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The Canadian Engineer

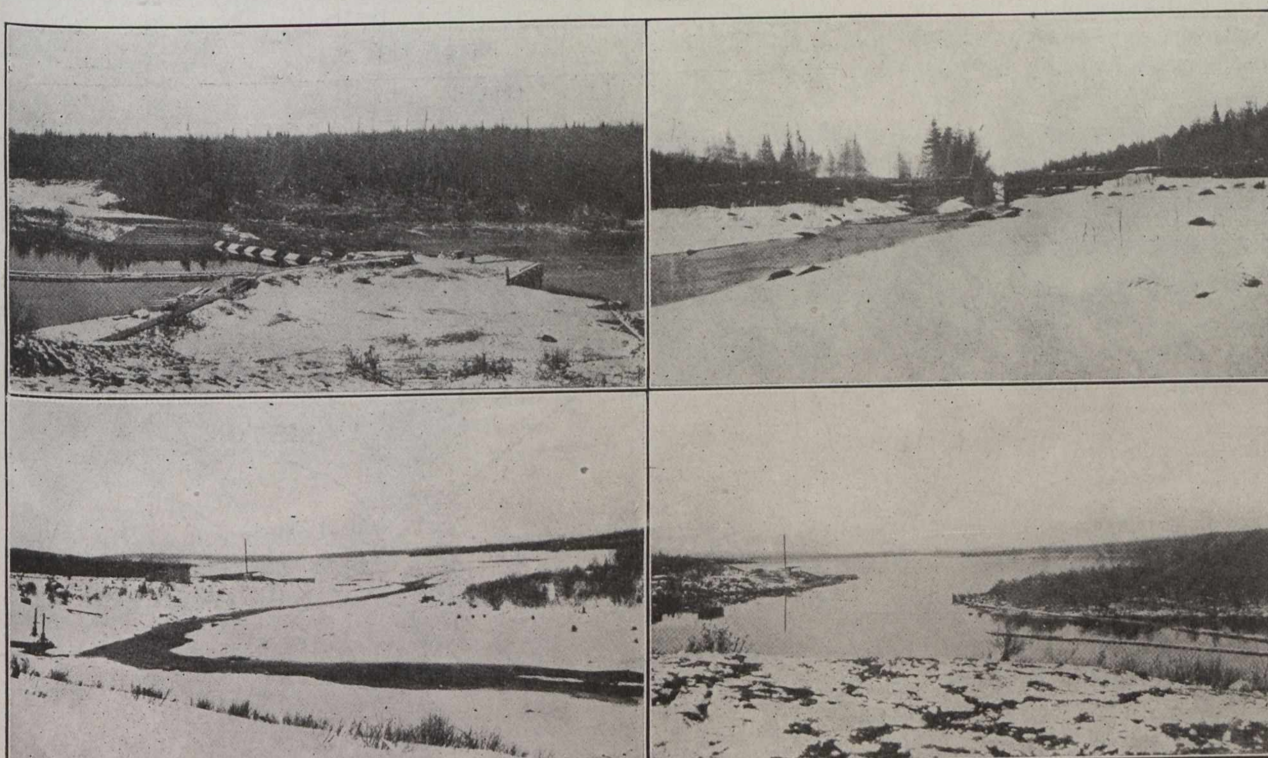
A weekly paper for engineers and engineering-contractors

ST. FRANCIS RIVER STORAGE DAM

DESCRIPTION OF THE STORAGE WORKS AT THE DISCHARGE OF LAKE ST. FRANCIS, NOW UNDER CONSTRUCTION FOR THE QUEBEC STREAMS COMMISSION FOR REGULATING THE FLOW OF THE RIVER AND ITS TRIBUTARIES.

IN *The Canadian Engineer* for July 8th, 1915, a brief outline appeared of the contemplated regulation by the Quebec Streams Commission of the run-off from the St. Francis River water shed in Quebec province. The river is one of variable flow and subjected to heavy spring freshets. In other seasons the various industries utilizing its numerous water powers are handicapped by shortage.

The regulation scheme consists chiefly of the building of a large storage dam at the outlet of Lake St. Francis. In addition, it involves the construction of a 540-ft. bridge across the River Sauvage as well as the relocating and building of about six miles of roadway. It includes, also, the expropriation of about four square miles of flooded lands and the buying of the rights and privileges from the owners of the present storages on Lakes St. Francis and Aylmer. The scheme is estimated to cost $400,000.



Present Dam at Outlet of Lake St. Francis. Flow in March from Lake St. Francis.

North Channel of River at Site of Proposed Dam. Flow in October from Lake St. Francis.

The storage dam, the location of which is shown on the accompanying map, and the contract for the construction of which has recently been awarded to Madden & Company, of Quebec, for the sum of $101,000, is designed to raise the water 27 ft. above low-water level, thus increasing the area of the lake 6.7 square miles and the capacity 438 square-mile-feet. This new capacity will make it possible to regulate the flow at the outlet of the lake at 600 second-feet during the whole of the year, which is an increase of 500 second-feet over the present minimum flow during eight months.

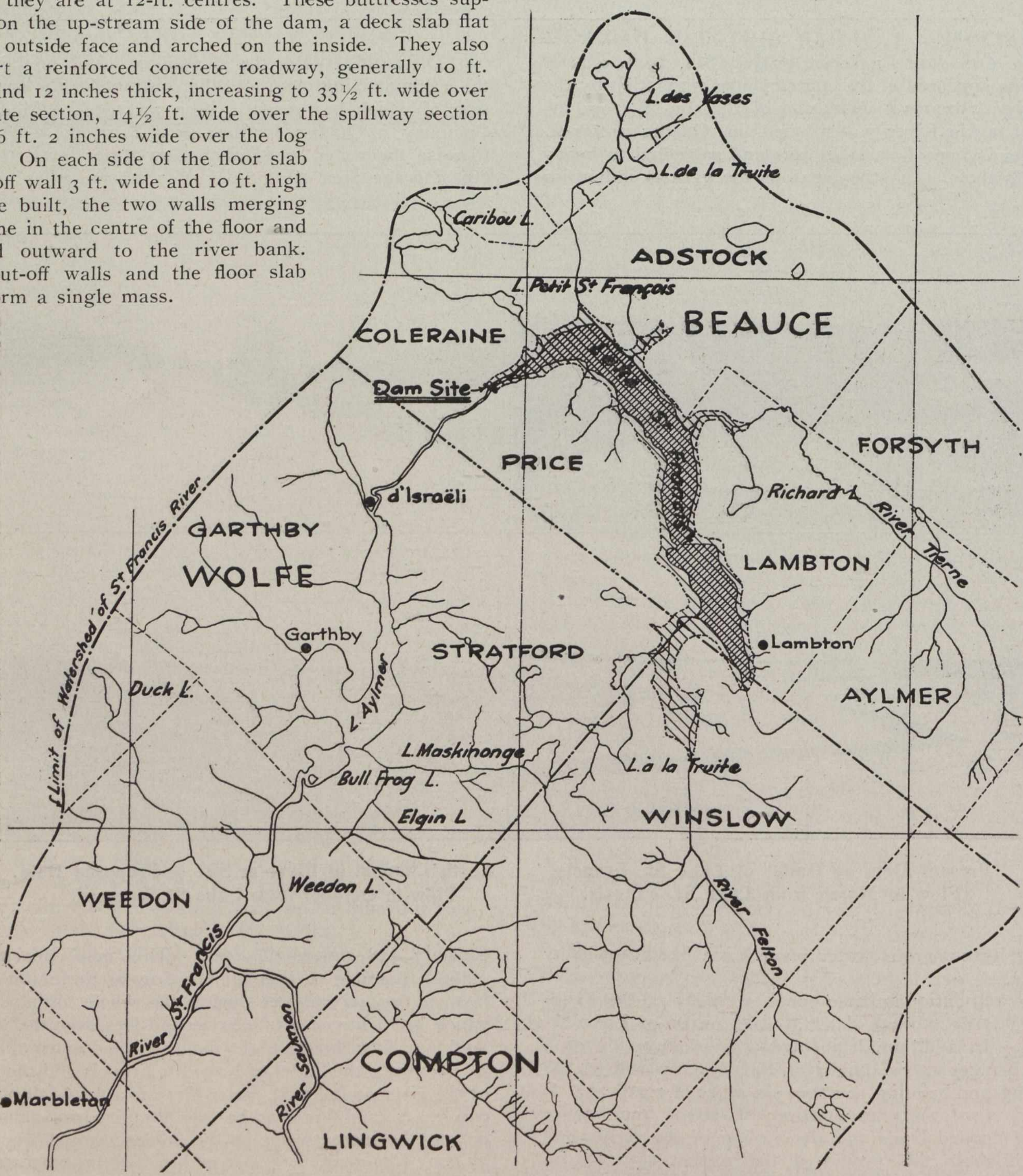
Between the outlet of Lake St. Francis and the mouth of the river at Lake St. Peter there is a total fall of about 900 ft. Should this head be wholly utilized for generating power, the increase due to the storage would amount to 27,000 h.p.-year, or 41,000 h.p. at the extreme low-water period. Only 200 ft. of the available head is being utilized, however, and hence the amount of power due to storage, and to be used immediately will be 6,000 h.p.-year. This will be sold to the power owners at a price per horse-power calculated to give an annual revenue sufficient to cover the interest and sinking fund on the capital invested and the cost of maintenance.

The proposed dam at the discharge of Lake St. Francis is about 1,500 ft. down-stream from the present dam of the Brompton Pulp and Paper Company, and about six miles above the village of D'Israeli. The accompanying plan, half-elevations and cross-sections illustrate the general design of the structure. It is to be of the hollow type with reinforced concrete floor slab supporting a series of concrete buttresses 5 ft. thick and at 20-ft. centres, except in the gate section of the dam where they are at 15-ft. centres and in the log slide section where they are at 12-ft. centres. These buttresses support, on the up-stream side of the dam, a deck slab flat on its outside face and arched on the inside. They also support a reinforced concrete roadway, generally 10 ft. wide and 12 inches thick, increasing to 33½ ft. wide over the gate section, 14½ ft. wide over the spillway section and 16 ft. 2 inches wide over the log sluice. On each side of the floor slab a cut-off wall 3 ft. wide and 10 ft. high will be built, the two walls merging into one in the centre of the floor and carried outward to the river bank. The cut-off walls and the floor slab will form a single mass.

The floor slab varies in thickness from 15 to 36 inches, depending on elevation. Its width also varies, as shown. It is reinforced with ¾-inch square twisted steel bars bent so that under the buttresses they are 3 inches above the bottom of the slab for a distance of 8 ft., and between the buttresses they are 3 inches below the face of the floor for a distance of 9 ft.

In the gate section another floor will be built 2½ inches thick with a width of 18 ft. and ending in a retaining wall, as indicated.

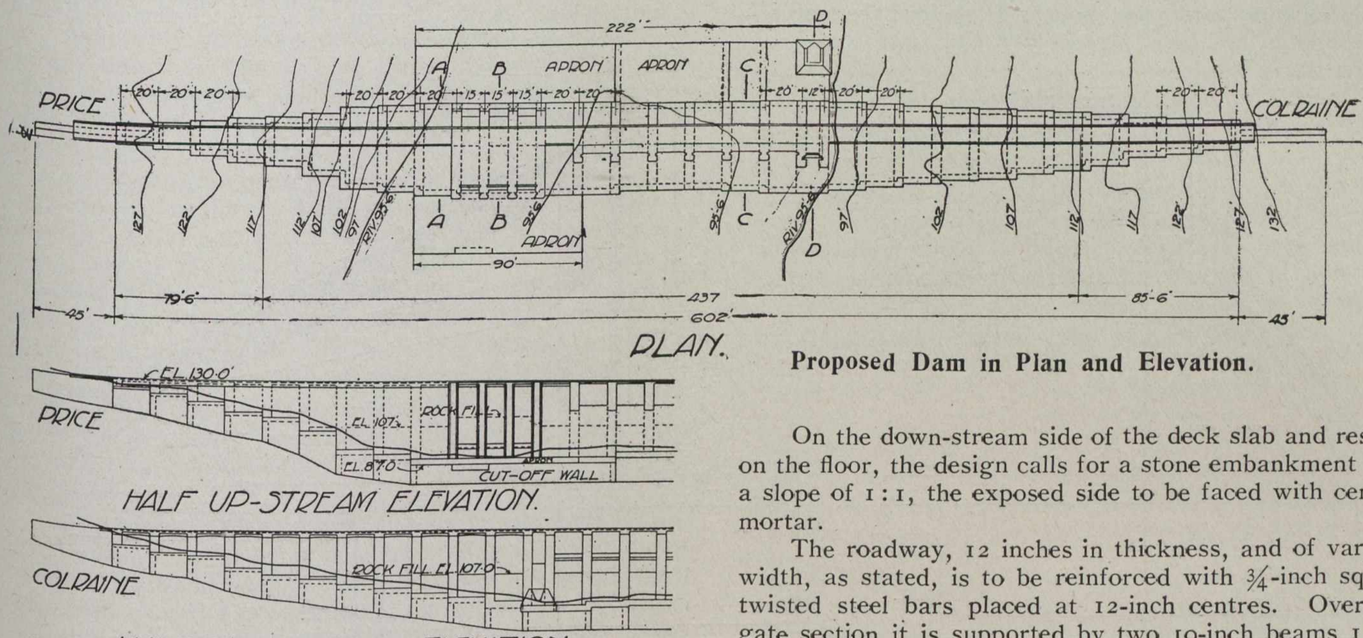
The buttresses, which are at 20-ft. centres, are 5 ft. in thickness, their length varying at the foot according to the elevation of the floor. As shown in section A-A, their up-stream face has a slope of 37 in 26, and their down-stream face a slope of 37 in 12. In the lateral faces



St. Francis Drainage Area, Showing Present Area of Lake (El. 100.00) Shaded Heavy; Land Flooded When Level is Raised (El. 127.00) Shaded Light.

of the buttresses and flush with their up-stream face seats are provided for supporting the deck slab. In the buttresses of the gate section both up-stream and down-stream faces rise vertically from the floor, as shown in section B-B, the slope in the upper portion being the same as that in section A-A. In these buttresses, which are at

The exterior face of the deck slab which rests on the floor and buttresses has the same slope of the latter from the floor changing to the vertical for its last three feet in height. The interior face is in the form of a circular arch of 15 ft. radius with a rise of 2 ft. In the log sluice the deck slab is replaced by a solid concrete wall.



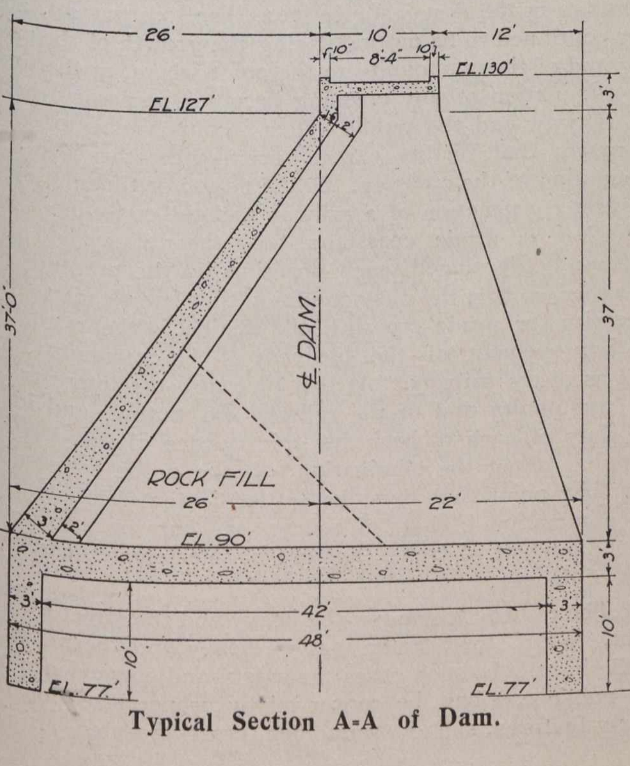
Proposed Dam in Plan and Elevation.

12-ft. centres, two sets of vertical recesses are built into the lateral faces to receive the stop logs and the gate. In the spillway section the form which the buttresses take is shown in section C-C. These are also provided in their lateral faces with vertical recesses 12 inches deep and 13 inches wide to receive the stop logs. It will be noted that the down-stream face of the spillway buttresses has the ordinary slope. The log sluice buttresses are sloped on their up-stream face for 22 ft. above the floor and vertical for 17 ft. 6 inches. In addition to recesses for stop logs these have another set of recesses for the log-slide support.

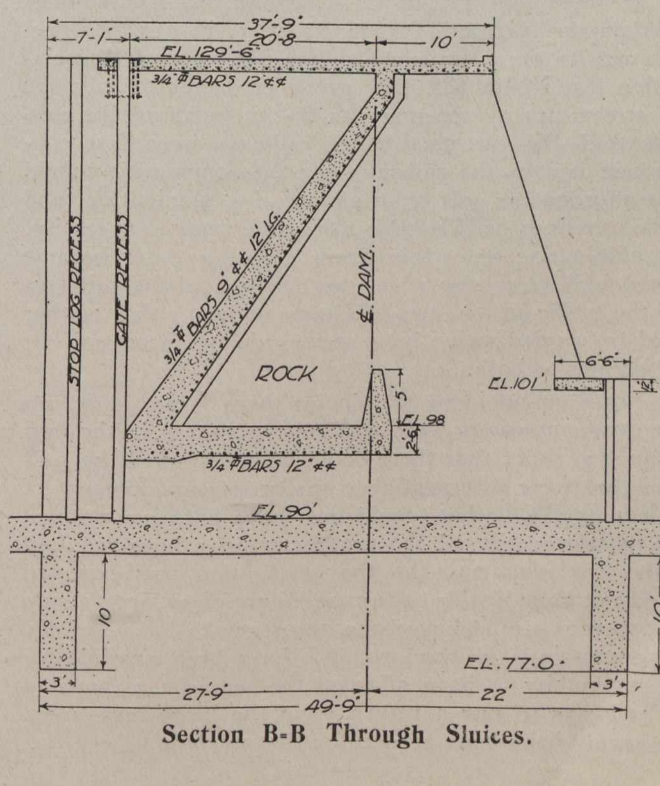
On the down-stream side of the deck slab and resting on the floor, the design calls for a stone embankment with a slope of 1 : 1, the exposed side to be faced with cement mortar.

The roadway, 12 inches in thickness, and of varying width, as stated, is to be reinforced with ¾-inch square twisted steel bars placed at 12-inch centres. Over the gate section it is supported by two 10-inch beams 15 ft. long embedded in concrete on the up-stream side. The down-stream side of the roadway forms a straight line from one end of the dam to the other. A parapet 6 inches high and 10 inches wide, equipped with drainage tile, protects the roadway on either side. A concrete surfacing is to be used.

The stop logs are to be of Douglas fir or yellow pine, the ends protected by steel plates. For the spillway and gates up-stream they will be 12 x 12 inches x 17 ft. and 12 ft. long respectively. Those for the gates down-stream will be 8 x 12 inches x 12 ft. long, and for the log sluice 10 x 12 inches and 11 ft. long.



Typical Section A-A of Dam.

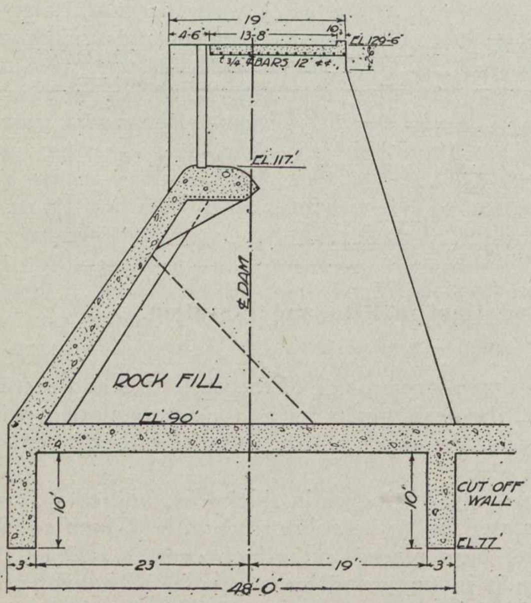


Section B-B Through Sluices.

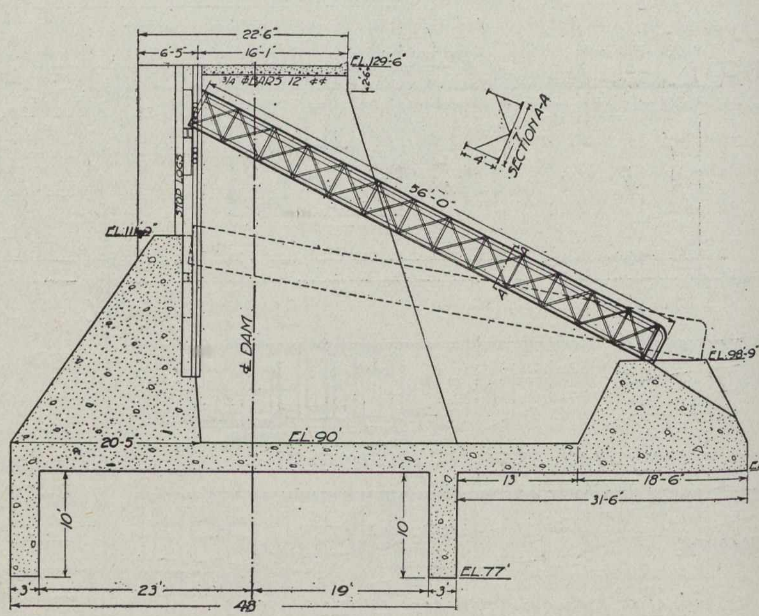
The bed of the river at the site of the dam is composed of a very stiff mixture of clay, small boulders and gravel, into which the whole of the floor slab and the cut-off wall are to be embedded. The river will be diverted by cutting a new channel and by cofferdams, and the river bed excavated, for the foundation of the main dam and aprons, to hard pan about 2 ft. below the natural surface of the ground. Wash borings revealed solid rock at depths varying from 14 to 48 ft. along the site of the dam.

The concrete will consist of a 1 : 2 : 4 mix for the deck slab and arches, and 1 : 2½ : 5 for the buttresses, flooring, aprons, etc., the proportions being dispensed by bulk measurement. The only steel reinforcement occurs in the floor slab, the roadway, the top of the spillway and in the roof of the sluices.

The work is being carried out by the Quebec Streams Commission. S. N. Parent, K.C., is chairman, Ernest Bélanger, C.E., and William I. Bishop, C.E., are commissioners; O. Lefebvre, C.E., is chief engineer and secretary, and Arthur Amos, C.E., is engineer representing the Department of Lands and Forests of the province of Quebec.



Section C-C Through Spillway.



Section D-D Through Log Sluice.

GRADE CROSSING ELIMINATION.

It was pointed out by C. E. Smith, assistant chief engineer, Missouri Pacific Railway, in a paper presented to the American Railway Engineering Association last November, that grade crossings of railways and streets are as necessary as the existence of the railways and the streets. When railways were first constructed, neither the railways nor the communities could have afforded the cost of grade crossing elimination, and grade crossings at that time were an economic necessity. The elimination of certain grade crossings later became an economic necessity when the business of the railways and the traffic on the streets became so heavy that neither could be carried on without serious delay, inconvenience and danger to both.

From an unbiased standpoint there is no doubt but that grade crossings were mutually necessary in the first instance in order that there could be constructed the railways that were so essential to the proper development of the country, and that could not have been constructed had the elimination of the grade crossings been required in the first instance. As the traffic that was expected would not have justified the expenditure of so large a sum of money as would have been necessary to have avoided grade crossings, neither would it have been possible for the community to have afforded the requisite revenue to the railways to pay a return upon the large investment that would have been needed for that purpose.

The interests of the public and the railways in grade crossings in the first instance were therefore mutual, and they continued to be mutual during the growth of the railway and of the community to the point where, at the time the elimination of any crossing becomes necessary, both the railway and the public suffer inconvenience to such an extent that further expenditure is necessary for the elimination of the crossing. In the period of time between the first construction of a railway and the consequent installation of grade crossings, both the railway and the community developed, each profiting by the presence of the other, so that the busy condition that later leads to the necessity for grade crossing elimination is the result of the improvement of the business of the community, as well as of the railway. At this time also the interests of the community and of the railway are mutual, and it is the duty of each to bear its fair burden of the cost of bringing about the elimination of the grade crossings. The first point that must be settled is the necessity for the elimination. That, of course, can only be measured by the amount of traffic, amount of interference, and extent of danger.

The railway traffic may be heavy and the street traffic light, or the street traffic may be heavy and the railway traffic light. In such cases the safety and convenience of the public can best be conserved by proper attention to safety features, such as watchmen, crossing gates, visible and audible signals, regulation of the speed of trains, etc., for the expense of elimination of the crossings would not be justified. It is in those cases where the traffic of both the railway and the public is so heavy that each become a serious burden of delay and a menace to the safety of the other, that grade crossing elimination is justified.

Manifestly all grade crossings cannot be eliminated at one time, nor can they be eliminated throughout any short period of years, as the economic conditions are such that the revenues of the railways would not justify the elimination of a large number of crossings at one time, nor a continued programme of grade crossing elimination at large; as on the one hand the revenues of the railway are not sufficient to pay a return on such a large investment, and on the other hand the community could not be expected to increase its payments to the railway, and in addition tax itself to such an extent as to eliminate the crossing in a wholesale manner. The railways would be only too glad to remove all grade crossings, to equip every mile of track with automatic block signals, to make every car of all-steel construction, but to do these things is utterly impossible without the money with which to pay for them.

The great burden of grade crossing elimination cannot be better pointed out than by stating that the Pennsylvania Railroad Company in a period of about ten years expended over $66,000,000 in grade crossing elimination —resulting in the elimination of over 1,000 grade crossings—approximately $65,000 per crossing. There are over 13,000 grade crossings on the Pennsylvania Railroad. Assuming even $50,000 as the average cost of eliminating a crossing, the total cost would be over $650,000,000. The annual interest, taxes, maintenance and depreciation on this investment would be not less than 12 per cent., amounting to a total of $78,000,000 per year increase in expenses of the railway, to obtain which would require an increase of approximately $312,000,000 per year in gross revenue to practically double that now obtained. It is, of course, unreasonable to assume that the gross revenue will double within any reasonable period of years so that the only source of revenue out of which such expenses could be paid would be by an increase in rates or practically double those now charged, which, of course, would not be tolerated.

On the Missouri Pacific there are approximately 10,000 grade crossings, and on account of the less density of population and the consequent less cost of construction, the average cost of eliminating each crossing on the system would be about 60 per cent. of that on the Pennsylvania Railroad, or approximately $30,000, making a total cost for the System of $300,000,000. The interest, taxes, maintenance and depreciation on the improvement would be approximately 12 per cent. of the total, *i.e.*, $36,000,000 per year, and to meet this increased expense would require an increase in the gross revenue of approximately $144,000,000 per year, to more than three times that now being earned by the Missouri Pacific Railway Company, so that the gross revenue would have to be three and one-half times the present amount to pay a return on such an investment. It is quite manifest that the gross revenue of the Missouri Pacific will not be increased from its present amount of approximately $60,000,000 per year by the necessary amount to $204,000,000 within any reasonable period of time, and it is equally manifest that such an increase in gross revenue could not be brought about by sufficient increase in rates. Even if such an increase in gross revenue could be expected, the increased traffic that would bring such revenue would require more equipment and increased facilities, which would make necessary further increase in revenue to meet the fixed charges on such enlargements and improvements.

From the above it appears that the economic situation will not for many years permit of the elimination of all grade crossings on the Pennsylvania Railroad, or on the Missouri Pacific Railroad, and the same will hold true on other railways. The burden is so tremendous that it does not permit of any large programme of grade crossing elimination, but each crossing must be considered on its merits with reference to the conditions that indicate the necessity for grade crossing elimination.

The development of the territory through which railways run requires the construction of additional highways, which bring about additional grade crossings, and past experience has indicated that the number of new grade crossings installed will practically equal, if not exceed, the number of crossings that can be eliminated; so that the expense of eliminating grade crossings will not decrease, but will be a constantly increasing burden as time goes on. It is certain that other means of protection must be adopted than grade crossing elimination, and expenditures for elimination must be confined to those points where traffic on railway and highway has increased to such an extent that the best known means of protection are inadequate.

Mr. Smith goes on to compare traffic conditions at numerous busy crossings in the United States and to indicate by diagram the interference of various kinds of traffic, to afford a basis of comparison for use with respect to grade crossings in general. He shows the mutuality of interest that the problem holds, when traffic at a crossing increases to the point where its elimination becomes necessary, and emphasizes the recognition that should be given it in apportioning the cost among the interests responsible for the condition.

In a paper presented in the Journal of the Boston Society of Civil Engineers last April the subject is dealt with in a very instructive manner by Mr. L. Bayles Reilly, under the headings: Apportionment of Cost; Manner of Obtaining Elimination, and Construction. The author observes that, in the laws which are being passed all over the country relative to the separation of grades there are two very important provisions, *viz.*, (1) the fixing of the manner of determining the necessity for proposed work, and (2) the apportionment of the cost.

As far as the apportionment is concerned, there is much to be desired, since there are arbitrary limits set which may not be equitable when the maximum amount is assessed upon any party, and since commissions have a tendency to assess upon the parties to the work the maximum percentages set by law, irrespective of the actual merits of each individual case.

One has but to note the difference between a crossing on a main highway in an unpopulated district and a crossing in the heart of the business section of a city to appreciate that flexibility in the apportionment of cost is desirable.

From the abstract of laws compiled by the Railroad Commission it is seen that in Arizona, California, Michigan, North Carolina and Wisconsin full power is delegated to the commission to apportion the cost according to the equities in each particular case. In Connecticut, Massachusetts, New Hampshire, New Jersey, New York, Ohio, Vermont and Washington the legislatures deny the commissions this privilege, and fix definite limits to the proportions to be paid by the various parties. These limits are arbitrary and cannot be changed even though the conditions of a particular case warrant a different apportionment. In New Hampshire and New Jersey the entire cost is imposed upon the railroads under all conditions. In Connecticut, New York and Washington the principle of priority in location is recognized.

In Connecticut the entire cost is paid by the railroad when the petition to separate grades is made by the railroad. In case the petition is made by the municipality, it may be charged 25 per cent. at highways in existence before the railroad was built, and 50 per cent. at crossings built across a railroad location.

In New York, when a new railroad is constructed across an existing highway above or below grade, the entire expense is borne by the railroad; whenever a new street is constructed across an existing railroad, the railroad company and the municipality divide the expense equally; and whenever a change is made in an existing crossing, the railroad pays 50 per cent., the municipality 25 per cent. and the state 25 per cent.

In Washington the railroad pays the entire cost when it crosses over or under an existing highway, and in all other cases it bears a portion of the cost, depending upon the equities of the case.

In Massachusetts the railroad pays 65 per cent. of the cost on the assumption that it receives the most benefit from the abolition. The street railway, when there is one, pays a maximum of 15 per cent.; and the remainder of the cost is apportioned between the commonwealth and the city or town, but not more than 10 per cent. of the total cost may be apportioned on the city or town.

The cost has usually been apportioned as follows: Railroad, 65 per cent.; commonwealth, 25 per cent.; and the city, 10 per cent. Where a street railway is involved, the steam road usually pays 65 per cent., the street railway 15 per cent., the commonwealth 10 per cent., and the town 10 per cent., although in the last two apportionments of note, at Quincy (estimated cost, $250,000) and at Taunton (estimated cost, $2,800,000), the street railway was assessed 12 per cent.

Actual cost is perhaps the most interesting thing to the parties involved, after the apportionment is decided upon. The following are a few unit prices Mr. Reilly has found useful when estimating the cost of construction of such projects. They are based on labor at $2 a day and the prices of materials current in 1912, but do not cover all cases, since accessibility of the work, length of haul, traffic and other factors influence them very much and each case must be considered independently.

Unit Costs.

Earth embankment (under traffic)	$ 0.70 cu. yd.
Earth embankment (from trestle)	0.40 cu. yd.
Earth excavation	0.50 cu. yd.
Pile foundations, spruce 25′ 0″ long	5.00 per pile.
Retaining wall (concrete)	7.00 cu. yd.
Abutments (concrete)	7.00 cu. yd.
Macadam roadway	0.80 to 1.25 sq. yd.
Granite block paving (new) gravel joints	2.00 to 2.50 sq. yd.
Granite block paving (relaid)	0.70 sq. yd.
Brick sidewalk	1.10 sq. yd.
Granolithic walks	1.80 sq. yd.
Tar concrete walks	0.75 sq. yd.
Edgestones reset	0.25 lin. ft.
Edgestones new	1.00 lin. ft.
Surface drains	1.80 lin. ft.
Relaying water pipe	3.00 lin. ft.
Arch culvert masonry (small spans)	12.00 lin. ft.
Temporary platforms (plank)	1.20 sq. yd.
Iron fencing	1.50 lin. ft.
Wooden fencing	0.50 lin. ft.
Main railroad tracks	1.50 lin. ft.
Temporary railroad tracks	0.50 lin. ft.
Railroad trestle, temporary	10.00 to 15.00 lin. ft.
Bridge steel (in place)	0.045 per lb.
Timbering, per M. ft. B.M., in place	60.00
Drains: 18 in.	1.50 lin. ft.
12 in.	1.00 lin. ft.
8 in.	0.80 lin. ft.
Taking up and relaying street railway track, without betterment	1.25 per ft.

The work is done by the railroad, and, as might be imagined, the actual cost is sometimes the subject of considerable discussion among the other parties. Charges are kept according to the specifications of the Interstate Commerce Commission, similar to ordinary railroad charges.

The following is a recapitulation of the points to be observed in designing or criticizing the design of a grade abolition project:

1. Cost.
2. Discontinuance of important public ways or continuance of same involving real damage to property without redress at law.
3. Drainage (railroad and highway).
4. Sewage flow (pipe changes, etc.).
5. Street junction, avoidance of danger points and pockets.
6. Minimum of taxable property to be devoted to new streets and ways.
7. Traffic routes—vehicular and street railway, distances, grades and maximum avoidance of curves.
8. Railroad grades should be slight at stations.
9. Highway grades.
10. Accessibility of stations to traffic—vehicular, street railway and foot.
    (*a*) In grades, elevations and layout.
    (*b*) Station driveways and carriage yards.
11. Industrial sidetracks.
12. Bridge headroom.
13. Minimum of land damage.
14. Maintenance of traffic during construction.
15. Bridges and other structures—strength, permanence, waterproofing.
16. Apportionment of work.
17. Betterments.

ACTIVATED-SLUDGE TANKS AT CLEVELAND.

As the results obtained from the experimental activated-sludge tank at Cleveland, Ohio, have been very satisfactory, the city is now about to build a 1,000,000-gallon unit of tanks. Plans have been completed, tenders called and the contracts will shortly be let. The plans have been so drawn that this unit may, with moderate changes, be made a part of the Imhoff sewage-treatment scheme already tentatively adopted for the east-side disposal works at Cleveland.

The annual convention of the Union of Alberta Municipalities is to be held at Bassano on October 20th and 21st. The programme will likely follow along the lines of last year's convention in dealing with the municipal financial problems that have had to be faced, owing to the changed conditions respecting valuations, assessments, subdivisions, etc., that have arisen during the past two years.

THE CANADIAN PACIFIC RAILWAY IRRIGATION SYSTEM IN ALBERTA

THE SIGNIFICANCE OF THE PROJECT—ITS WESTERN, CENTRAL AND EASTERN SECTIONS—THE HORSE SHOE BEND DAM AND THE BROOKS AQUEDUCT.

THE revenue-producing value of any agricultural country depends primarily on the intensity of its farming industry, the fertility of its soil and the certainty of proper maturity of its crops. The Bow River Irrigation Block in Alberta is a striking example of how these prerequisites may be interrelated. With millions of acres of fertile land in its possession, the Canadian Pacific Railway removed the liability of drought and beckoned the farmer. The result—a revenue-producing agricultural country. Millions were invested for an assured perpetuity in the form of traffic receipts.

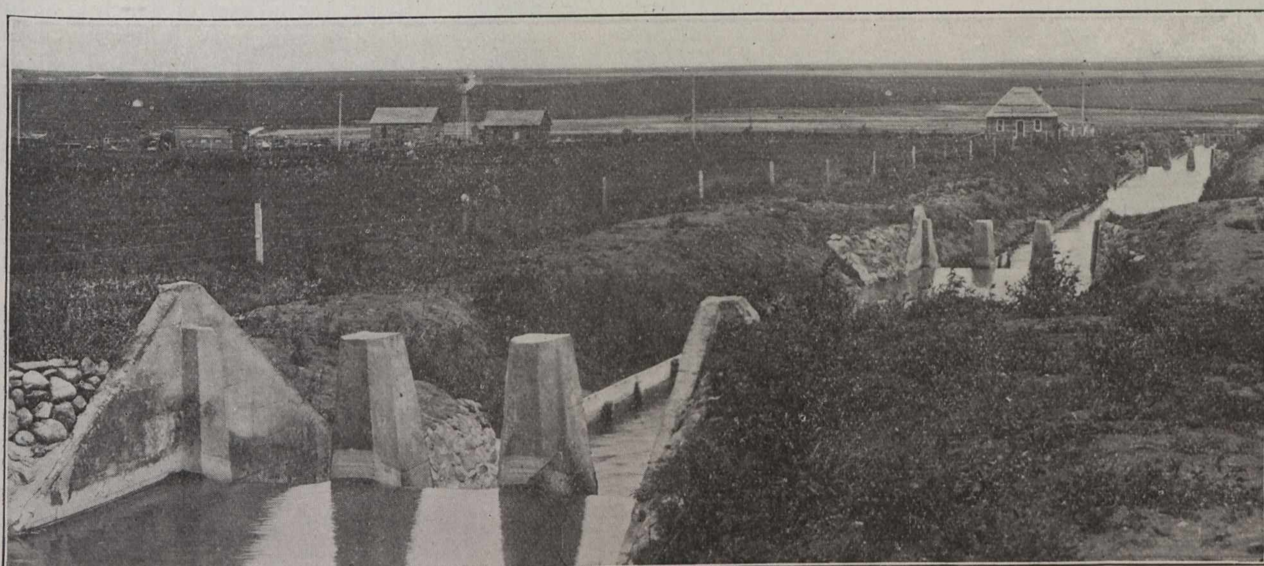
A series of dry years in Alberta a quarter century ago developed the question of artificial application of water to the doubtful crops. This was not new in the enterprises of civilization; the Egyptians, Arabians, Assyrians, Romans, and the Chinese found, as we find to-day, that it paid. There are over 100 million acres of irrigated land in the world, representing an investment of well over one billion dollars, and annually producing crops valued at considerably over that amount.

The Bow River Irrigation Block, owned by the C.P.R., has a length of about 140 miles eastward from Calgary with an average width of about 40 miles. It embraces an open prairie plateau 2,300 ft. above sea level at its eastern extremity, rising an additional 1,100 ft. toward its western boundary. It is divided by natural topography into three sections of about 1,000,000 acres each, designated the Western, Central and Eastern Sections.

The Western Section.

The irrigation works of this section have been in operation for several years. The section comprises 999,852.26 acres, of which nearly 300,000 acres have been brought under irrigation. The water is diverted from the Bow River at a point about two miles below Calgary. The head works were first constructed of timber, including wooden gates of the straight lift type, operated by rack and pinion, and about 1,750 ft. of pile and timber wall along the river bank. Last year permanent works were installed, which were placed in service December 17th, 1914.

They consist of a concrete intake to the main canal in East Calgary; and, immediately below and at right angles to it, stretching across the Bow River, a weir consisting of a bear trap dam with overhead bridge, 152 ft. long, a stop-log section 555 ft. long and earthen breaching 125 ft. long. The stop logs are handled by a travelling electric winch operating on tracks above them, while the bear trap is worked hydraulically. The head gate sluices may be worked by separate motors, not yet installed.

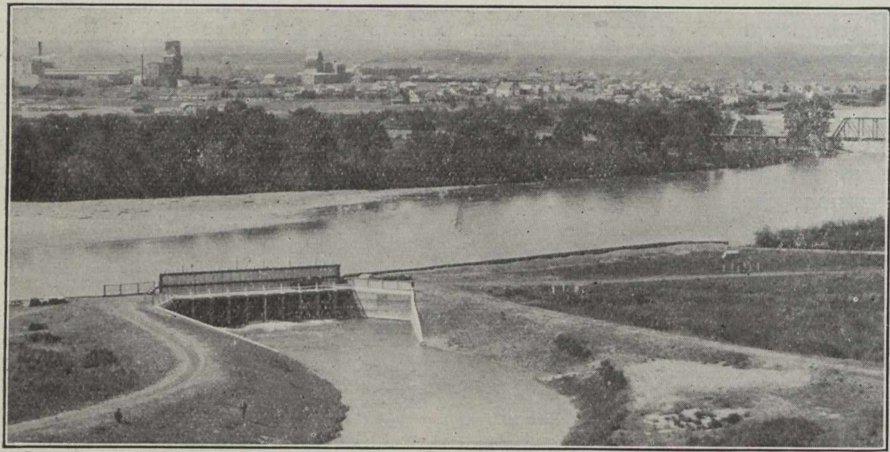


Drops in One of the Canals in the Western Section.

The water is carried south and east through a main canal 17 miles in length, which in part is 60 ft. wide at the bottom, 120 ft. wide at the water line and designed to carry water to a depth of 10 ft. The larger portion of this canal is 44 ft. bed width and 84 ft. wide at the water line. It delivers to a reservoir for which a natural depression has been utilized and where, by the erection of a large earth dam, a body of water 3 miles long, half a mile wide and 40 ft. deep, has been created. Just before reaching this reservoir the canal makes a vertical drop of 10 ft., necessitating a velocity-retarding water cushion.

From this reservoir the water is taken out in three secondary canals, A, B and C, and carried to different districts. These canals have a combined length of 250 miles. Canal A carries 8 ft. of water, with 18 ft. bed width; Canal B, 6 ft. of water with 28 ft. bed width; Canal C, 6 ft. of water, bed width 40 ft.; these dimensions relating to their westerly ends. From these canals the water is distributed in each irrigation district through a comprehensive system of ditches.

Altogether the western section comprises 17 miles of main canal, 254 miles of secondary canals and 1,329 miles of distributing ditches, not including several hundred miles of smaller ditches constructed by the farmers themselves. There are head gates, spillways, flumes, drops, bridges, syphons, weirs, etc., numbering in thousands, in the construction of which some ten million feet of timber and ten thousand cubic yards of reinforced concrete were used, and ten million cubic yards of material excavated.



The New Intake on the Bow River Near Calgary, Western Section.

The Central Section.

This section comprises 870,481 acres, of which it is estimated about 200,000 can be irrigated. The original intention was that this section be served by an enlargement of a portion of the trunk system of the western section, but this has, as yet, not been developed.

The Eastern Section.

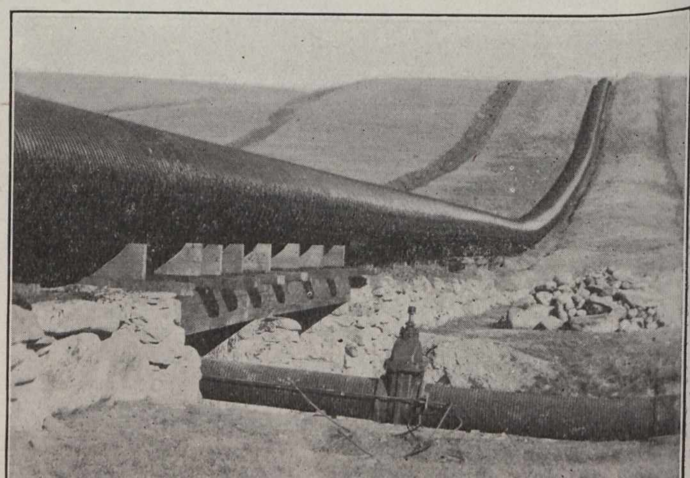
This section is composed of 1,245,732 acres, of which about 440,000 acres are rendered irrigable. Most of this land is of a gently rolling nature and susceptible to good drainage. The system is an entirely independent one from those just described, having an intake of its own located about three miles southwest of Bassano, a point on the main line of the C.P.R., 83 miles east of Calgary. Here it takes advantage of a low pass through the rim of the Bow valley, locally known as the Horse Shoe Bend, taking water from the river by an intake at that point. The dam, which was built a few years ago and which, known as the Bassano or the Horse Shoe Bend dam, is one of the outstanding engineering features of the whole development, will be briefly described in a subsequent paragraph.

At a point about five miles from the intake an earth dam 1,280 ft. in length, 35 ft. maximum height and containing 80,000 cubic yards, was built across the valley, forming a tail pool into which the main canal discharges and from which two branch canals head. The north branch, the smaller of the two, serves the country lying north and east of Mat-zi-win Creek. At the outset the canal has a bed width of about 30 ft. and carries about 6½ ft. of water. After crossing the railway line, it follows the west flank of Crawling Valley to a point about eight miles north of its intake, where it crosses the valley by a flume and runs northerly. It has numerous branches naturally becoming smaller as the distributaries are thrown off, and finally tailing out at the Red Deer River.

The east branch, where it heads out from the tail pool of the main canal, is about 70 ft. wide and carries 9.3 ft. of water. Its general course is southeast, and it serves the balance of the section. Its first branch is near Lathom, crossing the railway and watering a large area between the two forks of Mat-zi-win Creek. It is known as the Spring Hill Canal, and is about 35 ft. bed width, carrying 7 ft. of water.

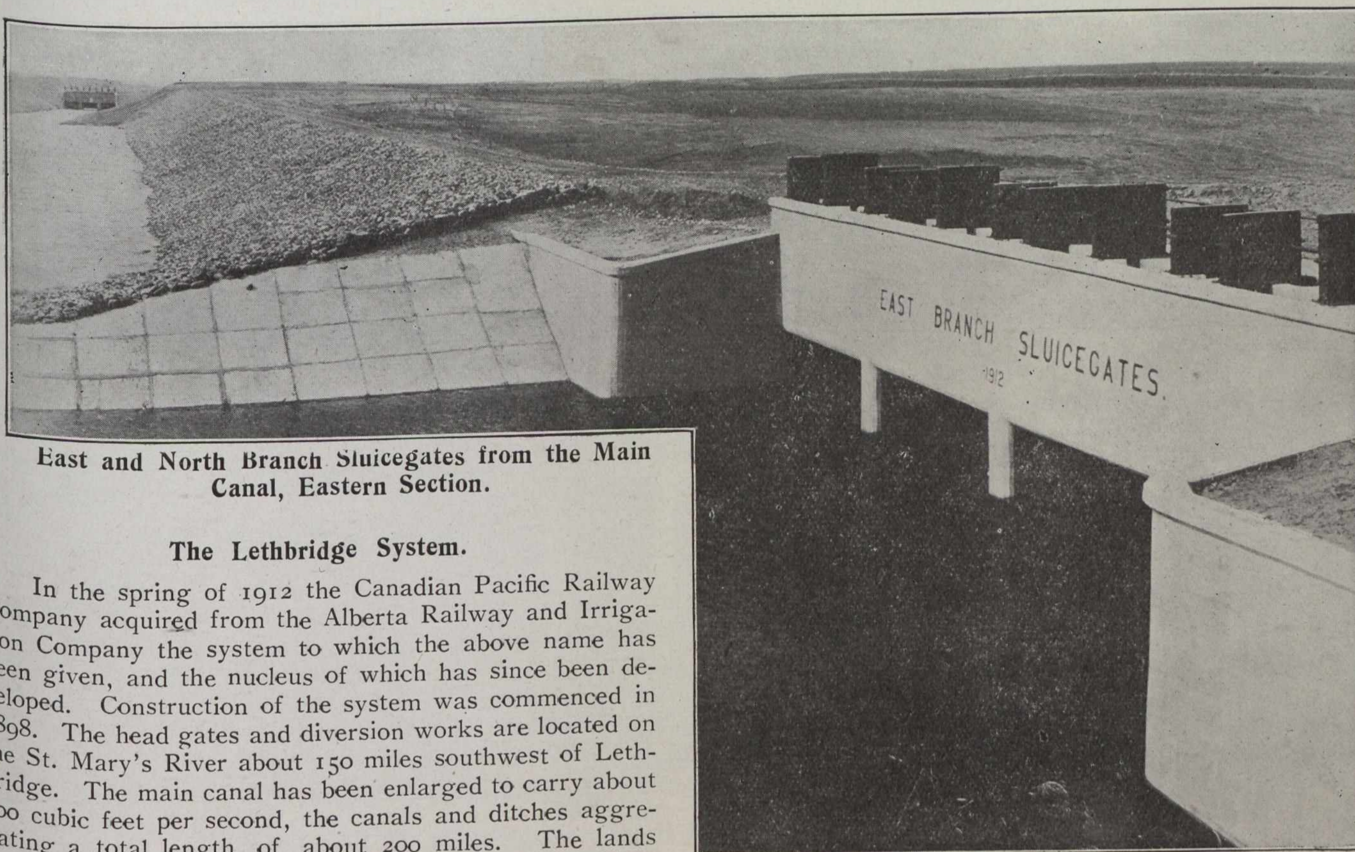
The east branch, continuing southeasterly, reaches a height of land at the head of Antelope Creek where it forks. One branch is the Bow Slope Canal, 17 ft. wide, 5 ft. water depth and serves all the land on the Bow Slope. At Cassils, two smaller canals are taken off and just south of Brooks the east branch discharges part of its water into Lake Newell reservoir, which was formed in a depression in the Little Rolling Hills by the construction of a number of earth dams, the largest of which is about 2,000 ft. long and 30 ft. in height. This reservoir is nine miles long and four miles in width, with a storage capacity of 185,000 acre-feet. The balance of the water in the east branch goes down the east flank of Rolling Hills on a high grade line in a canal 20 ft. wide and carrying 5½ ft. of water.

The Lake Newell reservoir outlets into a canal about 5 miles long, with 40 ft. bed width and 7 ft. depth of water. At its easterly end it discharges into a large reinforced concrete flume about 10,500 ft. in length, known as the Brooks Aqueduct, and possessing several very unique features which will be described later on. It delivers water to a canal serving north and south of the Bantry Hills. This Bantry Canal, until it forks, carries 7½ ft. of water and is about 45 ft. bed width. It has an eastern branch 20 ft. wide carrying 5½ ft. of water.



A Wood-Stave Syphon in the Western Section.

The system serving the eastern section is thus shown to be a very extensive undertaking, involving a number of large and important structures, the details of the construction of which had to be worked out with the greatest possible care. There are about 2,500 miles of canals as follows: main canal, 5 miles; secondary canals, 475 miles; distributing ditches, 2,020 miles. The earth work in connection with the construction of these canals amounted to over 20,000,000 cubic yards. Besides the two most interesting features to be dealt with below, there are drops, head gates, flumes, syphons, etc., to attract worthy attention from an engineering point of view.



East and North Branch Sluicegates from the Main Canal, Eastern Section.

The Lethbridge System.

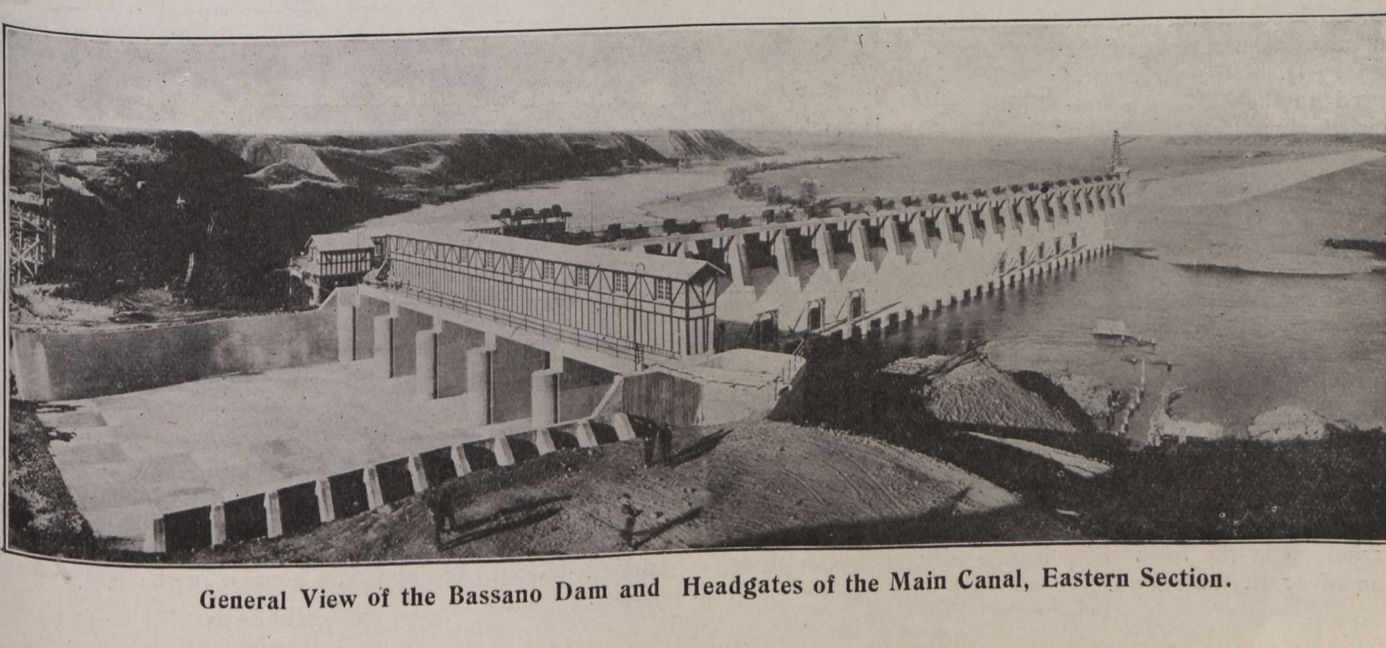
In the spring of 1912 the Canadian Pacific Railway Company acquired from the Alberta Railway and Irrigation Company the system to which the above name has been given, and the nucleus of which has since been developed. Construction of the system was commenced in 1898. The head gates and diversion works are located on the St. Mary's River about 150 miles southwest of Lethbridge. The main canal has been enlarged to carry about 800 cubic feet per second, the canals and ditches aggregating a total length of about 200 miles. The lands served by it are mostly tributary to the Lethbridge-Magrath and Lethbridge-Chin branches of the railway.

The Horse Shoe Bend Dam.

Owing to its attractive design and its many interesting details, this dam, frequently called the Bassano Dam, has received wide publicity in the engineering press since its completion three years ago. Only its most essential features will accordingly be mentioned here.

As stated, it admits water to the eastern section of the Irrigation Block from the Bow River at Bassano. The sills of the canal head gates are about 34½ ft. above the previously existing level of low water in the river at this point. The dam raises the water an additional 11 ft. above these sills, enabling the system to command a much larger area of land than it otherwise would, and reducing the quantity of material that had to be removed from the main canal cut, by a considerable amount.

The dam is a composite structure consisting of a long and high earthen embankment on the south bank of the river, and a reinforced concrete spillway in the existing river channel, connected at its northerly end with the



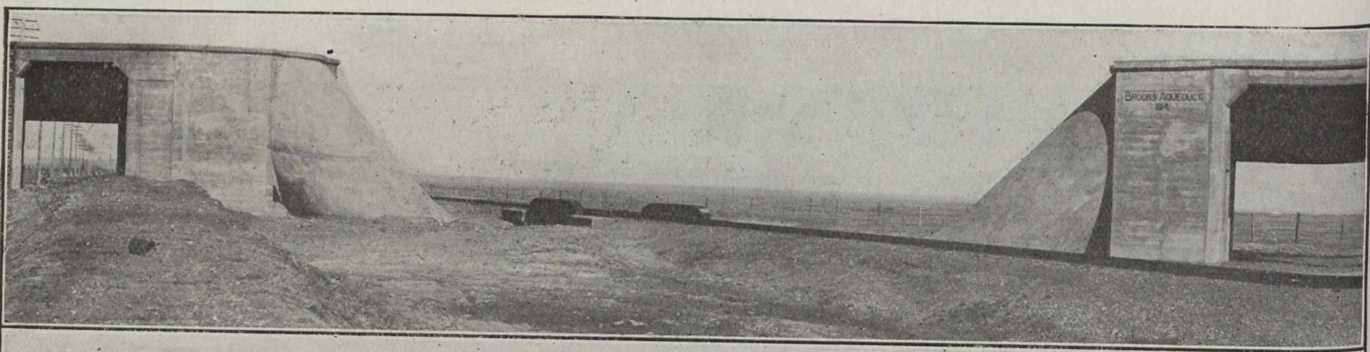
General View of the Bassano Dam and Headgates of the Main Canal, Eastern Section.

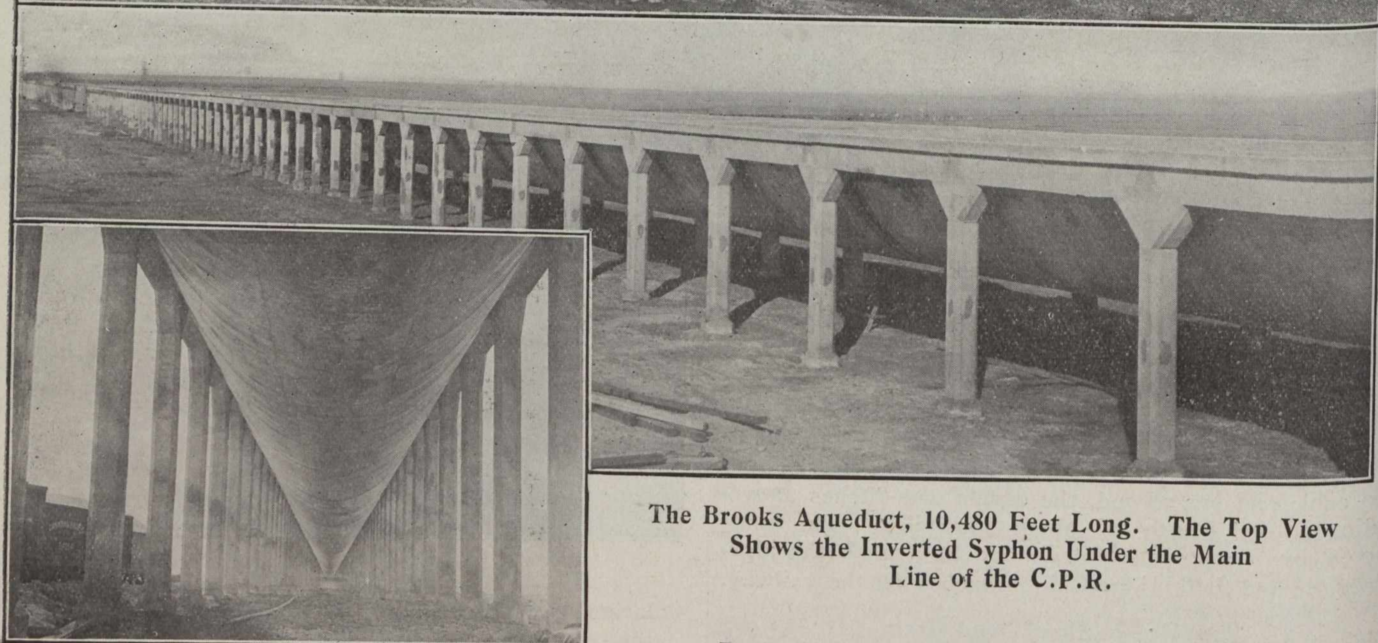
canal head gates. The structure is illustrated to advantage in the accompanying views.

The earthen embankment has a maximum height of about 45 ft., a total length of over 7,000 ft., and a width of base of 350 ft. at its highest point. It contains about 1,000,000 cubic yards of material. The wetted slope is 4:1 and the dry slope 3:1. It has a top width of 32 ft. with a free-board of 9 ft. above normal water level. Its upper slope is paved with concrete slabs. There is an extensive underdrainage system.

The spillway allows over its crest 100,000 second-feet of water without raising the surface of the pool more than 13 ft. above the crest. This required in the design a free length of weir of about 600 ft., but to allow for end contraction on account of the piers necessary to support the movable crest, an aggregate length of 650 ft. between piers was decided upon.

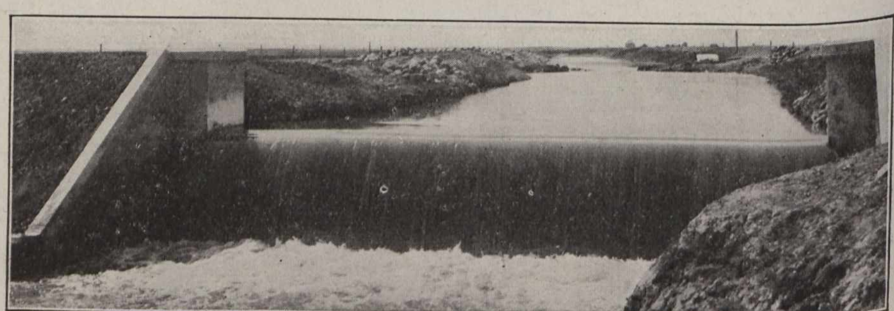
As the crest of the dam coincides in elevation with the sills of the canal head gates, the additional depth of 11 ft., for which the canal was designed, is provided by a movable crest over the entire length of the spillway. This is for service in time of extreme flood. It is divided into 24 sections, and supported between piers, giving 27 ft. clear spans. The openings are regulated by structural steel gates. The buttresses are spaced at 15-ft. centres, with every second buttress carried up in the form of a bridge pier, giving a clear span of 27 ft., as stated.





The Brooks Aqueduct, 10,480 Feet Long. The Top View Shows the Inverted Syphon Under the Main Line of the C.P.R.

The spillway proper is a reinforced concrete structure of the Ambursen type, consisting of a heavy floor built upon the bed of the stream, with suitable cut-off walls at its up-stream and down-stream edges; upon this floor are erected parallel buttresses of substantially triangular face with a slope on the up-stream edge of 45 degrees. Projecting from the faces of the buttresses are brackets or haunches which support concrete slabs running parallel to the up-stream edges of the buttresses and forming a deck which terminates in line with the top of the buttress in a curved crest, which passes down over the down-stream face of the buttresses in the form of an apron suitably curved to correspond as nearly as possible with the path of the overfalling water. In front of the dam the floor is carried down stream for a distance of about 90 ft., forming a tumbling hearth. At both edges of the structure, as well as at the centre, heavy cut-off walls are carried down to the clay and bonded to the body of the carpet.



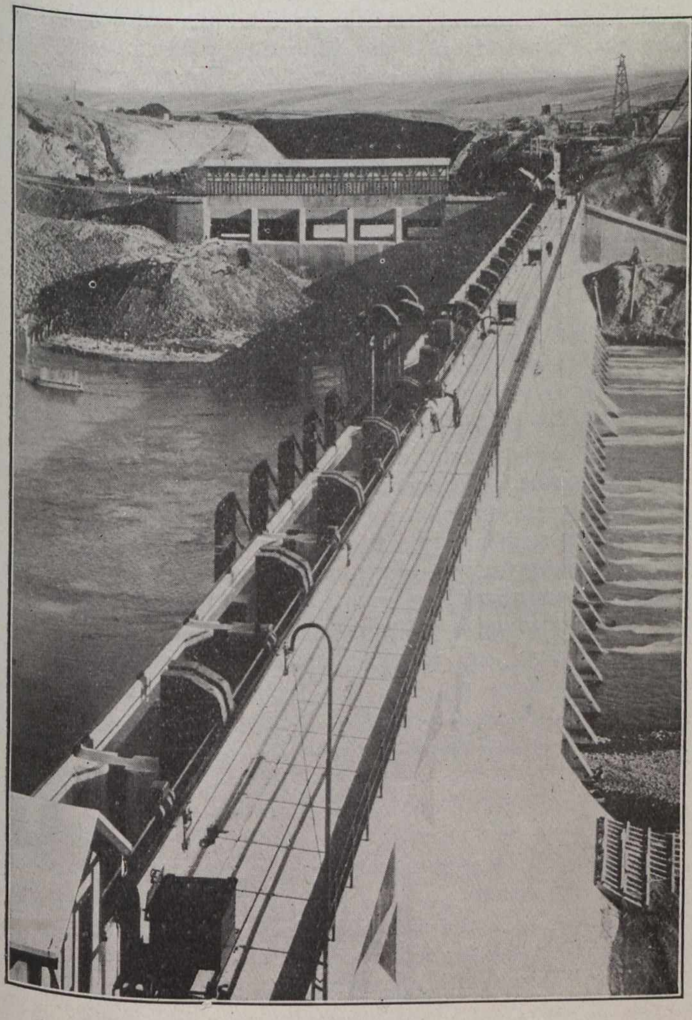
A Typical Drop in the Weed Creek Canal.

The structure is 720 ft. in length between abutments with a maximum height of 40 ft. to the overflow crest, not including the additional 11 ft. retained by the gates. It contains about 40,000 cubic yards of concrete and 2½ million pounds of reinforcing steel.

The abutments connecting the spillway with the earth dam are in the form of reinforced concrete retaining walls of the counterfort type.

A power plant comprising vertical turbines with direct connected generators is housed inside the dam, providing power for gate operation and for lighting.

The canal head gates form an integral part of the spillway structure at its northerly end and consist of five openings 20 ft. long, controlled by electrically operated Stoney sluices. The main canal into which this discharge empties (3,800 cu. ft. per second) has a bed width of 70 ft. and carries 11 ft. of water.



Crest of Bassano Dam, Headgates and Main Canal in the Background.

The Brooks Aqueduct.

Part of the water which reaches the Lake Newell reservoir after its 30-mile course from Bassano through the east branch canal, feeds the Bantry Canal, which irrigates 135,000 acres of land. About 2½ miles beyond the lake it is necessary to carry the water across a long flat valley on the summit of the water shed between the Bow and the Red Deer Rivers. This is accomplished by a reinforced concrete flume known as the Brooks aqueduct, completed August 31st, 1914. Its construction marked an interesting departure in the matter of water transportation. It is the first aqueduct in which the hydrostatic catenary, or elastic curve, has been adopted for the shape of the water section. This form was chosen as the most suitable, as it gives a maximum hydraulic radius for the given area, and a consequent low friction head. Structurally it is very economical since, when full, the shell is in simple tension, free from shear and bending moments. Mr. H. B. Muckleston, assistant chief engineer, Department of Natural Resources of the Canadian Pacific Railway, is responsible for the adoption of this unique design.

The curved shell which, as stated, has been constructed of reinforced concrete, is suspended between horizontal girders at 23 ft. ½ in. centres, the whole being supported by a reinforced concrete trestle, made up of two lines of columns spaced 20 ft. c. to c. longitudinally, and varying in bracing according to the height, which in itself varies from 24 to 60 ft. The aqueduct is 10,480 ft. in length with a total fall of 4.85 ft. The water cross-section is 126 sq. ft., carrying 900 cu. ft. per second on a grade of 0.00038, at a velocity of 7.146 ft. per second, the hydraulic radius being 4.37 ft.

An interesting problem existed in joining up the Bantry Canal with the aqueduct, which meant reducing the sectional area from 456 sq. ft. to 126 sq. ft., and increasing the velocity from 2 ft. per second to 7.146 ft. per second. This reducing channel is 150 ft. long with varying slopes in its initial sections until its flat concrete bottom gradually disappears at the entrance of the flume section.

Another interesting feature arose from the necessity of crossing the main line of the Canadian Pacific Railway, there being insufficient clearance for an overhead structure. Here the water is carried underneath the track by means of an inverted syphon, which gradually tapers with its decreasing elevation to a reduced section which increases the velocity of the water from 7.14 ft. per second to 12.25 ft. per second on the principle of the venturi tube. This design required less excavation under the tracks and assured better drainage. The gradual expansion of the section as it rises at the outlet is similar to the descent, the water entering the flume again at the same velocity with which it enters. The prevention of eddies and consequent loss of head in the syphon in addition to provision for hydrostatic pressure, and the usual stresses and moments, led to some most interesting details of design, arising out of extensive preliminary investigation. When the water was turned on last September the syphon remained perfectly watertight under its full pressure.

In the construction of the Brooks aqueduct some 25,000 cubic yards of concrete and about 4,000,000 pounds of reinforcing steel were used.

COBALT ORE SHIPMENTS.

The following are the shipments of ore, in pounds, from Cobalt Station for the week ended September 17th, 1915:—

Dominion Reduction Company, 88,000; Peterson Lake Silver Mine, 74,795; McKinley-Darragh-Savage Mines, 167,020; Buffalo Mines, 124,042. Total, 453,857 pounds, or 226.9 tons.

Ex-New Liskeard—

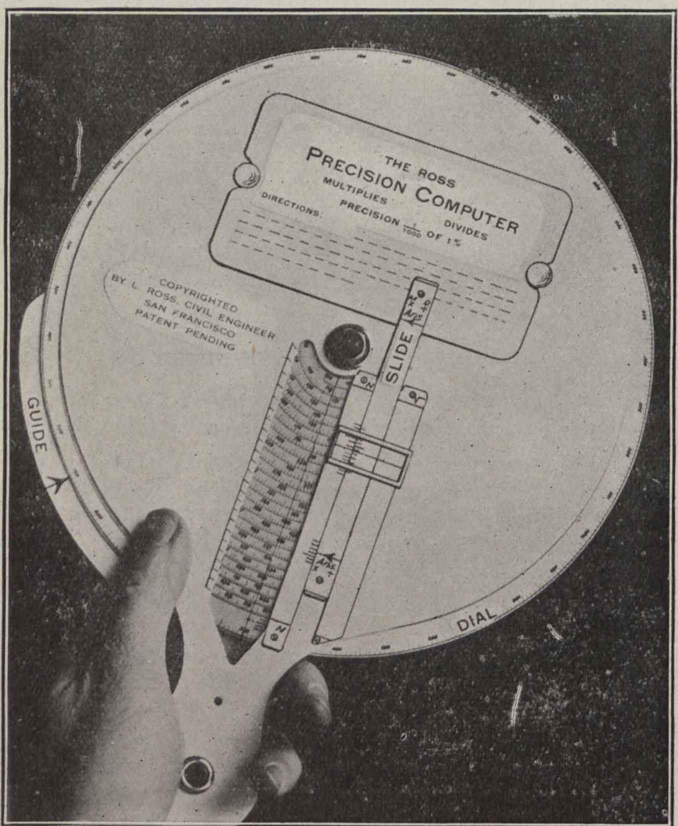
Casey Cobalt Mines, 61,211 pounds.

The total shipments since January 1st, 1915, are now 22,089,200 pounds, or 11,044.6 tons.

A NEW FIVE-PLACE COMPUTER.

A NEW computer for engineers has recently been devised, to give an accuracy of 5 figures in data and results. It solves problems like 879.65 × 72.638 ÷ 74.769 = 854.58, with an ultimate accuracy of 1/1000 of 1% or 1 in 100,000. It is claimed to be more than 100 times as accurate as the ordinary slide-rule and equivalent in accuracy to a slide-rule over 100 feet long. The system of graduations and accuracy is absolutely uniform throughout. Numbers are read as simply as on a watch dial or on a 10-to-the-inch scale. The instrument combines, moreover, means for both precise calculations and for approximate results, where that is sufficient.

The instrument is called the Ross Precision Computer and is shown in the illustration. It consists essen-



A New Computer of Unusual Accuracy.

tially of a graduated dial rotating with a floating guide under a slotter cover; and a slide at the right of the slot. The dial is numbered and graduated to read 5-figure numbers. The slide carries a scale which is a miniature of the dial scale and reads 3-figure numbers. Either may be used separately, but they are made to co-operate, so that the slide checks and points out the precise answer obtained by the dial operation, and incidentally determines its decimal point.

To multiply and divide any series of numbers precisely, it is only necessary to turn the dial once for each number, so as to set each number in succession under the reading line in the slot. Each turn of dial alone multiplies; each turn of dial and guide together divides. When all the numbers have been set, the answer appears also under the slot-line. By moving the slide, its arrow checks and points out the precise answer, and indicates the location of the decimal point in the answer. The detailed manipulations required are given on the face of the instrument.

At the left of the slot is a scale of equal parts; it co-operates with a similar scale at the rim of the dial, to give 5-place logarithms and anti-logarithms—quicker and simpler than tables—obviating fingering of pages, mental interpolations and errors. Powers, roots, and other complex operations may be carried out, either to a high degree of precision on the dial, or approximately, by using the slide alone. Trigonometric calculations made with the precision computer give a resultant accuracy of a few seconds of arc.

This computer is made wholly of metal; the frame and parts are of aluminum, while the graduated dial and slide are of bronzed brass; the graduations are deeply and sharply engraved on a dull silvered surface; to last indefinitely, without being affected by climatic conditions. The precision computer is 8½ inches in diameter. Its weight is less than a pound. The use of the instrument requires no knowledge of mathematics, logarithms or of any other computing device. It has been invented by Louis Ross, civil engineer, San Francisco, and is manufactured by the Computer Manufacturing Company, San Francisco.

FILING BUSINESS CARDS.

Into most offices come considerable numbers of business cards which, in many cases, it is desirable to file for reference. Unfortunately, notwithstanding all the great progress made in recent years in standardizing office equipment such as size of letter paper and of data cards, etc., business cards, like catalogues, are as far from being standardized as ever, though the convenience of such a procedure is admitted on all hands.

We are in receipt of a very interesting and useful suggestion submitted by Mr. A. S. L. Barnes, of the Hydro-Electric Power Commission of Ontario. It is that pending standardization of the dimensions of business cards, one may be conveniently filed by inserting its corners into slits in one of the standard 5-in. x 3-in. data cards. Another method that suggests itself is that of attaching the business card to the standard card by a touch of mucilage.

In this way any size of business card in common use can be put away for reference and filed under the "Dewey Decimal" or any other system.

SHEET ASBESTOS CONCRETE.

A new form of roofing and siding material is on the market consisting of cement reinforced by asbestos fibres. A dense homogeneous structure is secured by an extended beating together of the materials with an excess of water, subsequently building the material up in thin layers on a paper machine and finally subjecting the sheets to excessive pressure. These sheets are supplied in corrugated form to be used like corrugated iron.

Portland cement concrete offers such favorable resistance, among building materials, to the combined action of the elements that this adaption of it is interesting, in that its porous nature and its low tensile strength have been sufficiently overcome for the purpose of siding and roofing.

THE BRITISH COLUMBIA ELECTRIC RAILWAY SYSTEM.

In a special Pacific Coast issue in honor of the International Engineering Congress, "Electric Traction" publishes some interesting descriptions of the larger and more important electric railway properties along the Pacific seaboard. Among them is an outline of the extent of the system of the British Columbia Electric Railway Company, that reads as follows:

The British Columbia Electric Railway enjoys the distinction of being the most extensive electric railway system in Canada, as well as operating the longest interurban line in the Dominion. The territory covered by the company is located in the southwestern section of British Columbia, partially on the mainland and partially on Vancouver Island. On the mainland the company's field extends, roughly, 20 miles north and south and 80 miles east and west, while on the island its lines cover the city of Victoria and surrounding districts and extend 21 miles to the north, passing through the centre of the Saanich Peninsula. Within this territory reside 60% of the entire population of the province, and the company is called upon to meet all demands for electric railway transportation throughout the district.

The company's field on the mainland covers the cities of Vancouver, New Westminster and North Vancouver, and, on Vancouver Island, Victoria, the capital of British Columbia. All these points are covered by city and suburban lines.

Interurban service on the mainland is given by the company in the form of three lines connecting Vancouver with New Westminster, a line connecting Vancouver with Steveston, and the company's longest line running through the South Fraser Valley to Chilliwack, 76 miles from Vancouver. On Vancouver Island an interurban line connects Victoria with points on the Saanich Peninsula operating to Deep Cove, at the northern terminals of the tongue of land. The extent of the company's system may be judged when it is stated that its lines cover 350.65 miles of single track. The various divisions of the lines on a single track basis are as follows:

Vancouver city system		102.07 miles
Within city limits	63.48 miles	
In suburbs	38.59 miles	
Victoria city system		41.55 miles
Within city limits	30.43 miles	
In suburbs	11.12 miles	
New Westminster city system		16.66 miles
Within city limits	12.62 miles	
In suburbs	4.04 miles	
North Vancouver city system		11.07 miles
Within city limits	7.81 miles	
In suburbs	3.26 miles	

Interurban Lines.

Vancouver to New Westminster via Central Park	27.42 miles
Vancouver to Steveston, with branch to New Westminster via North Arm of Fraser	40.98 miles
Fraser Valley line (New Westminster to Chilliwack)	77.55 miles
Vancouver to New Westminster via Burnaby Lake	10.24 miles
Victoria to Deep Bay (Saanich Peninsula line)	24.29 miles

In the cities and suburban districts the company operates under agreements with the municipal authorities or its general charter. The interurban lines are operated over a private right-of-way. All the track is of standard gauge, the weight of rail ranging from 56 to 91 lb. In the cities extensive paving programmes have been carried on during the last five years, and in connection with these the company has laid permanent track according to the latest plans of electric railway engineers.

The rolling stock provided for its various lines by the company was reported as follows on June 30, 1915: City passenger cars, 321; interurban passenger cars, 69; mail cars, 2; express and baggage cars, 14; locomotives and shunters, 20; freight and box cars, 393; logging, stock and dump cars, 118; line cars, 6; street sprinklers, 3; snow sweepers, 6; miscellaneous work cars, 13; a total of 965 rolling stock units.

The company's railway service throughout is operated at 550-600 volts d.c. On the interurban lines two-car trains are operated between Vancouver and New Westminster, and on the Fraser Valley and Saanich interurban lines three-car trains are operated. The company does an extensive freight business on all of its interurban lines, for which locomotives ranging from 30 to 55 tons are employed. For tourist traffic special observation cars are operated during the summer season in Vancouver and Victoria. Provision for the storage of cars is made in three large car houses at Vancouver and two car houses at Victoria and one at New Westminster and North Vancouver. The largest building of this type is at Mount Pleasant, Vancouver, where a double deck reinforced concrete car house composed of two four-track units was recently completed. The main repair shops of the company are located at New Westminster, car building having until recent years been done at this point. In connection with each of the company's car houses, shops are provided which are equipped for the making of temporary repairs.

In connection with its service in the field of transportation the company provides light and power for the section covered by its trackage, as well as other districts. Current for this purpose is provided by the Vancouver Power Company on the mainland and the Vancouver Island Power Company on the island, both subsidiary concerns of the British Columbia Electric Railway.

Two hydro-electric generating plants are provided on the mainland, the combined output being 85,500 h.p. In Vancouver an auxiliary steam plant of 20,000 h.p. is also available, and the company also has at hand a stipulated service from the lines of the Western Canada Power Company.

On Vancouver Island hydro-electric power plants at Jordan River and Goldstream provide about 30,000 h.p. and at an auxiliary steam plant at Brentwood Bay 6,000 h.p. may be developed.

The standing of the British Columbia Electric Railway Company in British Columbia and the Dominion may possibly be best understood when it is stated that the investment of the company in the field of electric railway, light and power, etc., now represents a total of approximately $50,000,000.

The Canadian Car and Foundry Company, Limited, is understood to be closing another contract with the Russian government for 3,000,000 shrapnel and high explosive shells. The value of the new contract is placed at approximately $52,000,000. The Canadian Car and Foundry Company has been engaged for some time on contracts from the Russian government.

WATER POWERS OF QUEBEC.

ONE of the five monographs disclosing to engineers at the International Engineering Congress the remarkable water-power resources of Canada relates to the power situation in the province of Quebec. It was written by Mr. F. T. Kaelin, assistant chief engineer of the Shawinigan Water and Power Co., Montreal, at the request of J. B. Challies, C.E., Superintendent of Dominion Water Powers. The author's extensive knowledge and experience, coupled with the extraordinary developments that have been accomplished or are now contemplated in the province, make the pamphlet one of great value; for any country which possesses such large water powers as Canada, as illustrated in the province of Quebec, is destined to play a very important role among industrial nations, always deriving wealth and prosperity from such resources if developed with energy and foresight.

The following is Mr. Kaelin's review, in part, of the power resources of the province:—

Ottawa District.—In this district there are many falls and rapids, most of which are still undeveloped. The Quinze River, which is eighteen miles in length, and really a portion of the Ottawa River, flows near the Cobalt mining district, and has its course broken by fifteen rapids, from which its name is derived. There is a considerable demand for power in this region, and of the 90,000 available horse-power on the Quinze, none whatever is developed at the present time.

The Lievre River, one of the principal tributaries of the Ottawa River, has a drainage area of 4,000 square miles, containing a number of large lakes, and has a series of falls and rapids. The total available horse-power is estimated at 85,000, of which less than 10,000 h.p. is developed to date.

A still larger tributary of the Ottawa River is the Gatineau River, with a length of 225 miles and a drainage basin of 9,500 square miles. The Gatineau enters the Ottawa River at Ottawa, and its falls and rapids are capable of generating 225,000 h.p., none of which is utilized at present, although some developments are contemplated in the near future with a view to starting a pulp and paper industry, for which the locality is ideal.

The Carillon Rapids on the Ottawa River, between Quebec and Ontario provinces, is capable of developing 160,000 h.p. It is important on account of its proximity to Montreal.

There are several smaller rivers in the Ottawa district whose falls and rapids could be turned to great industrial use.

Montreal District.—The Montreal district embraces that portion of the St. Lawrence and its tributaries on both shores between the Rivers Ottawa and St. Maurice. The only large water powers in this region are on the St. Lawrence, although there is considerable available power on various tributaries, some of which is already developed. The Cedars and Cascade Rapids, situated about thirty-five miles from Montreal on the St. Lawrence, and having a fall of thirty feet, are capable of generating 500,000 h.p. At present, developments are being carried out by the Cedars Rapids Manufacturing and Power Company, and when complete will have an output of 180,000 h.p. The present installation comprises nine turbine units of the vertical type, each developing 10,000 h.p., of which 60,000 h.p. is being transmitted to Aluminum Works at Massena and the remainder to Montreal.

On the opposite side of the St. Lawrence the Canadian Light and Power Company's plant at St. Timothee is furnishing about 20,000 h.p. to Montreal, mainly for the tramways. This development when completed will consist of ten 5,000 kw. generators, 50,000 in all.

A development on the Soulanges Canal, close to Cedars Rapids, furnishes 13,000 h.p. for consumption in Montreal, in addition to sufficient power for lighting the canal and operating the locks. Still nearer to Montreal, on the St. Lawrence is Lachine, the total available horse-power of whose rapids is estimated at 400,000. There is an existing power plant here which supplies 13,000 h.p. to Montreal.

At Chambly, on the south shore of the St. Lawrence about sixteen miles from Montreal, there is a hydro-electric plant on the Richelieu River, providing Montreal with 20,000 h.p. for light and power purposes. Numerous small developments near Montreal supply power to flour mills, rolling mills, textile and other factories. Moreover, Montreal not only receives electrical energy from these local points, but also from Shawinigan Falls, situated nearly 100 miles distant on the St. Maurice River, in the Three Rivers district, and at the present day an aggregate of 126,000 h.p. is supplied to Montreal. Of the still available power around the city 240,000 h.p. can be easily developed as the demand arises.

Three Rivers District.—In this district the St. Maurice River has a length of 300 miles, and its drainage area, including many large lakes, totals 3,600 square miles. It flows through richly timbered areas, and an enormous amount of lumber is carried down by it annually to the pulp and paper and lumber mills upon its banks. Its course is broken by a dozen falls and rapids which will be capable of developing 650,000 h.p. when the upper St. Maurice dam (a $1,500,000 structure now being built) is completed. The most southerly water power on the St. Maurice is situated at Le Gres Falls, fifteen miles north of Three Rivers, where 60,000 h.p. is available, none of which is utilized at present.

Shawinigan Falls, 21 miles from Three Rivers, is the scene of the next hydro-electric plant on the river. This constitutes an ideal place for water power development. Not only is there an available high head and a large quantity of water with fairly constant flow, but the river widens into a lake just above the falls, and after making a sharp bend forms a second lake 145 feet below. This brings the upper and lower water-levels within a short distance of each other, thus providing an extremely economical location for the power plant at the bottom of the slope between them.

The entire water rights of Shawinigan Falls are owned by the Shawinigan Water and Power Company, which sells a portion of the water to local manufacturing concerns for their own use and operates its own large power plant with the remainder. This plant is capable of generating 155,000 h.p. Some of this power is used at Shawinigan Falls for the reduction of aluminum, the manufacture of carbide, cotton and other goods, but the larger portion is transmitted to Montreal, Three Rivers and various smaller towns, factories and mines in the district.

The town of Shawinigan Falls, with a population of 5,000, owes its existence entirely to the presence of the hydro-electric power there. It is served by both the Canadian Pacific and the Canadian Northern Railways, and with its abundance of water power, constitutes an ideal locality for the manufacture of products involving electro-chemical processes.

Situated twelve miles above Shawinigan Falls, on the St. Maurice, is Grand Mere Falls, with a head of 75 feet. This power site is controlled by the Laurentide Company, but when developments are complete the output of the generating plant will be far in excess of the power required by their paper mills. The available power at Grand Mere amounts to 100,000 h.p., all of which will be developed upon completion of extensions to the plant now under way. The output of the Laurentide Mills, which consume 30,000 h.p., is about 250 tons of paper daily.

About 103 miles from Three Rivers, on the St. Maurice, at La Tuque, there is a 70-foot water fall capable of generating over 75,000 h.p. The existing pulp mills at La Tuque are using only 3,500 h.p., thus leaving over 70,000 still available. There are a number of water powers on the St. Maurice, north of La Tuque, which still belong to the Crown, and are available for future development.

Considering that all the large powers on the St. Maurice are within easy reach of Three Rivers, it is at once apparent that it is a unique location as regards manufacturing facilities. Three Rivers is a port of call for both river and ocean boats, and it is also located on the Canadian Pacific Railway main line connecting Montreal and Quebec. The population is 19,000, and as well as being the commercial centre of a farming district with 500,000 inhabitants, it is essentially a manufacturing city, and large amounts of pulp and paper and cotton goods are produced there annually.

City of Quebec District.—Although a vast amount of water power is available in the region directly north of Quebec city, a comparatively small quantity only has been developed. The electrical supply for the city is at present only partly obtained from a number of nearby small developments, mainly on the north shore of the St. Lawrence. The larger water powers in this district are practically to be found upon rivers flowing to or from Lake St. John, and especially upon the Saguenay River, which connects Lake St. John with the St. Lawrence. The junction of the Saguenay with Lake St. John is situated about 120 miles due north of Quebec, which is connected with the various places on the shore of the lake and the Saguenay by the Quebec and Lake St. John Railway. Lake St. John has an area of 350 square miles, and a tremendous volume of water flows from it down the Saguenay.

At Grand Discharge, where the lake empties its waters into the Saguenay, there are two main falls, which are capable of generating 375,000 h.p., and the water rights have been secured by the Quebec Government, who have in view a storage scheme whereby the above available power would be increased to over 1,000,000 h.p. Construction work on this development is expected to commence in the near future.

Some 20 miles below the Grand Discharge is a series of rapids having an available power of over 240,000 h.p., none of which is yet developed. At Chicoutimi, a few miles farther down the Saguenay, where it is joined by the Chicoutimi River, a hydro-electric plant is developing 7,500 h.p., which represents about half of the power available. From Chicoutimi down to the St. Lawrence the Saguenay is navigable. There are considerable available water powers on some other tributaries of the Saguenay, chief of which are the Shipshaw River with 8,000 h.p. available, some of which is being developed, and the Perabouka River with 120,000 h.p. available.

A number of tributaries of Lake St. John, flowing from all directions, have their courses broken by numerous falls and rapids which might be turned to great industrial use, although but small demand has yet arisen for these powers. Of those rivers running into Lake St. John, the most important, from an industrial standpoint, are the Ashwapmuchuan River with 250,000 h.p. available. The Mistassini and Muskosibi Rivers each with 12,000 h.p., the Metabetchouan River with 11,000 h.p. available, and the Ouiatchouan River, whose falls are capable of generating 13,000 h.p. of which 5,000 h.p. is already developed.

A vast amount of power is obtainable in the Lake St. John region, most of which could be transmitted electrically to Quebec city, if desired, or used on the spot for electro-chemical processes and other purposes. This district is also richly timbered, and should prove attractive to those interested in the pulp and paper industry.

Miscellaneous Powers.—On the north shore of the St. Lawrence, between the Saguenay and the Atlantic ocean, the country is scattered with large water powers which, like the district itself, are entirely undeveloped. The principal rivers in this region are the Hamilton, Netashkwan, Romaine, St. John, Manitou, Manikuagan, Outards, Bersimis and Portneuf, and the total amount of available power is well over a million horse-power.

Fast-flowing rivers are comparatively scarce on the south shore of the St. Lawrence, the River de Loup, the Magdalen River, being the only ones east of Quebec with available water powers. The mouth of the River de Loup is almost opposite that of the Saguenay, and its Falls at Fraserville are capable of developing 3,500 h.p., of which 500 h.p. is at present utilized. The Magdalen River, which joins the St. Lawrence much farther east, has a series of rapids and falls with an available power of 50,000 h.p., none of which is yet developed.

The remaining water powers of Quebec province are scattered over the James Bay Slope, where such large rivers as the Harricanaw, Nottaway, Rupert and Eastmain run their courses. The available water power in this region is estimated at nearly a million horse-power.

Undeveloped and Developed Water Powers.—As far as it is possible to ascertain from existing figures the total developed water power in the province of Quebec amounted at the beginning of 1915 to 520,000 h.p. Of this power, about 370,000 h.p. is used in the form of electrical energy, 100,000 h.p. as mechanical power for the pulp and paper industry, and about 50,000 h.p. for other industries. This developed power represents less than 10 per cent. of that available, and the development of any considerable portion of the remaining water powers constitutes a gigantic task for the engineers of this country. Among the developed water powers are small as well as large ones distributed over a large portion of the province, but especially in the vicinity of industrial centres, near the St. Lawrence River. Those water powers within short distances of industrial centres and capable of easy development were naturally the first utilized.

The proximity of industrial centres, however, is now a secondary consideration, owing to recent achievements in long distance transmission, and the ease with which water powers farther afield can be utilized is now apparent.

We may consider, then, from the foregoing that the value of a water power depends on:—

1. Natural advantages, such as volume of water, steadiness of flow, height of fall, and the special natural disposition favorable for cheap development.

2. The location of the water power in regard to the market. This market might consist in the pulp and paper industry, and in this case would depend on the proximity of forests and timber limits. Pulp and papei mills are usually situated on power sites.

A market for power also exists near big industrial centres, where it is required for lighting, manufacturing and transportation purposes. This market is, of course, more or less confined to the larger cities near the St. Lawrence, and consequently most of the water powers around Montreal have already been developed.

BRIDGE CONSTRUCTION IN SASKATCHEWAN.

The bridge construction programme of the Board of Highway Commissioners of the province of Saskatchewan for the year 1915, while not so large as in some previous years, nevertheless includes several important permanent structures, some of these being works postponed and carried forward from last year. Materials had already been assembled for these and they are now being brought to completion. A few of the more important may be briefly mentioned.

An important crossing over the Souris River, near Elcott Siding on the Grand Trunk Pacific boundary section, is being bridged by a steel and concrete structure of 150-foot span. The contractor has finished the abutments and the superstructure will be erected and the bridge in commission by November 1. This bridge will provide access to the railway for a large and well-settled district.

Close to Carnduff, over the South Antler creek, a bridge existed which was a light steel span on pile abutments. This crossing is on one of the main arteries of traffic into Carnduff, and the bridge was one of the oldest in the province. It was deemed advisable to construct a new and more adequate bridge before the old one should become dangerous. All material for the abutments is already on the ground, and the work of construction is to be undertaken and carried to an early completion.

At Langenburg a much needed dam and sluiceway was completed this spring, and during the summer has proved a great boon to the people of the district, who formerly had difficulty in getting an adequate supply of good water.

A work which has been in hand for some little time is the new bridge across the narrows of Weed Lake, about seven miles south of Broadview. This bridge is 100 feet long and is built entirely of concrete, in three spans. The all-concrete bridge is still somewhat of a novelty in the West, and the Weed Lake bridge may be pointed to as one of the best examples of this class of construction in the province, ranking second to the Saskatoon spandrel arch bridge.

The construction of small timber bridges on many of the more important roads is being proceeded with, though the programme is not so large as in other seasons. The main part of the work, however, consists of reconstructing bridges which have outlived their usefulness, and replacing them with standard bridges of a more adequate character.

ENGINEERS AND WAR.—II.

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

THE last article traced, in a somewhat cursory manner, the part taken by engineers in war preparations and operations, up to the time of General Brialmont, the great Belgian engineer, who constructed the Antwerp fortifications which were considered as the second strongest in the world. The destruction of these forts was accomplished only a few months ago, and will be referred to again. For the present it is desirable to consider the engineers and the navy.

The navy had to be supplied with guns, machinery and equipment, but in the operation of a ship and in a naval war the engineer took no important part until a few decades ago.

A battleship in 1800 had a displacement of 2,000 tons, and had about 30 guns—24-pounders on deck and about 25-32-pounders on the spar deck. She was a sailing vessel and had to get into close quarters to become an effective fighter. This was fairly typical of the character of the British navy up to the Crimean War (1854).

The armor plating of wooden ships was suggested by Sir Wm. Congreve in 1805. Mr. John Stevens, of New York, submitted plans of an armor-plated vessel to the Congress in 1812. Experiments were conducted in England between 1827 and 1854, but beyond this nothing was done. The Turkish fleet was destroyed by shell fire in 1853 and probably this awoke the governments to action.

Wooden sailing vessels with steam as auxiliary power were also built prior to 1854. It was in that year that the Earl of Rosse, "a man of singular mechanical genius," induced the Admiralty to put iron plating five inches thick on a ship to resist the effects of hot shot. The French also commenced plating their warships. Hot shot was then the best means of setting ships afire. The shot was heated to wafer-red color. During the long siege of Gibraltar, many of the Spanish and French ships were destroyed in this manner.

Steam boats were introduced about 50 years prior to the Crimean War. The "Savannah," 380 tons, built in New York, made the passage from Savannah to England and back more or less by steam-driven paddle wheels. The paddle wheels were so designed as to be capable of being removed and placed on deck. In 1825 the "Enterprise," 470 tons, sailed from London to Calcutta via the Cape of Good Hope in 103 days. When she arrived in the Table Bay she sailed round the bay three times to show her powers, and there were general jubilations in Capetown to celebrate the event.

Yet, a certain Dr. Lardner thought it was a waste of time to discuss the possibility of a direct voyage across the Atlantic Ocean because the weight of machinery and coal would be so great. This was soon refuted by the steamer "Great Western," a ship 212 feet long and of 2,300 tons displacement, being launched in 1837, and crossing the Atlantic in 13 days. The "Great Eastern"—Brunel's wonder—was built in 1852, a vessel 680 feet long, having a displacement of 27,420 tons.

The H.M.S. "Thunderbolt," built in 1856, was the first "ironside" with 4½-inch sheet armor. From this time on to the present day, it has been a contest between guns and armor. The thickness steadily increased until some ships had 24 inches of armor, which inevitably tended to encumber the vessel. Steel armor was first used in 1894. As the destructive force of guns was rapidly increasing the engineers, metallurgists and chemists set about to find a process of toughening, surface hardening and otherwise increasing the resistance of armor plates, and so there evolved the Harveyized plate with its carbonized surface, gas-hardened Krupp plate, Schneider nickel steel, Krupp nickel-chrome steel, and so on.

An interesting pioneer ship was the H.M.S. "Captain," the invention of Captain Cowper Coles, which was considered a masterpiece and constituted the pioneer of a new class of warships. It had 900 horse-power engines and a displacement of 4,272 tons. It was armored on the sides 8 inches thick and on the turrets 12 to 18 inches thick, and carried four guns, capable of discharging 600-pound shot. As has been the case with many pioneers, this ship met with disaster, for she foundered in the Bay of Biscay in 1870.

It is instructive to note that the shape of the bow of a ship has a very material effect on the resistance due to the passage through the water. A box-shape bow has a resistance of, say, 1. Rounding the corners reduces it to 0.66, a curved line has a factor of 0.33 and Russel's experiments show that the resistance can be reduced to 0.08.

The increasing of the ships to twice their former size has the effect of quadrupling the resistance through the water, but the tonnage is increased eight times. Increasing the speed entails adding more boilers and engines, as will be observed from the following figures:—

Ship.	Date built.	Displacement (tons).	Horse-power.	Speed (knots).
Majestic	1895	14,900	14,900	17½
Lancaster	....	.....	27,000	23
Indomitable	1907	17,250	41,000	26
Queen Mary	1912	27,000	75,000	28
Queen Elizabeth ..	1914	27,500	.....	..
Fuso (Japan)	1915	30,500	.....	22½

The increase in horse-power from 14,900 to 75,000 is equal to about 400 per cent. but the increase in speed from 17½ to 28 is only 60 per cent. It will thus be seen that although there have been great improvements made in the steam consumption during the last quarter of a century, the quantity of fuel required has mounted up enormously, especially when long voyages have to be undertaken or the warship has to provide for a prolonged absence from the base. This has brought to prominence the use of oil fuel and, as is well known, the new ship "Queen Elizabeth" is equipped with oil tanks, furnaces, etc. One of the problems which engineers have had to solve is the designing of the power plant on board a warship, so that the vital parts are removed from danger of being disabled during a battle, and space is economized.

The navy consists of many kinds of vessels—battleships, cruisers, destroyers, submarines and others. Each has its own peculiar function and each possesses a mine of interest to engineers.

Engines which, by ample advertisement, have become known as the "Diesel," although apparently invented by a British engineer named Akroyd, are largely used in the navy; and latterly in practically all the navies of the world the steam engine is gradually being replaced by the internal combustion motor for the propulsion of auxiliary craft such as pinnaces and other boats. At least 500 motor boats have been put into naval service since the outbreak of war. Whilst motors are usually run on gasoline and paraffin, alcohol motors are frequently installed, especially by German authorities.

With regard to submarines, which are now the only naval weapons used by Germany, it is interesting to note that, according to the Scientific American, there were references to submergible ships as early as 1372. Several British patents were taken out in 1727, and in 1775 the H.M.S. "Eagle" was attacked in New York harbor by a submarine built by David Bushnell. The first German submarine was invented by a Bavarian named Bauer and built in 1850, but when submerged it did not rise again.

The present submarine is a wonderful mechanical construction. The newer boats are said to have a cruising range of 3,000 miles, and have 3 periscopes, 6 torpedoes and a 12-pounder quick-firing gun. These undersea boats have oil power for surface propulsion and electric power for submerged propulsion, and are water-ballasted so that by admitting or rejecting water the buoyancy of the boat can be controlled. The maximum depth to which submarines can submerge is about 200 feet, but the crushing pressure of the water and the resisting strength of the boat have to be considered. Waters must have a depth of 30 feet to permit these undersea boats to operate. The submarine has a crusher gauge to indicate the pressure on the hull when submerged, a spirit level to indicate its position, a depth gauge, and many most ingenious contrivances which would require too much space to describe. These undersea boats can rest on the sea bed for 24 hours and for even longer periods by using chemical purifiers. The cruising range is stated to be dependant on the physical endurance of the men more than on the storage of fuel. As the intricacy and complexity of these peculiar craft increase with their size and power, so must the skill, knowledge and dexterity of the crew develop in proportion. Mr. Peter Swan is of the opinion that the time may come when sea-power will be measured in terms of submarines, not dreadnoughts.

The torpedo boat was the creation of France, but it is now superseded by the submarine and the torpedo. Inasmuch as submarines have to voyage on the surface or at a depth not exceeding 200 feet, usually much less, one method of intercepting them is by cable nets. Nets have been thrown across the Strait of Dover and the Irish Sea and this is probably the reason why the attacks are now made outside these waters.

The torpedoes may be discharged from the side of a battleship, 15 feet or so below the water surface, from the deck of a destroyer or from the nose of a submarine. Some submarines can discharge torpedoes from broadside as well as fore and aft. They are discharged from a battleship when the range is short, from the destroyer at night and from the submarine at all times.

The torpedo is a tube containing about 250 pounds of guncotton in the head, compressed air in the body and ingenious mechanisms in the rear portion. It is automatically steered, has an initial velocity of about 40 knots per hour, can travel 7,000 to 10,000 yards, and keep submerged by secret contrivances.

The electrically driven Obry gyroscope gear converted the torpedo from a menace to friend and foe, into a deadly weapon of certainty. The long range of torpedoes is obtained by heating the compressed air with alcohol burners, but usually firing is done at close quarters.

Submarine mines are spherical vessels containing about 500 lbs. of guncotton. Some are anchored, others are cast afloat, and still others are connected by wire for electric contact from the land. The anchored mines have cables from the bottom to the anchor chambers within which are windlasses, and below which are plummets to keep them at the required depths. The mines, being spherical, roll along the ship hull until the trigger is struck, the detonator is operated and the mine explodes. The mines are always invisible, consequently there are no means of avoiding them, except by a knowledge of their location.

As the guns and torpedoes were increasing in power, size and range and their handling made more facile, the ships were also increasing in size and speed and their armor improved. The introduction of breech-loaders in 1880 caused a great change in the construction of ships. The deadly effect of torpedoes rendered it necessary to provide more protection by greater subdivision of the ships and by the plating of the hull below the main belt down to the bilges. The ship which possesses the most powerful guns and the greatest speed can keep out of the range of other ships and thus be out of danger of being hit by the enemy. This is the value of the dreadnought "Queen Elizabeth" class.

It is interesting to note the increase in power of the guns. For example, formerly 12-inch guns were 30 calibres in length, used 88½ lbs. of cordite and the projectile had a muzzle energy of 28,000 foot-tons. The newer 12-inch guns are 50 calibres in length, require about 400 lbs. of cordite and the muzzle energy is 53,400 foot-tons. The 15-inch guns on the "Queen Elizabeth" class of dreadnought fire shells weighing 1,925 lbs. with a muzzle velocity of 2,500 feet per second and a muzzle energy of 83,500 foot-tons.

The engineers are called upon to build guns that will withstand the enormous and ever-increasing stresses. The wire guns are built in sections, the tube and jacket are made from steel ingots. The centre of the ingots are cut out owing to the fact that in cooling the ingots have different qualities as to strength and it is necessary to use only the portion that is uniform in quality. One hundred and thirty-five miles of steel wire ¼ x 1/16 inch are wound on the tube under great tension.

The range of such guns is over 10,000 yards, at which distance the opposing battleship is on the horizon and its hull cannot be seen by the men at the guns. Admiral Percy Scott, who was recently appointed to adopt protective measures in London against Zeppelins, invented the fire director. This device is placed at or near the top of the mast where the men can observe the enemy's ship and from that position the officer, provided with powerful and accurate range finders, can train, elevate and fire the gun and watch the effects. The gun crews merely attend to the loading.

The warships are equipped with electric machinery, light, telegraphs, telephones, wireless telegraphs, mechanical devices of various kinds, pumps, hydraulic machinery, winches; in short, the warship is a veritable floating workshop containing complicated machinery which depends for its efficient operation in the distraction and excitement of a battle, upon the stamina of the men. As Lord Charles Beresford said: "You may have what size of ship you like, as many as you like, with guns, armor, boilers and engines, but remember it is the human element, and only the human element, that wins battles."

From what has already been stated, it is almost superfluous to state that the officers of the Royal navy and any navy are engineers by the very nature of their profession and the function of their office. But until a few years ago the engineer was regarded by the deck officer as a kind of "glorified mechanic—a smoke admiral" —or, as one admiral styled him, "the king of grease." Some improvement was effected, yet there is still the remains of the aristocratic attitude towards those who have occasion to dirty their hands. Mr. Peter Swan, in a letter to "Engineering" of August 13th last, stated that "in the Royal navy the captain must have a genteel beamaphrodite to come between the oily wind of the artificer and his nobility." Under the present system the cadets in Great Britain have to attend the R. N. College at Greenwich or the engineering college at Portsmouth for four years before going to sea, and have to study physics, marine engineering, use of tools and machines. They afterwards go to sea for two years as midshipmen and have there to study mechanics, applied sciences, marine engineering, gunnery and navigation. They then become sub-lieutenants and have to pass an examination, after which they select their future course. Up to this point all officers receive the same training but afterwards they specialize. Lieutenants who elect to follow the engineering branch specialize as executive engineers, although their status is claimed to be unsatisfactory.

The men also are trained, for while the officers may direct and control, the men constitute a most important factor in the handling of ships. The stokers and operative engineers in the hold of the vessel, a considerable distance below the water line, and liable to disastrous attacks by submarines, etc., the gunners in the turrets under bombardment from the huge guns, the electricians who have to maintain the electric equipment while the battle is raging, the telegraphists, and so on, all require training in times of peace.

The salvaging of sunken submarines is a business which until recently was not organized until after the disasters occurred, but France, in 1911, built a submarine salvaging dock to prepare for such accidents. This consists of a great hollow sided hull, 328 feet long by 82 feet wide. It has no bottom and the top is occupied by 10 massive girders. There is a space 42 feet wide between the two hollow sides so that when a submarine weighing about 1,000 tons has to be raised great chains are slung from the girders and secured to the sunken submarine by divers. When everything is ready the winches on the dock are operated and the submarine is brought up suspended on the chains between the walls of the dock.

Floating docks are more familiar as they are to be found in many ports and harbors where ordinary graving docks are not available or where the cost of construction of such docks is too great. Floating docks are built of hollow walls and floor, and when a ship is to be received for repairs, cleaning or painting, water is admitted into the hollow space, which causes the great dock to sink. When the floor is at a sufficient depth the ship is floated over it and the water is pumped out, causing the dock to rise again, raising the mightiest warship high and dry.

Engineers have also designed and built lighthouses and furnished them with powerful lights and signals to warn the seafaring community, thrown great breakwaters into the sea to quell the turbulent waters, constructed graving docks and ordinary docks, piers and jetties, cut canals which cross continents and join oceans, harnessed waters and reclaimed lands. They have also made contrivances which are delicate, sensitive and exceedingly accurate, gauges, micrometers, balances and a host of instruments which require thought, care and precise action.

In August over two million pounds of halibut were landed at Prince Rupert. The salmon pack there amounted to 12,000,000 pounds. The total amount of fish handled at that port was 15,121,500 pounds.

Editorial

THE NEW ENGINEERING STUDENT.

Canadian universities open this week under conditions that are considerably less turbulent this year than last, but under the influence, nevertheless, of the ravages of war upon men, money and mental activity. The effects are well illustrated in the industries which depend upon these essentials. A year of war has likewise made itself felt in the universities. There are some vacant chairs in the assembly rooms of the staff, and in the corridors the handclasps of senior years are not as frequent or as merry. Many classmates are in the trenches, others are in training and there are those who have bravely and unhesitatingly answered the last call for their King and country—as others still must do. The seats of learning have responded nobly for the defence of the Empire, and the student of yesterday who is a common soldier in the trenches to-day, is making a sacrifice that, under conditions other than those of war, the country could not well afford.

The new engineering student must recognize at once that his responsibilities are considerably greater than those of his recent antecedents at the university. The war has given a new aspect to many things connected with college life, and also to the engineering career he proposes to follow. There has been a universal inception of military training and lectures. With a view to preparedness the student should take full advantage of this extra burden borne by his senior confréres. It is an induced activity which, for the time being, supplants in large measure the athletic side, so essential for the development of men of sound judgment and agile minds, as well as of health and strength. In addition, the military work curtails to some extent the normal periods of technical study and application. Obviously, greater attention on the part of the student is necessary to countermand this encroachment upon a curriculum already overcrowded.

It is very important, also, that the student of to-day prepares to meet a new order of things in Canada when the war is over. What is behind the veil of circumstance arising out of the war is hard for him to conjecture, but he may be assured that it has deeply affected industrial and engineering activities, and that there will necessarily be a readjustment when hostilities cease. It is to his own interest, therefore, to keep abreast with current events and tendencies, to keep informed of the trend of industrial progress. He must become familiar with the extent and practice of engineering in Canada, the principles it involves, the methods by which it is applied, and, in addition, acquaint himself with a volume of information hardly a part of, but tributary to, the acquirement of a well-balanced engineering education.

Every student of our engineering schools, before he advances far in his course, should begin a careful collection of engineering reports, public documents, catalogues, etc. These should not be laid aside for possible future demand, as they soon become out-of-date. Nor should they be considered other than subservient to his text books and engineering periodicals; but they should receive his attention and careful perusal, as they will be found of advantage in the serious business of associating present studies with engineering.

Finally, it must be remembered that there are many requirements attached to the training of a successful engineer. A university course is a good stepping stone, but the mistake should not be made of regarding it as the whole process.

STANDARD RATING OF CONCRETE MIXERS.

Up to the present time there has never been any standard method of rating batch mixers. Some mixer manufacturers rate their machines by their capacity in mixed concrete, while other manufacturers rate them by their capacity in loose unmixed material. It is a well-known fact that a mixer having a batch capacity of 8 to 9 cubic feet of unmixed sand, stone and cement will hold only about 6 cubic feet of mixed concrete per batch. For this reason the term three, four, or nine-foot mixer has never had any real, definite significance.

In the United States the National Association of Mixer Manufacturers, at their August meeting, took steps toward remedying this difficulty by adopting a resolution providing for the uniform rating of batch mixers. This resolution provides that the members of the association in future catalogues and circulars shall specify the capacity of their mixers as "size of wet, mixed batch," and not otherwise. The resolution further provides that the dry, unmixed capacity of a mixer may be approximated as one and one-half (1½) times the wet, mixed batch, assuming the use of cement, sand and one and one-half (1½) inch crushed stone, with 1¾ gallons of water per cubic foot of mixed concrete. The members of the association further agreed not to use the dry batch rating in their correspondence, advertising, etc., unless the standard wet batch rating were used also and with equal prominence.

This is a step that should prove beneficial to all contractors, mixer manufacturers, and everyone, in fact, connected with the concrete and cement industry. A contractor can now arrive at a real comparison between mixers—not only in price but in capacity. This would have been much more difficult without the aid of a standard rating such as the above.

BENCH-MARK FOR GEODETIC SURVEYS.

The standard bench-mark adopted by the Geodetic Survey of Canada consists of a copper bolt, three-quarters of an inch in diameter and four inches long, stamped on the end with the letters "G.S.C., B.M." (Geodetic Survey of Canada, Bench-mark). The bolt is sunk horizontally in rock or masonry so that only the circular end is visible; the number of the bench-mark is stamped on this end as well as the letters mentioned above, and a horizontal chisel line is cut, upon which the elevation is taken. At certain points concrete bench-mark piers have been built; these project from six inches to one foot above the ground and extend below the frost line; the copper bolt upon which the elevation is taken is placed horizontally as in other cases, and is about nine inches below the top of the pier.

The Engineer's Library

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer, 62 Church Street, Toronto.

CONTENTS.

BOOK REVIEWS.

Materials of Construction: Their Manufacture, Properties and Uses. By Adelbert P. Mills, Assoc.M.Am.Soc. C.E.; Assistant Professor of Materials, College of Civil Engineering, Cornell University. Published by John Wiley & Sons., Inc., New York; Canadian selling agents, Renouf Publishing Co., Montreal. First edition, 1915. 682 pages; 346 illustrations; 6 x 9 ins.; cloth. Price, $4.50 net.

This is a primary reference book for engineers and a text book for students, rather than a treatise. It covers its particularly broad field in a comparatively concise and thoroughly modern manner, and older text books on the subject are surpassed in the matter of up-to-date information concerning new processes of manufacture, with consequent change in properties of materials, and in information concerning new materials themselves.

In Part I. the materials of masonry construction are treated as cementing and non-cementing materials. Under the former are chapters devoted to gypsum, plasters, quicklime, hydrated lime, hydraulic lime and grappier cements, Puzzolan and slag cements, natural cements, Portland cement, and concrete, the manufacture, properties and uses of the material being dealt with in each case. This section of Part I. comprises 200 pages. Under non-cementing masonry materials are building stones and stone masonry, bricks and other clay products, to which 20 pages are devoted.

The ferrous metals are considered in Part II., 284 pages, the chapter headings including pig iron, cast iron, malleable cast iron, wrought iron, steel, and the special alloy steels. Some of these chapters, such as that dealing with the manufacture of steel, are quite extensive, and in good accord with the importance of the materials.

The third section of the book treats of the non-ferrous metals and alloys and timber, taking up the remaining 120 pages of text. In each case, the processes of manufacture, properties and uses are dealt with in a very systematic and logical order. The method of treatment is to preface the consideration of each material by a discussion of its ordinary application in engineering construction and a study of its manufacture or natural occurrence. The main treatment is then devoted to a discussion of its physical properties in relation to its use.

The book is certainly a valuable one for use in the dual capacity to which we have referred above.

Economics of Contracting: A Treatise for Contractors, Engineers, Manufacturers, Superintendents and Foremen Engaged in Engineering Contracting Work; Vol. II. By Daniel J. Hauer, Construction Economist and Consulting Engineer. Published by E. H. Baumgartner, Chicago, Ill. First edition, 1915. 334 pages; 27 illustrations; 6 x 9 ins.; cloth. Price, $2.50.

Volume I. of "Economics of Contracting" appeared two years ago. It dealt with contracting in its infancy as a profession, calling for expert knowledge and previous training. It entered with detail and precision into questions of contracts, proposals, bonds, arbitration and other features of contracting. It analyzed separately and fully the business and the clerical ends of contracting, construction camps, outfit, plant, etc. The management of contracts and of men was also dealt with. In short, the book is a valuable one to the contractor, whose library is not extensive at best, in that it gets him away, for a while at least, from his well-thumbed handbooks and cost sheets, and gives him a broader and a better balanced view of his work.

In Volume II. the author takes up new subjects of special interest to contractors, pertaining both to the field and the office. Its chapter headings are as follow: Estimating and Bidding Upon Contracts; Making Contracts and Obtaining Bonds; Financial End of Contracting; Preventing Law Suits; Planning Construction Jobs; Handling and Training Men; Office Filing Systems; Organization of a Construction Company; Lines of Contracting and Specialization and the Standing of Contractors, with an appendix, By-laws for a Construction Company.

The book deals with the vital points in a contractor's business, the questions upon which his success depends. No other book in print indicates more plainly or directly the pitfalls that beset the inexperienced or even the veteran contractor. The author lays great stress upon the importance of cost records and upon careful analytic estimating, upon care and training of men, upon open and honest dealing, and numerous other stepping stones to better and more efficient contracting.

It is well worth the reading of all men engaged in contracting work and should be of considerable value to young engineers contemplating taking up general contracting.

Steam Boilers and Combustion. By John Batey. Published by Scott, Greenwood and Son, London, Eng. First edition, 1915. 220 pages; 18 illustrations; 5 x 7 ins.; cloth. Price, $1.00 net.

This book is to be recommended to those whose education is limited to the common schools and who wish to obtain a working knowledge of steam boilers and the physical laws governing their operation.

The author, after describing the raw materials for steam making (coal and water) in the first three chapters, then devotes four chapters to different types of boilers. In chapter eight steam boiler practice is given. The author's opinion that good hand firing is more economical than stoker firing is not that of most steam engineers.

The remaining chapters of the book give information on combustion, the constituents of coal, their action with air under high temperatures, the measurement of the heat evolved, and the calculation of the quantity of steam formed. Some simple experiments are also given.

The book ends with the movement of gases through tubes. This covers chimney draft and its causes.

The Design of Drill Jigs. By A. N. Haddow. Published by Emmott & Co., Limited, London and Manchester, Eng. First edition, 1915. 96 pages, including 22 tables; illustrated; 5½ x 8½ ins.; cloth. Price, 75 cents net.

This little book is called by the author "a practical manual," and it well deserves the name. It is full of useful hints to the designer of jigs. Many of them are of quite a simple nature, such as would be readily thought of independently by anyone after his first mistakes in overlooking them, but this book will save even the first mistake and, incidentally, much annoyance.

The illustrations are good, being apparently taken from working drawings in most cases, though they are undimensioned—a matter of no importance since the designs are applicable to varied classes of work requiring different dimensions.

At the end of the book are several useful tables giving dimensions of Whitworth screw threads and of twist drills, also wire gauges, tables of tapers and angles, etc. A useful addition for this country would be details of the Seller's thread, but as these are readily available from other sources their omission is not a matter of great importance.

The book will be particularly useful to young engineers who have to design jigs and have not yet learned by experience what to avoid and what end it is specially desirable to gain. Even older heads may find some new ideas.

Waterworks Buyers' Guide and Reference Manual.—Published by McGraw Publishing Co., Inc., New York City. 1915 edition. 185 pages; 15 illustrations; size, 6 x 9 ins.; cloth.

The publishers state in the introduction to this book that its purpose is to furnish superintendents and engineers of waterworks not only with a classified directory of manufacturers of products for which they may be in the market, but also a manual which contains such working data, reference tables, diagrams, etc., as are most frequently needed by these men.

The whole book, with the exception of about 60 pages, is devoted to a classified directory of manufacturers and to advertisements of firms supplying waterworks material and machinery. The directory refers entirely to United States firms and not to any Canadian firms, and the same remark, of course, pertains to the advertisements.

Seventeen pages are devoted to rates, an alphabetical list of the cities and towns over 3,000 population in the United States and Canada being given. The following information for each city is tabulated: Population; rate charged per annum for water supply; rate charged for bath; rate charged for closet; maximum and minimum meter rate.

The remainder of the book, about 44 pages, is devoted to an illustrated reference manual, presenting the following tables: Density of water at various temperatures; pressure and equivalent head; head and equivalent pressure; loss of head in small pipes; equation of pipes of different diameters; values of *C*, Kutter's formula; discharge in gallons through various sizes of pipe; standard dimensions and weight of cast iron pipes; nozzle discharge; reach of fire streams; friction loss in fire hose; cost of laying cast iron pipe; efficiency and duty of pumps; cost of electric and steam pumping; relation of duty to coal per h.p.-hour; cost of construction and operation of filters; quantity of water passing over weirs; area of filters.

In addition to the above tables the manual includes a few pages of text regarding flow over weirs; flow of water through pipes; turned and bored pipe; cement-lined pipe; flexible joint pipe; fire service systems; standard specification for hydrants; water waste prevention; construction; pumps and pumping; filtration.

Several of the tables are from Turneaure & Russell, Hamilton & Smith's Hydraulics, Transactions of American Society of Civil Engineers, American Handbook for Electrical Engineers, Gillette's Cost Data, and other sources, but they are grouped together in very convenient arrangement for waterworks men.

The publishers offer a copy of this guide to every waterworks superintendent or engineer in return for information regarding his plant for publication in the McGraw Waterworks Directory.

Working Data for Irrigation Engineers. By E. A. Moritz, Assoc.M.Am.Soc.C.E., Engineer U.S. Reclamation Service. Published by John Wiley & Sons, New York; Canadian selling agents, Renouf Publishing Company, Montreal. First edition, 1915. 388 pages; 46 figures; 65 tables; 6 x 9 ins.; cloth. Price, $4.00 net. (Reviewed by Thos. H. Hogg, C.E., Assistant Hydraulic Engineer, Hydro-Electric Power Commission of Ontario.)

The author states in the preface that his object in presenting this volume "has been to produce a book that would result in the conservation of the time and mental energy of the user, as well as to present material not readily obtainable from other sources."

The book naturally falls into two parts, the first three chapters giving a brief discussion of the various features of irrigation engineering, and leading up to the use of the tables and diagrams which occupy the remaining four chapters. This introductory portion takes up the usual steps in the development of an irrigation project in the order of their sequence.

Chapter I. deals with examination and reconnoissance. Many references are made to U.S. water supply papers published by the Geological Survey. A good index of these papers is included, together with tables of annual precipitation.

Chapter II. is entitled "Investigations and Surveys." In it the author gives a concise but valuable resumé of what the locating engineer should keep in mind, and the observations should be valuable as well for the designing engineer.

Chapter III. deals with the design of irrigation structures. A good deal of valuable data, most of it original, is presented in concise form on seepage losses from canals. This chapter forms a most interesting digest on the hydraulics of canals.

Chapter IV., on hydraulic diagrams and tables, includes a series of diagrams based on Kutter's formula, for the losses in canals, circular pipes, etc., also diagrams giving the various hydraulic elements of various sections, discharge and velocity in pipes of various materials, discharge over weirs, etc.

Chapter V., Structural Diagrams and Tables, covers a variety of subjects, such as, diagrams of excavation and embankment for canals, formulas, diagram and tables for reinforced concrete design, tables for use of timber in timber structures, tables for design of wood-stave pipe, diagrams for estimating and design of steel pipe, and various other diagrams and tables.

Chapter VI. contains a collection of miscellaneous tables and data, such as weights of various substances convenient equivalents, metric conversion tables, and a number of mathematical tables.

Chapter VII. has a digest of specifications on the various works and appurtenances used on irrigation systems. This chapter is one of the most valuable in the book, providing it is used with caution.

Taking the book in all, it is well worth the purchase price to the engineer who deals with hydraulics. In fact, it might even be called indispensable to the hydraulic engineer. Perhaps some will consider this statement extreme, yet the vast amount of data collected and made so easily accessible by means of tables and diagrams, makes the book a most valuable one.

Alternating Current Work. By W. Perren Maycock, M.I.E.E. Published by Whittaker & Co., London and New York. Second edition, 1915. 415 pages; 258 illustrations; 5 x 7½ ins.; cloth. Price, $1.50 net.

This book is virtually a revised and extended edition of "The Alternating Current Circuit and Motor," an earlier work from the same pen. In its new form it is said to be an introductory book for engineers and students.

The present book is written in simple language leading up step by step from the simplest electrical phenomena to the more complex, a very elementary knowledge of the subject, on the part of the reader, being assumed. The diagrams are numerous and effectually illustrate the points to which they refer.

The author is evidently a great believer in mechanical analogies, which are almost essential to many minds if they are to obtain clear conceptions regarding alternating currents. A number of points regarding such currents, their behavior and effects are elucidated by means of these analogies.

The main headings in the book are: General Principles, Power, Polyphase Currents, Alternations, Transformers, Choking Coils, and Motors. A few formulæ of a very simple character are used but the book is not at all mathematical.

Those readers for whom it is intended, should find it very helpful and owing to the character of the book and the way in which it is written the information contained will be as useful in Canada as in England.

Electrical Measurements and Meter Testing. By David P. Moreton, B.S., E.E., Associate Professor, Armour Institute of Technology. Published by Frederick J. Drake & Co., Chicago. First edition, 1915. 328 pages; 191 illustrations; 5 x 7 ins.; cloth.

The author of this work has endeavored to present a book to meet the requirements of the practical man, unable to take a technical course in electrical engineering, but desirous of a working knowledge of the subject. The elementary principles relating to electricity, magnetism and direct-current circuits are concise and effectively presented. The measurement of resistance, inductance, capacity, current and voltage are similarly treated. The last five chapters of the work are devoted to descriptions of electrical measurement apparatus of various kinds. These descriptions are for the most part quite up-to-date, and they should prove of considerable value to the student as well as to the practical man.

The fundamental theory underlying the applications of electricity is not dealt with in a technical way, but the method is simple and readily understood. It is supplemented by practical applications where possible, and the examples given afford the reader a fair idea of modern practice.

An appendix presents wire tables, temperature coefficients, capacities, etc. The book is well indexed.

PUBLICATIONS RECEIVED.

Composition of Natural Gas.—A 22-page pamphlet of the U.S. Bureau of Mines, giving the composition of gas used in 25 cities, with a discussion on the properties of natural gas.

Director of Forestry.—Report for year 1914, being part 6 of the annual report of the Department of the Interior. It contains also the reports of district inspectors of forest reserves in various provinces.

Coal Mines in Canada.—List of coal mine operators, arranged according to location of mine by provinces and districts, also a list of manufacturers of oven coke. Issued by the Mines Branch, Department of Mines, Canada.

Ontario Mining Publication.—Bulletin No. 25, Ontario Bureau of Mines, being a list, revised to October 1st, 1915, of all publications of the Bureau, including reports, maps and bulletins; compiled by W. R. Rogers, topographer of the Bureau.

Value of the High-Pressure Steam Test of Portland Cements.—Technologic paper No. 47 of the U.S. Bureau of Standards, prepared by R. J. Wig and H. A. Davis (abstracted in *The Canadian Engineer* for September 23rd, 1915, page 401).

Monazite Thorium and Meso-thorium.—A 32-page bulletin of the U.S. Bureau of Mines, dealing with the properties of the minerals, their occurrence, production, methods of mining, estimates of resources, valuation, etc., in the United States.

Mines in Canada.—A list of those other than metal and coal mines, stone quarries, clay plants, etc. It includes such products as asbestos, corundum, feldspar, graphite, gypsum, kaolin, peat, petroleum, etc., etc. Issued by the Mines Branch, Department of Mines.

Investigation of the Durability of Cement Drain Tile in Alkali Soils.—A report on results of first year tests of the U.S. Bureau of Standards, prepared by R. J. Wig and G. M. Williams, summarized in *The Canadian Engineer* for September 2nd, 1915, page 331.

Structural Relations of Rocks North of Ottawa and St. Lawrence Valleys.—A consideration of the pre-Cambrian and Palaeozoic rocks in these localities, prepared by Messrs. E. M. Kindle and L. D. Burling. Issued as Bulletin 18, Geological Survey, Department of Mines.

The Salt Deposits of Canada and the Salt Industry.—A 150-page report prepared by L. H. Cole, B.Sc., of the mines branch, Department of Mines, Canada, dealing with salt and its associated minerals, theories of its origin, occurrences in various provinces, statistics of production, technology of manufacture, etc. It is fully illustrated, and comprises a very valuable treatment of the industry.

Occurrence of Explosive Gases in Coal Mines.—Bulletin 72 of the U.S. Bureau of Mines, prepared by N. H. Darton. 248 pp.; 6 x 9; illustrated with maps, diagrams and photos. The author deals with the gases to be found, conditions under which they are emitted, etc. The various gases are fully described as to their variation of composition, volume, permeability of rocks, explosiveness, etc.

A List of Canadian Mineral Occurrences.—By R. A. A. Johnston. Memoir 74, Geological Survey, Department of Mines, Canada. An alphabetical arrangement of the minerals with localities comprises Part I., while Part II. is devoted to the names of municipal and mining divisions and localities in which minerals occur, arranged alphabetically under provinces and territories. 275 pp.; 6 x 9 ins.

Rules and Regulations for Metal Mines.—This is an extensive report of 296 pages prepared for the U.S. Bureau of Mines and published as Bulletin No. 75. It reviews the investigations, makes a general report and follows with an extensive draft for a law covering metal mines. A discussion follows on certain matters of practice, and a digest is presented of state metal mine inspection laws.

Electric Service, Meters, Wiring and Motors.—A book of rules and information pertaining thereto, issued by the Commonwealth Edison Co., Chicago. A very handy publication for contractors, architects and engineers. It relates to systems of electrical distribution, services, wiring, motors, meters, lamps, inspection, etc., and is well supplied with wiring diagrams and illustrations of service apparatus.

Vitrified Brick Pavements for Country Roads.—A 38-page 6 x 9-in. booklet issued by the U.S. Office of Public Roads, containing information relating to brick roads. In order that the varying physical characteristics of brick may be understood the raw materials and processes of manufacture are first discussed. Then follow sections on construction, cost and maintenance. Two appendices deal with specifications and with methods of inspection and test.

Tarred Granite Macadam: Is It a Failure?—This is an authoritative exposition of the views of English road engineers and manufacturers as to the claims for this material. It is a book of 84 pages, 5 x 7 ins., and comprises reprints from articles which recently appeared in the Sanitary Record and Municipal Engineering, London, England. The publication is for sale by the Sanitary Publishing Co., Limited, Chancery Lane, London, W.C., the price being 40 cents.

Methods of Constructing Large Capacity Deep Wells.—A bulletin issued by the American Well Works, Aurora, Ill., containing some valuable information relating to deep wells for irrigation work. It outlines the properties of an efficient well, the economical method of its construction and to deep well irrigation development work in various localities. The booklet describes the type of machine used, and of the various parts involved. 40 pp.; illustrated.

Precise Levelling, Vol. II. No. 1.—By F. B. Reid, D.L.S., supervisor of levelling, Geodetic Survey, Department of the Interior, Ottawa. One table describes all bench-marks established on routes between terminal points. Another gives the elevations, distances, differences, etc. Another shows the elevations at railway stations, crossings, intersections, bridges, etc. The lines dealt with are: Halifax, N.S., to Yarmouth, N.S.; Depot Harbor, Ont., to Renfrew, Ont.; Winnipeg, Man., to Kenora, Ont.; Saskatoon, Sask., to Wainwright, Alta.; Maple Creek, Sask., to Coutts, Alta.; Lethbridge, Alta., to Calgary, Alta.

CATALOGUES RECEIVED.

Steam Pumps.—Catalogue No. 9 of the Smart-Turner Machine Co., Limited, Hamilton, illustrating some recent designs of power and steam pumps. 30 pp.; 5 x 7 ins.

Aztec Asphalt.—An illustrated catalogue of original design, issued by the United States Asphalt Refining Co., New York, describing this type of asphalt, and listing and illustrating its use in many cities, counties and state highways in the United States.

Ore and Rock Crushing.—A 20-page illustrated catalogue issued by the Denver Quartz Mill and Crusher Co., Denver, Col., describing its various types and capacity mills involving some quite interesting features. In this type a convex roll revolves in a concave mortar with a special driving device.

Finding and Stopping Waste in Modern Boiler Room.—A handsomely prepared, illustrated catalogue of 68 pages, relating to prevention of waste by Cochrane meters, for measuring and recording boiler feed, condensate, blow-off, heating returns, cooling water, etc. Issued in Canada by Canadian Allis-Chalmers, Limited, Toronto.

Fiala Scout Sketching Case.—A 4-page leaflet issued by W. and L. E. Gurley, Troy, N.Y., descriptive of equipment for map sketching as practised by army engineers and by the Boy Scouts in their surveying course. It comprises drawing board 6 x 5 ins., to which sketching paper is applied and adjusted by rollers at each end. The equipment includes rulers, etc.

Fabroil Gears.—A 20-page bulletin issued by the Canadian General Electric Co., Toronto, describing the construction, weight, tooth-cutting, lubrication and operation of fabroil gears, of which the company is one of the makers. It also includes gear tables of standard and sleeve construction for various diametral pitches, with speed and capacity charts, tooth profiles, etc.

Transvaal gold production for six months ended June 30, 1915, totals 4,408,050 ozs. (value $90,865,000). This compares with an output of 8,394,322 ozs. (value, $173,523,885) for the entire calendar year.

Kensington, England, is arranging for an interesting roadmaking experiment. Some wooden paving, which was never intended for the heavy traffic it has of late years been called upon to bear, is wearing out, and the Borough Engineer is trying a scheme of pulling off the wood, laying down bituminous concrete instead, and putting down another wearing carpet of concrete on the top.

COAST TO COAST

Kingston, Ont.—The new incinerator was put into operation last week.

West Vancouver, B.C.—The municipality has spent $175,000 on its water front improvements.

Kingston, Ont.—This year the city is spending over $4,000 on tarvia surfacing of roads in the city.

Point Grey, B.C.—The construction of the Fourth Avenue diversion between Imperial and Trimble Streets, has been finished.

St. Catharines, Ont.—The ratepayers carried a by-law recently to purchase natural gas from the Relief Gas Co., aiming to sell it to its customers at 35 cents per thousand feet.

Ottawa, Ont.—Zinc is reported to have been discovered in large quantities in the vicinity of Burbidge Lake in the Upper Gatineau District. Dominion Government engineers are investigating.

Galt, Ont.—Work on the Lake Erie and Northern road bed within the city limits is nearing completion. A retaining wall has been completed along State Street and a large amount of filling has been done.

Victoria, B.C.—According to Mr. J. S. MacLachlan, the resident engineer for the Dominion Department of Public Works, on the construction of the breakwater and wharves at Ogden Point, this work will be finished early in the fall of 1916.

New Westminster, B.C.—Considerable progress has been made on harbor development this season. It consisted chiefly of filling and reclamation. A new wharf extending 192 feet out from the old water line has been completed, and industrial tracks laid.

Oak Bay, B.C.—During the last seven years the municipality has installed 33 miles of water mains and about 2,000 services. Since the installation in 1912 of the sewerage system, over 30 miles of sewers have been laid. Road improvement began in 1911 and last year alone some 2½ miles of new pavement was constructed and over six miles of earlier work resurfaced. Some 18 miles of sidewalks have been built.

Edmonton, Alta.—For over a year past the Edmonton City Council has had under consideration the offers of several private concerns to supply electric power for municipal and industrial purposes within the city boundary. At a special meeting held on September 14th, 1915, it endorsed the offer of the Edmonton Hydro-Electric Power Company, and ordered that an agreement between the council and the company, on the basis of a thirty-year franchise, be prepared and submitted to the burgesses. The company (with whom are associated Messrs. G. W. Farrell & Company, of Montreal, and Sir John Jackson & Company, of London, England) proposes to establish a hydro-electric power station on the Saskatchewan River near Rocky Rapids, and, in addition to its power line, to connect the power station with the city by means of an electric railway. The estimated cost of the power station and contingent works amounts to almost $6,000,000. Mr. E. W. Downess, consulting engineer, 307 C.P.R. Building, Edmonton, is the local representative of the company. Unsuccessful offers were made by the Canadian Coal and Coke Company, Limited, and the Wabamun Power and Coal Company, Limited, both of which are steam propositions, who proposed to develop coal areas adjoining the city.

PERSONAL.

C. M. SMALL, of the engineering staff of the city of Edmonton, has been appointed by the commissioners to take charge of all local improvement work.

Prof. ALEX. M. GRAY, Assistant Professor of Electrical Engineering at McGill University, Montreal, has been appointed Professor of Electrical Engineering in Sibley College, Cornell University.

ALEC CRICHTON has been appointed Canadian manager and Thos. King field manager of the New Brunswick Gas and Oil Fields Company, Limited, a new corporation with headquarters at Moncton, N.S.

JAMES HUTCHEON, former city engineer of Guelph, and now inspector of surveys for Ontario, is a member of the commission appointed by the Dominion Government to confer with a commission appointed by the United States Government concerning the raising of the level of water in the Lake of the Woods.

S. W. HOWARD, who has been general sales manager of Steel and Radiation, Limited, Toronto, for the past several years, has resigned to accept a position in the United States. Mr. W. A. Cook, who has been assistant sales manager for four years becomes general sales manager, and Mr. H. O. Morris becomes assistant general sales manager.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

Montreal Programme for 1915-16.

The following programme has been arranged for the 1915-16 season of the parent Society, meetings to be held in the assembly rooms at 176 Mansfield Street, Montreal:

1915—October 7th—Monthly meeting.
October 21st—General Section meeting.
November 4th—Monthly meeting.
November 18th—Electrical Section meeting.
December 2nd—Mechanical Section meeting.
December 16th—Monthly meeting.
1916—January 6th—Mining Section meeting.
February 3rd—Monthly meeting.
February 17th—General Section meeting.
March 2nd—Monthly meeting.
March 16th—Electrical Section meeting.
March 30th—Mechanical Section meeting.
April 13th—Monthly meeting.
April 27th—Mining Section meeting.

The committee on meetings consists of a chairman, the officers of sections and the chairman of branches, as follows:

W. J. Francis, chairman, General Section; S. P. Brown, vice-chairman. H. H. Vaughan, chairman, Mechanical Section; J. M. Robertson, vice-chairman. R. M. Wilson, chairman, Electrical Section; J. C. Smith, vice-chairman. J. B. Porter, chairman, Mining Section; H. E. T. Haultain, vice-chairman.

S. S. Oliver, chairman, Quebec Branch; A. St. Laurent, chairman, Ottawa Branch; W. P. Wilgar, chairman, Kingston Branch; J. R. W. Ambrose, chairman, Toronto Branch; E. Brydone-Jack, chairman, Manitoba Branch; F. H. Peters, chairman, Calgary Branch; O. W. Smith, chairman, Regina Branch; W. Muir Edwards, chairman, Edmonton Branch; R. F. Hayward, chairman, Vancouver Branch; D. O. Lewis, chairman, Victoria Branch.