary twice during the year, both before and after improvement. A column is provided to show this. This gives a record of the growth of traffic due to the improvement, and further furnishes us with information by which to adapt other types proper to the locality. A column is provided for the date when the highway is completed, for quick determination of its age.

From the above-described sheets we may make rapid comparisons between roads of the same type. From a comparison of the average cost of construction and maintenance of these various types, facts will be discovered that should tend to more economic consideration and design than has been had heretofore.

INTERESTING METHOD OF ERECTING LOCK GATES.

THE accompanying illustration shows a distinctly unusual method employed in the erection of two lock gates at Port Severn on section 2 of the Holland River division of the Trent Valley Canal. The usual practice is to use some form of submersible pontoon for this work, or alternatively a floating crane.



Equipment for Erecting Lock Gate.

In this instance, the contractors, the York Construction Company, Limited, used two 10-ton worm gear chain blocks for hoisting the lock gates into position. The illustration shows the gates in the canal with the chain blocks attached to a temporary support and the operation about to commence. It also is an interesting illustration of the masonry design of the canal walls.

We are indebted for the illustration to the Herbert Morris Crane and Hoist Company, Toronto, who supplied the chain blocks. Mr. A. Lothian was superintendent for the contractors on this section of the canal.

ENGINEERS AND WAR.—III.

By R. O. Wynne-Roberts, Consulting Engineer, Toronto.

ENGINEERS have been busy from biblical times to the present in building guns. It is recorded in the Old Testament (II. Chronicles 26:15) that there were "engines invented by cunning men to shoot arrows and great stones." An interesting statement given in the Encyclopædia Britannica is that the Turks, when they besieged Constantinople in 1453, used a great force of artillery and also some monster pierces. Some of the latter survived for over 350 years and engaged the British squadron in 1807 when a stone shot weighing 700 pounds cut the main mast of the admiral's flagship in two. Artillery was employed in early wars, but its mobility and position in warfare were first established by a Swedish officer, Gustavus Adolphus, in 1631. The artillery branch of the military service was not developed and organized in England in the early days as it was on the continent of Europe, for it is stated that in the time of Queen Elizabeth the gunners in the London Tower were old men, some 90 years of age. Yet, it was in good Queen Bess's time that the Spanish Armada set sail from Spain for England and was defeated in 1588 when the British proved the power of their cannon and their skill in handling them.

The development of artillery did not call for a separate branch of the military service until about 1716, when an order was issued for a separate corps, but it was some time afterwards that it was actually put into active operation. A military school for artillery and engineers was established in England in 1741, but a laboratory had previously been provided at Woolwich in 1672.

Reference has already been made to red hot shot and its destructive use at Gibraltar. It was invented by Stephen Batory, the King of Poland. Until guns were grooved within the barrel the shots were spherical, but when rifling of the gun barrels was invented conical shot came into use. The rifling of guns, that is, the cutting of grooves having a number of turns in the length of the barrel, causes the projectile to have a rotative motion which, during flight, has the quality of equalizing any irregularity in form or weight of the projectile. This tends to lessen its liability to depart from a straight line and to some extent helps to overcome the resistance of the air.

Shrapnel was invented by General Shrapnel in 1784. It was a spherical common shell filled with lead bullets mixed with bursting charge. At first it was not entirely satisfactory, but was afterwards improved. Time shrapnel projectiles are now considered, par excellence, the most effective. The time fuse became possible only after the discovery of fulminate of mercury in 1799, but it was not introduced into actual service until the bichlorides were invented. In 1866 they produced a most startling effect on the military organizations of the world.

To show the extent to which guns have been improved and increased in power, a few words will be devoted to the description of the Austrian Skodo mortars which destroyed the Antwerp fortresses. These guns have 12-inch bores, discharge projectiles weighing 850 lbs. with an initial velocity of 1,115 feet per second. These shells do not burst until they have penetrated into the concrete work. Antwerp fortresses were destroyed at a range of 7½ miles, which fact seems to suggest the death knell of permanent fortifications. The engineers have made it possible to transport these guns on four trucks each having 100-h.p. motors and capable of travelling at the rate of 12½ miles per hour on a level road and 1½ miles per hour up a 16 per cent. grade. Only a few years ago the Japanese, when at war with Russia, had to use light railways to facilitate the moving of their 11-inch siege guns.

The power of modern artillery, however, is said to owe even more to the improvements in the building up of the projectiles than to that of the guns. It is self-evident that projectiles being self-contained are more effective, quicker in action, liable to less accidents in delays of delivery than powder, wads, shot, etc.

As the power and range of the artillery increased, improved methods for controlling them had to be devised. Range-finders had to be made which measured the distance more accurately than before. Gunners formerly saw their targets and were able to direct operations, but now, as has so often been explained in the despatches from the field of battle, they depend on men stationed in some position of vantage. Information is sent by telephone or by signals as to the elevation, kind of fire to employ, type of projectile, time of fuse, etc. Guns must be concealed as much as possible and consequently means must be adopted whereby the men can obtain reliable information so as to work their guns to the best advantage.

The palæolithic man was probably able to throw a stone 300 feet, requiring an angle of 45 degrees. The present-day artillerist can throw several hundred pounds 3,000 feet with an elevation of but one or two degrees.

With regard to the weapon of the infantry, Fleet Surgeon Beddnell, in a recent letter, gave the following figures showing the power of rifles and muskets.

Date.	Rifle.	Calibre, inches.	Danger zone for 750 yards range. Length in yards.	Percentage.
1842	Brown Bess	0.750	50	6.7
	Snider	0.577	150	20.0
1871	Martini-Henry	0.450	200	26.7
1888	Lee Metford	0.303	400	53.5
	Mauser	0.276	630	84.9
	Mannlicker	0.256	650	87.5
	Krag-Sorgensen	0.236	700	94.3
1910	Spitz-Geschos	0.315	750	100.0

The following diagram, copied from the Encyclopædia Britannica, will show the trajectory of three of the above named rifles.

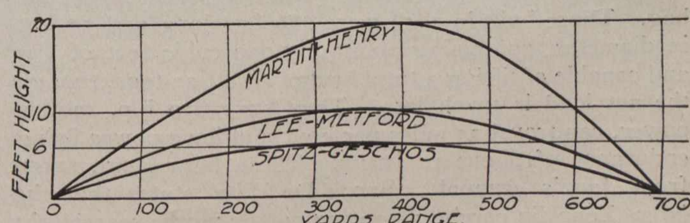


Fig. 1.—Trajectory of Different Rifles.

As will be seen by the table, the weight of the bullet is being whittled down, the trajectory is flattened and the danger zone is increased.

Some readers will remember the time when powder shot, bullets, wads, copper caps, etc., had to be carried separately, but this was changed by the introduction of cartridges which carried their own means of ignition. The expansive cartridge cases prevent the escape of the gas at the breech and consequently increase the explosive power of the charge.

It may be instructive to state that the power developed in a rifle barrel by the firing of a cartridge is over 8,000 foot-pounds, whilst in a 16-inch gun it is about 300 million foot-pounds, which is about equal to dropping vertically a block of granite measuring 30 ft. x 30 ft. x 20 ft. from a height of 110 feet.

Aircraft.—Mr. Peter Swan, in a letter to the "Engineering" in August last, made use of the following words: "An entirely new branch, the Flying Corps, has proved to be of inestimable value in scouting. In a short time it will be found the most terribly offensive weapon of war; squadrons of aeroplanes, numbering many thousands, will be used to destroy ships, cities and arsenals with greater immunity from loss than could be obtained by any force operating on land or on board a ship. The fate of nations may in future be decided in the air. For this service very special training is required. The airman is a man apart, and his value as a fighting unit is increasing every day."

When we think over Sir Percy Scott's arguments concerning the value of submarines, that they do away with three of the five important functions of a warship, namely, bombardment of ports, blockading of the enemy's ports, convoying of landing parties; that warships will not venture out of port to attack the enemy's battleships and commerce, it will be noticed that by combining the destructive force of aeroplanes and submarines war in future will be even more terrible to contemplate than it is to-day. Both these craft have only recently been introduced into active service, and even during the last year they have been immeasurably improved and developed. What, then, will take place in the next few years? Sir Percy Scott's arguments have not been entirely fulfilled in the present war, for the British fleet has fought on the high seas, it has blockaded German ports, it has convoyed troops to France and Turkey, it has attacked the enemy's ships when given an opportunity, and it has swept the enemy's commerce off the oceans. But the power of the submarine has nevertheless been proved to be great. Captive balloons were used at Fleurus in 1794 when General Jordon defeated the Austrians. They were used in the French Revolution and the American Civil War with success.

The first Zeppelin was built in 1900, after two years' exhaustive enquiries and labor. It was 420 feet long and 38 feet in diameter, built of aluminum framing, covered with silk and linen treated with pegamoid. It had 17 compartments, each provided with an independent gas bag. Those built in 1914 were 486 feet long and 53 feet in diameter, containing about 717,000 cubic feet of gas and capable of lifting a total load of about 23 tons, though the net load is much less. They have 650 h.p. motive power, can travel 53 miles per hour and have power flying endurance of about 72 hours. These figures are taken from Jane's Annual. Baron De Witz states that the latest Zeppelin carries a 400,000 candle power searchlight to illuminate the country from a height of 4,000 feet.

In 1902 Santos Dumont won the Deutsch prize by flying round the Eiffel Tower in Paris. The writer witnessed one of these thrilling flights in that year. Britain had her first military airship in 1907, but the military authorities were circumspective in their selection of aircraft.

Zeppelins have been prominent in this war, particularly in the way in which the commanders have contravened all recognized laws of nations and yet achieved so little. It is, in fact, more or less recognized by military authorities that they have not been as successful as aeroplanes, which have revolutionized warfare. Aeroplanes are often used as scouts in place of cavalry. Secrecy of movements and strategy which was formerly insisted upon, is to-day almost impossible, because aeroplanes are capable of hovering over the enemy like eagles, and of reporting what is taking place. It is stated that the British in their retreat from Mons to the Marne, in August, 1914, owed their immunity from irreparable disaster to aeroplanes. Four years ago the writer saw a great and wonderful display of 30 aeroplanes at Chicago. Previous to that France was the scene of great feats by these craft.

The firing of big guns is now directed by signals from aeroplanes flying well beyond the range of the enemy's anti-aircraft guns.

We read of reconnaisances made by aeroplanes into the enemy's territory when high explosive shells were dropped into the camps, etc. Some aeroplanes are capable of flying at a speed of 160 miles per hour; these are light and carry only the pilot. Other aeroplanes carry two or more men and a gun, but are necessarily slower and their range of operation is more limited.

Monoplanes are now being discarded, fast tractor bi-planes being adopted instead. The former are more limited in their carrying capacity and range of vision, and are low in speed. Other European military authorities are scrapping hundreds of their aeroplanes owing to inherent defects, but the British stick to their product—the bi-plane—which is faster, lighter and can outfly and outfight the German Taubes.

The French now make an aeroplane equipped with 200 h.p. motor, to travel 88 miles per hour, carrying 4 men and a six-pounder gun, to throw high explosive projectiles. The Germans are said to have a tri-plane in course of construction to carry 20 men and 4 machine guns, but the statement that the motor is only 180 h.p. suggests erroneous information.

The United States have built aeroplanes to the value of $8,000,000, a fact which indicates the employment by the belligerent nations of an enormous number of aircraft.

Wright's machine was the first American machine to fly successfully, and it will be recalled how this inventor startled Europe by his exploits in 1908. Bleriot, in 1909, was the first to fly across the English Channel. Curtiss produced his flying boat and made the first successful flight at San Diego, Cal., in 1911, and in 1913 built a flying boat to carry 4 passengers. Curtiss' flying boat is stated to have 160 h.p. motors capable of carrying two men, five hours' fuel and 250 pounds of bombs, etc., at a speed of 55 to 85 miles per hour.

The work of the engineer in connection with aircraft is evidently most important. The maximum strength of materials, coupled with stability and lightness in weight, are essential in these machines, and aerodynamic efficiency is a primordial requirement, whilst the lighting, compass errors, and other points are receiving close attention at the hands of the British Advisory Committee for Aeronautics and other authorities.

"We have achieved wonderful technical results," writes a correspondent to the Times' Engineering Supplement, "and it is recognized by engineers that some day the aeroplane can acquire the whole of the properties and qualities of airships." But at present the airship can travel ten times as far, can stay in the air twenty times as long, and carry ten times as much load at much the same speed as an aeroplane, and there is, therefore, some ground to cover before aeroplanes can equal that of airships in these respects. The dropping of bombs from a height onto an object is not an easy task. There is to be taken into account the speed of the aircraft giving a forward momentum to the bomb. The wind currents are often erratic, for which allowance must be made. The aeroplane rolls or sways and the bomb releaser is not always in a correct line over the object, and the speed of travel is not accurately known. All these circumstances have to be taken into consideration when bombing the enemy.

Tennyson, in 1886, wrote the poem "Locksley Hall," in which he in imagery

"dipped into the future, far as human eye could see,
Saw the vision of the world, and all the wonder that would be;
Saw the heavens fill with commerce, argosies of magic sails,
Pilots of the purple twilight, dropping down with costly bales;
Heard the heavens fill with shouting, and there rained a ghastly dew
From the nation's airy navies grappling in the central blue."

Fortifications.—There have been great changes in respect to fortifications. Frederick the Great said that "in spite of so much labor and such terrible appliances, modern fortresses are not impregnable." This was about 150 years ago, yet permanent fortifications were afterwards built, apart from those already mentioned. Italy was determined to build the forts at Spezia and Torento which would defy the power of guns. Gruson's chilled cast iron domes, 60 inches thick on the breast and 24 inches thick on top, were installed, but the fall of Antwerp with the massive metal domes is the answer. Modern battles, as an United States engineer recently stated, tend more and more to resemble the operations of a regular siege. The use of aeroplanes and dirigibles and the enormously destructive power of guns and rifles increase the tactical difficulties of attack and generals must now rely more than ever on technical troops for the construction of field protections.

A German general declared that Japan won against Russia in Manchuria by the systematic attack with the shovel. Capt. Daley, United States engineer, expressed his opinion that siege earthworks are more valuable than tons of concrete and carloads of armor. Siege earthworks must be thrown up to comply with varying tactical situations. The British field works at Tagus in Portugal, in the Peninsula War of 1809, defended by only 50,000 men, could not be taken by the French as the trenches could not be outflanked. At Sabastopol the Russians threw up trenches and successfully attacked the Allies. These are considered by military experts to be brilliant examples of field works properly adapted to tactics. The Americans, during the Civil War, used entrenchment to cover the front and then moved round to the flank. Capt. Daley states that the siege engineer is self-made by careful preparation and training.

(Continued in next week's issue.)

COBALT ORE SHIPMENTS.

The following are the shipments of ore, in pounds, from Cobalt Station for the week ended September 24th, 1915:—

Penn-Canadian Mines, 56,680; La Rose Mines, 87,285; Dominion Reduction Company, 88,000; Mining Corporation of Canada (Cobalt Lake Mine), 85,800; Mining Corporation of Canada, 69,144; Buffalo Mines, 113,015. Total, 500,-124 pounds, or 250 tons.

COST OF CONCRETE PAVEMENTS IN THE UNITED STATES.

At the Cornell Good Roads Convention last spring, Mr. H. E. Hilts, of the Association of American Portland Cement Manufacturers, presented some interesting figures showing the average cost of 1½ million square yards of concrete pavements laid in 20 different States in 1914, under the inspection of the association, to be $1.058 per square yard. This is actual cost and does not include contractors' overhead charges and profits.

It is of interest to notice, as an illustration of the efficiency with which the building of concrete roads is now performed, that of the total cost of the paving 70 per cent. is the cost of materials, leaving 30 per cent., or a little over 30 cents per square yard for the entire cost of labor, the hauling of the material and the use of the mechanical equipment on the job. In other words, the cost of the raw materials was $0.74 and the cost of the labor, $0.31, making a total of $1.05. Ordinarily the concrete pavement is 6 inches thick.

TORONTO HYDRO-ELECTRIC SYSTEM.

The fourth annual report of the Toronto Electric Commissioners has recently been issued. This report, covering the year 1914, relates to the distributing system in Toronto by which electric power is supplied in the city from Niagara Falls by the Hydro-Electric Power Commission of Ontario. It will be remembered that in 1908 Toronto became a joint party with other municipal corporations in an agreement with the Provincial Commission providing for the construction of a transmission line from Niagara Falls. The rates charged the participating municipalities by the Commission for electric power supplied under the agreement includes provision for the repayment of the capital cost of the transmission line within a period of thirty years.

The construction of the distributing system in Toronto was commenced by the corporation as an ordinary branch of the municipal services, but subsequently the completion and entire management were vested in a board of three commissioners. These at present are Messrs. P. W. Ellis (chairman), R. G. Black and Mayor Church.

The report shows satisfactory progress, there being an increase in the gross income of 29½ per cent. over 1913, and in commercial income of 40 per cent. over 1913. Additions have been made to the system during the year in connection with street and park lighting, civic car line supply and commercial requirements. The number of customers at the end of the year was over 31,500 and their connected load over 88,000 h.p. Some 2,400 lamps were added in the city streets.

The gross income for the year amounted to $1,501,-291.47. The cost of electric current and the expense of operation and management, including repairs and maintenance, absorbed $874,358.58, leaving a balance of income on operating account for 1914 of $626,932.89.

Appended to the report of Mr. H. H. Couzens, general manager, is a list of men, former employees, who have gone to the front or are at present in training. Under the policy adopted by the commissioners in the case of these men the System has paid the difference between the Government pay and the rate of wages previously received from the System.

ONTARIO MINERAL PRODUCTION.

The output of gold in Ontario for the six months ending June 30, 1915, amounted to $3,570,072 as compared with $2,011,069 for the corresponding period in 1914. Of the total yield for the half year under review $3,267,620 came from Porcupine. The production of the Porcupine group is thus seen to be steadily increasing, and the existing scale of operations, if maintained for the full year, will give an increase of about 50 per cent. over the yield of 1914.

The diminution in the output of silver continues, the falling off as compared with the first six months of 1914 being $1,864,655. Part of the shrinkage is due to the fall in price of silver since the war began. The output of nickel has never been so great as it is at the present time. Compared with the corresponding period of 1914, the value of the nickel output went up by over 18 per cent., while that of copper increased by over 2 per cent.

The figures for the six months in 1915 and 1914 are as follow:—

	1915.	1914.
Gold	$3,570,072	$2,011,069
Silver	5,188,763	7,053,418
Copper	1,229,894	1,197,059
Nickel	3,393,528	2,872,843
Iron ore	288,296	118,119
Pig iron	2,856,040	4,429,664
Cobalt	34,443	22,581
Cobalt oxide (including nickel oxide)	56,812	379,152

CARBON STEELS.

What is called .10 carbon steel is usually known in the trade as soft, basic open-hearth steel. It is a material commonly used for seamless tubing, pressed steel frames, pressed steel brake-drums, sheet steel brakebands and pressed steel parts of many varieties. It is soft and ductile and will stand much deformation without cracking.

The steel in a natural or annealed condition has little tenacity and must not be used where much strength is required. This quality of material is considerably stronger after cold drawing or rolling; that is, its yield point is raised by such working. This is important in view of the fact that many wire and sheet metal parts above mentioned are used in the cold rolled or cold drawn form.

It must not be forgotten that when this steel (cold worked) is heated, as for bending, brazing, welding, or the like, the yield point returns to that characteristic of the annealed material. This remark also applies to all materials that have an increased yield point produced by cold working.

This material in a natural or annealed state does not machine freely. It will tear badly in turning, threading and broaching operations. Heat treatment produces but little benefit, and that not in strength but in toughness. It is possible to quench this grade of steel and put it in a condition to machine better than the annealed state.

Physical Characteristics.

	Annealed.	Cold rolled or cold drawn.
Yield point, lbs. per sq. in.	28,000 to 36,000	40,000 to 60,000
Reduction of area	65-55%	55-45%
Elongation in 2 in.	40-30%	Unimportant

The heat treatment which will produce a little stiffness is to quench at 1,500 degrees in oil or water. No drawing is required.

This steel will case-harden but is not as suitable for this purpose as .20 carbon steel, which is an open-hearth steel, and often known as machine steel.

This quality is intended primarily for case-hardening. It forges well and machines well, but should not be considered as screw machine stock. It may therefore be used for a very large variety of forged, machined and case-hardened parts of an automobile where strength is not paramount.

Steel of this quality may also be drawn into tubes and rolled into cold rolled forms, and, as a matter of fact, makes a better frame than that formerly described, because of the slightly higher carbon and resulting strength. The increased carbon content has no detrimental effect as far as usage is concerned, and it is only the most difficult of cold forming operations that cause it to crack during the forming. For automobile parts it may be safely used interchangeably with .10 carbon steel as far as cold pressed shapes are concerned.

Heat treatment of this steel produces but little change as far as strength is concerned, but does cause a desirable refinement of grain after forging, and the toughness is materially increased.—The Iron Tradesman.

THE WORKING OF ASBESTOS.

FIFTY years ago there was practically no asbestos industry. To-day the yearly output runs well up into the millions of dollars in America alone, while every civilized community in the world uses the mineral in various forms.

Although we have ample evidence that this material was known and used by the versatile Egyptians and their long-buried contemporaries, it was almost forgotten for many thousands of years, until in quite recent times the advent of high pressure steam brought the need for a material which would resist higher temperatures than anything then in use.

Attention was therefore directed to the large deposits of asbestos known to exist in Canada, particularly in the eastern townships of Quebec Province. This region is to-day the principal and almost the sole source of supply for the world's consumption, as although asbestos is found in many other countries, it is either unsuitable for manufacturing purposes or else the difficulties of mining and transportation have tended to greatly restrict the output.

The history of Canadian asbestos mining may be almost described as a chapter of accidents. But for the burning away of the forests and the subsequent denudation of the overlying strata of soil and gravel it is highly probable that the existence of asbestos deposits would never have been even remotely suspected.

Asbestos lies in veins or pockets varying in width from ½ inch to 4½ inches, sandwiched in between layers of hard, semi-volcanic serpentine, which in this particular section is exposed on the surface of the ground at many points.

Owing to the irregularity of the veins, mining by means of shaft or tunnel is practically impossible and the open quarry system is almost universal, despite the drawbacks incidental to bad weather and the long winter season.

The extraction of the asbestos involves the removal of a great deal of valueless serpentine rock. Frequently as much as ten or even twenty tons of waste is removed to secure one ton of asbestos ore. This naturally adds considerably to the cost of the finished product.

The crude asbestos, as mined, is a rough block often containing numerous impurities, such as sand, rock, traces of iron and other metals. All of these must be removed before the actual manufacturing stage is reached.

From the floor of the mine the crude material is conveyed by a cable-way to the ore bins, where it is roughly sorted into various grades.

The finest pieces are first hand-treated with hammers, which removes the external impurities. This process is known as "cobbing." The lower grades are sent direct to the crusher, following which in both instances they go through the following additional processes: Crushing by machinery of the Blake or rotary types; drying by centrifugal machinery to extract the superfluous moisture; fiberizing or breaking up the fiber into threads in similar manner to the beating of flax and hemp.

The fiberized asbestos goes thence to a "cyclone," which stirs it up, agitates it violently with blasts of air and in the end tosses the lighter silker fibres one way and the coarser ones another, while the dust and refuse fall out below.

From the "cyclone" the fine fibres drop into a shaker, which further agitates and separates them. Thence they are lifted by powerful fans. The finer particles travelling farthest are caught in one compartment while the less fine are separated into various grades. This completes the milling process and the crude asbestos is now ready for manufacturing purposes.

Chemically, asbestos is a silicate of magnesia, with slight traces of other minerals, combined with a variable percentage of water. The larger the proportion of combined water the longer and more flexible are the fibres. It is this quality which makes the Canadian asbestos superior to any other.

Asbestos possesses a faculty unique among minerals, that of being spun and woven into thread and cloth. It is also capable of being felted, but unlike all organic fibres which are tubular in their formation and therefore easily twisted without breaking, asbestos is non-tubular and for a long time this threatened to be a stumbling block in the way of its manufacture into textiles.

It is certain the ancients overcame this trouble by mixing a vegetable fibre with the asbestos, but for modern purposes this is impossible. The difficulty has now been successfully overcome by special machinery, so that asbestos is now spun into thread, twisted into cord of considerable strength and woven into a variety of fabrics.

The list of possibilities of asbestos manufacture is far from being exhausted by textiles.

The engineer is indebted to it for packings, for valves, pistons and joists, non-conducting coverings for boilers, pipes, steam chests, and all heated surfaces, brake blocks, stack and flue ducts and linings and a variety of minor articles. Wherever heat begins to show a tendency to become unruly, asbestos can be depended upon to curb it.

The electrician and electrical engineer owe a great deal to the introduction of asbestos because it is the base of many of the best non-conductors of electricity yet discovered.

More recently, the H. W. Johns-Manville Company have introduced two kinds of asbestos "wood," which is being largely used for switchboard purposes and a variety of other electrical uses, including station, street car and railway panelling, and flooring, telephone and motion picture booths, etc., for which its ease of working, lightness and fireproof qualities make it specially suited.

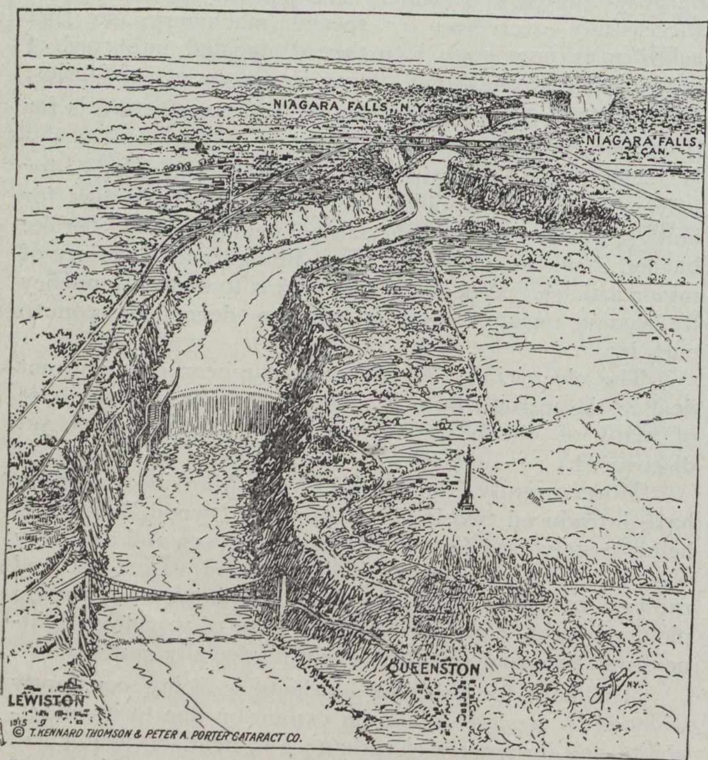
The field for asbestos products is being constantly widened by modern industrial expansion due to its adaptability and its powers of resistance to heat, oil, water and acids, combined with a capacity for almost indefinite wear.

We are indebted to the H. W. Johns-Manville Co. for the above brief outline of the industry and to the Mines Branch, Department of Mines, Ottawa, for the following list of Canadian developments:

Firm.	Address.	Location of mines.
Asbestos Corporation of Canada, Ltd.	Montreal	Megantic Co., Que.
Black Lake Asbestos and Chrome Co., Ltd.	Toronto	" "
Johnsons Asbestos Co., Ltd.	Thetford Mines, Que.	" "
Bell Asbestos Mines	Ambler, Pa.	" "
The Martin Bennett Asbestos Mines, Ltd.	Thetford Mines, Que.	" "
The Jacobs Asbestos Manufacturing Co., Ltd.	Montreal	" "
The B. & A. Asbestos Co.	Robertsonville, Que.	" "
The Berlin Asbestos Co., Ltd.	Berlin, Ont.	" "
The Windsor Asbestos Co., Ltd.	Tecumseh, Ont.	" "
Asbestos and Asbestic Co., Ltd.	Asbestos, Que.	Richmond Co., Que.
The Quebec Mines and Metal Co.	Beauceville, Que.	Beauce Co., Que.
Broughton Asbestos Fibre Co.		" "
Eastern Townships Asbestos Co.	Beauceville, Que.	" "
The Frontenac Asbestos Co., Ltd.	Quebec, Que.	" "
Boston Asbestos Co., Ltd.	St. Ann de la Perade, Que.	" "
The Ling Asbestos Co., Ltd.	East Broughton, Que.	" "
Montreal Asbestos Co., Ltd.	Montreal, Que.	" "
Brome County Asbestos Co., Ltd.	Montreal, Que.	Brome Co., Que.
Mackay Asbestos Co.		" "
Pharaoh Asbestos, Ltd.	Mansonville, Que.	" "
Robertson Asbestos Manufacturing Co.	Quebec, Que.	Megantic Co., Que.
W. H. Lambly	Inverness, Que.	" "
Brompton Lake Asbestos Co.	Montreal, Victoria Square	Richmond Co., Que.
The Danville Asbestos Granite Co., Ltd.	Danville, Que.	" "
Belmina Consolidated Asbestos Co., Ltd.		Wolfe Co., Que.

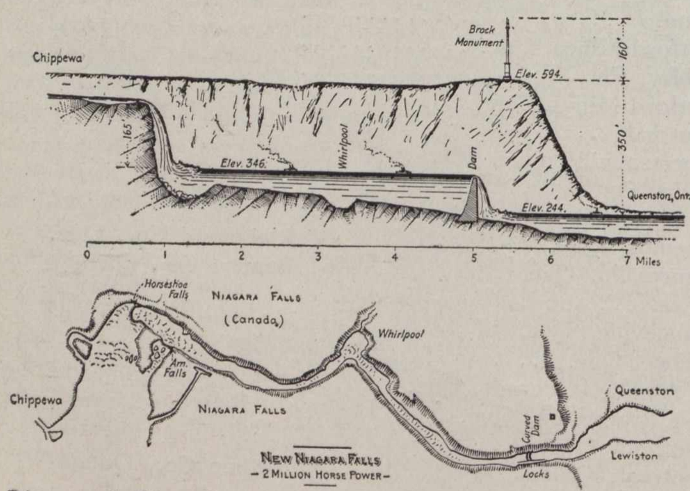
THE THOMSON-PORTER NIAGARA RIVER DEVELOPMENT PROJECT.

THE proposed scheme for developing 2,000,000 h.p. from the Niagara River at a point near Queenston (as outlined in *The Canadian Engineer* for August 12th, 1915, page 261) is illustrated in the accompanying sketches. The plan is that of Dr. T. Kennard Thomson, consulting engineer, New York, and was pre-



Sketch Showing Location of the Proposed Dam on the Niagara River.

sented by Mr. Peter A. Porter to the New York Legislative Commission last August. The estimated cost of the proposed undertaking was about $100,000,000. It is suggested that the State of New York and the Pro-



Plan and Elevation showing Method proposed by Dr. T. Kennard Thomson of Utilizing the Lower Niagara River for Power Purposes.

vince of Ontario undertake the project jointly or grant the right to a private corporation, which would pay a fixed tax on the amount of power developed.

From the foot of Niagara Falls to the end of the Gorge above Queenston the river drops about 100 ft., the distance being about five miles. The plan, as explained to *The Canadian Engineer* by Dr. Thomson, calls for a dam rising 90 ft. above the existing water level at that point, and providing a sufficient head to generate the quantity of power mentioned above. The dam would impound water almost to the foot of the Falls, necessarily increasing the width of the river considerably at various points along the five-mile stretch, but not interfering with or detracting in any way from the scenic value of the Falls.

At the site of the proposed dam the water is approximately 35 ft. deep. The structure is designed with a length of about 1,000 ft., and will be of curved alignment to divert the stresses toward the anchorage on either shore.

No subsurface borings have as yet been made to ascertain the nature and depth of the river bed, which on its surface at least is of rock, scoured bare. The dam will necessarily require heavy foundation and footings, and underlying rock work will involve some unusually difficult cofferdam work. Connected with the finished dam the plan calls for a canal of four suitable locks to provide a commercial highway which the industries along the banks of the river would in time require.

EXPLOSIVES FROM WOOD PULP.

Experts at the wood pulp mills are much interested in wood pulp which they understand has been developed by a German scientist. Some of the paper mills have correspondents in Norway and Sweden, where they have sought to obtain pulp, and thus keep in close touch with what is transpiring in their industry across the ocean.

It is understood the German scientist was seeking to utilize wood pulp as a substitute for cotton in the manufacture of explosives, and that he has thus succeeded in opening up an entirely new field for wood, and a field which may be available for lumbermen in this country who operate in the soft woods suitable for the making of pulp.

Previous experiments in the use of wood pulp in explosives have failed because not all the impurities were removed. The new process, it is understood, is the same in its early stages as the ordinary production of wood pulp. The lumber is ground up, cooked, changed into liquid form, and then by the use of this new process it is carefully and thoroughly cleansed until nothing but absolutely pure wood fiber is left. The material is then rolled into sheets and is ready for the process of nitrification which changes it into a high explosive of tremendous power.

A pamphlet, entitled "The World's Supply of Potash," has been issued by the Imperial Institute of Great Britain. It contains an account of all the more important sources of potash in the world, including the Stassfürt deposits, which before the war had an almost complete monopoly of the entire supply. The information contained in this pamphlet, which is in its way encyclopædic, has been collected at the Imperial Institute in response to commercial inquiries for particulars of new sources of potash in view of the cessation of German supplies. Both the old and the new sources, soluble potash minerals, salt lakes and brines, sea water, vegetable sources, wool washings, nitre earths, and insoluble minerals are described as far as details are available.

Editorial

RESEARCH WORK AND THE MANUFACTURER.

The aim of all industrial operations is toward perfection, both in process and mechanical equipment, and every development in manufacturing creates new problems. It is only to be expected, therefore, that the industrial researcher is becoming less and less regarded as a burden unwarranted by returns. Industrialists have, in fact, learned to recognize chemistry as the intelligence department of industry, and manufacturing is accordingly becoming more and more a system of scientific processes. The accruement of technical improvements in particularly the great chemical industry is primarily dependent upon systematic industrial research, and this is being increasingly fostered by American manufacturers.

Mr. W. A. Hamor, of the Mellon Institute of Industrial Research, writing recently in The Scientific Monthly, and discussing the contributions of the research student to the industries, calls attention to the very extensive service which he is rendering. He reviews the industrial achievements of the scientific scout, and his handiwork in such industries as copper, asphalt, cement, soda, leather, wine, sugar, corn products, fertilizer, flour food transportation and preservation, illumination, pulp and paper, celluloid, and a number of others. In the water supply of cities, too, the chemist has put certainty in the place of uncertainty; he has learned and has shown how, by chemical methods of treatment and control, raw water of varying quality can be made to yield potable water of substantially uniform composition and quality. Mr. Hamor states that ten thousand chemists in America are at present engaged in pursuits which affect over 1,000,000 wage-earners and produce over $5,000,000,000 worth of manufactured products each year. These trained men have actively and effectively collaborated in bringing about stupendous results in industry. There are, in fact, at least nineteen American industries in which the chemist has been of great assistance, either in founding the industry, in developing it, or in refining the methods of control or of manufacture, thus ensuring profits, lower costs and uniform outputs.

Robt. A. Falconer, president of the University of Toronto, is quoted to have stated recently that that University has inaugurated a scheme for enlarging its scope for post graduate work, and that a special board will immediately be established to take up the question. Dr. Falconer states that there should be 20 or 30 scholarships in the University, that it has the laboratories and the staff sufficient for present needs, but that scholarships are really needed, to encourage research work, thereby enlarging the sphere of activity of the institution.

The Engineering Alumni Association of that University established a research scholarship fund in 1911 and awarded several scholarships, one of which was extended for three successive terms. The importance of such research work has been amply manifested in the interest taken therein, and it is regrettable that there is not more co-operation between manufacturers and the universities in a like respect. The president's remarks indicate the general attitude of the educational institutions. But the manufacturers are standing in their own light, in the matter of scientific research. They are quite naturally opposed to publishing any discoveries made in their plants, since "knowledge is power" in manufacturing as elsewhere, and new knowledge gained in the laboratories of a company may often very properly be regarded as among the most valuable assets of the concern. The universities and the scientific societies, on the other hand, exist for the diffusion of knowledge, and from their standpoint the great disadvantage of the above policy is this concealment of knowledge, for it results in a serious retardation of the general growth and development of science in its broader aspects, and renders it much more difficult for the universities to train men properly for such industries, since all the text-books and general knowledge available would in all probability be far behind the actual manufacturing practice.

Fortunately, the policy of industrial secrecy is becoming more generally regarded in the light of reason, and there is a growing inclination among manufacturers to disclose the details of investigations, which, according to tradition, would be carefully guarded. These manufacturers appreciate the facts that public interest in scientific achievements is stimulating to further fruitful research, that helpful suggestions and information may come from other investigators upon the publication of any results, and that the exchange of knowledge prevents many costly repetitions.

NEW STEP IN ENGINEERING EDUCATION.

Beginning with this academic session at Columbia University all the engineering courses are on a graduate basis, requiring a college course before admission. This is a new departure in educational training of engineers, although the professions of law and medicine have already been benefiting by its establishment in several large schools, requiring a bachelor's degree for admission. Such a broad qualification as that, however, is regarded insufficient as a preparation for an engineering career, as preliminary work in the latter instance must include a definite amount of training in mathematics, physics and chemistry, which are very necessary to the engineer.

The new course at Columbia School of Engineering consists of three years spent in any college giving these fundamental scientific subjects and three years' professional work at Columbia. How successful the plan will be remains to be seen. At any rate, the procedure is a step in the right direction, as our educational institutions have all realized that it is impossible to accomplish much in the professional line if the general subjects are given as completely as they should be. Some have included a more thorough technical training and given a professional degree. Others do not give a professional degree. It is recognized, however, that as a general rule graduates are lacking in some very important qualifications, particularly the ability to express their ideas in speech and writing in a clear and forceful manner, and partly in the broad attitude of mind which comes from a good, liberal education.

THE STAVE FALLS HYDRO-ELECTRIC PLANT OF THE WESTERN CANADA POWER CO.

THE second largest producer of hydro-electric power in the province of British Columbia at the present time is the Western Canada Power Co., Limited. The British Columbia Electric Railway Co., Limited, leads with some 112,500 h.p. developed in three plants—3,000 h.p. on Vancouver Island at Goldstream, 25,000 h.p. on the Jordan River and 84,500 h.p. at Lake Buntzen, Burrard Inlet. The Western Canada Power Co. is at present developing 26,000 h.p. at Stave Falls, about six miles north from the junction of the Fraser and Stave Rivers. At this site it has under construction at the present time an addition of equal capacity. It has storage rights to the extent of 50,000 h.p. in Stave Lake,

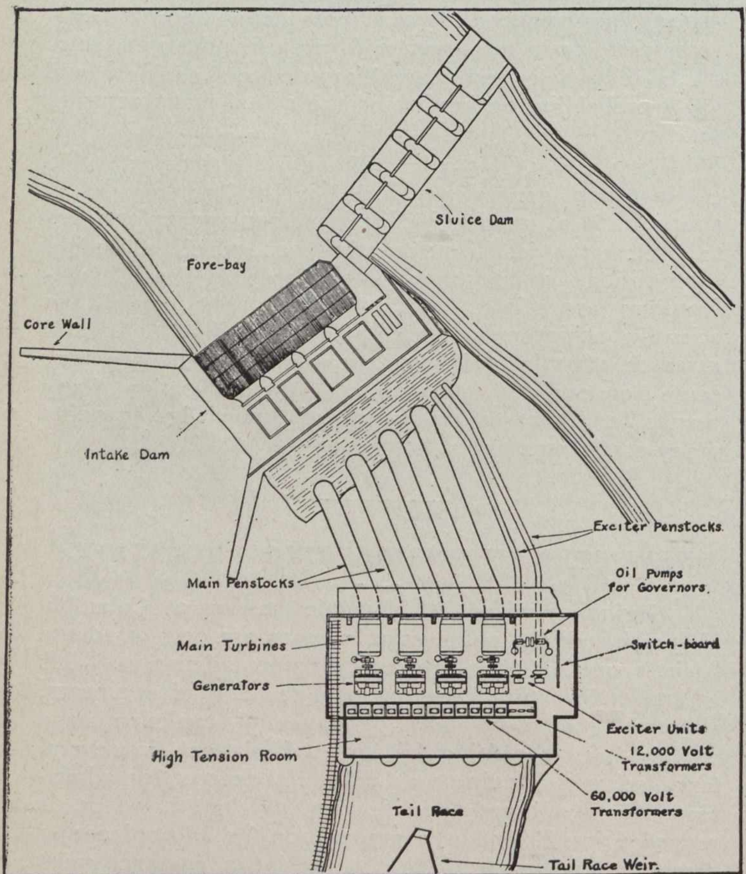


Fig. 1.—General Plan of Power House and Intake.

and rights to develop a second power site of 50,000 h.p. at the mouth of the Stave River.

The initial development was commenced in 1910, and the first installation, consisting of two 9,000 kw. units, was put into service in January, 1912. This installation was described in *The Canadian Engineer* for February 15th, 1912, and March 20th, 1913. The entire development, however, forms the subject of a very comprehensive paper to be read in Montreal before the Canadian Society of Civil Engineers on October 7th. The author is Mr. R. F. Hayward, chairman of the Vancouver branch of the Society, and general manager of the Western Canada Power Company. When the company determined, in 1909, to undertake the development, Mr. Hayward was made chief engineer and manager. Accordingly, it has been under his careful guidance that the enterprise has been carried to a successful issue.

The paper under consideration strongly brings out the principles essential to power development, *viz.*: (1) Far the most important consideration in western development is the determination of the conditions governing the amount of storage capacity required for the economical development of the watershed. (2) Until this determination has been made, no power plant plans can be intelligently laid out. (3) When this determination has been made it will nearly always be possible to lay out a progressive plan of development so that the unit cost of the initial plant does not bear too high a proportion to the unit cost of the complete development.

In illustrating and emphasizing these points the author necessarily dwells in great detail upon the preliminary investigations of the river and watershed. The present company purchased the property in 1909 from the Stave Lake Power Company, formed in 1899. Proceeding at once with the contemplated development, questions of location, topography, rainfall, run-off, flood discharge and storage were fully investigated, and are accordingly described in detail in Mr. Hayward's paper. The calculation of available power and of the economic height of the dams are also dealt with. We extract the following notes concerning the constructional features of the development:—

Generating Plant.—The hydraulic conditions governing the choice of turbine units are as follows:—

Maximum head—reservoir full	120	ft.
Mean head	110	ft.
Minimum head—reservoir empty	100	ft.
Maximum variation in tailrace level	2.5	ft.
Maximum velocity of water in penstocks	8	ft. per sec.
Mean flow to be utilized for generating power	3,000	c.f.s.
Maximum flow to be utilized for generating power	5,000	c.f.s.

The power house was laid out for four turbines, each to develop 13,000 brake h.p. under mean head; with a penstock 14 ft. 6 in. diameter. The general arrangement of the plant is shown in plan and elevation in Figs. 1 and 2. The turbine chosen was of the double horizontal Francis type, with central discharge, running at a speed of 225 r.p.m., and enclosed in a cylindrical flume with penstock connected axially. Had this plant been designed three or four years later the vertical type of single runner Francis wheel would, without doubt, have been adopted, not only on account of its higher efficiency, but because it would have made possible a very material saving in the cost of the power house. The turbines were built by the Escher Wyss Company of Zurich, Switzerland. In them there is no intermediate bearing, the shaft (14.2 inches in diameter) being stiff enough to need no support between the outer bearings, thus removing the obstruction of a middle bearing to the discharge of the water in the draft tube.

The casing is 18 ft. in diameter and built of ¾-in. steel plate with very heavy forged steel flanges. It is divided along the horizontal diameter, to admit of easy erection and repair. The end plate of the casing is of cast steel designed to withstand a total thrust of nearly 1,000 tons which may come upon it when the governor suddenly shuts the gates, under full load and head. The runners are 63 inches in diameter, and built of steel plates cast into cast steel hubs. The bearings are water cooled, the larger one being 15¾ inches in diameter.

The draft tubes are built in concrete to a carefully designed expanding section commencing with a circle 10 ft. 8 in. diameter, and ending in a rectangle 9 ft. 5 in. x 21 ft. 9 in. The velocity of the water when the turbine is discharging 1,300 c.f.s. is reduced gradually from 14.6 ft. per sec. at the top of the draft tube to 6.3 ft. per sec. at its outlet.

The governor is of the Escher Wyss hydraulic type operating with oil under a pressure of 300 lbs. per sq. in. The oil is supplied from a central pumping plant through a ring pipe system.

There are two high-pressure three-throw oil pumps, each operated by an impulse wheel. Each pump takes its water from either exciter pipe and is capable of supplying all four turbines. The pump runs continuously, discharging oil through a relief valve into the suction tank when oil is not being taken by the governors, and maintaining a receiver two-thirds full of oil and one-third full of air under pressure ready to provide for sudden large movements of the governors. These are very sensitive and very sure in their action, and acting on a turbine which has so short a penstock and a flywheel provided by the rotor of the dynamo which weighs 65 tons, they give very satisfactory regulation.

The exciters are driven by two 500-h.p. single-runner Francis wheels, with volute cases—taking their water from two 46-inch steel penstocks.

The turbines were built on a guarantee of 83 per cent. efficiency at full load and 110 ft. head. Under 107 ft. head they have developed 10,000 kw. of electric power.

The generators, exciters and transformers were built by the Canadian General Electric Company. The generators are 3-phase, 60-cycle, 4,400-volt machines rated at 8,825 k.v.a., with 40 deg. cent., and 11,031 k.v.a. with 55 deg. cent. temperature rise. There are two exciters of 250 kw. capacity each. There are twelve 3,000 kw. water-cooled oil-insulated transformers arranged in three banks to step up from 4,400 to 60,000 volts. The switchboards consist of 60,000, 4,000 and 12,000-volt oil switch equipment, with a vertical panel control board, and were made by the Canadian Westinghouse Company.

Power House Building.—The power house is a reinforced concrete building which when completed for four units will be 165 ft. long by 70 ft. wide, with a 14-ft. extension at the east end for the control board, and a 28-ft. two-story lean-to along the side for the switches and busbars. Up to the main floor of the turbines the foundations are built of mass concrete with steel rail reinforcement over the tailrace arches. The superstructure consists of a light steel frame, enclosed in reinforced concrete. The transformers are housed in individual concrete vaults accessible to the travelling crane from the top.

A feature of the design of the power house is the ample space around all the machinery, every part of which, including the transformers, are directly under the 60-ton travelling crane which spans the main building.

The 60,000-volt switches and busbars are contained in the lower story of the lean-to building, and all switches and busbars are separated by reinforced concrete barriers which were poured in place. The 4,000-volt switches are contained in the room above the 60,000-volt apparatus, and the lightning arresters are carried on the roof.

Tailrace.—The tailrace channel was excavated by steam shovel in the old river bed. It is 70 ft. wide and 1,500 ft. long. About 75,000 cu. yds. of sand and clay overlain with heavy boulders, and 22,000 cu. yds. of rock were taken out. As the tailrace discharges into a channel with a considerable fall, some provision was necessary to keep the tailwater at the power house at approximately constant level. For this purpose a low V-shaped concrete weir was built in the tailrace about 100 ft. below the power house. The point of the V points to the power house, and the weir is 300 ft. long. This provides for the full discharge of the four turbines with a range in height of the tailwater not exceeding 30 inches.

Penstocks.—The main penstocks are 14 ft. 6 in. inside diameter. The upper ends, which are embedded in the concrete of the intake dam, are belled out to a diameter of 19 ft. The maximum velocity of the water at the entrance of the bellmouth is 4.6 ft. per sec., and in the penstocks it is 8 ft. per sec.

The penstocks were fabricated in Vancouver, the plates being made in Scotland under rigid specifications and shipped to Vancouver via the Suez Canal. The plates at the upper end are ½ in. thick, and at the lower end ¾ in. thick. The rings are 8 ft. wide, and formed of three sheets 16 ft. long. The ring seams are double riveted, longitudinal seams triple riveted. All holes were punched 1/16 in. small, and reamed out after assembling in the shop. Every alternate ring is stiffened by a 5-in. x 5-in. x ½-in. angle riveted to the outside. In the third

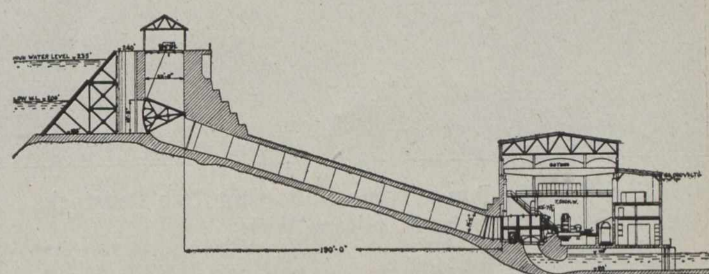


Fig. 2.—Section Through Power House and Intake.

and fourth penstocks each ring is stiffened by a 6-in. x 4-in. x ½-in. angle.

For the greater part of the length the penstocks are supported in concrete up to the centre line, and at the entrance to the power house they are entirely enclosed in a heavy mass of concrete.

There are two separate 46-in. steel penstocks for the exciter and oil pumps.

Intake Dam.—The intake dam is a gravity section concrete dam founded on granite. It is 160 ft. long, and when finished to the full height will be 70 ft. high. There are four main intakes separated from one another by piers 11 ft. wide, projecting upstream from the face of the dam proper, and forming four gate chambers, 19 ft. wide and 24 ft. long. The gate chambers for the exciter pipes are set in the concrete dam to the east of the main gate chambers, and the water reaches them through a short tunnel in the concrete. Across the whole upstream side of the dam there is a screen 120 ft. wide, set on a slope of 45 degrees.

The granite which forms the foundation of the dam, although jointed in all directions, is very impervious. There was only one place found where any water made its way through fissures in the rock, and this was easily taken care of by a 4-in. drain. The surface of the rock was excavated to a considerable depth, and a thoroughly good foundation with plenty of irregularities, to form security against sliding, was secured. As an additional precaution 2-in. steel rods, spaced 5 ft. apart, were set 5 ft. deep all over the foundations. A further point of security lies in the arrangement of the rock abutments, between which the dam sets as a wedge.

The intake gates are of the radial type and were designed and built by the Escher Wyss Company. They close an opening approximately 20 ft. square, the bottom sill of which will be 45 ft. below the high-water line when the dam is computed. The gates weigh 23 tons each, and are operated by an electrically driven winch, controlled from the power house switchboard. The water seal at the sides of the gates is made by segments built up of strips of oak, which are free to move laterally, so

Fig. 3.—The Power House, Showing Two Penstocks and Tailrace Weir.

that the pressure of the water forces them against the sides of the gate chamber.

The gate chamber is necessarily large, and forms a very efficient entry to the penstocks, and the gate itself is easily operated.

For this dam the cost of radial gates was about the same as the cost of Stoney roller gates—but the radial gates involve considerably more cost in the structure of the intake, both on account of the length of gate chamber required, and of the added weight of masonry necessary to overcome uplift due to possible pressure of water below the gate chamber floor when the gate is closed. For this reason, the author would in future use Stoney gates in a similar situation, though where the radial gates can be installed without increasing the cost of structures, they are preferable.

In front of the gate chamber, stop-log checks are provided for emergency or repair work.

The screens are supported on a combination of reinforced concrete piers and structural steel. They are not built so heavy as usual as ice never forms in the river, and so little drift gets to the screen that even in flood time attention is necessary only for a few minutes once or twice a day.

On the west side of the dam, where the rock abutment dips at a sharp angle, and is overlain with a heavy deposit of glacial meal, a core trench is to be sunk to a sufficient depth and filled with concrete, to ensure against any possibility of seepage along the contact between the rock and the glacial silts, when the water is raised to the higher levels.

Sluice Dam.—The sluice dam was the first piece of construction work undertaken by the Stave Lake Power Company. It was designed to take the whole flood discharge of the river, at a flow line too low to make the Blind Slough available for spillway. As the total length of the dam was only 150 ft., and as drift and huge logs had to be passed, an overflow dam was out of the question.

The sluice dam is of the same design as the Chaudiére dam at Ottawa. It consists of reinforced concrete piers, 8 ft. wide, with five sluice ways, 22 ft. wide closed by stop logs. The stop logs are made of clear Douglas fir—22 ft. long x 16 in. x 24 in.; they are bolted together in pairs with a ⅝-in. steel plate between them to give additional strength. They are raised and lowered by means of an electrically operated winch built to the same design as those in use at the Chaudiére dam.

On the whole, the stop logs and the arrangements for handling them have proved satisfactory, for depths below the bridge not greater than 15 ft. For greater depths than this, it is difficult to remove the logs or to replace them so that they do not leak.

The stop-log dam, when properly designed, is a very suitable and economical type of dam for regulating a reservoir or river for varying heights of flow-line, and at the same time providing for heavy flood discharge.

During the summer of 1913, the foundations were put in for raising the dam to its full height. In excavating for the new foundations, several pot holes were opened up, one of them 40 ft. deep, almost under the toe of the existing dam. This excavation gave a good indication of the watertightness of the rock, for although the bottom of the pot hole was nearly 80 ft. below the water level, there was no sign of seepage.

The dam will be completed to its full height as a solid gravity dam of spillway type with a row of gates on top for partially controlling flood discharges; the majority of which will be taken care of at the Blind Slough dam.

Blind Slough Dam.—For a flow line at elevation 210 ft., the Blind Slough forms a natural rock spillway dam,

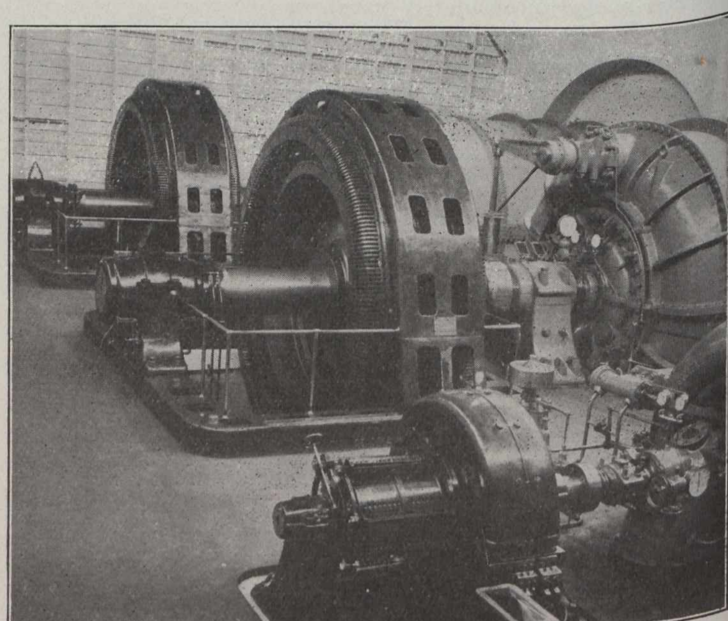


Fig. 4.—Power House Interior, Showing Two Turbines.

400 ft. long with a channel 50 ft. wide, and 20 ft deep at one side.

At the present time the channel is closed by a timber crib dam, which forms a temporary spillway 450 ft. long at elevation 218.

The permanent dam will be a log sluice dam, with concrete piers, similar in general design to the existing sluice dam, but having two steel undersluices in the deep section.

Future Developments.—From the tailrace level of the existing plant to mean tide level at the mouth of the Stave River, there is a total fall of 134 ft. The daily range of the tide is about 4 ft. In June and July, when the Fraser River is in flood, the water may rise as much at 16 ft., though 12 ft. is the usual maximum rise. During Stave River freshets, the water near the mouth of the river may rise several feet.

As freshets will nearly all be controlled by the dam at Stave Falls, and as the Fraser River floods affect the situation for less than two months in the year, it is feasible to design future developments to utilize a fall of 130 ft.

This could be developed in one plant by building a dam in the narrow gorge just above the mouth of the river and driving a 2,000-ft. tunnel for the penstocks. The dam would back the water up to the tailrace of the existing plant, forming a storage reservoir that would be large enough to hold a day's supply for the plant with a variation in head of less than 10 ft.

The dam would have a maximum height of 170 ft. in a channel 100 ft. wide, though outside of the channel it would not be more than 100 ft. high.

While this development would be quite economical for the full capacity of the plant, the initial cost would be high, as the dam alone would cost $1,000,000.

As the full development will not be required for a number of years, and as it is important that expenditures on future construction shall not be made further in advance of actual demand than absolutely necessary, a plan is under consideration for the development in two plants, each operating under a head of 65 ft.

The lower canyon allows of a very economical development under this head, and a good site for the middle plant exists about two miles below Stave Falls.

Both these plants would be designed for single-runner vertical turbines of from 10,000 to 12,000 h.p. capacity.

By the adoption of this plan of development, the Western Canada Power Company, Limited, can increase its plant capacity step by step, to keep pace with the demand for power, until it has installed a total of 120,000 h.p.

CUTTING SHEET STEEL PILING BY OXY-ACETYLENE BLOW-PIPE.

The superiority of the blow-pipe over the old method of cutting sheet piling is illustrated by reference to a piling job at Jacksonville, Fla., where a large drawbridge is under construction over the St. Johns River by the Florida East Coast Railway Co. Lackawanna sheet steel piling has been used in the construction of the protection piers. This piling is driven down in sections. Each sheet or section consists of 3/8-inch web, being about 2 1/4 inches thick on the lock joint. In all, approximately 860 feet of piling had to be cut off at a uniform height. An oxy-acetylene cutting blow-pipe was used, employing Prest-O-Lite gas and compressed oxygen, both in portable cylinders.

On account of the peculiar construction of the lock joints, the operator was handicapped in making speed, although the work was completed at an enormous saving over the old method of sawing through, which would have been an extremely slow and tedious operation. At the lock joint practically four sections of metal had to be cut through, requiring frequent changes in the adjustment of the blow-pipe. Nevertheless, it is stated that between 40 and 50 lineal feet of piling were cut in seven hours, one man handling the entire job.

MITIGATION OF ELECTROLYSIS.

THE subject of electrolysis, comprising a comparison of electrolysis conditions in America with those in other countries, a discussion of electrolytic corrosion proper as distinguished from self-corrosion, and touching briefly on electrolysis effects in concrete and steel buildings is dealt with in a technologic paper of the United States Bureau of Standards, newly issued. There is also a brief discussion of the effects of stray currents other than corrosion, such, for example, as the production of fires or explosions.

Methods of electrolysis mitigation are discussed at length. All of the various methods of mitigation that have been proposed or tried are discussed under two main heads: First, those methods applicable to underground pipe and cable systems; and, second, those applicable to the railway negative return. Those methods applicable to underground pipe systems comprise the following: (1) Surface insulation of the pipes; (2) chemical protection,—that is, rendering the pipe surface passive by surrounding it with earth filled with lime or other chemical that will prevent corrosion; (3) cement coatings; (4) cathodic protection,—that is, maintaining the pipe or cable always negative to earth by means of a motor generator set or battery or other sources of electromotive force; (5) favorable location of pipe with respect to tracks; (6) the use of non-corrodible conducting coatings; (7) electric screens; (8) the use of insulating joints in pipes; and (9) pipe drainage.

The discussion leads to the conclusion that of the various methods under this class that have been tried none are suitable for general use as primary means of preventing electrolysis trouble. The methods of chemical protection, cement coatings, cathodic protection, and conducting coatings should be regarded as substantially worthless in their present state of development. Surface insulation of pipes by means of paints or dips is not much more reliable, but insulation by putting pipes in troughs or conduits filled with pitch may be used in special cases where the expense would be justified. The practice of placing all pipes as far as possible from railway tracks affords a certain measure of protection, of which advantage should always be taken wherever practicable in laying new lines or relaying old ones. The use of electric screens is often a valuable expedient in taking care of acute local cases of trouble in existing mains.

These methods, with the exception of that relating to the proper location of pipes in new work, are suitable only to special conditions, however, and are not usually to be considered as important factors in any general plan for electrolysis mitigation.

Pipe drainage is sometimes useful, but should be used with proper restriction and with due precautions against setting up any dangerous conditions either in the system drained or in neighboring systems. In general, in city networks where there are a number of independent underground systems to be protected pipe drainage should be used as little as possible, the chief reliance being placed on mitigative measures applied to the railway negative return. The drainage of lead cable systems will, however, usually be desirable, and these should always be drained by means of suitable insulated feeder systems so arranged as to drain the least practicable current from the cables in order that neighboring structures may not be subjected to unnecessary danger thereby.

The most valuable mitigative measure that can be applied to the pipe system consists in the proper use of insulating joints, and the extensive use of such joints should be encouraged in new work and in making repairs. Precautions are necessary in their use, however, and these are set forth in the discussion.

Taking up the methods applicable to the railway system, there is a very brief reference to the alternating-current system, double-trolley system, the use of negative trolley, and the periodic reversal of trolley polarity. This is followed by a somewhat extended discussion of methods of reducing potential differences in the uninsulated portion of the negative return. These various means comprise: (1) Proper construction and maintenance of way; (2) grounding of tracks and negative bus; (3) use of uninsulated negative feeders; (4) use of insulated negative feeders without boosters; (5) use of insulated negative feeders with boosters; (6) three-wire systems; and (7) proper number and location of power-houses.

The discussion leads to the conclusion that the alternating-current system, the double-trolley system, the use of negative trolley, the periodic reversal of trolley polarity, and the use of uninsulated negative feeders in parallel with the rails, when considered solely as methods of electrolysis mitigation, are either impracticable or else open to the objection that the expense or operation difficulties attending their application are rendered unnecessary because of the fact that there are other adequate methods available for general application which are comparatively cheap to install and which introduce but slight complications into the operating system.

The importance of proper construction and maintenance of track return is emphasized, and the drainage of the roadbed where practicable is urged. Also where the track is laid on private right of way the rails and ties should be kept as far as possible out of direct contact with the earth by the use of good rock ballast.

It is also pointed out that the three-wire system, when viewed solely from the standpoint of electrolysis mitigation, possesses large possibilities. Attention is called to the fact, however, that up to the present time sufficient experience has not been had with this system to determine whether it is practical from the operating standpoint under average conditions of service. It is, therefore, urged that experiments with this system be made under conditions to which it is best adapted.

The most effective methods that have been thoroughly tried out in practice over long periods are the use of insulated negative feeders either with or without boosters, generally the latter. In most cases where the feeding distances are not too long an insulated feeder system without boosters will prove cheapest and at the same time more satisfactory because of its greater simplicity. It is possible, by the proper application of such systems, to reduce the potential gradients in the earth to such low values that in most cases little damage would result. In many cases, however, it may be better, where conditions are favorable, to combine one of these methods with either the insertion of a moderate number of insulating joints in the pipes or with the use of a very limited amount of pipe drainage, provided local conditions are favorable to the use of this method. The insulated feeder system would be applied to reduce the potential gradients throughout the system to very low values, and one or the other of the auxiliary systems used to eliminate largely any residual electrolysis that might still remain.

The last section of the paper is devoted to a discussion of regulations regarding electrolysis mitigation. The subject of what criteria should be used for determining the adequacy of electrolysis conditions is taken up at some length, and it is shown that potential measurements showing a total drop of potential in the railway negative return and also potential gradient measurements throughout the track network are very valuable. It is also shown that all-day average values of these potential readings give a better criterion of the actual danger from electrolysis than any short-time peak value. It is recommended that in fixing voltage limitations some plan analogous to the zone system should be adopted, the voltage limits prescribed for the various zones being determined largely by the degree of development of the underground utilities in the various zones. The voltage drops either in the tracks or in the pipes, and earth may be used as the basis for fixing limitations, but in general the latter is to be preferred. The question of what constitutes a safe limit for voltage drops in the track return is discussed at some length, and the conclusion is reached that for the overall potential drop in the railway tracks a limit of from two to four volts is reasonable and adequate, and the potential gradient should in general be restricted to 0.3 or 0.4 per thousand feet, these figures being all-day average values. Where short-time peak values are used, the figures would, of course, be considerably higher.

In order that ready determination of voltage drops may be made at any time, potential wires should be installed running from some central point to selected points on the railway or pipe networks. These points should include the points of approximately highest and lowest potential and preferably, also, some intermediate points. It is recommended that exemption from any regulations regarding track voltages should be made in special cases as described in the paper where local conditions make it improbable that any serious damage would result. The responsibilities of the owners of underground utilities regarding the mitigation of electrolysis troubles is discussed, and it is recommended that any regulations governing electrolysis mitigation should be made to apply not alone to the railway system, but should also define the responsibilities of the owners of underground utilities, since the latter can often contribute materially to the diminution of the trouble at a practically negligible cost.

PROGRESS ON BLOOR STREET VIADUCT, TORONTO.

The following official figures relating to work completed on the Don and Rosedale sections of the Bloor Street viaduct, Toronto, were recently issued by Mr. R. C. Harris, Commissioner of Works. A comparison is presented of the amounts of excavation and concrete completed up to July 31st, with the total amounts required, *viz.*:—

Don Bridge.

Total excavation required	49,651 cu. yds.
Total excavation completed	33,882 cu. yds.
Total concrete required	43,344 cu. yds.
Total concrete completed	8,971 cu. yds.

Rosedale Bridge.

Total excavation required	31,208 cu. yds.
Total excavation completed	19,800 cu. yds.
Total concrete required	16,748 cu. yds.
Total concrete completed	4,969 cu. yds.

COAST TO COAST

Brandon, Man.—The new extensions of the street railway system have been completed.

St. Mary's, Ont.—Work has commenced on the new hydro line from St. Mary's to Exeter.

Chilliwack, B.C.—The Union of British Columbia Municipalities held its annual convention here two weeks ago.

Calgary, Alta.—The Home Grain Co. has started construction work on another elevator at Stanmore and on another at Watts, Alta.

Toronto, Ont.—The Toronto-Hamilton highway construction is being inspected this week by the promoters of the Toronto-Oshawa road.

Calgary, Alta.—Duncane, Dutcher & Co., of Vancouver, have offered to sell the city of Calgary the power rights of the Elbow River Power Company for the sum of $90,000.

Stonewall, Man.—The municipality is anxious to improve its road system and drainage, and is willing to spend dollar for dollar with the government in early improvements.

Edmonton, Alta.—According to Mr. C. M. MacLeod, general manager of the Canadian Northern Railway Co., the line from Edmonton to Vancouver will be placed in service by November 1st.

Victoria, B.C.—The British Columbia Government has decided to extend financial assistance to the French Complex Ore Reduction Co. for the erection of a demonstration plant at Nelson, B.C.

Port Arthur, Ont.—Some rich deposits of gold have been discovered by Capt. T. H. Trethewey, mining engineer, Goderich, Ont., in the Siene River district, near Mine Centre station on the C.N.R.

St. Malo, Que.—The laying of the Y-tracks from Cap Rouge bridge to the Transcontinental shops has been completed by Messrs. Cavicchi & Pagano, the Nova Scotia contractors who had the job.

Guelph, Ont.—It is reported here that the Hydro-Electric Power Commission has purchased the Toronto Suburban Railway line from Toronto to Guelph, but no confirmation has as yet been obtained.

Edmonton, Alta.—The central unit of the University of Edmonton, under construction for the past eighteen months, is ready for occupancy. The George A. Fuller Co., of New York, had the general contract.

Winnipeg, Man.—The Provincial Government will shortly issue an instruction pamphlet prepared by the department of Mr. Alex. McGillivray, provincial highway commissioner, regarding the operation of the split-log drag.

Moose Jaw, Sask.—Mr. George D. Mackie, city engineer-commissioner, has announced a saving of $9,900 in the operation of the waterworks department over the 1914 expenditures, with an efficiency still sufficient to meet all requirements.

Toronto, Ont.—The Toronto Terminals Co. started a gang of about 100 men last week clearing the site of the new Union Station, and it has been announced by Mr. Howard G. Kelley, president of the company, that there will be no further delays.

Winnipeg, Man.—On October 3rd the Canadian Northern Railway opened 71 miles of new line, including a 25-mile line from Wroxton to Yorkton, 8 miles from Elrose Junction to Dunblane, 8 miles from Laird to Carlton, 21 miles from Canora to Sturgress Junction.

Magrath, Alta.—The Ellison Milling Co. has completed the erection of a $40,000 elevator at this point, and a similar one at Foremost. The Taylor Milling Co. have also erected two new elevators each of 35,000 bushels capacity, one at Milk River and the other at Coutts.

Berlin, Ont.—Mr. Herbert Johnston, city engineer, reports that during the past year 22,867 square yards of pavements have been laid, including 2,100 square yards of concrete and 20,767 square yards of tarvia. In addition, some 98,850 square feet of sidewalk have been constructed.

Vancouver, B.C.—Mr. H. J. Landahl has a proposition to establish iron and steel works in British Columbia, believing the Swedish system of steel production by electrical process specially adapted to the ores of the province and to the water powers available. The Board of Trade is considering his proposals.

Toronto, Ont.—The York County Highway Commissioners are finishing up their programme for the season. The concrete bridge over the Rouge River near Cashel has been finished; a small stretch of roadway on Yonge Street near Thornhill is being completed, and Dundas Street, near Lambton, is under repair.

Toronto, Ont.—Mr. J. F. Whitson, in charge of provincial road development in Northern Ontario, reports delay this season in the Port Arthur district owing to wet weather. In Timiskaming district, however, the season has been favorable for road building. This year's programme will be completed early in October. The government expenditure for 1915 on northern development work has been approximately $650,000.

Windsor, Ont.—The municipalities of Windsor, Walkerville and Sandwich will urge the provincial government to approve of the formation of a metropolitan commission, whose duty it will be to assume control of waterworks, sewers, hydro-electric systems and street railways in the three towns. It is felt that these public utilities can be managed more intelligently and satisfactorily than under the present system of individual control.

Winnipeg, Man.—Speedy construction of a timber trestle is announced by the Grand Trunk Pacific Railway. On September 2nd the trestle between Uno and Miniota on the main line was carried away in a heavy storm. In three weeks' time the wreckage had been removed, the new trestle completed and service resumed. The trestle is 1,600 ft. long and has a maximum height of 120 ft. Over 1,600,000 ft. of timber were used in its reconstruction.

Hamilton, Ont.—Mr. Westropp Armstrong, bridge engineer of the Toronto-Hamilton Highway Commission, has resumed his engineering duties after having completed a military course at Niagara, and is taking soundings for the new bridge at the Valley Inn hill, near Hamilton. Rock has been located at a depth of 91 ft., and it is still a question whether a bridge of large dimension will be erected, or whether the problem will be better solved by an extensive fill.

Victoria, B.C.—The Imperial Oil Co. is preparing plans for a large wharf to be constructed at Maclaughlin Point in connection with its new plant. Work commenced over a month ago on one of the large fuel oil tanks, and it is now practically completed. The wharf itself will be T-shaped, jutting into the water about 150 ft. It will support warehouses 80 ft. in length and 40 ft. wide. A channel 25 ft. deep and 85 ft. in width will be dredged in front of the wharf next year.

Edmonton, Alta.—Mr. F. C. Field has returned from an investigation of the asphalt deposits in the Fort McMurray country, and vigorously discounts the opinion abroad that the tar sands along the Athabasca River, north of Lesser Slave Lake, will not prove up to the standard for street paving. The paving done in Edmonton with the Alberta asphalt is said to be as good as that done with imported material. Time alone will disclose, however, the durability and wearing qualities of the new product.

Montreal, Que.—The question of sewage treatment is receiving considerable attention. The Provincial Board of Health has ordered the city to discontinue polluting the waters of the Back River. Chief Engineer Mercier recommends against the construction of six sewage treatment plants, and is in favor of a large trunk sewer to connect all the sewer openings along the river and convey the sewage to a single basin near Rosemount. The estimated cost is upwards of $1,000,000, and surveys for the proposed sewer are now being made. One purification plant will, under this arrangement, be all that is necessary, whereas, in the former scheme, seven plants would be required in a distance of three miles. In any event, the Notre Dame de Grace sewer, which has cost $500,000, and which drains Mount Royal, Cote des Nieges and Notre Dame de Grace wards, cannot be used until some system of sewage treatment has been installed.

PERSONAL.

Major R. W. LEONARD, of St. Catharines, president of the Coniagas Smelters, has received an appointment to the rank of Lieutenant-Colonel.

H. B. SIMS, assistant engineer of the British Columbia division of the Canadian Pacific Railway, has been granted a commission and leaves shortly to join the Canadian Railway Construction Corps at the front.

NORMAN McKENZIE, a former student in civil engineering of the University of New Brunswick, has been granted a lieutenancy with the Royal Engineers. He went to England last winter with the 23rd Battery, C.F.A.

W. F. ANGUS, vice-president and managing director of Canadian Steel Foundries, has been appointed a director of the parent company, Canadian Car and Foundry, Montreal, to fill the vacancy caused by the death of M. E. Duncan.

T. R. F. CASE has been appointed assistant general manager of Steel and Radiation, Limited, Toronto. Mr. Case will have general charge of the business and plant under the direction of Mr. H. H. Macrae, managing-director. Mr. R. J. Cluff, formerly general manager of the company, resigned recently to devote his entire attention to his own private interests.

C. E. HENDERSON, B.S., who has been assistant city engineer of Port Arthur since the spring of 1911, and who was assistant engineer for some time previous to that appointment, leaves next week to become city engineer of Saint Augustine, Florida. Mr. Henderson graduated in civil engineering University of Illinois, 1906. He spent one and a half years as assistant engineer in Kansas and Oklahoma of the Missouri, Kansas and Texas Railway, two years as engineer, masonry construction on the Chicago, Milwaukee and St. Paul Railway, and also spent a year as instructor in civil engineering at his Alma Mater.

OBITUARY.

The death occurred at Campbellton, N.B., last week of Mr. Evan Price, superintendent of the North Shore district of the Intercolonial Railway.

While working on one of the towers on the transmission line north of Cornwall, Ont., of the Cedars Rapids Manufacturing and Power Co., Mr. Harry Duclos, line-inspector, was instantly killed recently. The deceased was 28 years of age and a resident of Montreal.

OTTAWA BRANCH, CANADIAN SOCIETY OF CIVIL ENGINEERS.

The annual meeting of the branch will be held in the board room of the Commission of Conservation, on October 14th, at 8.15 p.m. Ballots for the election of officers for 1915-16 will be opened and the new officers installed. The membership of the branch as it stands at present is as follows: Honorary members, 1; members, 45; associate members, 124; juniors, 32; students, 17; Ottawa associates, 18. Total, 237.

REGINA ENGINEERING SOCIETY.

We regret to note that the Society has been obliged to discontinue, for the present at least, the publication of its Journal. There are publications whose *raison d'etre* can scantily compare with the unifying power and service which the Journal has striven to be and give among the members of the young Society. The present is a time when its mission is most needful. Its support has dwindled, however, in the pinch of hard times, and with the inevitable result.

It is to be hoped that the Society will rally despite adversity and that the light of the Journal will soon show itself again among the shadows with which wartime is besought.

COMING MEETINGS.

NATIONAL PAVING BRICK MANUFACTURERS' ASSOCIATION.—Annual convention to be held in Dayton, O., October 11th and 12th, 1915. Secretary, Will P. Blair, B. of L. E. Building, Cleveland, O.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Annual convention to be held in Dayton, O., October 12th to 14th, 1915. Secretary, Charles Carroll Brown, 702 Wulsin Building, Indianapolis, Ind.

Mr. H. B. Fergusson, of Montreal, the Canadian representative of the Russian Government, is seeking experienced railway construction men in Canada, whom he wishes to send at once to Russia for the purposes of working on an emergency railway that, when completed, will be of inestimable value to Russia and the allies. Track layers, track foremen, blacksmiths and timber men are all required. The work will be done 500 miles from the firing line, and men undertaking it will be paid at Canadian rates of wages, and will be required to undertake a six months' contract. Men offering must be British subjects and must be medically fit.